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# Design of innovation spaces in universities: a tool to support the management of Academy-Industry projects

Lorena Delgado

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Université de Lorraine  
Ecole doctorale SIMPPÉ  
ERPI (Equipe de Recherche sur les Processus Innovatifs)

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THESIS PRESENTED IN VIEW OF OBTAINING THE DEGREE OF

**DOCTOR**

*DE*

**L'UNIVERSITE DE LORRAINE**

Specialty: INDUSTRIAL SYSTEMS ENGINEERING

By: **Lorena DELGADO CADENA**

Under the direction of: Prof. Laure MOREL

**"Design of innovation spaces in universities: a tool to support the  
management of Academy-Industry projects"**

---

*Publicly defended on September 20, 2022*

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# GENERAL INTRODUCTION

## Context of research and associated problems

Today, innovation is considered as an effective way to boost economic and social growth. Decades of research on innovation in organizations have been motivated by the assumption that creative ideas must be implemented to increase profits; strengthen competitive advantage and ensure the survival of the company (Amabile & Pratt, 2016; Çekmecelioğlu & Günsel, 2013; George, 2007). In that sense, innovation that was once the purpose of some organizations has now become a widespread need. However, the innovation process is complex, in which many factors converge ranging from cognitive (Nijstad et al., 2010), affective (Amabile et al., 2005) and social aspects (Amabile & Pratt, 2016), to one of the most important which is creativity (Hennessey & Amabile, 2010). The latter brings innovation with it, and in turn, new business opportunities. The flaw is that organizations are looking for creative people, but the spaces they have to develop this activity are not ideal, since they are mostly homogeneous, rigid, closed, and individualized environments (Maurer et al., 2002). Human beings depend on a context, the environment, the people around them, the historical moment, etc. For this reason, the place where people develop their work is so important in the search for good results (Akgunduz et al., 2018; Volery & Tarabashkina, 2021). Consequently, to encourage creativity and generate innovation in turn, work spaces must be open; encourage the development of ideas; motivate the connection among people; encourage collaboration among different team members and integrate technologies (Wu et al., 2016). Under all these perspectives, innovation spaces (ISs) arise as a response to an evident need for change and become increasingly popular, both in the private and public sector. Being companies or universities, these two types of organizations have opted for the development theme in the different formats that can be found: Fab Lab, Makerspace, Cowork, Living Labs, etc<sup>1</sup>. The number growth of ISs is evidenced (Lena-Acebo & García-Ruiz, 2018) by those who mentioned in their research how the creation of 3 Fab Labs was registered in 2003, and this number increased until reaching the number of 1.112 Fab Labs in 2017. From its part, the European Network of Living Labs (ENoLL)<sup>2</sup> posted on its website that: since its formation in 2006, it has labeled more than 440 Living Labs. Finally, hackerspace.org<sup>3</sup> reports 2,426 Hackerspaces listed, from which 911 are marked as active. The motivation for companies to invest resources in the creation of these spaces is based on the emerging opportunity to develop innovative projects, integrating the user in the creation and design of new products. For universities, the benefit begins with the generation of environments that support teaching and research. However, the main objective is to generate relationships with the government, civil society, the private sector, entrepreneurs, etc., through projects. The historical evolution of the university's role has led to a concept defined as the 'third mission', which promotes the generation of activities with a focus on economic development, without neglecting research and teaching (Readings, 1996). UNESCO<sup>4</sup> defines three basic functions at the "World Conference on Higher Education, 2009": teaching and learning, research, and community service under conditions of institutional autonomy and academic freedom (UNESCO, 2009). By supporting these three missions, the ISs that universities have created are consolidated as non-formal learning environments, where students, professors, the university community and companies are in a common context, interacting and learning in a constant and bidirectional way (not only students receive

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<sup>1</sup> For definitions see (Morel & Le Roux, 2016); Fab Labs Innovative User 2016. Available at: <https://www.perlego.com/book/998508/fab-labs-pdf>

<sup>2</sup> Website ENoLL: <https://enoll.org/network/living-labs/>

<sup>3</sup> Website hackerspace: <https://hackerspaces.org/>

<sup>4</sup> Website UNESCO: <https://en.unesco.org/>

knowledge, but all the actors that are linked). This new model of entrepreneurial university gives the institution an active participation at the local and regional level (Clark, 1998). In this sense, governments have decided to develop financing policies to encourage the production of scientific knowledge that can be transferred to industry, and benefit technological development and the commercialization of innovative products and services (Botchie et al., 2018; Meissner & Kergroach, 2019). This effort to encourage scientific knowledge responds somehow to the parameters defined by the World Intellectual Property Organization (WIPO)<sup>5</sup> in the global innovation index (2019)<sup>6</sup> that measures annually the quality of innovation, according to the following criteria: 1) the quality of local universities (QS classification of universities); (2) the internationalization of patented inventions (patent families in 2 or more offices); and 3) the quality of scientific publications (H index of document citations), to finally obtain the level of quality of innovation of each country.

In the context of Latin America, the development of this type of spaces is slow and a bit formal. The structure of Latin American universities, where they have currently continued to use educational plans and old teaching methods, hinders the growth of spaces that require a dynamic and active management. Additionally, governance, which has traditionally been resistant to change, delays the processes of investment and improvement of spaces, due to bureaucratic barriers and rigid administrative systems. Along these lines, The World Bank<sup>7</sup> points out that university educational institutions in Latin America have improved considerably in some areas, for example: expanding to larger regions; greater investment in innovation; more participation of the private sector in university projects. However, these advances contrast with poor academic quality; a questionable duration and adequacy of educational programs; poor research progress; and poor talent attraction (*Higher Education Expanding in Latin America and the Caribbean, but Falling Short of Potential*, n.d.). Moreover, the absence in literature of a model that defines the structure and activities that should compose the innovation spaces in universities (ISU) is identified as a barrier to the management of ISU. In this line, different authors have worked on establishing management models for innovation spaces without delving into the context (private, public, academic, business, etc.), orienting their findings to a business approach. Thus, (Moultrie et al., 2007) define 5 pillars for ISs: strategic intention, creation process, physical space, use process, and carried out intention. Subsequently, (Osorio, 2021) update this framework, keeping the five pillars, but integrating concepts associated with the ecosystem such as: the engagement of the different actors that intervene in the space; the influence of the environment and real life on the dynamics of the work; the importance of the user as the center of innovation; etc. On this basis, our research focuses on the field of innovation management in universities. The specific interest is to evaluate the capabilities of the ISU and establish how an IS must manage its resources and competencies to successfully develop an innovation project. To this end, our research aims to answer the following questions: **What are the factors and dimensions that define innovation spaces in universities? What should the design of an innovation space to support the development of the university's missions be? What are the factors that define the appropriate process to develop projects in university innovation spaces? How can this type of project be managed?**

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<sup>5</sup> Website WIPO: <https://www.wipo.int/portal/en/index.html>

<sup>6</sup> Website: <https://www.wipo.int/publications/es/details.jsp?id=4434>

<sup>7</sup> Website The World Bank: <https://www.worldbank.org/en/home>

## Research Questions:

As previously mentioned, our main hypothesis is that the multidimensional development in an innovation space positively influences the good management of projects within universities, strengthening their missions. This approach leads us to explore the possibility of generating a tool that helps universities to implement strategies for space management and the development of innovation projects. To do that, we have divided the thesis project into two complementary questions as shown in Figure 1:

**1. How to define a methodological model that supports the design of an IS based on the university's missions?**

**2 How to develop a diagnostic to generate recommendations and follow up projects tool in university innovation spaces?**

To address the first questions, a reference framework was defined that integrates the characterization of innovation spaces and the characterization of the university's missions, and also a diagnostic tool is proposed.

Regarding the second question, a conceptual framework of project typology and project management processes is defined to propose a tool that evaluates the complexity of the project. In addition, this tool generates a profile of the minimum requirements necessary for the development of the project and a plan of recommendations to improve the IS maturity level. The tool is validated in real cases of Chilean universities.

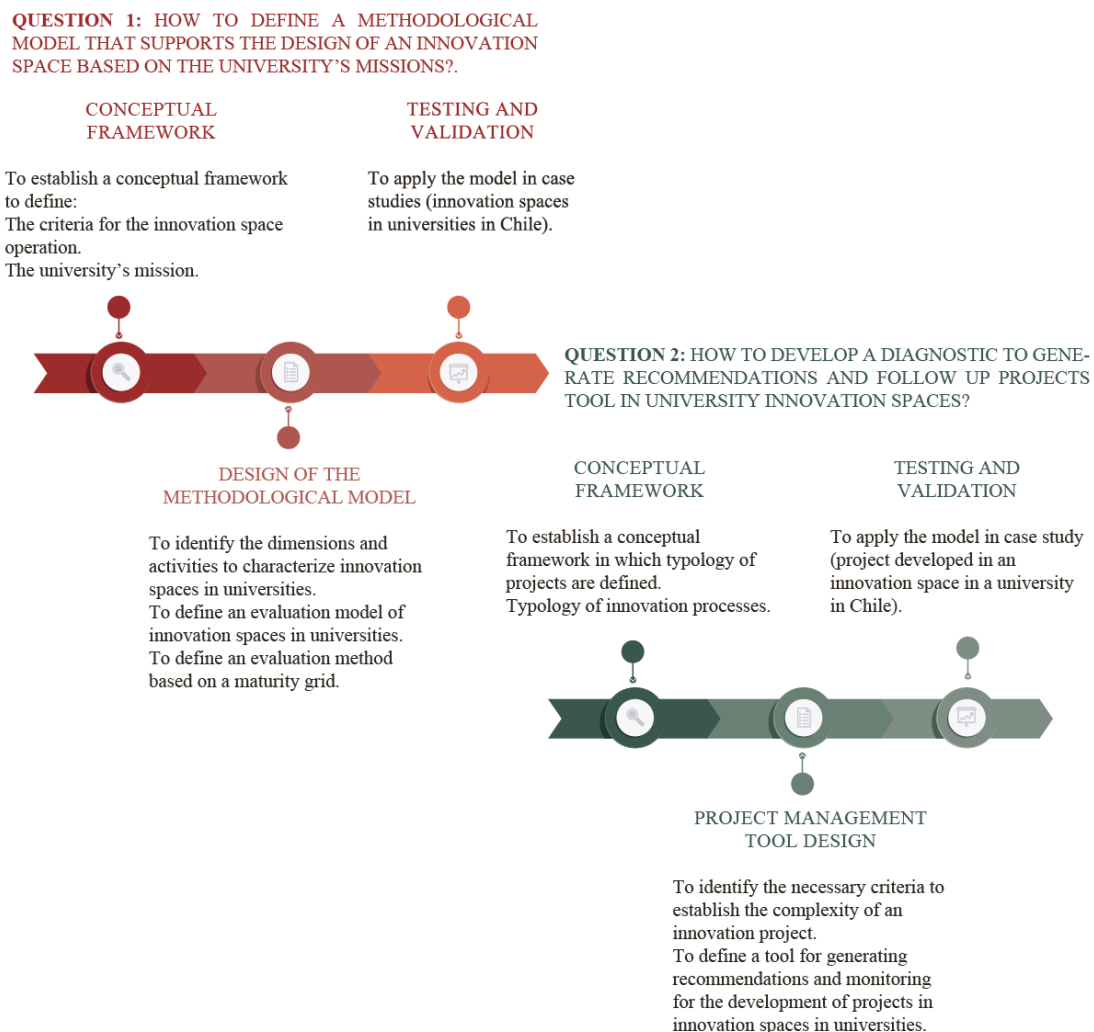


Figure 1: Methodological approach, Source: own elaboration.



## Thesis structure

In order to answer our research questions, a methodological approach is pursued as shown in Figure 2 and this thesis is organized in the same structure.

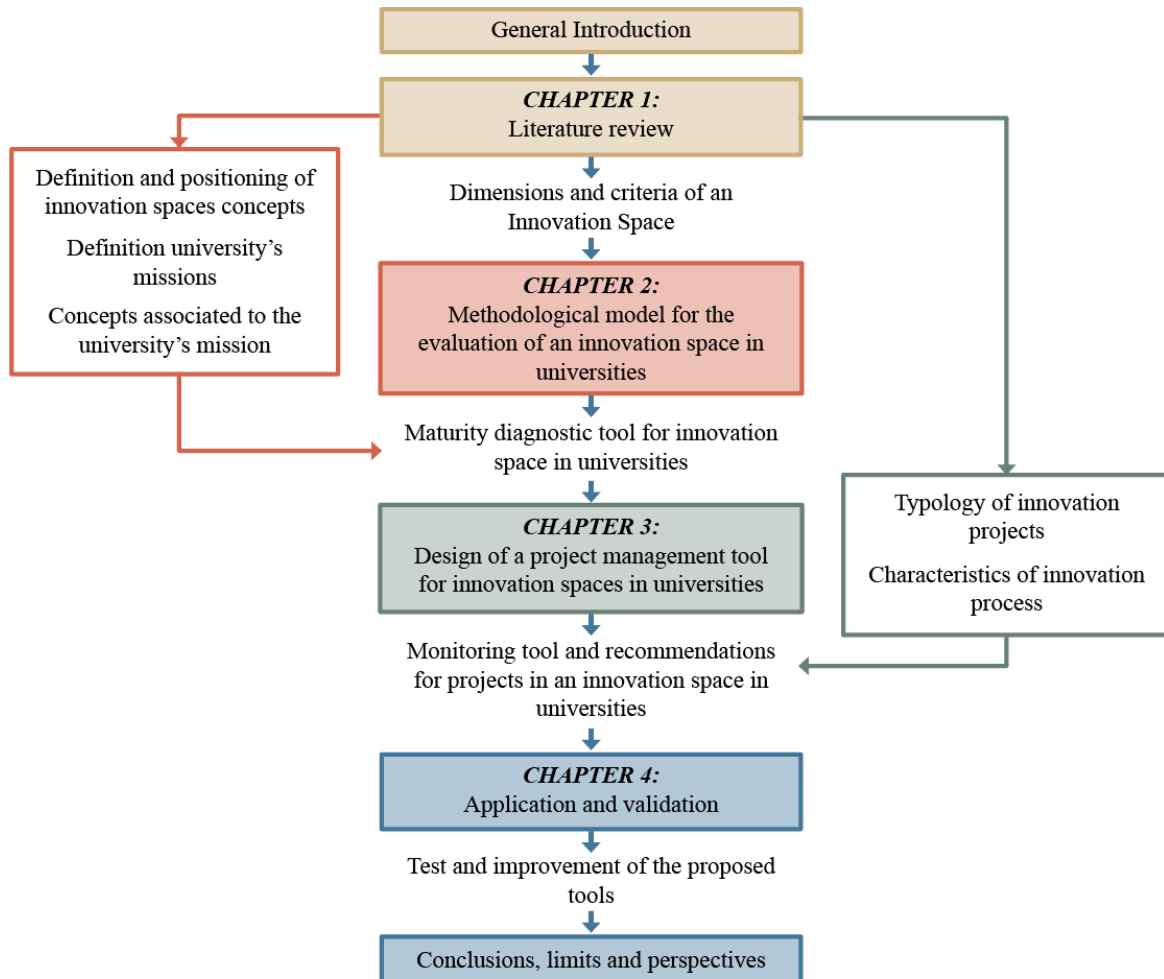


Figure 2: Thesis manuscript structure, Source: own elaboration.

After our general introduction, our thesis is divided into 4 chapters:

**Chapter 1:** The creation of innovation spaces in both public and private sectors is becoming more frequent. Universities are organizations that have provided important resources for the creation of this type of spaces as a strategy to encourage innovation in the academic context. However, the investment is not reflected in the results in many cases. This may be because there are no standardized models that guide the creation and subsequent management of this type of spaces, which leads to decisions being made based on the manager's intuition, without following measurable parameters that benefit continuous improvement. In this chapter, we conduct an exhaustive literature review to identify the dimensions and criteria that define an innovation space. After that, we analyze the definitions associated with universities to identify concepts that define their objectives and missions today. Finally, we focus our search on innovation projects, looking into the existing typologies and management processes that can be implemented for their development.

**Chapter 2:** The literature review presents different models that allow to identify the dimensions of an innovation space. The context of universities is particular and it demands an adapted model that considers the missions of this type of institution. Thus, in this chapter, we propose a model for evaluating the maturity of an innovation space in a university, based on a maturity grid that will allow to obtain a multidimensional diagnosis of the innovation space. Based on the diagnosis, a plan of recommendations is generated to help the person in charge of the space to make decisions to improve the maturity level of the innovation space.

**Chapter 3:** Considering that the development of projects is what gives life to innovation spaces, and their good management can benefit their growth and consolidation. In this chapter, we focus on developing a tool that generates recommendations and follow-up to support project management in innovation spaces in universities. As a first step, a typology of projects is defined based on the literature, and criteria is established to evaluate the complexity of the projects. This characterization makes it possible to obtain a profile of the degree of maturity required in the innovation space to ensure the development of the project. Finally, a recommendation plan and a follow-up strategy based on a Stage-Gate system principle are obtained, which verify the implementation of recommendations by establishing evaluation criteria that block or authorize the project progress in the IS.

**Chapter 4:** The experimentation phase is carried out in two stages: first, we evaluate the methodological model of the innovation spaces in different universities in Chile. This evaluation was applied to a sample of universities located in different regions of the country, among which there are both public and private universities. For the second stage of the experimentation, an innovation space was chosen among the universities in the sample. In order to implement the use of the project management tool from start to the end, we selected an innovation project that was developed in precise where exactly? Finally, the results were analyzed in order to verify the relevance of the diagnosis, the feasibility of the recommendations given and the contribution in the management of the project.

Finally, this thesis manuscript presents the first version of a methodological model for the evaluation of an innovation spaces in universities, and a project management tool for the development of projects in this type of spaces. Despite the different stages of validation, this work has its limitations and perspectives.

These aspects are developed in our general conclusion.

## **2 CHAPTER 1: STATE OF THE ART: INNOVATION SPACES AND PROJECT DEVELOPMENT IN UNIVERSITIES**

### **2.1 Introduction**

In the last decade, a significant amount of research has shown the importance of innovation spaces in the development of projects with social, territorial and economic impact. Universities, as growth managers who seek the permanent improvement of society, have studied its context and have generated places to store new knowledge, and they take a preponderant role in the execution of this type of projects. From this, it can be understood why many universities are betting on the construction of innovation spaces that support not only learning and research, but also benefit the relationship with the industrial sector. However, the creation of innovation spaces in universities has a low level of research that validate the structure, dynamics and processes of this type of places, so there are no standardized models to manage innovation spaces in universities. To address this limitation, a review of the literature divided into two parts is carried out in this chapter, considering that it is not enough to identify the dynamics of operation of the innovation space only, but to understand the characteristics of innovation projects, which will give life to the space in their execution. Thus, chapter 1 begins with the identification of the characteristics and dimensions of innovation spaces. Subsequently, it is sought to identify the common factors to the functioning of universities, therefore their missions are analyzed, looking in depth into the activities that give life to each one of them. This first part lays out a theoretical framework for the characterization of innovation spaces in universities.

In the second part of this chapter, the characteristics and typologies of innovation projects are defined, emphasizing the relationship between academia and industry. Finally, the monitoring methodologies for innovation projects are identified in order to establish the relationships between the capacities of the innovation space and the execution requirements of the projects.

### **2.2 Innovation spaces: a stimulus to creativity**

#### **2.2.1 Definition of innovation spaces**

The changing nature of innovation has led to the transformation of traditional workplaces into places that demonstrate open and flexible physical structures, where different professions and disciplines converge in a better way. In the last decade, the variety of innovation-focused spaces (co-working spaces, Fab Labs, Living Labs, creativity rooms, etc.) has aroused growing interest in both industry and academia, which has triggered the creation of these spaces worldwide (Wagner & Watch, 2017b). An innovation space is defined as a place meant to stimulate users' creativity. Innovation projects are executed in it taking advantage of the availability of spaces and resources that benefit creativity and prototyping (Lewis & Moultrie, 2005). In fact, these spaces are used to increase the capacity to generate new products (R Gey et al., 2013; Villani et al., 2017).

Depending on the context, these physical spaces can be transformed into laboratories that involve practices such as creativity and prototyping. Thus, (Lewis & Moultrie, 2005) propose the concept of 'innovation laboratory', which can be considered to generate creative behaviors and support innovative projects through proper management of their resources, generating new projects thanks to their capacity for restructuring (Lewis & Moultrie, 2005; Moultrie et al., 2007). The 'innovation lab' can offer real benefits to organizations, reinforcing corporate commitment to innovation and creativity, providing a physical manifestation of dynamic ability

and dual-cycle learning (Lewis & Moultrie, 2005). For this reason, when referring to innovation labs, it is necessary to think about how physical space stimulates people's creative behavior within the laboratory. Not only referring to them as customers and employees, but as users. According to (Lewis & Moultrie, 2005), one of the main goals in the design of an innovation lab is to reduce hierarchy and encourage user participation. The physical design of the space must promote dynamism, joy and debate, in order to achieve optimal conditions that generate a creative climate (Ekvall, 1997).

In this way, the relevance of good design and management of an innovation space is evident. However, to be assertive in the creation of a space with these characteristics, it is necessary to analyze the different aspects that influence its configuration and implementation.

## **2.2.2 Configuration of innovation spaces**

The creation of an innovation space is based on the need to promote a work environment that benefits everything that positively influences the innovation process. Organizations have understood that the workspace can become a catalyst for developing creative and innovative thinking in the development of new projects. However, the configuration of these spaces requires a plan in which both physical and infrastructural aspects must be considered. In this context, (Lewis & Moultrie, 2005) developed a preliminary conceptual framework that collects relevant literature considering two key themes. First, the framework explores the physical nature of the lab, including the structural content (e.g., architecture, interior design); and second, the infrastructure of a 'typical' innovation lab is analyzed (e.g., brainstorming software and interactive displays).

Considering a physical asset, a laboratory is defined as a research environment dedicated to the execution of different types of experiments, which usually occurs in a separate room or in a set of rooms spatially reconfigured for specific activities (for example, moving walls, cubicles and open spaces, etc.) where interaction and observation among participants is important (R. Griffin & Michele Kacmar, 1991). In addition, many innovation laboratories recognize that architecture, decoration, design, lighting, etc., also have a crucial influence on the behavior of participants (Muratovski, 2015). For example, in the attempt to encourage creativity of the whole group, many spaces eliminate traditional physical manifestations and hierarchy, such as rectangular rooms or tables and chairs facing from front to back.

In relation to the infrastructure, (Moultrie et al., 2007) express that physical space must provide a series of high and low-tech support tools for the innovation process, such as, visualization tools, idea generation, idea evaluation, or modeling and simulation tools. (Jones et al., 2011) have a similar view expressing that most of innovation labs incorporate simple elements such as large writing spaces, display materials (post-it notes, paper, pens, cards) and sophisticated 'information and communication technologies' (ICT) to support brainstorming and group work (Danes et al., 2020; Kaeri et al., 2020).

As an additional aspect, (Schwartz, 1995) adds a person to strengthen the use of the work environment, establishing that: innovation laboratories need a facilitator to act as a mediator in the innovation process. The facilitator must have knowledge in methodologies and is responsible for adapting the sessions according to the type of innovation and the users' needs. For his part, (Osorio, 2021) proposes 4 profiles to establish a work team in the context of an Innovation Lab: Facilitator (mediation, moderation, participation, intercultural); Maker (Design Methods, creative thinking, interdisciplinary work, telecommunication techniques, etc); Visionary (entrepreneurial thinking, networking, communication) and Manager (project management, self-organization, evaluation).

The dynamics of an innovation space involve various types of resources and capabilities, which can give better results if supported by good management. However, good management depends on a total recognition of the space, for which it is necessary to characterize and define a structure that allows to guide the processes and evaluate their results.

### 2.2.3 Characterization of innovation spaces

Innovation spaces are multidimensional spaces configured to promote user participation and meet their needs (Lewis & Moultrie, 2005). These spaces must be dynamic, promoting communication and discussion in a comfortable environment, generating optimal conditions to create a creative space (Ekvall, 1997).

Different authors have studied the multidimensionality of innovation spaces. (Peschl & Fundneider, 2014) characterize these spaces by defining 6 factors: infrastructural, social, cognitive, emotional, epistemological and technical space. The challenge is to integrate all these factors by considering them in the design and operation of the innovation space. (Kallio et al., 2015) propose a triangle formed by physical space, organizational culture and creativity. Focusing on collaboration, (Dupont, 2009) proposes a framework based on the pillars of participation of the different actors, the attitude towards collaboration and the structure of the process to develop urban projects. Studying the influences of the different actors that can participate in innovation laboratories (designers, operators and users), (R Gey et al., 2013) propose a structuring model of the space characterized by 8 categories that define the functions and tasks of the space operation. From a Living Labs perspective factors associated with the integration of users and the community are considered (Schuurman et al., 2013b; Veeckman et al., 2013) (Moultrie et al., 2007) propose a framework based on 5 pillars that characterize the innovation space: the strategic intention, the creation process, the physical space, the process of use and the perceived intention. Each of these pillars is explained by a series of sub-criteria. Thus, strategic intention is determined by strategic objectives, support objectives, efficiency, effectiveness, teamwork, customer information, and dynamic capabilities. The creation process includes the relationship with the innovation process, creativity activities, user and/or facilitator participation, availability of resources, restrictions and foreseen events. The process of use depends on the innovation support, design, creativity, teamwork, users, and current facilitators and events. Physical space is determined by real or virtual location, size, flexibility, computing resources, information, visualization of resources, physical limits, and the evolution of the environment. The perceived intention aims at evaluation considering the achievement of the strategic intention with qualitative and quantitative evidence. Recently, (Osorio, 2021) proposed an update to this framework, keeping the five pillars, but integrating concepts associated with the ecosystem, the real-world context, the importance of the user, the duration of the project, culture and community in the pillar of strategic intention.

Table 1 presents a summary of the factors and dimensions proposed by several authors to characterize innovation spaces.

SOURCE(S)	FACTORS/DIMENSIONS	SOURCE(S)	FACTORS/DIMENSIONS
(Moultrie et al., 2007)	Strategic intention Process of creation Physical Space	(Peschl & Fundneider, 2014)	Physical space Social, cultural and organizational space Cognitive space

	Process of use Realized intention		Emotional space Epistemological space
(Dupont, 2009)	Governance and stakeholders Collaborative methodologies Change management Process Technology	(Kallio et al., 2015)	Technological space Location Organization Architecture Openness
(R Gey et al., 2013)	Actors of innovation Methods Interaction between operator and lab Operators and operations User Creativity	(Klooker et al., 2015)	Work modes Collaboration Interaction Initiative Product development Place and equipment Advanced technical devices Space Curriculum and experience Motivation Identity
(Schuurman et al., 2013b)	Infrastructure Natural setting Method User Stakeholders Planification		
(Veeckman et al., 2013)	Innovation outcome Technical infrastructure Ecosystem Openness Community Lifespan Context Evaluation Context research Co-creation User	(Osorio, 2021)	Strategic intention Process of creation Physical Space Process of use Realized intention

Table 1: Factors and dimensions of innovation spaces proposed in the literature. Source: own elaboration.

Table 1 shows the interest of several authors in generating a structure that represents innovation spaces. As expected, a recurrence of factors and dimensions can be visualized, since there are references such as (Schuurman et al., 2013b) that have somehow led the way.

With this visualization of factors and dimensions, the bibliographic analysis regarding innovation spaces ends, and the analysis of the context of universities begins, which will allow establishing the relevance of generating a link between the dynamics of innovation spaces and the dynamics of universities.

## 2.3 The university as an active actor in the context of innovation

### 2.3.1 Definition, characteristics and university's mission

With the aim of analyzing the role of universities in the creation of innovation spaces, considering the missions that educational institutions must fulfill, an analysis is initiated to understand the meaning of the term 'university'. The *Real Academia Española* (RAE)<sup>8</sup> defines a university as "an institution of higher education comprising several faculties and conferring the corresponding academic degrees. Depending on the time and the country, it can include faculties, institutes, departments, research centers, professional schools" (RAE, 2001). However, this has not always been its definition, the role of universities has evolved; at first, they were considered only as institutions that confer knowledge and research, but today they have become a fundamental entity in the generation of innovation and new technologies, an essential resource to promote the development and growth of a region.

Analyzing the historical origins, universities were born, in the eleventh century, as an expression of the intellectual renaissance around philosophy and theology (Benedicto Chuaqui, 2002). Thus, at the beginning of the Middle Ages, university communities were organized into medieval guilds that, through monasteries, offered knowledge and education using cathedrals, such as Bologna, Paris and Salerno. Later, in the twelfth and thirteenth centuries, a division was created between the university for the people called 'universita estudiare' that trained doctors and notaries; and the church university called 'universita magister' that formed in theology and native languages (Readings, 1996). As a result of the changes that universities have undergone throughout history, today it can be said that they have the mission of contributing to the local and regional development of the community from a social, economic, cultural, and political point of view. Under this perspective, (Achwan et al., 2020) defines university as an institution legitimized through cultural foundations, highlighting its importance in society and stating that universities have taken an active position in their work context.

These definitions allow us to understand the contemporary vision, in which universities are increasingly perceived as producers of knowledge, innovation, technology and economically qualified workforce, contributing to regional, national and international competitiveness (Boucher et al., 2003). In recent years, the model of university with an entrepreneurial spirit has increasingly positioned itself, giving universities an active role at the local and regional level (Clark, 1998; OECD, 2001). The entrepreneurial university acquires a 'third mission' focused on economic development, joining the two traditional missions of research and teaching (Readings, 1996). In this context, with the aim of formalizing the relationship between university and its environment, the UNESCO organization, in its World Higher Education Conference defined three basic functions:

- 1) teaching and learning,
- 2) research,
- 3) and the provision of services to the community in conditions of institutional autonomy and academic freedom (UNESCO, 2010).

Consequently, universities are seen not only as organizations that provide training for qualified workforce, conduct research, generate new knowledge and disseminate it within socio-economic systems (OECD, 2001), but also make direct and indirect contributions to the activities of production structures (Mowery & Sampat, 2009).

Under this new perspective, universities assume a fundamental role in the development of innovative ecosystems (Benneworth & Hospers, 2007), in joint research with industry (Cowan

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<sup>8</sup> Website RAE: <https://www.rae.es/>

& Zinovyeva, 2013) and in the creation of new high-tech companies (Agrawal & Cockburn, 2003), as a response to the new educational challenges. (Reichert, 2019) argues that universities must work with regional or local companies to develop new and innovative businesses.

Thus, the Organisation for Economic Cooperation and Development (OECD)<sup>9</sup> suggests a series of criteria to consider when evaluating the role of a university in both local and regional development:

- 1) Knowledge creation through advanced research and technology transfer,
- 2) Transfer of knowledge to society through education and human resource development,
- 3) Cultural and civic development of the community, which can generate optimal conditions for innovation (Santiago et al., 2008).

In this way and based on the characterization made in the previous section, innovation spaces have great potential to support the development of universities. To better understand how this type of space can impact the development of universities, their missions are studied in more depth, and the link with innovation spaces is established.

### **2.3.2 The university and its academic mission**

Universities have been increasingly perceived as producers of knowledge, innovation, technology and skilled labor, thus contributing to improve global competitiveness through education. From this perspective, the role of the university as a mediator of regional, national and international development has been widely recognized (Loet Leydesdorff & Etzkowitz, 1996). At the same time, the dynamics of creation and consumption of new knowledge have forced universities to reinforce the efforts that allow them to develop high technology (Doutriaux, 2003; Öner, 2017).

Analyzing the teaching processes, it is shown how education has changed in terms of methods implemented. Mass education has established itself as a global trend (Bleiklie & Kogan, 2007; Geuna & Muscio, 2009) that has changed the situation of universities in terms of their visibility and costs. As a result, education has increasingly become a global public property, being obliged to compete at the international level (Marginson, 2004). For this reason, universities have changed their strategies to gain or maintain a competitive advantage (Zilahy et al., 2009). However, the main objective of universities continues to create and transmit knowledge (Berbegal-Mirabent et al., 2015a), considering the current teaching/learning paradigms that have established new missions, both for students seeking to develop competences, and for teachers who acquire a new role of companion, guide, tutor or learning promoter. The Recommendation for Key Competences for Lifelong Learning was first adopted by the European Parliament and the Council<sup>10</sup> in 2006. Following a consultation and review of this framework in 2017, a revised framework was proposed and adopted in 2019 (European Commission, Directorate-General for Education, Youth, 2019). It highlights that is a need to implement teaching that strengthens the development of skills and abilities, both social and professional, such as: collaborative work, critical thinking, reflection on action and two-way communication, which enhance the integral development of students, allowing them to face current social challenges (Webster et al., 2017).

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<sup>9</sup> Website OECD: <https://www.oecd.org/>

<sup>10</sup> Website European Union: [https://europa.eu/european-union/index\\_en](https://europa.eu/european-union/index_en)



### 2.3.2.1 A new conception of the educational teaching model

Generational changes together with the development of new technologies, and a globalized and interconnected world, have motivated a significant change in educational models (Rodrigo-Alsina & Lazcano-Peña, 2014). Universities have been challenged to adapt, renew and face the emergence of a new educational paradigm in the best way (López et al., 2019), from which emerges a competency-based model (Lobanova, 2008), which seeks to encourage students' skills by unifying knowledge, values and personal skills (Souto & Rodríguez-López, 2021; Spitzberg, 2015).

However, the competences developed at university must be aligned with the ones asked the labor market. This induces to move away from a manual and technical work to jobs based on communication and personal interrelation (Deming, 2015). In this context, the efforts of universities to incorporate new methodologies within the teaching processes to favors the development of communicative abilities begin to make sense (Spitzberg, 2015). In relation to these efforts, active teaching-learning methodologies are proposed that strengthen the development of skills and capacities, both social and professional, reinforcing collaborative work, critical thinking, reflection on action and two-way communication (Webster et al., 2017). Among the most recurrent methodological proposals we can find: problem-based learning, the project method, collaborative learning, learning by discovery, case studies, etc. (Moreno Olivos, 2011).

Table 2 summarizes the objectives of different methodologies in relation to the development of capacities that are sought to be developed in the new educational model.

METHODOLOGY	OBJECTIVES	COMPETENCES	SOURCE(S)
Project-based learning	To integrate the student in a situation that requires solving a real problem from various areas of knowledge.	-Creativity. -Individual responsibility. -Collaborative work. -Critical opinion. -Decision making. -Efficiency to express personal opinions.	(Younis et al., 2021)(J et al., 2018)(Chu et al., 2017)
Flipped Classroom	To transfer learning outside the classroom, extending the physical classroom to another environment. Benefitting learning from anywhere and at any time.	-Autonomous work. -Team decision making. -Communication.	(Gilboy et al., 2015)(O'Flaherty & Phillips, 2015)(Munir et al., 2018)
Cooperative learning	To build knowledge based on teamwork.	-Collaborative work. -Critical thinking. -Social skills. -Communication skills.	(Johnson et al., 1999)(Shimazoe & Aldrich, 2010)(Felder & Brent, 2007)
Problem-based learning	To research, interpret, argue and propose solutions to problems,	-Critical thinking. -Independent thinking. -Collaborative work.	(Roh, 2003)(Ting et al., 2021)

	creating a simulated scenario and analyzing the probable consequences.	-Solving complex problems. -Multidimensional skills. -Communication skills.	
Gamification	To apply game dynamics in the educational field to stimulate competition, cooperation, creativity and values.	-Collaborative work. -Acceptance of challenges. -Distance training. -Self-assessment.	(Hakulinen & Auvinen, 2014)(Morán-Barrios et al., 2020)

Table 2: Learning methodologies. Source: own elaboration.

In general, the mentioned methodologies propose teaching strategies that seek to develop not only cognitive abilities, but also reasoning skills, social interaction, cooperation, creative thinking and decision making. One of the recurring competences that stands out in the different methodologies is the concept of “collaborative work”, being a type of learning that universities seek to develop more and more frequently.

### 2.3.2.2 Collaborative learning and the innovation space: a commitment to strengthen teaching, research and innovation

Facing a new perspective of university education and with the aim of generating new forms of teaching that strengthen research and innovation further, collaborative learning has attracted a lot of attention due to the growing importance of teamwork and networking in solving complex problems of contemporary life, work, and society (Munir et al., 2018). Collaborative learning is an effective teaching method that can facilitate working in small groups to achieve a common goal and has been widely used in physical and virtual classrooms (Liu & Tsai, 2008; Ormrod, 2008).

Some characteristics of collaborative learning are the generation of benefits in terms of achievement, motivation and social skills (Slavin, 1994). However, successful collaboration requires a complex mix of interrelated processes. According to (P. Griffin et al., 2011; OECD, 2017), two fundamental dimensions of collaboration can be recognized: social and cognitive. The cognitive domain is related to problem solving and self-regulated learning (P. Griffin et al., 2011; Schunk & Zimmerman, 2011; Winne & Hadwin, 1998) and includes task regulation and knowledge creation. The social domain focuses on the necessary processes for productive collaboration (OECD, 2017). For example, (Hesse et al., 2015) postulate that the social domain includes participation, the adoption of perspectives, and social regulation.

Collaborative learning seems to have great potential to improve the performance of research and innovation; nevertheless, there is not enough research to fully understand this phenomenon. Some research has suggested that collaborative innovation can stimulate mutual creativity, reduce R&D costs and risks, and improve innovation performance (Davis & Eisenhardt, 2011; Faems et al., 2005; Mishra & Shah, 2009). Other authors argue that knowledge is usually integrated into the innovation process, but that it is often ‘permeable’ and difficult to disseminate (M. T. Hansen et al., 2005). A similar approach was tested in a mechatronics course for first-year engineering students (Hassan et al., 2018), using project-based learning. Its positive results show that an adapted learning strategy reinforces innovation skills in students.

As for the physical space and influence of an innovation lab, according to (Allen & Henn, 2007) getting people to communicate with each other is the only really effective way to advance the

innovation process. The integrated creative processes presented by (Kristensen, 2004) suggest that there are differences in space needs according to the different stages of the creative process. The preparation and development stages usually require a combination of community and private space. The incubation and comprehension stages are likely to require more private space. (Thoring et al., 2012) suggest that a creative space should allow interaction and movement between people and ideas. Whiteboards, post-it notes, and colored pens should be used to encourage visual thinking. For example, useful information presented in the form of objects, devices, tables, images, boards, etc. can facilitate the process at the implicit level.

### **2.3.3 The university and its research mission**

Universities are perceived as knowledge-producing institutions, which are positioned as engines of social and economic development. Thanks to intersectoral collaborations, they play a central role in advancing sustainability at the local, regional and national levels (Trencher et al., 2014). As a contribution to the processes of regional strengthening and growth, universities have sought to assure the understanding, dissemination and exploitation of their scientific and technological resources. In this way, universities have created internal structures dedicated to research and innovation, that is, research centers that allow creating communication channels to transfer research results in an organized and effective way (Rubiano et al., 2015).

Like business or territorial innovation spaces, literature does not present a clear definition of University Research Centers, possibly due to the heterogeneity of the centers and the great diversity of their objectives (Sabharwal & Hu, 2013). However, according to (Bozeman & Boardman, 2003), a research center is defined as "a formal organizational entity within a university, which exists primarily to serve a research mission, which is defined beyond the departmental organization, and includes researchers from more than one department." At this point, it is important to highlight the strong relationship among innovation, research and technology, converging all three in these laboratories where the daily dynamics show how research is considered crucial for innovation, since they allow the creation of new and differentiated products, thus promoting technological advantages (Sedlacek, 2013). Although, what role do these research laboratories play with respect to students' academic activities and vocational training?

Fortunately, academic training has not been separated from research, because they are complementary. Therefore, the notion of "modern university" implies an interconnection between teaching and research that contributes to the overall objective of vocational training (Gläser et al., 2010) and guarantees a high proportion of relevant topics in teaching and research.

### **2.3.4 The university and its business mission**

In addition to analyzing the internal institutional structure of a university to generate new knowledge and contribute to regional development, it is necessary to look into the external institutional structure that focuses on strengthening the relationship among government, companies, and other universities.

Traditionally, science and technology have been the main source of economic and social development at the local and regional level. In this sense, the role of universities in supporting this innovative environment has been essential and highly recognized (Doutriaux, 2003; Henry Etzkowitz, 1998). However, the economic crisis of the 90s and 2000s has forced governments to reduce the financial support provided to universities. In addition, the emergence of distance

education has created new rivals and increased competition in the education system. To cope with these situations, universities have been forced to change traditional teaching methods and create new services for students, adopting a more commercial, associative and global perspective (Civera et al., 2020), which in parallel responds to the new expectations of society. Universities must cooperate with industry and governments to foster innovation and economic development, especially in a world of continuing economic crisis and unemployment.

This third mission encompasses several activities (Tuunainen, 2005), such as the creation, use, application and exploitation of knowledge in non-academic settings. According to (Santoro & Chakrabarti, 2002), collaboration between university and industry represents teamwork, which means that the activities of one (university) complement the activities of the other (company) working towards a common goal. In other words, companies benefit from the physical facilities and academic capabilities of professionals to make scientific discoveries and technological advances (Van Looy et al., 2011). Moreover, as universities do not have knowledge of the market, they rely on companies and industry professionals to be closer to users and recognize their needs (D. S. Siegel et al., 2003). This virtual relationship benefits the development of new, applicable and successful technologies; in addition, it is an opportunity for universities to get private funding that is essential to assure the viability of future research (Fischer et al., 2019).

(Etzkowitz, 2003) writes about an 'entrepreneurial' university model that has been gaining ground around the world, changing from the traditional role of universities as providers of education and creators of scientific knowledge, to a more complex model that adds the faculty of commercializing knowledge and adopting an active participation in the development of private companies. The entrepreneurial university can be a great step for the evolution of universities in the XXI century, expanding their traditional teaching and research functions through a third mission (Goddard et al., 2016), thus recovering their role in society and revaluing their relations with communities and the private sector.

#### **2.3.4.1 Triple helix model: collaboration among university, industry, and government**

The Triple Helix model was proposed by (Leydesdorff et al., 1996) to explain innovation as a result of collaborative creative processes involving three main actors: universities, industry, and governments (Etzkowitz et al., 2000). The model describes the interrelationship among these three entities and highlights the potential to generate synergy and innovation in the knowledge economy (Etzkowitz et al., 2000). The concept of synergy, first introduced in 1965 by Ansoff in his book "Corporate Strategy: An Analytic Approach To Business Policy For Growth And Expansion", represents the generation of better results by combining several resources, versus the sum of the results that would be obtained with each of them individually. One way to assess potential synergies is through the transfer of core competencies (Saftiana et al., 2018).

According to the Triple Helix model, university-industry-government interactions facilitate the flow of knowledge and contribute to innovation and regional development: emblematic cases such as MIT and Boston or Stanford and Silicon Valley in the US (Etzkowitz, 2017), are the most faithful reflection of this approach.

It should not be ignored that the triple helix model is one step ahead with respect to the previous linear models that are based on increased demand or technological advancement. These old models fail to support innovation in economic systems in which knowledge has become an important asset (Leydesdorff et al., 1996). During the last decades, the growth of economic competitiveness and new development models, in which knowledge is a key factor, academia's relationship with industry has grown so much that universities and R&D centers have been

recognized as a fundamental source of knowledge and innovation (Mowery & Sampat, 2004), becoming a pillar to innovation systems based on knowledge economies (Badillo et al., 2017; Godin & Gingras, 2000).

It is to be expected that small and medium-sized companies may have difficulties carrying out R&D in-house, as it requires complex infrastructure and advanced services for product development. Universities can provide companies with the research service and/or the use of infrastructure. It is therefore essential to identify common interests (J. Lee & Win, 2004) list some of the potential benefits of cooperation between universities and companies:

- Researchers can improve their performance by generating insights in industry that lead to new research.
- University-industry partnerships help reduce the time between discovery and practical application of an innovation.
- Universities have access to private financial resources that facilitate activities in new fields of research.
- Universities give companies access to human capital, knowledge and innovation networks.
- Universities help companies identify technological opportunities and make an important contribution in the pre-competitive phases of product development.

In relation to governments, the intention to promote innovation in private companies is increasingly evident, in order to boost their competitiveness (Alarcón & Arias, 2018). It is interesting to note that (Etzkowitz, 2003), several years ago, warned of the need for policymakers to get involved in scientific and technological matters. In this context, University Research Centers are fundamental for the strategic use of science and technology (Czarnitzki et al., 2016).

#### **2.3.4.2 Technology Transfer Offices (TTO) and academic entrepreneurship**

The U.S. Bayh-Dole Act from 1980 encouraged universities to establish technology transfer offices to patent and license the results of their research, generating an increase in the entrepreneurial intention of academics ((Meyer, 2003). (Bercovitz & Feldman, 2008) found that academics who were familiar with TTO activities were more likely to engage in entrepreneurial activities as they learned business norms and skills needed to commercialize research.

(Hayter et al., 2018) define academic entrepreneurship as the creation of new technology-based business ventures by professors, postdocs, and students. (Klofsten & Jones-Evans, 2000) describe academic entrepreneurship as any activity that occurs beyond the traditional academic roles of teaching and/or personal research. (Maria Abreu & Grinevich, 2013) incorporates into this definition the value of innovation, and the element of risk and financial reward. In one of the most cited literature reviews on the subject, (Rothaermel et al., 2007b) describe university entrepreneurship as any entrepreneurial activity in which a university could be involved. These activities involve, but are not limited to patenting, licensing, creating new businesses, facilitating regional economic development and technology transfer through incubators and science parks. On the other hand, collaborative research, contract research, advisory contracts, networking, joint publications with industry, and technology transfer activities in general that somehow integrate external participation, are teaching activities that also promote academic entrepreneurship (Grimaldi et al., 2011).

Consequently, researchers and teachers increasingly see universities as sources of entrepreneurship (Krabel & Mueller, 2009), thus promoting the production and dissemination

of knowledge (Guerrero & Urbano, 2012). These academic entrepreneurs are protagonists within the dynamics of innovation systems, since they function as vehicles for the commercialization of knowledge, connecting research with industrial activities (Markus Perkmann & Walsh, 2007).

Up to this point, the context of universities has been addressed, highlighting the evolution that their mission has had throughout their history. In general terms, the definitions of three missions are highlighted, the ones that guide the activities carried out in this type of institution. As a summary, Figure 3 shows the emergence of each of the university's missions and the link that has been established with the new teaching models and the triple helix model. Without forgetting research, which, in practice, contributes strongly to these two models. This figure is made based on the literature review presented above.

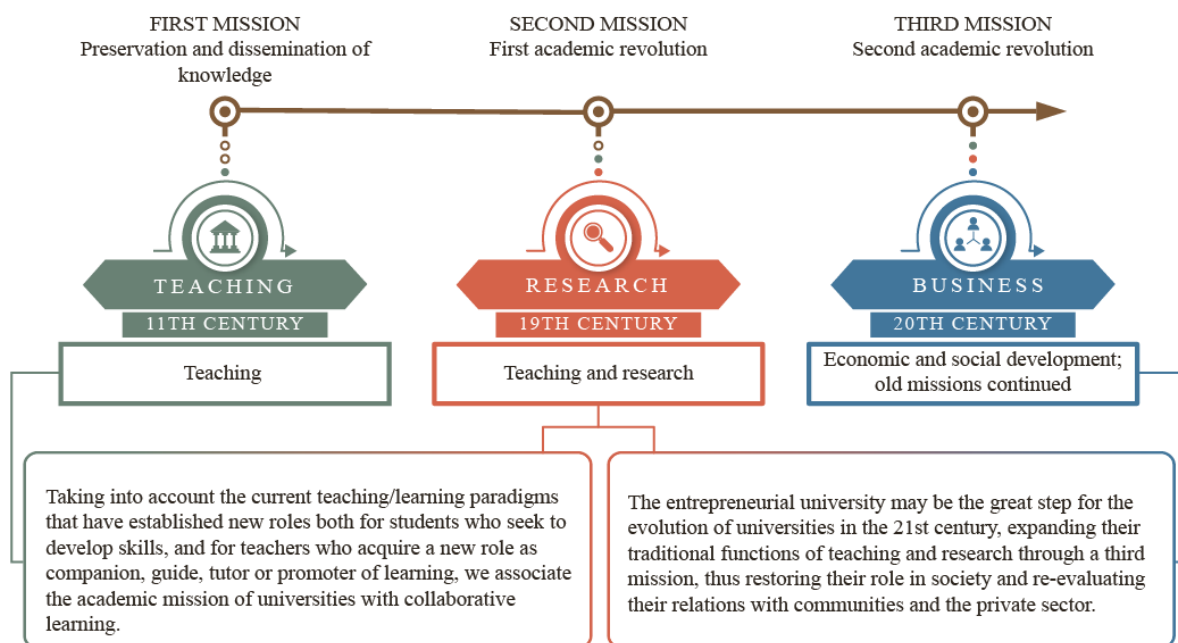


Figure 3: Missions of the university. Source: our research.

Figure 3 concludes the context of universities by entering fully into a complex but indispensable topic to analyze as it is: innovation and innovation projects.

## 2.4 Innovation and innovation processes

One of the missions of universities is to promote scientific, technological, social and human progress. Universities must be open to the future, willing to cultivate the interdisciplinarity of knowledge; they must disseminate the advances obtained internally with sufficient scientific and technological rigor, and they must publicize the innovative studies carried out by researchers, teachers and students (D'Este & Perkmann, 2011).

Currently, the term that has the greatest impact on improving educational quality in universities is the word 'innovation', a key term that is sometimes used to express an improvement or a renewal of methodological conditions, or another times, it traduces the dissemination of results obtained from a practice, a discovery or invention either in laboratories, classrooms or other training places.

Over the past thirty years, innovation has evolved as a synonym for development, technological progress, and a driver for success. The term 'innovation' is increasingly used in academia and business, so it is important to understand its definition, and the classification assigned to it according to its objectives and context.

In classical interpretation, Schumpeter suggested that innovation is the result of the introduction of a new good or service, a new production method, the opening of a new market, the generation of a new raw-material source, or the implementation of a new organization (Schumpeter & Swedberg, 2018). According to the Schumpeterian concept, innovation is related to small (incremental) or large-scale (radical) changes, which have a significant impact on structural changes in industries and market segments.

The Organisation for Economic Co-operation and Development (OECD) describes innovation as: "... all those scientific, technical, commercial and financial steps, necessary for the successful development and marketing of new or improved manufactured products, the commercial use of new or improved processes or equipment, or the introduction of a new approach to a social service. R&D is just one of these steps.". More recently through the Oslo manual<sup>11</sup>, the OECD updates the definition postulating that innovation is: "the implementation of a new or significantly improved product (good or service) or process, a new marketing method or a new organizational method in business practices, workplace organization, or relationships" (Organisation for Economic Co-operation and Development., 2001). Thus, the OECD goes from focusing on the steps of innovation, to paying more attention to the typology and implementation of innovation.

In general, different aspects of innovation can be addressed. (Garcia & Calantone, 2002) have studied different ways of categorizing the depth of innovation, among which the following stand out: Radical-Incremental, Continuous-Discontinuous, Revolutionary-Evolutionary, and Low-Moderate-High. However, it should be noted that these categories refer to different objects, which refer either to the product or the process. Beyond the process dimension, (Wang & Kafouros, 2009) recognize innovation as a driver of value: "innovate by infusing new products and services and boost the emerging economies by opening international trade opportunities." In their book *Innovation Management: Context, Strategies, Systems and Processes*, (Ahmed & Shepherd, 2010) define 6 aspects of innovation:

Creation: the use of resources to invent a new product or service.

Dissemination and learning: when acquiring, supporting or using a product or service.

Event: discretion when developing a single product.

Change: incremental or radical.

Process: level of the company to develop activities.

Context: region, nature, networks, etc.

The analysis of innovation definitions shows that the discussion of the characteristics of innovation has progressed substantially. Nowadays, innovation is seen not only as a process of change or improvement of a physical object, but also as an instrument of change in society and economy.

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<sup>11</sup> <https://www.oecd.org/science/oslo-manual-2018-9789264304604-en.htm>

## 2.4.1 Types of innovation

Not only the innovation definition has evolved. But different authors have also internalized about the types of innovation, from those found in the literature in the development of new products, to those found in the areas of Marketing and Services. Knowing the typology of innovation is fundamental in the execution of academic and business projects, since it allows to have a clear perspective of the range and objectives to which it is aimed in its development, supporting the allocation of time, resources and investment.

The following points are different ways in which types of innovation can be classified:

**1-‘Multitype’ classification:** This classification is the most used in the literature and proposes to group the types of innovation in non-cross classes. Thus, the Oslo manual aligned with the OECD methodology, proposes to create 4 groups: product innovation, process innovation, marketing innovation and organizational innovation. The description of these groups is summarized in Table 3.

Type of innovation	Field of application	Distinctive characteristic
Product innovation	Innovations related to goods and services.	Significant improvements in the technical specifications, components and materials of a product. Improvements in the functional and usability characteristics of the software.
Process innovation	Implementation of new or significantly improved methods of production or delivery of the product.	Significant changes in technology, production equipment, software and / or delivery methods.
Marketing innovation	Implementation of new methods of marketing, significant changes in design or packaging of the product, market promotion and market-based prices.	Increased consumer satisfaction. Creation of new markets or new, more favorable market position. The objective is to increase the company's sales.
Organizational innovation	Implementation of new forms and methods of organization of business companies, the organization of jobs and external relations.	Implementation of new business practices that impact the organization, jobs and external relationships previously used. Implementation of new strategies.

Table 3: Typology of innovation in the OECD methodology; Source: authors' adaptation from OECD Oslo Manual (Oecd, 2005).

Reinforcing the influence of the OECD, (Bessant & Tidd, 2021) build on the classification of the Oslo manual, maintaining process innovation and present three new types of innovation: Production innovation: contemplates improvements in technical specifications, program components and materials integrated in the degree of feasibility and functional characteristics. Position innovation: seeks to position a certain product in a specific industry or business segment.

Paradigm innovation: proposes to change the traditional functioning of industries or companies.

**2-Classification of degree of ‘strength’ or ‘power’ of innovation:** This classification relies on the degree variation of innovation based on the ‘strength’ or ‘power’ of innovation. (Freeman et al., 1982) present one of the broadest classifications, identifying seven levels of intensity



ranging from the weakest (improvements) to the strongest (technological revolutions). (Garcia & Calantone, 2002), and (Coccia, 2005) present a review of the literature where some examples of the classification of innovation types according to intensity are shown in Table 4.

Authors	Types of innovations
Mensch, 1979	Improvements → basic innovation → fundamental innovation.
Freeman et al., 1982	Improvements → continuous → radical → new technological systems → change of technoeconomic paradigms → technological revolutions.
Kleinschmidt and Cooper, 1991	Low innovativeness → moderate innovativeness → high innovativeness.
Wheelwright and Clark, 1992	Incremental → new generation → radically new.
Freeman, 1994	Unrecorded → incremental → minor → major → systemic.

Table 4: Classification of innovation types according to the degree of innovativeness; Source: (Kotsemir et al., 2013)

**3-Multilayer classification of innovation:** This typology proposes several levels of classification of innovation. Being multilayer, a type of general innovation is proposed, which is sub-divided into more specific types of innovation. (Zawislak et al., 2014) identify two types of innovation: technology-driven and business-driven. Subsequently, each type is divided into two subtypes: technological innovation and operations innovation for technology-driven innovation; and management innovation and transaction innovation for business-driven innovation. These types are shown in Table 5.

Type of innovation	Essence of innovation
<b>Technology-driven innovation</b>	
Technological Innovation	Development of new design, new materials, new products, machinery, equipment and new components.
Operations Innovation	New processes, improvements in existent processes, introduction of modern techniques, new layouts, etc. The objective is to help the company to manufacture products with quality and efficiency at the lowest possible cost.
<b>Business-driven innovation</b>	
Management Innovation	Development of new management methods, new business strategy, improved decision making, etc. The objective is to reduce the "internal friction" between the different areas of the company, improving work performance.
Transaction Innovation	Development of ways to minimize transaction costs with suppliers and customers. The objective is to create new commercial strategies, improve relationships with suppliers, streamline market knowledge, etc.

Table 5: Multilayer classification of innovation types; Source: authors' adaptation from (Zawislak et al., 2014).

Another example of the multilayer classification of innovation can be found in the work of (Walker et al., 2011). Here the authors identify three types of innovation: Auxiliary innovation, which proposes that the success of its incorporation depends on factors that are beyond the control of the organization; service innovation, which takes place in an operational area and affects the technical system of an organization; and finally, the process innovation that deals

with the way in which services are provided. The latter being so complex meets the necessary characteristics to be subdivided and (Walker et al., 2011), propose three subtypes: the innovation in the organization that refers to the main work activity of an organization, and changes in the social system; innovation in marketing that deals with purchasing methods, service delivery and income generation; finally, technological innovation involving IT, hardware (physical equipment) and software (organizational systems).

**4-Dichotomical classification:** This typology proposes a classification based on the definition of an innovation concept which is divided into two generally opposite concepts. Table 6 presents examples of this type of classification of innovation in different dimensions.

Authors	Types of innovations
<b>"Strong" innovation/"weak" innovation dimension</b>	
Arrow, 1962; Gilbert and Newbery, 1982	Non drastic/drastic
Priest and Hill, 1980	Incremental/discrete
Utterback, 1996	Evolutionary/revolutionary
Schmidt and Calantone, 1998; Song and Montoya-Weisse, 1998	Really new/radical
Rice et al., 1998	Breakthrough/incremental
Freeman, 1994; Balachandra and Friar, 1997	Radical/incremental
Coccia, 2005	Elementary(micro-incremental)/cluster(new technological system)
<b>"Genuine innovation" / renovation dimension</b>	
Norman, 1971	Variations/reorientation
Maidique and Zirger, 1984	True/adoption
Yoon and Lilien, 1985	Original/reformulated
Rorthwell and Gardiner, 1988	Innovations/renovations
<b>"Everyday" innovation / disruptive innovation dimension</b>	
Grossman, 1970	Instrumental/ultimate
Myers and Tucker, 1989	Radical/routine
Christensen, 1997	Sustaining/disruptive
<b>Other dimensions</b>	
Robertson, 1967; Anderson and Tushman, 1990	Discontinuous/continuous
Dosi, 1988	Market pull/technology push

Table 6: Examples of dichotomical classification of innovation types in scientific literature; Source: (Kotsemir et al., 2013).

It is evident that the typology of innovation has followed a development path similar to the concept of innovation, evolving from a less structured system to a more complex and difficult-to-structure classification system. However, most of this classification is subject to be adapted depending on the requirements of the innovation to be executed. There is even the possibility of combining different types of innovation to result in a different innovation.

#### 2.4.2 Innovation processes: a reference model for project management in different contexts

The implementation of an innovation project does not only imply the recognition of the type of innovation that is generated. It is important to define objectives that allow establishing activities to be carried out to achieve them. The process or set of activities that entail a result is known as

innovation management. The first to propose a model of innovation processes was (Utterback, 1971) who defined a single management process composed of the following activities: generation of ideas; resolution of problems whose result is an original technological solution or an invention; implementation, which allows the introduction to the market; and dissemination, where the result is to generate a significant economic impact.

Later (Wheelwright & Clark, 1992) proposed the development funnel model; this model allows the admission of many ideas that fit a large input through a channeling process that selects projects progressively. (Cooper, 1990; Cooper et al., 2002) focuses on the new product development (NPD) process and defines a sequence of stages and decision points (milestones) for the conduct of development projects, thus creating the most widely used model in innovation management, called Stage-Gate. This model proposes that the innovation process is a linear sequential flow of predefined stages: generation of ideas, selection of ideas (screening), development and market launch. Thus, (Cooper, 2008) uses the phrase "from idea to launch", to suggest that 'idea generation' starts the process and 'launch' ends it.

However, from the field of project management (Kok & Biemans, 2009; Shenhar, 2001) have expressed their disagreement with this single approach for all projects, arguing that there is no such approach that suits all cases. This argument is validated by (Augusto et al., 2010) in their exploratory studies; they were able to verify that companies use different types of innovation process, adapting the 'classic' stages to the needs of the company. From this point of view it can be inferred that (Shenhar, 2001) perspective of adapting or modifying the model 'idea generation - selection / development – launch' is not only possible, but even desirable.

In sync with the Shenhar approach, other works have proposed a more comprehensive vision of the innovation process and its management. (Hansen et al., 2007) conducted a study based on large multinational companies and proposed the idea of the value chain in innovation. This study allowed them to conclude that NPD is an important activity, but there are other equally important activities executed before and after, such as idea generation, selection / conversion, and dissemination. (Carvalho & Rocha, 2007; Hansen et al., 2007) proposed the Pentathlon framework, a five-dimensional model for innovation management: creativity/idea management, innovation strategy, human resources management, selection and implementation (NPD). However, in both NPD and innovation management, authors adopt the one-size-fits-all approach to some extent, proposed by (Slavin, 1994; Wheelwright & Clark, 1992) followed by the proposals described above.

Based on the terminology and pictorial representation of (Hansen et al., 2007), this traditional process is represented by Figure 4.

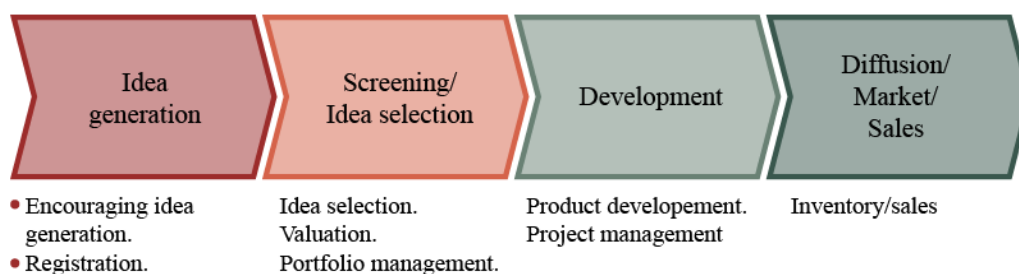


Figure 4: Traditional innovation process: from idea to launch. Source: (Salerno et al., 2015).

Considering projects as temporary organizations with specific objectives (Shenhar, 2001), it is reasonable to suppose that innovation projects can assume different process configurations, adapted to each situation or context. Under this theory, (Salerno et al., 2015) proposes a typology of innovation processes, validated through the comparative analysis of 132 product innovation projects developed in 72 companies with different characteristics such as: sector (including hospitals, engineering consulting and R&D services), size, age, and with or without a formal R&D department. A limitation of the study is that it does not include projects developed in universities within the sample (specifically). However, in the absence of a previous theory that establishes a taxonomy on innovation processes, it is reasonable to take the typology proposed by (Salerno et al., 2015) as a reference, and analyze its relevance under the structural and administrative context of a university, since this study defines that "the companies were selected in order to provide diversity of situations, an important topic to cover different contingencies."

From empirical research, (Salerno et al., 2015) identified eight types of innovation processes: 1) Traditional process: from idea to launch; 2) Anticipating sales: the tailor-made approach (open order); 3) Anticipating sales from a given client specification (closed order); 4) Process started by a call; 5) Process with a stop: waiting for the market; 6) Process with a stop: waiting for the advance of technology; 7) Process with a stoppage: waiting for the market and for the advance of technology; and 8) Process with parallel activities. As expected, the process most used by companies is the traditional process: from idea to launch, so the second place was taken by the process started by a call.

Table 7 presents the main characteristics of the 8 types of innovation process models used in project management.

Type of innovation process	Characteristics	Source of resources	Project uncertainty	Contingencies
1- TRADITIONAL PROCESS: FROM IDEA TO LAUNCH	Common in large companies that mass-produce for inventory; typical of incremental innovations; it is usually used by companies with a well-structured innovation process.	Sales occur after production.	General market uncertainties; technological uncertainties during the conversion phase.	Medium-long life cycle of the product; a mature market; mature technologies; medium-high expenses in R&D and engineering (RD&E); product improvement; product development and production for inventory.
2- ANTICIPATING SALES: THE TAILOR-MADE APPROACH (OPEN ORDER)	The idea of innovation is built together with the customer; sometimes it includes a large service component; the delivery of the product ends the process.	The customer pays for the development before the delivery of the product, defining penalties for non-compliance with the contract.	Customer uncertainties regarding their own needs; uncertainty related to the company's ability to develop the product; there is no uncertainty related to dissemination and sales.	The relationship with the customer.

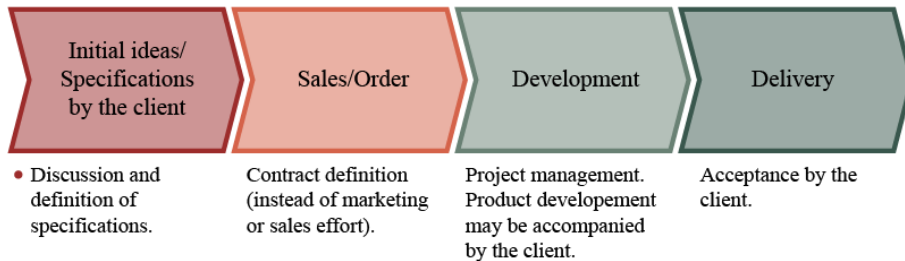
  

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graph LR
    A[Initial ideas proposed and worked with client] --> B[Sales/Order]
    B --> C[Development]
    C --> D[Delivery]
  
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- Ideation, predevelopment, selection and budgeting.
- Contract definition (instead of marketing or sales effort).
- Product development may be accompanied by the client. Project management.
- Acceptance by the client.

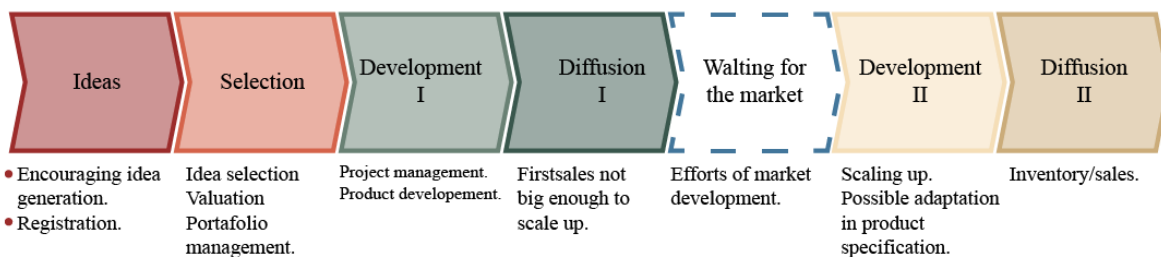
<p>3- ANTICIPATING SALES FROM A GIVEN CLIENT SPECIFICATION (CLOSED ORDER)</p>	<p>The specifications are defined by the customer, but the company can suggest new functionalities or specifications.</p>	<p>Sales precede development.</p>	<p>There is no uncertainty related to the construction of the idea; uncertainty related to the company's ability to develop the product; there is no uncertainty related to dissemination and sales.</p>	<p>The relationship with the customer.</p>
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<p>4- PROCESS STARTED BY A CALL</p>	<p>It is usually linked to public contracts. However, there are also tenders for private contracts; the flow begins with a feasibility analysis of the project for the company; The main activities of the innovation process occur after winning the call.</p>	<p>Expenses are generated before the contract, so resources are pre-allocated to prepare a feasibility analysis and supporting documentation, the sale occurs when winning the call.</p>	<p>There is no uncertainty related to the construction of the idea, the call usually defines the functional requirements of the product to be developed; the call reduces market uncertainties by anticipating sales.</p>	<p>The relationship with the customer during the process.</p>
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<p>5- PROCESS WITH A STOP: WAITING FOR THE MARKET</p>	<p>They contain an interruption after the initial selection and development of the idea that is caused because the perceived market is not large enough to warrant further development; the project is reactivated when a market expansion is guaranteed.</p>	<p>Sales occur after production and competitive production efficiency is achieved only with high volumes due to economies of scale.</p>	<p>Uncertainty in demand growth during initial sales. This process runs until an unforeseeable major uncertainty arises that pauses development.</p>	<p>The market, these products target non-mature markets or markets in formation.</p>
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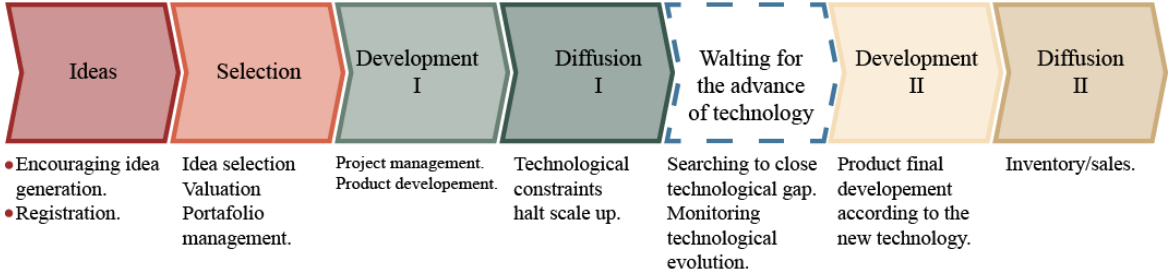
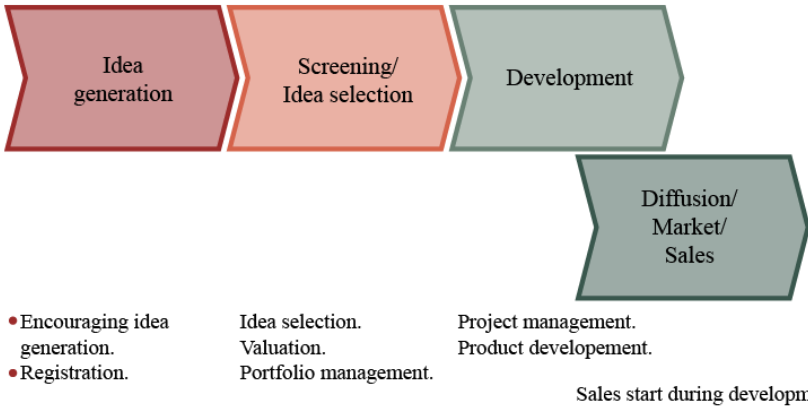
<p>6- PROCESS WITH A STOP: WAITING FOR THE ADVANCE OF TECHNOLOGY</p>	<p>The pause of this process is due to a technological bottleneck within the development of the product. The first phase of the process contains the generation of ideas, selection, initial development and initial dissemination. Once the technological bottleneck is overcome, the final development of the product begins and the dissemination / sale closes the process; its occurrence is largely involuntary, it can arise as part of a contingency plan.</p>	<p>Sales occur after production.</p>	<p>Technological uncertainty.</p>	<p>The technological trajectory</p>
				
<p>7- PROCESS WITH A STOPPAGE: WAITING FOR THE MARKET AND FOR THE ADVANCE OF TECHNOLOGY</p>	<p>There is a first stoppage due to technological problems and a subsequent stoppage to wait (actively) for the viability of the market.</p>	<p>Sales occur after production.</p>	<p>Technological and market uncertainty.</p>	<p>Combination between the market and technology.</p>
<p>8- PROCESS WITH PARALLEL ACTIVITIES</p>	<p>Two phases are developed simultaneously, example the dissemination / sale phase begins before the end of product development and continuous development until you have the product.</p>	<p>Sales occur after production.</p>	<p>Market and/or technological uncertainties do not justify pauses in the development process.</p>	
				

Table 7: Types of innovation processes. Source: adaptation from (Salerno et al., 2015).

For process 1 (traditional process), the first stage begins with the registration of ideas and the last one ends with the product available for sale. Although, in the literature there is still no established and accepted guideline that validates whether the process is completed with the launch or with the sales of the product.

Processes 2, 3 and 4 are processes that anticipate sales, understanding 'sales' as the formalization of the services offer (prerequisites, limitations, costs, etc.) and signing contracts subsequently. Additionally, these three processes share practices associated with the relationship with the client, integrating this actor into the innovation process (Carbonell et al., 2009). This way of approaching projects benefits collaborative activity for R&D (Chesbrough, 2003). (Salerno et al., 2015) suggest that the role of customers shapes the structure and content of the innovation process, assuming their presence changes the way in which the generation and dissemination of ideas is carried out.

Processes 5, 6 and 7 contain an interruption where the cause of it is as important as the stoppage itself, since the company must analyze the entire context to conceptualize and implement actions at the management level before, during and after the pause.

Finally process 8, process with parallel activities: it allows to start the stage of dissemination and sales with the first version of the product, which tends to change when continued in parallel in the development stage, as a result of the feedback obtained in the dissemination.

Consequently, the definition of different innovation processes helps entities to better manage different types of innovation projects, avoiding the rejection of projects that do not fit into the traditional innovation flow. In the case of universities, it allows the adoption of processes such as 2, 3 and 4 that do not involve a dissemination and market stage, these activities being inappropriate for educational institutions (this task is assumed by the customer). In the same way, by promoting the integration of the customer in the innovation process, the mission of universities is supported, which seeks to generate links with the industry and impact on the territory.

## 2.5 Conclusion

Considering that this research is based on the idea of identifying the characteristics of innovation spaces to define their functioning within the universities, this chapter begins with definitions that show the emergence of innovation spaces as an alternative to the traditional workplace, integrating elements to encourage creativity and natural interaction among the people who converge in it.

Under this idea, the need arises not only to generate the space, but to manage it efficiently. However, the management of innovation spaces requires a real recognition of the internal resources and the dynamics that are developed.

To achieve this goal, several authors have defined different dimensions that define innovation spaces. A recurrence analysis allowed to identify 5 basic dimensions that are integrated into research as a guide to design and manage an innovation space:

- Strategic dimension: the pillar where innovation spaces must consider the operational objectives, space dynamics, evaluation metrics, efficiency and effectiveness of the processes and resources used.
- Physical Dimension: it contemplates the structure, and the physical and design elements of the space, which through their configuration must support creative processes.
- Technological dimension: this includes manufacturing, development and usability testing tools; and the technology used for interaction within space.

- Emotional dimension: it refers to the interaction and sense of community that must exist in an innovation space. The personal motivation that connects users with the space.
- Social Dimension: this places the innovation space in the context of the real world, recognizing the social and cultural influence on its functioning. The importance of the social and geographical environment in the creation of relationships.

In that sense, this first vision provides an overview of the objectives and operation of an innovation space. However, there is a need to validate whether this model is equally functional in the context of universities, as this is the scope of our research.

Under this premise, the definition of universities is analyzed, based on their evolution and the emergence of their 3 fundamental missions: the academic mission, the research mission, and the business mission. The literature review shows light on the emergence of innovation spaces in universities, considering it as an established environment to support activities of the three missions. Later in the analysis of the university's mission, two concepts emerge that are important to highlight because these will generate the link between the dynamics of an innovation space and the missions of universities; these two concepts are: collaborative learning and academic entrepreneurship.

At the end of this chapter, the evolution of the concept of innovation and its typologies are presented, and in turn, the typologies of innovation project management are analyzed. Knowing that it is the projects that ultimately give life to the space and contribute directly to the mission of the university.



### **3 CHAPTER 2: METHODOLOGICAL CONTRIBUTION: DESIGN OF A MODEL FOR EVALUATING THE MATURITY OF INNOVATION SPACES IN UNIVERSITIES**

#### **3.1 Introduction**

As explained in the previous chapter, the evident growth of innovation spaces (ISs) has drawn the attention of many authors, who have analyzed this phenomenon with the aim of reaching a consensus both in its definition and structure. However, these researches have been based on analyzing internally what happens with ISs without framing them in a specific context, considering that there are public and private ISs. In this sense, there is a need to analyze how ISs should work within universities, understanding that the functioning of these institutions is governed by clear guidelines both in resources and results (based on their three fundamental missions), which places them in a special context in the field of innovation.

Thus, the objective of this chapter is to propose a model that defines the structure of an innovation space in the university (ISU). From this model, a method is generated to evaluate the maturity level of the space, generating a diagnosis and a plan of recommendations as the final result.

To meet this objective, the first step will be to analyze the definitions of ‘innovation spaces’, presented in chapter 1, identifying the factors highlighted by the authors and regrouping them into dimensions.

From the definition and characteristics of universities (chapter 1), the second step will be to identify concepts that represent the university’s missions, that can be connected with the dynamics of an innovation space. The third step will be to identify the factors that represent the concepts associated with the university, to carry out the same process as with the IS, regrouping the factors into dimensions. The results obtained is a conceptual structure based on dimensions that will allow defining the intersection area between the innovation spaces and the concepts associated with the university’s missions. Finally, the practices that characterize the common dimensions between IS and university missions are identified. These practices describe the activities performed by the ISU and will be the basis for defining the tool for assessing its maturity level. This evaluation tool, through a maturity grid, will provide a diagnosis of ISU performance and a plan of recommendations.

#### **3.2 Characterization of innovation spaces in universities**

##### **3.2.1 Characterization of innovation spaces**

The creation of an innovation space is based on the need to foster a work environment that positively influences the innovation process, increasing the capacity to generate new projects as a strategy for institutional growth and strengthening (Villani et al., 2017). In turn, the type of projects that are sought to be developed must respond to specific needs and contexts. In the case of universities, both innovation spaces and the projects developed in them must contribute to regional, national, and international competitiveness; through the generation of knowledge, innovation, technology, and qualified labor (Boucher et al., 2003).

In order to define the structure of the ISU, a bibliographic review of the innovation space definition is carried out, which is presented in details in chapter 1, evidencing the view of different authors in terms of the factors that identify this type of spaces. Based on this literature analysis, the factors are highlighted by the authors (presented in Table 1). These factors are

analyzed according to their definition, objective and contribution to IS, regrouping them into 5 development dimensions. Therefore, a model of the structure of an innovation space is proposed with 5 dimensions as shown in Figure 5.

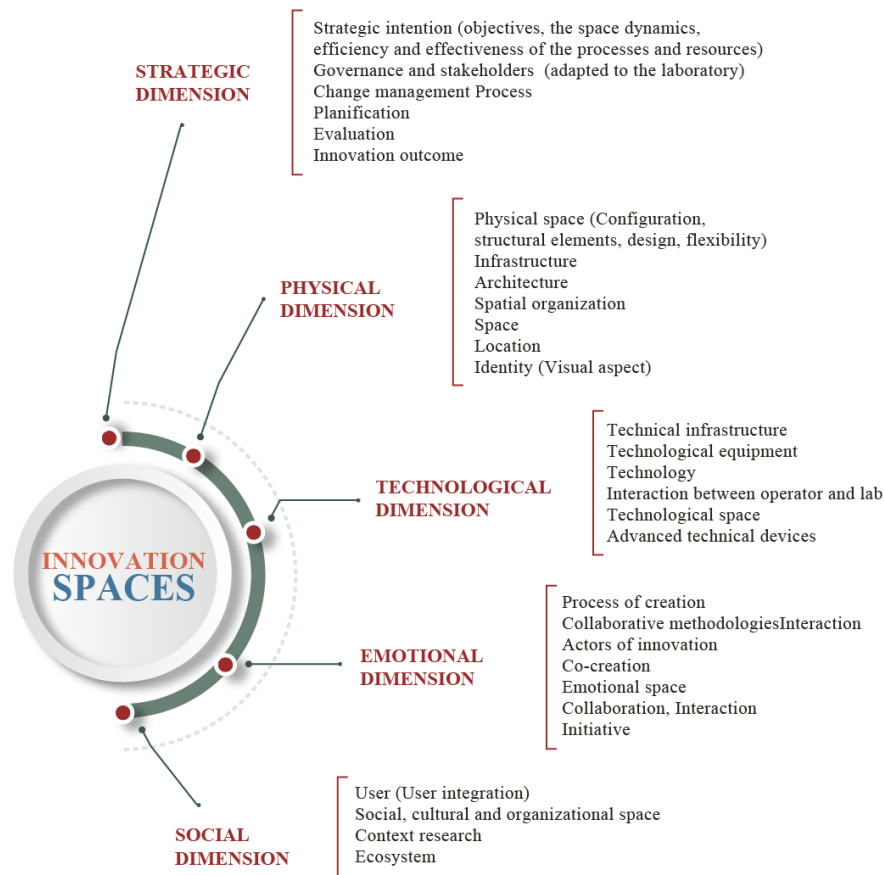


Figure 5: Dimensions and factors of an innovation space. Source: own elaboration.

This model allows understanding the factors and areas of development to be considered when managing an innovation space. The proposed model considers 5 dimensions: the strategic dimension as a starting point for the definition of objectives and planning of the space, the physical dimension that considers the aspects of location and infrastructure, the technological dimension that deals with equipment and technical resources, the emotional dimension that fosters collaboration and creativity, and the social dimension that considers the integration of the space to its specific context. These 5 dimensions group the most relevant factors of the literature, being the basis for structuring an innovation space.

To understand this characterization of innovation spaces in a better way, each of their dimensions and factors are detailed below.

**Strategic dimension:** Innovation spaces need to develop a strategic vision because they function as an organization. To (Moultrie et al., 2007) and (Osorio et al., 2019) in the strategic intention pillar, innovation spaces must consider the objectives, the dynamics of the space, the efficiency and effectiveness of the processes, and resources used. (Dupont, 2009) integrates the concept of governance and management of the processes that must be adapted to the laboratory. Finally, the strategic vision must be complemented by a mechanism for evaluating the results obtained. In this sense, (Veeckman et al., 2013) propose the innovation results and evaluation as

characteristic factors of an innovation space, with the aim of analyzing the operation and making future strategic decisions. (Osorio et al., 2019) highlight the need to generate evaluation indicators to objectify the performance vision of the space. (Klooker et al., 2015) extend this analysis not only to the results but also to the product development process.

***Physical dimension:*** Several authors initiate the characterization of innovation spaces by associating them to the physical dimension. One of the main currents characteristic refers to the space configuration, allowing flexibility for the execution of different activities (Moultrie et al., 2007; Osorio et al., 2019). To define physical space, (Peschl & Fundneider, 2014) propose two main ideas: architecture and design. The architecture considers all the structural elements of the space and the design associates the configuration of furniture and moving elements. These two main ideas should give flexibility to the space and highlight characteristics that benefit the execution of varied activities. Another point of consensus among the authors is ergonomics. (Kallio et al., 2015) associate the comfort of space with spatial organization and architectural details, while (Schuurman et al., 2013a) associate it with infrastructure, highlighting in both cases comfort as an element of motivation for actors interacting in the space. Another recurring factor associated with the physical design of the space is the need to generate identity (Klooker et al., 2015) or the need for a value design (Osorio et al., 2019), in other words, the visual aspect of the space must be considered, including factors such as luminosity, colors, images, etc., to promote creative work. Finally, a factor that is repeated is the location of the space that should promote both internal and external interrelationship.

***Technological dimension:*** From the technological point of view, the authors focus on two lines of action: technology as a tool for usability tests, and technology as a support for interaction within an innovation space. (Klooker et al., 2015) propose that the technological equipment of innovation spaces should be advanced and follow trends. (Veckman et al., 2013) postulate that the technological space should allow testing by the user, when (Moultrie et al., 2007) claim that an innovation space must have technological resources for its use. In this way, the technological devices of an innovation space must support the execution of activities, for example, in the stage of testing by the user. (Ronny Gey et al., 2013) refer to the need for interaction between the operator and the laboratory. From the point of view of Living Labs, the innovation space must interact with the ecosystem and users (Dupont, 2009; Veckman et al., 2013), this view proposes that technological support should be friendly and compatible with the technological knowledge of people who interact with the space. (Peschl & Fundneider, 2014) include the use of technology in the process of developing innovation projects, and the interaction with actors thanks to technological devices of the technological space. Finally, (Osorio et al., 2019) and (Moultrie et al., 2007) refer specifically to information technologies (IT) as a technological support of innovation spaces.

***Emotional dimension:*** The most recurrent concept proposed by the authors responds to the interaction and sense of community that must exist in an innovation space. (Ronny Gey et al., 2013) postulate the existence of different actors involved in the process, (Veckman et al., 2013) introduce the concept of community and (Klooker et al., 2015) propose to integrate the concept of interaction. In all these studies, the aim is to consider participation, communication, and relationship among the different actors within innovation spaces. In fact, (Osorio et al., 2019) recommend considering the active participation at least of end users and facilitators in the different development stages of an innovation project. After assuring the opening of innovation spaces to different actors of the context, other authors highlight the support of the dynamics that must occur for a successful interaction in work teams, working under the concept of collaboration (Dupont, 2009; Klooker et al., 2015).

**Social dimension:** (Peschl & Fundneider, 2014) highlight the importance of considering the social and cultural aspect of an innovation space, since its activities must be placed in a specific context. (Veeckman et al., 2013) write about the real-world context and the research context to situate the innovation space in a social context. From this point of view, it is important that innovation spaces are placed in the real-life context of the participants, improving their familiarity with the space. A resource needed to be able to work on issues of the community's interest is to integrate the user as a source of information, to define needs and problems that represent the external participants of the innovation space. Different authors address this point under the concept of user integration (Ronny Gey et al., 2013; Veeckman et al., 2013).

This characterization provides parameters to design and manage innovation spaces in a general way, as already mentioned at the beginning of this chapter, the authors do not establish a specific context. However, each space must be adapted to the context in which it is located to obtain consistent results with its purpose of operation. That is why the university's missions are below analyzed, in order to characterize them and obtain a methodological structure that allows establishing the parameters of the innovation spaces in the work context of universities.

### **3.2.2 Characterization of the missions of the university**

The new challenges of education position universities as fundamental institutions in technological, social, and economic development (Benneworth & Hospers, 2007), evidencing the need for a change in the university ecosystem to better support knowledge and innovation. Thus, new organizational structures are created to promote knowledge transfer and technology development beyond the university sector (Carayannis & Von Zedtwitz, 2005). An example of these new structures are the innovation spaces that, within universities, can be key in the strengthening and development of their missions (UNESCO, 2010). Although the objective is clear, the process to create this type of innovation spaces is not so evident. Hence the importance of understanding its structure to plan a strategy that allows valuing the results of the activities or projects developed in these innovative environments is crucial.

To align the design of the innovation space with the needs and characteristics of universities, the definitions referring to the university's missions in chapter 1 are analyzed, defining the following axis of action:

- First axis of action based on the teaching and learning mission of universities -First university's mission - (Academic Mission of the innovation space).
- Second axis of action based on the mission of entrepreneurship and link with the business environment of universities -Third university's mission - (Business Mission of the innovation space).

These axes of action that, from now on, will be mentioned as missions of the ISU (academic mission of the ISU; business mission of the ISU) show different characteristics and objectives, so it is interesting to analyze the complementarity that they can have with the structure of an innovation space individually.

However, the same does not happen with research (second university's mission), literature shows an important contribution of this mission both in the activities developed in teaching and learning (Gläser et al., 2010), and in the mission of linking it with the business environment (Trencher et al., 2014). Then, the strategy will be to integrate the mission that refers to research in the 2 axes of action as a connecting axis between the innovation spaces and the two missions defined above. Understanding that the learning process in an IS promotes research activities (Zilahy et al., 2009), and similarly research is the main motivation why companies seek to create links with the ISU (Bergeb-al-Mirabent et al., 2015b).

The emergence of these two axes of action or missions explained above is presented in Figure 6.

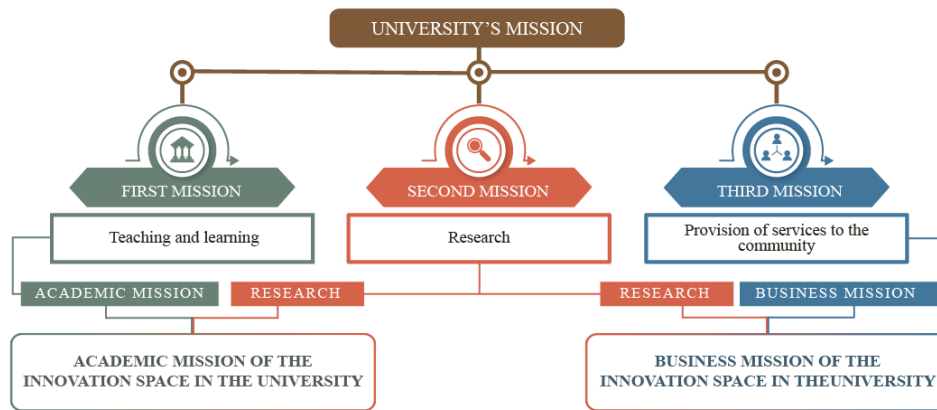


Figure 6: The two missions of innovation spaces in universities. Source: own elaboration.

In order to characterize the two missions defined for innovation spaces in universities, it is necessary to identify a concept that represents each of them, and that can be promoted in an innovation space at the same time.

The analysis for the academic mission of the ISU is carried out from the definitions of the authors regarding active learning methodologies. Considering that the competences developed in universities must respond to the ones demanded by the labor market and society (Deming, 2015), there is a special relevance to address not only theoretical knowledge, but also the development of human communication skills, socialization, decision making, etc.(CHELLI, 2013). In this sense, the methodologies presented in Table 8 address different training objectives, which will be analyzed from the teacher's role and the student's expectations, highlighting the proper work environment to be developed, proponing criteria that will allow choosing the concept that has the greatest relationship with the characteristics of an innovation

PROJECT-BASED LEARNING (Younis et al., 2021)(J et al., 2018)(Chu et al., 2017)	
Objectives	To integrate the student in a situation that requires solving a real problem from various areas of knowledge.
Teacher's role	The teacher guides the teams throughout the learning process, stimulating students to deepen their understanding of the problems addressed, to ensure that everyone actively participates in the learning process.
Student's role	The student develops competencies such as critical thinking, communication, collaboration, and creativity in problem solving.
Work environment	Physical or virtual spaces that facilitate communication, collaborative work, stimulating creativity.
FLIPPED CLASSROOM (Gilboy et al., 2015)(O'Flaherty & Phillips, 2015)(Munir et al., 2018)	

Objectives	To transfer learning outside the classroom, extending the physical classroom to another environment.
Teacher's role	The teacher ceases to be the main source of knowledge to become the facilitator and guide to access information.
Student's role	The student abandons their passive role as a receiver, attending classes prepared to share their knowledge, clarify doubts, and create learning experiences with classmates and the teacher.
Work environment	Flexible virtual environment.
<b>COOPERATIVE LEARNING (Shimazoe &amp; Aldrich, 2010)(Felder &amp; Brent, 2007)</b>	
Objectives	Socio-affective purposes in which students help each other to achieve a goal. Methodology preferably used in primary and secondary education.
Teacher's role	The teacher is responsible for structuring the process. The teacher resembles an expert who proposes, distributes, and supervises the tasks to the group, acquiring an observer role that feeds back and evaluates the tasks.
Student's role	Students help each other to achieve a common goal by establishing a specific plan.
Work environment	Physical or virtual spaces enabled to promote the development of individual and group skills from the discussion.
<b>COLLABORATIVE LEARNING (Liu &amp; Tsai, 2008; Ormrod, 2008)</b>	
Objectives	It is sought to develop personal and social skills by focusing the students' work on the process value and not the result. Relevant methodology in stages of higher education.
Teacher's role	The teacher works together with the student experiencing horizontal learning, where the teacher is a facilitator, intervening through the participation and promotion of co-evaluation.
Student's role	The student is responsible for structuring the process. Students are not dependent on the teacher; work is done in a horizontal way.
Work environment	Open and free environment that stimulates creativity. Spaces that motivate personal commitment and give freedom to participate or not.
<b>PROBLEM-BASED LEARNING (Roh, 2003)(Ting et al., 2021)</b>	
Objectives	Based on self-learning and the development of critical thinking, students tackle real or hypothetical problems in small groups, under the supervision of a teacher.

Teacher's role	The teacher directs the learning process to ensure that the team does not lose focus on the topic and make reasonable choices.
Student's role	The student enters the process of interactive search in groups, with shared responsibilities, times and means.
Work environment	Traditional classroom.
<b>GAMIFICATION (Hakulinen &amp; Auvinen, 2014)(Morán-Barrios et al., 2020)</b>	
Objectives	The mechanics of games are transferred to the educational field in order to increase people's motivation to achieve a specific goal
Teacher's role	The teacher guides students during the journey they take as players
Student's role	The student reflects on the situation represented, actively participates in an environment of experimentation; and individually creates their own concepts and knowledge.
Work environment	Traditional classroom.

Table 8: Analysis of active learning methodologies. Source: own elaboration.

Analyzing the learning methodologies of Table 8, we can observe a general concept in changing the role of students as recipients of knowledge with respect to traditional learning methodologies. Students become generators of knowledge, being responsible for leading part of the teaching process, which helps them to develop social, leadership and communication skills. It is positive to show this factor, since one of the characteristics why innovation spaces arise is precisely to transform traditional workspaces into ones that promote communication and interaction among people (Wagner & Watch, 2017a). Considering this fundamental characteristic of innovation spaces, the first filter will be based on discarding methodologies that do not require an adapted physical space to promote communication and interaction. In that sense, the first methodologies that will be discarded are: Problem-based Learning and Gamification.

The second filter is based on discarding the methodologies that promote their development in virtual spaces, **considering that the focus of our research is on physical innovation spaces.** As a result, the following methodologies are discarded: Project-based Learning and Flipped Classroom. Finally, the methodologies that are most related to the dynamics of an innovation space, and that would therefore have greater relevance to represent the academic mission of the ISU are: collaborative learning and cooperative learning. These two methodologies are based on the construction of collaborative knowledge. There is a lot of similarity between them, to such an extent that some authors consider that cooperative learning is part of the collaborative learning process (Laal & Laal, 2012). (Illeris, 2004) highlights that collaborative knowledge operates according to two concepts: learning environment and learning processes. A few years later, (Illeris, 2007) once again presents a system based on three dimensions: the content dimension, that encompasses understanding, knowledge, skills, ability, aptitude, and attitude; the incentive dimension, with the emotional, motivational, sensations, and will aspects; and the social dimension of interaction, communication, cooperation, and where we would add collaboration. This validates the relevance of these methodologies with the dimensions proposed for an innovation space in Figure 5.

However, it is necessary to choose only one of the two methodologies and, due to the relevance of the research context (universities), the choice leaned towards "Collaborative learning", based on the fact that (Bruffee, 2010) highlights greater relevance of the implementation of this methodology in higher education processes, while cooperative learning has a greater relationship with primary and secondary education.

Finally, in the case of the Academic mission, the concept that responds most precisely to the structure and dynamics of an innovation space is ‘collaborative learning’. So, this will be the associated concept.

For the ISU's business mission, the analysis that is performed in the search for the associated concept is different; this will be carried out from the analysis of the international scientific literature, identifying, and comparing the publications that present or incorporate as keywords: university; technology transfer, and innovation. The choice of these keywords responds to the analysis of the definitions and activities associated with the third university’s mission presented in chapter 1. The result of the selection of publications is presented in Figure 7.

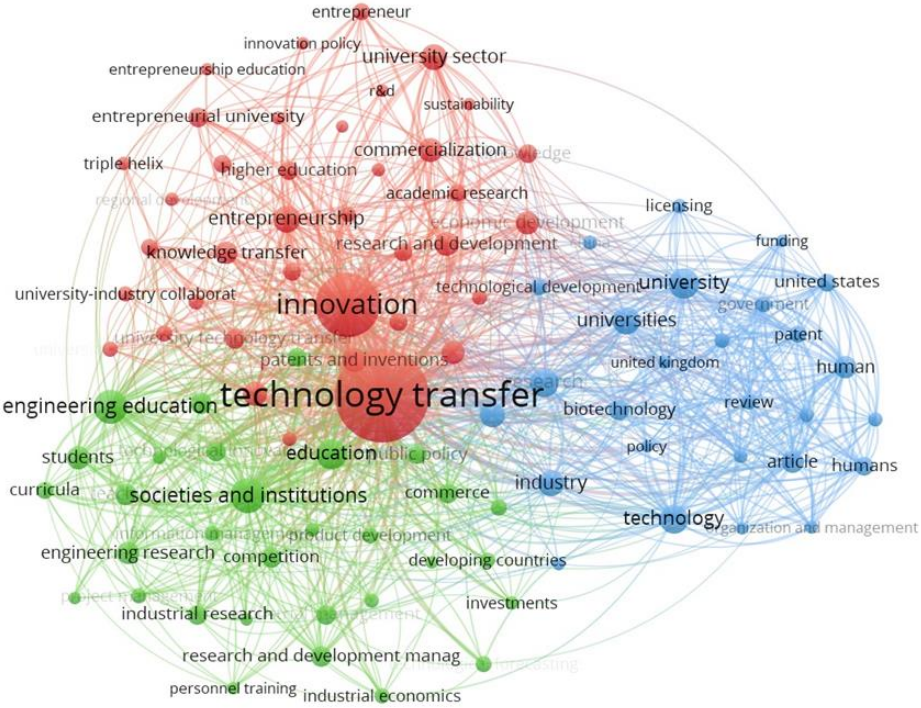


Figure 7: VOSviewer diagram of the publications in the university business mission, Source: own elaboration.

Figure 7 is a diagram showing three clusters formed by the most frequent words in the summaries of the publications. Each cluster represents different types of objectives, which the third university’s mission is related with:

**Cluster 1 red:** this group presents the literature on the entrepreneurial university. Different regional and world congresses on higher education include entrepreneurship as an approach to be adopted by university institutions. The UNESCO at the “Regional conference on policies and strategies for the transformation of higher education in Latin America and the Caribbean” (CRESALC - UNESCO, 1996); stated in one of the points of its final declaration that "higher education needs to introduce pedagogical methods based on learning to train graduates who



learn how to start up a business, so that they are able to generate their own jobs and even create productive entities that contribute to reduce the scourge of unemployment.". However, this step of universities towards entrepreneurship demands relevant changes both in university's management and structure. The (*III CRESALC*, 2018); proposed an Action Plan with recommendations for governments and higher education institutions (HEIs). Guideline 3 dedicated to Educational Innovation, recommends regional governments to "create the normative and promotion instruments that induce the entrepreneurial vision and educational innovation." Guideline 4 on the Regional Agenda on Science, Technology, and Innovation (STI), recommends HEIs to "create institutional instruments for the management of knowledge transfer and innovation as incubators, entrepreneurship disciplines, technology parks, intellectual property protection policies, among others".

**Cluster 2 green:** in this group, the publications are oriented towards analyze science, technology, and research in universities. It is the group that presents the most traditional vision of universities, focused on the generation and transmission of knowledge. Research is the most transversal concept in the 3 groups presented in Figure 8, which may be due to the reason that regardless of the activity that is carried out at university, it will always have a research component motivated by the teaching work. Therefore, it is consistent to say that research productivity helps to improve the quality of teaching (Desselle et al., 2018). Regarding the way in which the productivity of university research should be evaluated, some authors propose to measure it in quantitative terms, such as the number of publications or patents (Kosyakov & Guskov, 2019; Nguyen et al., 2021), and others propose to measure it based on the quality of the research, such is the impact it generates on society and industry (Daigle & Arnold, 2000).

**Cluster 3 blue:** this last group presents the analysis that authors have made regarding the connection that has been emerging between universities, industry, and government. These relations constitute a complex system (Loet Leydesdorff, 2004) that creates a synergy that leads to innovation (Etzkowitz et al., 2000). Even though this group presents relevant characteristics to represent the third university's mission, when analyzing the research that composes it, it can be defined that although it focuses on universities and their relationship with the environment, it does not propose the activities or strategies to reach this link, rather it defines the management that leads to establish this relationship. It shows also the areas in which the synergy that is beneficial for both university and its environment is established. In other words, this research group refers to the capacities that universities have to integrate into economic and social fields, developing a fundamental role in the production, discussion, application, and dissemination of knowledge (Irarrázaval & Irarrázaval, 2020) and the management that should be developed to formalize these relationships.

Considering that this bibliographic analysis aims to identify a concept that allows characterizing the business mission of the ISU, it has been observed that cluster 1 presents greater coherence in terms of the emergence of innovation spaces in universities. Somehow, the authors propose strategies to encourage the entrepreneurial and business vision in universities with the creation of spaces, such as technology transfer offices, or even business incubators. In this way, by making a deeper analysis of the keywords in cluster 1, a concept that draws attention is noticed when describing the involvement of academics in activities that manage to contribute to the growth and development of society from universities. This concept is 'academic entrepreneurship', whose basis seeks to define how academics should be integrated into the commercial development of their inventions. Moreover, how they should value their contributions in teaching, research, dissemination of culture/knowledge, and in general, all entrepreneurship activities at the university that aim to encourage innovation and economic growth (Klofsten & Jones-Evans, 2000). Academic entrepreneurship presents strategies for

teaching and industry to converge in the same place, respecting each of the actors' autonomy. Under these criteria of relevance, the concept associated with the business mission of ISUs will be 'academic entrepreneurship'.

This analysis concludes the search for the concepts associated with the missions of innovation spaces in universities, defining 'collaborative learning' for the academic mission, and 'academic entrepreneurship' for the business mission of the ISU as shown in Figure 8. The association of these two concepts will allow us to move forward with the search for the methodological model of the ISU. Each mission is then characterized in the same way as the definitions of 'innovation space', analyzing the literature to identify representative factors of each concept that will later be grouped into dimensions.

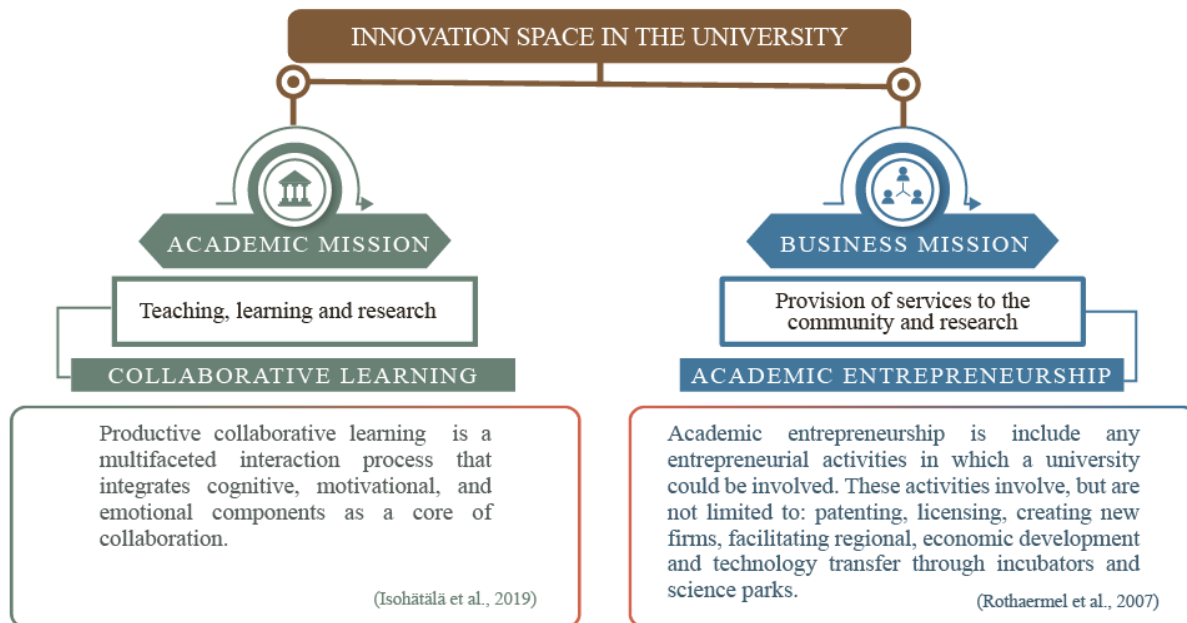


Figure 8: Concepts associated with the missions of the innovation space in universities. (Isohätälä et al., 2019; Rothaermel et al., 2007a). Source: own elaboration.

Finally, the association of these concepts will allow characterizing each of the two university's missions.

### 3.2.2.1 University's academic mission – collaborative learning

Collaborative learning is based on the construction of knowledge through the cooperation of group members, in contrast to traditional teaching methods that are based on competition or individual work (Laal & Laal, 2012).

This teaching method facilitates teamwork and is used both in physical classrooms and in distance or online teaching (Liu & Tsai, 2008; Ormrod, 2008). Some of the benefits that students experience are motivation; individual responsibility; the development of social skills and greater objectivity in group self-assessment processes (Johnson et al., 1999; Slavin, 1994). (Rodríguez Sánchez & Rodríguez Sánchez, 2015) group the benefits provided by this methodology into 3 visions:

**1. Pedagogical:** which generates commitment and social positioning; it also generates interaction, exchange of knowledge; builds diversity, and the possibility of creating learning communities, among others.

**2. Psychological:** where participants learn to negotiate, manage problems and solve them. Additionally, peer support benefits the absence of anxiety, creating greater self-esteem and self-regulation.

**3. Cognitive:** where flexible group support and management activate learning processes exponentially, the naturally link content and information filtered in groups, and they encourage creative capacity by stimulating critical thinking.

However, in order to obtain these benefits, it is necessary to plan and design physical or virtual spaces that allow the correct implementation of the activities associated with collaborative learning, understanding that this methodology is part of the paradigm shift in education that seeks to focus on active and participatory learning; without focusing exclusively on information transfer (knowledge) from the teacher to the student.

From this point of view, it is necessary to characterize collaborative learning to understand its range and limitations. Table 9 presents different studies that have proposed criteria or factors that determine the success of this new learning modality.

AUTHOR	FACTORS/CRITERIA
(Oblinger, 2006)	Stakeholder Integration Leadership Different perspectives Balance patience/performance Active and social learning Human centered Use of technological devices Physical space
(Zhang et al., 2019)	Teamwork engagement Trust Social engagement Reward
(Chu et al., 2017)(Chen & Kuo, 2019)	Interactivity
(Haataja et al., 2018)	Interdependence Cohesion tasks Psychological Security
(Van den Bossche et al., 2006)	Social dimension Interactivity
(Miyake & Kirschner, 2014)	Social networks Functionality Ease of use Perceived enjoyment
(Al-Rahmi & Zeki, 2017)	Cognitive heterogeneity in groups Social homogeneity in groups
(Chen & Kuo, 2019)	Cognitive monitoring Social monitoring

Table 9: Collaborative learning success criteria. Source: own elaboration.

Successful collaboration requires a complex mix of processes. The analysis of literature shows that most authors agree on two essential dimensions for collaborative learning: social and cognitive dimensions. The cognitive dimension represents learning and the social dimension represents the collaborative aspect of this type of teaching. Other dimensions that can be

identified as recurrent in the literature analysis are the following three: physical, technological and emotional. These three dimensions appear as a support to learning activities in work groups. Of these 5 dimensions found associated with the collaborative learning and the academic mission of universities, 4 of them are shared with the dimensions found in the general model of innovation spaces. This confirms the complementarity between an innovation space and the academic mission of universities. The social, physical, technological and emotional dimensions are common, while the cognitive dimension is particular to the academic objective that is required for the innovation space to support this mission of the university. Figure 9 presents the dimensions that compose the academic mission of an ISU.

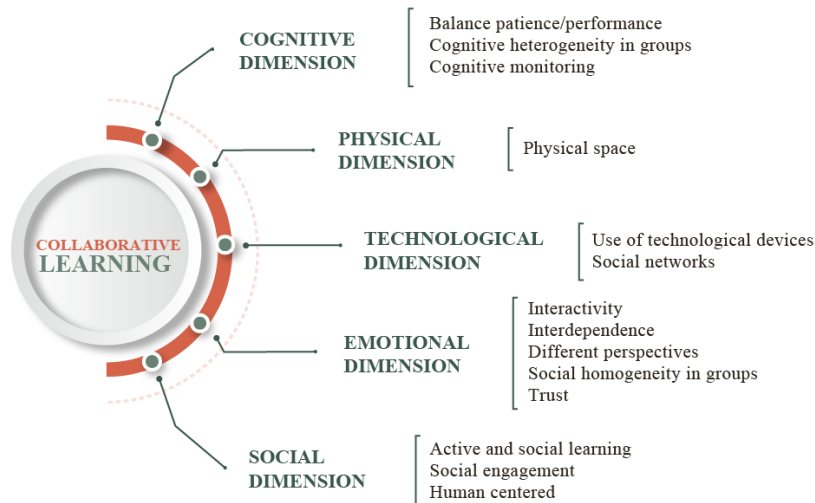


Figure 9: Dimensions of the academic mission of an ISU. Source: own elaboration.

To better explain the characterization of the academic mission, each of the proposed dimensions and factors is detailed below.

**Physical dimension:** it is mainly defined by comfort, flexibility, and sensory stimulation. According to the theory of learning and the student's needs, (Oblinger, 2006) highlights the flexibility to configure the physical space in different ways, allowing the execution of different learning activities. Comfort and sensory stimulation aim to maintain students' attention and motivation through ergonomic furnishings and colorful, bright, and illuminated places.

**Technological dimension:** it is mainly associated with two factors. (Oblinger, 2006) talks about the importance of technological devices as tools to support learning. These tools should be seen as a complement to the daily relationship that students have with technology, i.e., devices such as smartphones, tablets, and computers as tools to support collaborative learning. The second factor is the use of social media. (Al-Rahmi & Zeki, 2017) validated the positive impact of this factor on collaborative learning. A social network must be functional, easy to use, and offer fun to students so that it has the expected impact.

**Emotional dimension:** it is one of the most complex to manage. Interactivity among different actors is a factor cited by several authors (Van den Bossche et al., 2006). (Oblinger, 2006) postulates that the different actors must be integrated while respecting and understanding all points of view. (Chen & Kuo, 2019) highlight the conformation of the work team, showing that, at the level of interpersonal relationships, the team must be homogeneous. In that sense, (Lei et

al., 2010) propose familiarity among members as one of the 6 key factors in the formation of teams for collaborative learning. Another emotional aspect is trust among team members (Zhang et al., 2019).

***Social dimension:*** it is closely related to the emotional one but integrates other criteria as well. (Oblinger, 2006) states that active learning is positively influenced by its social role, allowing the student to engage and participate in the activities of the learning process. Success in learning outcomes is positively influenced by team engagement, which in turn is enhanced when there is social engagement and associated reward (Zhang et al., 2019). User integration is another mechanism for improving learning outcomes (Oblinger, 2006).

***Cognitive dimension:*** the one that is most related to learning. In this dimension, the strategies and activities that are carried out must be adapted to the student's needs and types of learning (Oblinger, 2006). According to (Chen & Kuo, 2019), there are four learning roles that must be considered when forming a team (supervisor, information provider, problem solver, and atmosphere creator); their study shows that groups in which all four roles were located had higher learning performance than those in which at least one role was missing. A cognitive heterogeneity in the conformation of the group improves learning outcomes, while at the emotional level it is better for team members to be homogeneous.

A transversal factor is the monitoring of the work team. (Haataja et al., 2018) propose cognitive, social, and emotional monitoring. Cognitive monitoring commonly allows the adaptation of learning strategies. However, the lack of social and emotional monitoring can be a cause of failure because it negatively impacts the collaborative functioning of the team (Haataja et al., 2018). Therefore, it could be understood that the cognitive, social, and emotional dimensions should incorporate some tool or monitoring strategy to benefit their good development.

The concept of 'collaborative learning' allowed characterizing the academic mission of the ISU, the result obtained (Figure 9) is a model that allows establishing the structure of a university innovation space with an academic orientation.

Then, a similar analysis will be made to determine the characterization of the business mission from the concept of academic entrepreneurship.

### **3.2.2.2 University's business mission – academic entrepreneurship**

Academic entrepreneurship emerges as a concept to strengthen technology transfer from universities to industry, generating more direct links among science, technology, and research (Rippa & Secundo, 2019). Different perspectives have studied this evolution and the new activities with an entrepreneurial approach in universities. (Henry Etzkowitz, 2003b) proposes the perspective of the third mission, referring to all commercial activities aimed at the business aspects of universities. The response to the execution of the third mission is based on a triple helix view. The activity of creating university companies is a view to understand the creation of start-ups and spinoffs, fed by the results of the research work. In this case the university carries out its commercial activities by working with industrial partners (O'Shea et al., 2004). The generation of start-ups using university-developed technology, or the licensing of private companies, are considered within the perspective of university start-ups (Grimaldi & Grandi, 2005). A broader view is that university entrepreneurship encompasses all the business activities that universities can carry out: technology transfer, patents, licensing, creation of start-ups, among others (Rothaermel et al., 2007a). There is also the view of a process defined by 4 stages: dissemination of innovation and intellectual property, creation and industrial alliances, selection of commercialization mechanisms, and finally commercialization (Wood, 2011). (D.

Siegel & Wright, 2015) integrate different ways to develop academic entrepreneurship: accelerator support, entrepreneurship garage, networks with industry and alumni, incubators, and employee mobility. The search for solutions for the community or industry based on university research is considered in the perspective of academic entrepreneurship as a research university (Etzkowitz & Zhou, 2017).

Within these perspectives, some authors have analyzed the factors that define the success of academic entrepreneurship. (Fischer et al., 2019) propose 4 aspects of the academic environment related to university entrepreneurship activities: networking activities; infrastructure and habitats; organizational practices of universities; and university orientation (academic or research). In that sense, (Fischer et al., 2019) analyze academic entrepreneurship from sustainability, defining 4 factors: context (governance and trends), institutional framework, key people, and external interaction. In Mexico, (Cantu-Ortiz et al., 2017) propose the REPITA model to help different universities to recreate entrepreneurial activities. This model is based on 6 pillars: Research, Ecosystem, People, Intellectual Property, Transfer and Alignment. Research must have research platforms and support for the development of activities; the Ecosystem seeks to catalyze the environment with resources and incentives; People focus on recommendations for the creation of work teams; Intellectual Property seeks to define intellectual protection policies; Transfer refers to technology transfer mechanisms; and Alignment seeks to align technology with the incubation of companies for marketing.

Table 10 highlights the factors proposed by different authors to characterize academic entrepreneurship.

AUTHORS	FACTORS/DIMENSIONS
(Fischer et al., 2019)	Networking activities Infrastructure and habitats Organizational practices University orientation
(Fichter & Tiemann, 2018)	Environmental context Institutional framework Key persons External interaction
(Cantu-Ortiz et al., 2017)	Research Ecosystem People Intellectual property Transfer Alignment
(Miranda et al., 2017)	Subjective norms Creativity Perceived utility Self confidence Business experience Training Business environment
(O'Shea et al., 2004)	Human resources Institutional resources Financial resources Commercial resources
(Rasmussen & Borch, 2010)	Opening new paths of action Balancing academic and commercial interests Integrating new resources

Table 10: Academic entrepreneurship success criteria. Source: own elaboration.

In recent years, the attempts to analyze the factors that lead academics to acquire entrepreneurial behavior have increased, in contrast to the authors' initial efforts to measure the university's entrepreneurial activities through technology transfer only (D. Siegel & Wright, 2015).

In analyzing the factors presented in Table 10, they can be regrouped into 6 dimensions: physical, technological, emotional, social, cognitive and financial. In this case, the relationship between innovation spaces and the business mission appears to be more direct due to the existing link between the concepts of innovation and entrepreneurship. When analyzing the dimensions, the complementarity between the innovation space and the academic entrepreneurship concept is based on 4 common dimensions: physical, technological, emotional and social. While the other two dimensions are particular to the business mission, the cognitive dimension due to the role of the university and the financial dimension to foster the achievement of entrepreneurship projects. Figure 10 presents the assignment of factors to the dimensions identified in literature that compose the business mission of an ISU.

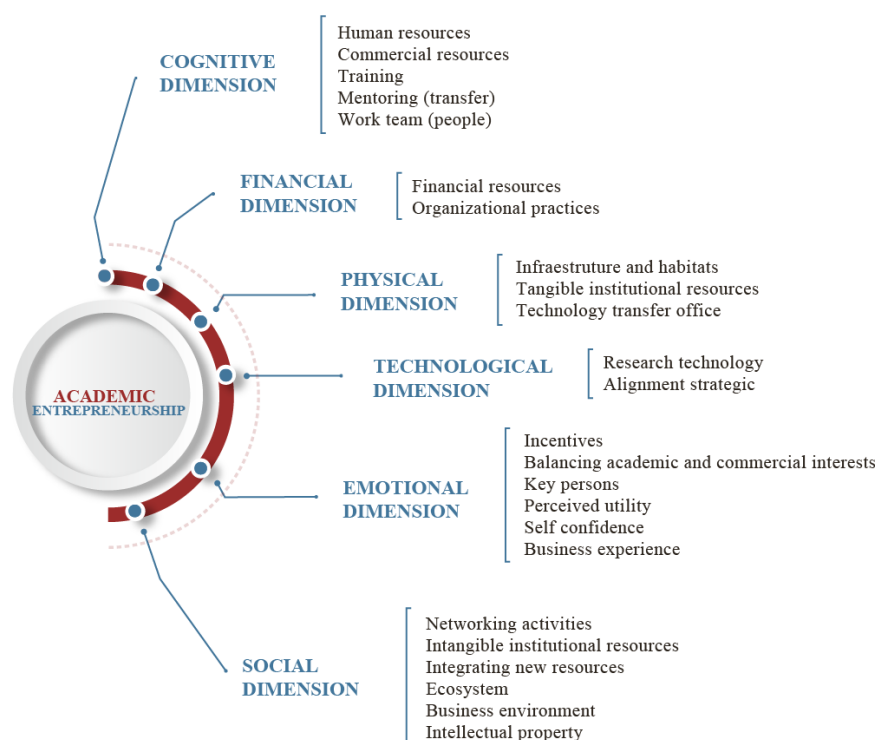


Figure 10: Dimensions of the business mission of an ISU. Source: own elaboration.

Based on the analysis and identification of the factors found in the literature, the dimensions and factors proposed to characterize the business mission of the ISU are described below.

**Physical dimension:** pace, habitat and infrastructure can support entrepreneurial activity in a university. Technology transfer offices, incubators, accelerators, science parks, and entrepreneurship centers are relevant within the internal university ecosystem (Fischer et al., 2019). Tangible institutional resources, such as technology transfer offices, are an engine for entrepreneurial activity (O’Shea et al., 2004).

**Technological dimension:** in the REPITA (Research, Ecosystem, People, Intellectual property, Transfer, Alignment) model proposed by (Cantu-Ortiz et al., 2017), the Research factor focuses

on a technological research infrastructure, where new technologies or methodologies are constantly created. This infrastructure can be made independently in each space or supported by others. There must be a strategic alignment between technology and business so that they adapt to the external context (Cantu-Ortiz et al., 2017).

***Emotional dimension:*** to encourage business activity to motivate a change in the daily activities carried out by academics (Fischer et al., 2019), it is necessary to balance academic and business interests (Rasmussen & Borch, 2010). The integration of important actors can also have a positive impact on academic business activity (Fichter & Tiemann, 2018). The perception of utility, that is, the relationship among risks, effort, and expected income, impacts on the academic actors' decision to participate or not in a business project (Miranda et al., 2017). The academic's self-confidence and past entrepreneurial experience also support entrepreneurship (Miranda et al., 2017).

***Social dimension:*** networking activities aim to strengthen the academic relationship with industry. (Fischer et al., 2019) argue that contact and relationships with entrepreneurs can strengthen the entrepreneurial competencies of academics. In addition to providing topics such as development opportunities, that is, working on current industrial problems of companies, intangible institutional resources such as history or institutional culture generate relevance by supporting the development of entrepreneurial academic activity (O'Shea et al., 2004). The integration of new resources from industry, whether cultural or social capital, has a positive effect on academic activity (Rasmussen & Borch, 2010). To catalyze the ecosystem to generate motivation that allow the coexistence of entrepreneurial academic activities with other university's activities, incentives can be economic, social, cultural, etc. (Cantu-Ortiz et al., 2017). Intellectual property should be considered as a mechanism for the protection of knowledge, but also as a reward mechanism for the actors involved in business projects (teachers, students, industry) (Cantu-Ortiz et al., 2017). The business environment affects the perception of business opportunities and projects by academic actors (Miranda et al., 2017).

***Cognitive dimension:*** human resources mainly associated with the quantity and quality of researchers influence the success of entrepreneurial activity in universities (O'Shea et al., 2004). Business resources also have a cognitive orientation focused on mentoring and user relationships (O'Shea et al., 2004). Organizational practices directly influence academic entrepreneurship, these academic factors support mentoring and coaching (Fischer et al., 2019). Marketing, financial, and operational skills must be combined in the training of the work team, in addition to integrating the specialized skills of each project (Cantu-Ortiz et al., 2017). Moreover, mentoring should be provided in research, intellectual property, incubation, and all business development, this is usually done by technology transfer offices (Cantu-Ortiz et al., 2017). Training related to business competencies should be considered to increase the probability of success and the academy's interest in business projects (Miranda et al., 2017).

***Financial dimension:*** financial resources such as R&D expense and investment capital, whether from public or private sources, support the number of entrepreneurial projects in universities (O'Shea et al., 2004). Organizational practices for entrepreneurial initiatives directly influence academic entrepreneurship; economic factors help fill capital shortfalls (Fischer et al., 2019).

Finally, the characterization for the innovation space has been established; the university's academic and business mission represented in a structure of dimensions. This characterization was carried out for each concept individually, and although it is evident that there are



dimensions that are transversal for the three concepts analyzed, the description of each dimension responds to a vision of the concept. As shown in Figure 11.

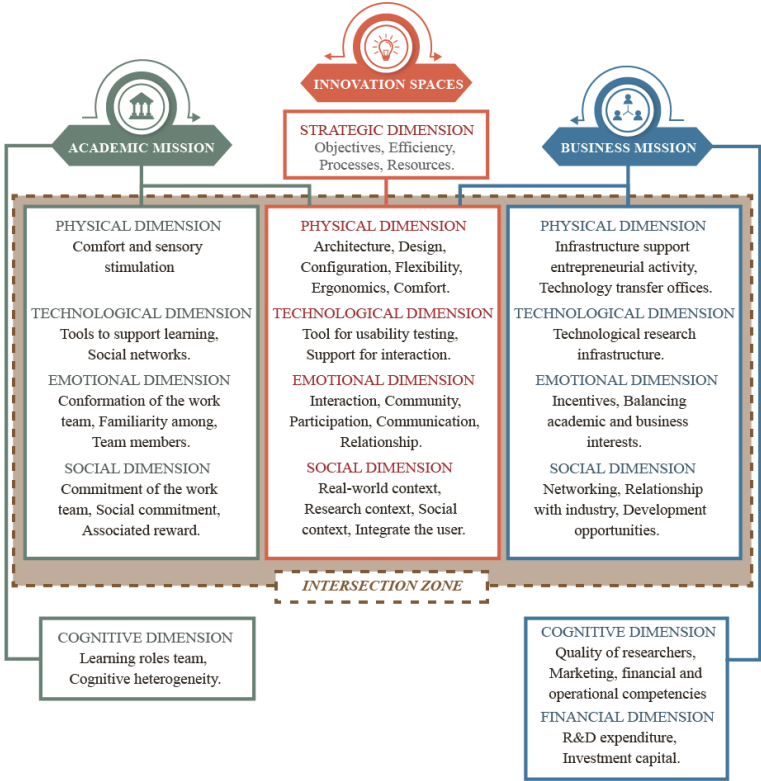


Figure 11: Consolidated dimensions and practices of an ISU. Source: own elaboration.

Thus, an ISU that seeks to support the academic mission should develop 6 dimensions. The strategic dimension proper to the innovation space; the physical, technological, emotional and social dimensions that are common and the cognitive dimension proper to the academic mission. While an ISU supporting the business mission should consider 7 dimensions: the strategic dimension, proper to the innovation space, the physical, technological, emotional and social dimensions that are common and the cognitive and financial dimensions that are proper to the business mission. This model presents a general orientation to design and plan an ISU considering the missions of the University.

The ISU model structure according to the university's missions based on dimensions will serve as the basis for the creation of a tool to assess the level of maturity of this type of space. In this way, the aim is to establish a decision support tool for ISU management to improve the performance of the space.

### 3.3 Structuring the evaluation tool

The proposed model allows visualizing the complexity of the structure and the different dimensions that characterize an ISU. At this level, the model provides a general guide to the dimensions to be considered for the design or operation of an innovation space; however, it does not allow determining the level of maturity of the ISU. In this sense, the model should be complemented with an evaluation method with the objective of establishing the basis for an

evaluation tool to support the management decision making process of the ISU. The construction of this tool is based on the following procedure (Figure 12):

**1 Structure of the tool:** The proposed dimensions for an ISU are defined by factors drawn from the literature. The definitions of the factors are broad, which makes it difficult to assess the IS directly through the factors. For this reason, a second analysis is performed in which the factors are described as practices representing daily activities and processes performed by the IS. Then, the practices are evaluated through observable phenomena that are structured as maturity grids ordered in progressive levels. The definition of practices is validated through expert opinion.

**2 Evaluation Method:** Each of the practices will be evaluated in levels of progression that evidence the degree of maturity of each observable phenomenon. Thus, the tool is based on facts that demonstrate the performance of the practice and allows managing the subjectivity of the person performing the assessment.

**3 Diagnosis and recommendations:** Finally, a plan of recommendations is established based on the identification of the practices that represent drivers or brakes for the functioning of the ISU.

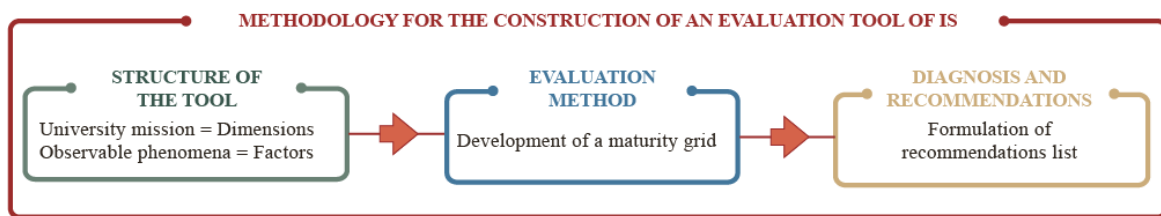


Figure 12: Methodology for the construction of an IS evaluation tool. Source: own elaboration.

Thus, the design of the ISU assessment tool involves three main stages in which the structure of the tool must be formalized, followed by the definition of the assessment method and the generation of a plan of recommendations that will favor ISU management.

In this way, a model with two levels of aggregation is established. The first level has the dimensions of ISU and the lower level has the practices that allow its evaluation. The level of practices is especially adapted to IS in universities since they are associated according to their contribution to the missions of these institutions.

The following is the creation of the tool for each of the innovation spaces in universities: academic mission and business mission.

### 3.3.1 Structure of the tool for an innovation space for collaborative learning

To structure the evaluation tool, the dimensions of the ISU model are characterized for each university mission. First, for the ISU of the academic mission, the practices that characterize its 6 dimensions are studied. Based on the literature review, the activities, routines or actions that support collaborative learning are identified and associated with their respective dimensions of development. Figure 13 proposes a model (dimensions and practices) that characterizes an innovation space that promotes collaborative learning.

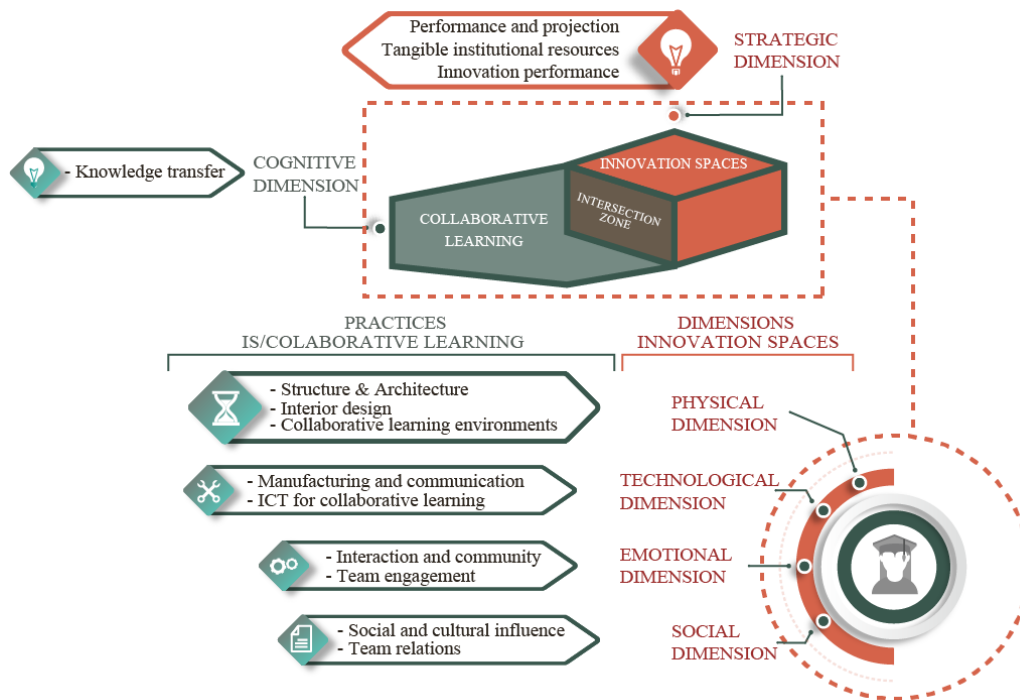


Figure 13: Dimensions and practices for an ISU that promotes collaborative learning. Source: own elaboration.

In this way, each dimension can be evaluated based on the level of development of its associated practices. The strategic dimension is characterized by 3 practices; therefore, its evaluation will reflect the average maturity level of the ISU in these three practices: performance and projection, tangible institutional resources and innovation performance. The physical dimension is characterized by three practices, the technological dimension by two practices, the emotional dimension by two practices, the social dimension by two practices and the cognitive dimension by only one practice.

Below is the definition of each practice by dimension, to understand its contribution to an ISU supporting the academic mission (particularly, the collaborative learning).

### ***Strategic dimension***

Once the common dimensions between the innovation space and collaborative learning have been defined, it is important to highlight that the strategy dimension of the innovation space is the one that will integrate the parameters to define whether the space has an academic, business or mixed mission. This definition should be consistent with the operational objectives, resources and results strategically projected for IS.

**Performance and projection:** The operating strategy plays a key role in the management of innovation spaces; establishing the route to be followed to have a good performance (Mantere & Sillince, 2007). Operating strategies must have at least a strategic objective, a defined scope, execution time, budget and a responsible assigned (Hamel & Prahalad, 2010).

**Tangible institutional resources:** Innovation spaces contain various levels of physical resources, from infrastructure and technological resources to furniture (Peschl & Fundneider, 2014; Schuurman et al., 2013). Each configuration is made according to specific constraints such as: resources, space, skills and trajectory (Klooker et al., 2015).

**Innovation performance:** It is necessary to analyze and define indicators that help evaluate the performance of innovation spaces (Veeckman et al., 2013). Innovation requires proper

planning of activities, realistic objectives, constant monitoring of the development of activities and measurement of results (Osorio, 2021).

### *Physical dimension*

**Structure and Architecture:** The first practice to consider is flexibility, which is a point of consensus between innovation spaces and collaborative learning. As shown by (Moultrie et al., 2007) and (Osorio, 2021), the space must allow an agile reconfiguration and the execution of different activities. Oriented to collaborative learning, these activities should include group work, master classes and user experience, among others.

**Interior design:** The second practice is comfort. In innovation spaces, this criterion is related to the following terms: infrastructure (Schuurman et al., 2013a), architectural space (Peschl & Fundneider, 2014), spatial organization and architectural details (Kallio et al., 2015). The ergonomics of the space should motivate students to be active, make them want to go visit this space, integrate it as a common place in their daily life, and frame it in the notion of living space. It is also important to consider the sensory stimulus. As well as comfort, it is related to terms such as infrastructure and architecture, but from a more visual point of view. (Osorio, 2021) define it as a design value. Thus, the space must be designed with bright colors, and have a technological and familiar visual aspect at the same time.

**Collaborative learning environment:** Learning environments that respond to the needs of students and support collaborative pedagogical processes must integrate in a balanced way concepts such as flexibility, comfort, sensory stimulation, technological support and decentralization (Oblinger, 2006).

### *Technological dimension*

Within this dimension, two criteria are important: the use of technological devices to support learning, and the use of social networks (Oblinger, 2006).

**Manufacturing and communication:** To be successful, technological devices must be easily linked to the devices that students usually use, such as smartphones, tablets, and computers. The tendency to integrate the user into innovation spaces has made the technological equipment of these spaces more accessible and easier to understand (Oblinger, 2006). In addition, technological advances in 3D printing, virtual reality, Arduino, among others, have brought this type of technology closer to citizens, especially students from 18 to 25 years old, since they are very fond of technologies (Osorio, 2021). For other more complex technologies, many innovation spaces have a technological facilitator (fabmanager, maker, etc.). In conclusion, the equipment of the space must aim at functionality and interaction with users or work teams belonging to this space, and the space must have a technological leader who facilitates its use.

**ICT for collaborative learning:** In the collaborative learning process (Oblinger, 2006) highlights the importance of technology as a tool to support learning. In that sense, ICTs favor communication processes making them faster and more effective; allowing to show results in an organized and simple way (Ezekoka & Gertrude, 2015). The use of social networks generates a virtual space of interaction that complements the physical space of the laboratory (Al-Rahmi & Zeki, 2017).

### *Emotional dimension*

**Interaction and community:** The main practice of this dimension is interactivity. Collaborative learning thrives on the convergence of different points of view. In this sense, the term 'community' used in innovation spaces presents an opportunity for the development of this interconnectivity. (Schuurman et al., 2013a) talk about multi stakeholder, (Kallio et al., 2015) about openness, and (Veeckman et al., 2013) about community and co-creation, all

criteria to support the interrelationship of stakeholders in a climate of respect and shared values through different opinions.

**Team engagement:** (Peschl & Fundneider, 2014) directly include the emotional dimension in innovation spaces, focusing on aspects such as security, trust, and commitment. These aspects should be the basis of the team encouragement, defined as a success factor of collaborative learning. In an innovation space within a university, the main actors are students. Given this, the role of monitor is defined to focus on the three aspects proposed by (Peschl & Fundneider, 2014) to ensure the proper functioning of work teams.

### *Social dimension*

**Social and cultural influence:** (Osorio, 2021) integrates the practice associated with communication with the outside world and user integration as relevant variables for the design of an innovation space. This integration of context and ecosystem allows actors to constantly work with the community surrounding the laboratory, thus generating the social commitment that collaborative learning needs. User integration is a common point between innovation spaces and collaborative learning, so it is a factor that must be developed and maintained in both cases.

Thus, a workspace that constantly addresses the problems faced by social actors, and that constantly integrates the user into their activities will allow the development of the social dimension of collaborative learning.

**Team relations:** Social relationships are a critical point in learning processes and environments (S. J. Lee et al., 2011). Socialization and discussion of ideas stimulate students' thinking, creativity, confidence and learning (Faranda & Clarke, 2004). This is how conducting collaborative activities has a positive effect on students' learning habits (Molinillo et al., 2018).

### *Cognitive dimension*

**Knowledge transfer:** Finally, the cognitive dimension of collaborative learning will be integrated into the model of the innovation space to reinforce the academic intention of the space. Considering that, at the cognitive level, innovation spaces have as their central axis the development of competences associated with the innovation process, this dimension will provide work teams with a cognitive reference point that allows them to control and adapt their learning strategy by identifying the roles that each team member must take. The innovation space must have leaders in the innovation process to guide each stage of it and advise work teams. These leaders will help cognitive tracking, by suggesting adaptations to the learning strategies adopted by the team.

Thus, the evaluation tool for an ISU with an academic mission is made up of 6 dimensions characterized by 13 practices. The construction of the structure of the evaluation tool for a business mission ISU is presented below.

## **3.3.2 Structure of the tool for an innovation space for academic entrepreneurship**

Analogous to the procedure followed with the academic mission ISU evaluation tool. From the literature review, the practices associated with the seven dimensions of the business mission ISU are identified. Figure 14 shows the model with the dimensions and practices.

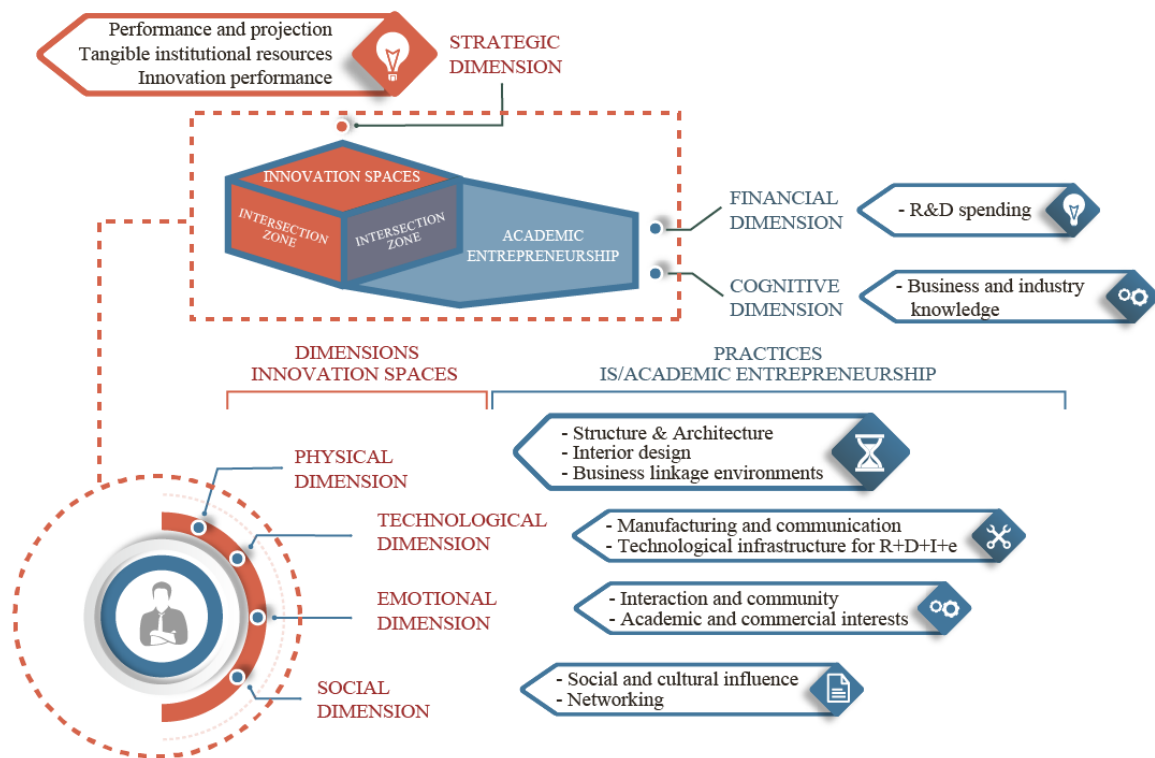


Figure 14: Dimensions and practices for an ISU that promotes academic entrepreneurship.  
Source: own elaboration.

This evaluation model, as in the academic mission, is structured in two levels: dimensions and practices. The tool consists of 7 dimensions and 14 practices. The business mission ISUs share several practices in common with the academic mission ISUs. The strategic dimension is the same in its three practices for both missions. The physical dimension shares 2 common practices: structure and architecture and interior design. The technological, emotional and social dimensions share one common practice each one: manufacturing and communication, interaction and community, and social and cultural influence respectively. In the following, only the 6 particular practices of a business mission ISU will be defined (since the common practices were already defined in the previous section).

**Physical Dimension**

**Business linkage environments:** The innovation space configuration must allow the execution of different activities (Moultrie et al., 2007; Osorio et al., 2019), including entrepreneurship and technology transfer activities. For (O’Shea et al., 2004), tangible institutional resources, such as technology transfer offices, are the engine of entrepreneurial activities. (Peña-Vinces et al., 2011) proposes a list of infrastructural features to better support the development of entrepreneurship and business activities, that includes: production areas, such as laboratories equipped with internet network (LAN, broadband, etc.) and electrical systems; common offices for incubators that allow the joint use of information and communication technologies; and business rooms that have visual aids such as communication systems, high-speed internet network, computers, software developer, etc.

### ***Technological dimension***

**Technological infrastructure for R&D&I&E:** The technological equipment of innovation spaces must be advanced and follow trends (Klooker et al., 2015). For (Cohen et al., 2017), digital technologies such as social media, mobile devices, business analytics, Internet of Things, big data, advanced manufacturing, 3D printing, etc., open up opportunities for entrepreneurs and become a dominant source of innovation in academic entrepreneurship. (Nambisan, 2017) highlighted the role of digital technologies in entrepreneurial processes and synthesized this concept into three distinct but related elements: 1) Digital artifacts: understood as a digital component, an application, or multimedia content that is part of a new product or service, and offers a specific functionality or value for the end user; 2) Digital infrastructure: defined as digital technology tools and systems that offer communication and collaboration capabilities; 3) Digital platforms: referring to the sets of shared and common services, as well as types of software that provide functionality shared by modules or interfaces (Apple's iOS, and Mozilla's Firefox browser). The basis of this technological implementation must be based on the space operation strategy (Cantu-Ortiz et al., 2017) with the aim of avoiding the acquisition of unnecessary technologies that are not integrated into the space operation. Thus, technological support must be friendly and compatible with the technological knowledge of the people who interact with the innovation space (Dupont, 2009; Veeckman et al., 2013).

### ***Emotional dimension***

**Academic and commercial interest:** Defined by most of the authors as the interaction and sense of community that must exist in an innovation space. (Veeckman et al., 2013) propose to consider participation, communication, and relationship among the different actors of the space as an important aspect. In this context, (Fichter & Tiemann, 2018) show the need to integrate industry actors into innovation processes to generate a positive impact on academic business activity. In fact, (Osorio et al., 2019) recommend considering the active participation of end users and facilitators in the different development stages of an innovation project. An important aspect of motivating a sense of community in academic entrepreneurship is to balance academic and business interests (Rasmussen & Borch, 2010). This balance can be generated by strengthening academic incentives such as: formal collaborative research activities; contract research and consultancy; informal activities of counseling, training, etc (Abreu et al., 2009; Perkmann et al., 2008).

### ***Social dimension***

**Networking:** The activities of innovation spaces must be placed in a specific context, in social and cultural terms (Peschl & Fundneider, 2014). In this sense, the integration of new resources from industry, whether cultural or social capital, has a positive effect on academic activity (Rasmussen & Borch, 2010). Working on common projects with industry provides academics with knowledge and opportunities to jointly develop inventions that can be patented or licensed (Rasmussen & Borch, 2010).

Intellectual property should be considered as a reward mechanism for actors involved in business projects (Cantu-Ortiz et al., 2017). However, the generation of work networks should not only be established towards companies, the integration of academics with other spaces within universities, such as research centers, positively influences the generation of new projects and benefits the emergence of topics of interest for the community (Bozeman & Corley, 2004). Thus, generating a new type of social relationship with the community. Different authors address this point under the concept of user integration (Ronny Gey et al., 2013; Veeckman et al., 2013).

### Cognitive dimension

**Business and industry knowledge:** The cognitive dimension of academic entrepreneurship aims to promote a learning dynamic in the innovation space aimed at academic staff, where training related to research valorization is established to provide the bases on which relationships with industry must be developed. Teachers must be aware of the implications, commitments and benefits that arise from the participation of business projects. They must develop cognitive skills that benefit negotiation under conditions of equality, and allow them to visualize the contributions they can make from their experience and knowledge. In this sense, the innovation space must establish incentives to support teachers in the acquisition of knowledge or the participation of events that develop that commercial characteristic linked to research.

### Financial dimension

**R&D spending:** The financial dimension is what establishes the greatest challenge for academic entrepreneurship. The main thing is to understand that the financial structure must respond to parameters that support R&D spending. Understanding that innovation spaces respond to common and non-personal benefits, individual payment or incentives are not considered as financial criteria; unless those payments are expressed in terms of education or training, which could be somehow necessary for the development of a project, and it could consequently return as a benefit to the IS. The financial dimension shows a type of contingency associated with the resource origin and how to establish financial autonomy, considering that normally any structure that belongs to the university depends on a centralized resource management by the university's direction.

To finalize the proposal of the model design for an innovation space in universities, Figure 15 integrates the structure of the academic mission model with the structure of the business mission model, to propose a mixed model of an ISU. This mixed model is based on the same definitions presented above.

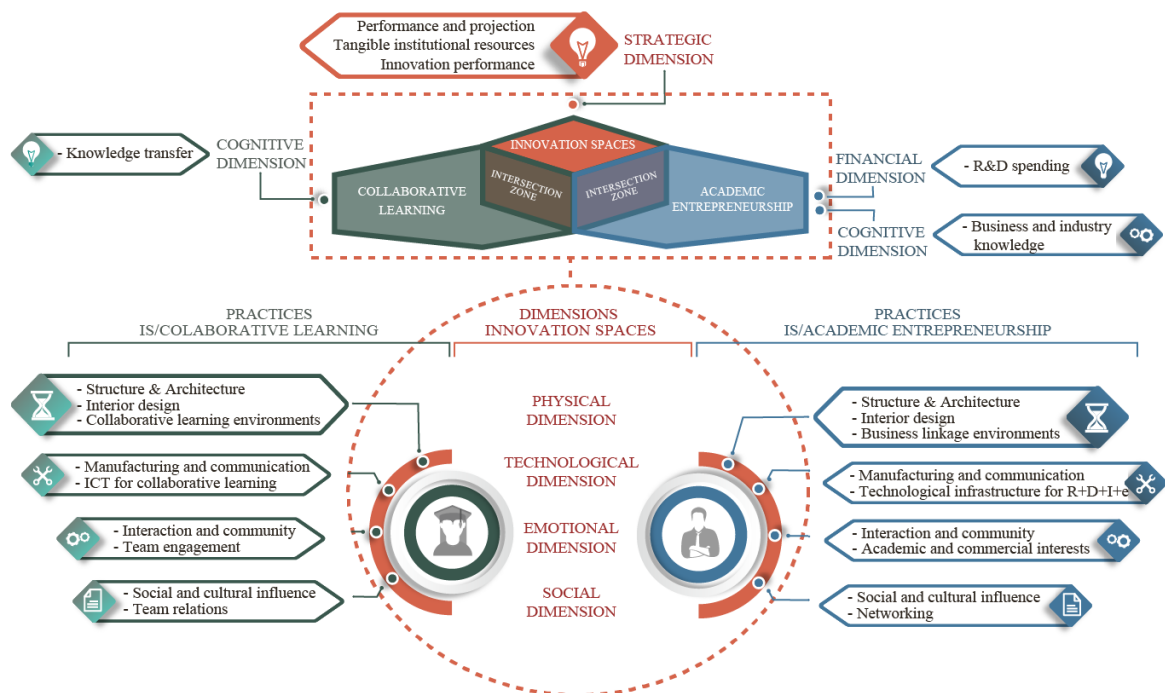


Figure 15: Dimensions and practices for the design of an ISU with a mixed mission. Source: own elaboration.



This concludes the proposed stages to define the structure of the evaluation tool of an ISU. However, being a model based on the literature and presented for the first time, it is considered essential to validate its relevance in practice. In this sense, universities are the natural scenario where the dynamics represented in the model are developed. Below is the implementation of a qualitative validation based on interviews and carried out with directors of innovation spaces in Chilean universities.

### 3.4 Validation of evaluation tool structure

Considering that the main validation objective is to define the relevance of the proposed model, and considering innovation spaces managers as the most suitable people to contribute to this validation from their experience in the management of ISU, it is proposed to use the following parameters as a validation framework:

- ***Selection of experts:*** people directly involved with the problem, who have the knowledge and experience to contribute their opinions to the research. Managers of innovation spaces in universities.
- ***Qualitative approach:*** collection of information through interviews. Synchronous online interviews.
- ***Improvement proposal:*** based on the observations collected in the interviews. Analysis of results.

In this way, the development of each parameter is described below.

#### **Selection of experts**

Higher education in Chile is constituted by a diversified system, composed of three types of institutions recognized by the State that are offered to those who graduate from secondary education: universities; professional institutes; and technical training centers. Universities constitute the highest level of teaching, where the functions of teaching, research, and extension converge.

In Chile there are 25 universities considered as ‘traditional institutions’, which have full autonomy and are coordinated through the Council of Rectors of Chilean Universities (CRUCH). This group of universities includes 16 state universities and 9 universities with private legal personality.

Of the total of 25 universities, 5 of them, 3 state and 2 with private legal personality, are invited to participate in the validation of the ISU model:

- Arturo Prat University: State, Tarapacá Region, Chile.
- Catholic University of Valparaiso: Private, Valparaiso Region, Chile.
- University of Santiago de Chile: State, Metropolitan Region, Chile.
- University of Concepcion: Private, Bío Bío Region, Chile.
- University of Bío Bío, State, Bío Bío Region, Chile.

As evidenced in the information presented, these universities are located in different regions of Chile, which is a contribution to research in terms of variety of university contexts.

Based on the experience and knowledge that managers must have about the innovation space they direct, the validation of the ISU model considers the participation of 7 experts responsible for innovation spaces in the universities presented above:

- Arturo Prat University: Innovation Center.
- Catholic University of Valparaiso: The Lift Pre-Incubator; Makerspace Faculty of Engineering.

- University of Santiago de Chile: Entrepreneurship and Innovation Laboratory; Innovation Center Faculty of Engineering LEIND.
- University of Concepción: UdeC Incubator.
- University of Bío Bío, Innovation Center for the Bio Bio region.

A further description of the innovation spaces mentioned will be made in the next chapters. At this stage, the variety of innovation spaces is highlighted in order to cover a wide range of activities in the validation model that can be identified in innovation spaces in universities, based on the experience of the space managers either for an innovation center, an incubator, a Makerspace or an innovation laboratory.

### **Qualitative approach**

The qualitative approach is based on the analysis of a set of reflections or checks that are obtained through the data extracted from the most significant and relevant information in relation to the subject of research.

Data extraction will be carried out through interviews with experts. According to (Agarwal et al., 2020), qualitative interviews is a main path to explore the way in which subjects understand or experience a particular situation. It provides access to the environment of subjects who describe their activities, experiences and opinions in their own words.

To obtain reliable results, it is important to configure the questions in a clear and concise way, directing exactly the aspects that need to be evaluated. The interview script implemented in this validation stage was done to obtain information about the:

- Relevance of the dimensions presented in the model.
- Clarity of the definitions presented for each dimension.
- Relevance of the practices presented in the model.
- Representativeness of the model facing the reality of each IS.

Table 11 presents the guidelines that were followed to configure the model of validation through interviews for innovation spaces in universities.

GUIDELINES FOR SETTING UP THE INTERVIEW	
<b>Invitation and contact</b>	It will be done individually by email. It will include a presentation and brief information about the status of the researcher.
<b>Interview request</b>	After a positive response from the interviewee to the interest of participating in the research, a formal question will be asked that clearly explains the request to be part of the research as an interviewee, and the date and time of the interview will be scheduled. A clear proposal will be made, and the purposes of the research, the topic of the interview, and the possible monitoring will be explained.
<b>Contribution benefit</b>	Interviewees are proposed to keep them informed of research and publications (articles and final thesis project).

Interview questions	Open-ended questions will be asked, motivating the interviewee to give their opinion in a broad way. Visual resources will be presented to repeat questions that require clarification.
Interview implementation	It will be carried out in a meeting through a virtual platform, recording the session with the prior authorization of the interviewee.

Table 11: Guidelines for setting up an interview. Source: own elaboration.

Once the guidelines for conducting the interview have been established, the structure of the interview and the steps to follow through the meeting with the experts are defined. In this sense, Table 12 presents the structure of the interview proposed for the model validation.

MODEL VALIDATION INTERVIEW STRUCTURE	
Introduction	<ul style="list-style-type: none"> <li>- A short presentation is made about the researcher and the objectives of the interview.</li> <li>-The interviewee is asked to make a short presentation about their professional profile and their job in the innovation space.</li> </ul>
Model presentation	<ul style="list-style-type: none"> <li>-The model objective is presented.</li> <li>-The methodology that was followed to obtain the model is presented.</li> <li>-The model is described.</li> </ul>
Interview	<ul style="list-style-type: none"> <li>-The interviewee is asked the following questions:               <ol style="list-style-type: none"> <li>1) The university's mission is taken into account to establish the operational objectives of the IS that you direct (describe it), if not, on what do you base the operational objectives of the space?</li> <li>2) Can you relate the model presented above with the IS that you direct and show the relevance in the dimensions that compose the model? Yes/No. Why?</li> <li>3) Can you describe the dimensions you recognize you have put into practice in the IS and exemplify how you approach them in practice?</li> <li>4) Do you consider the definitions of dimensions appropriate in terms of clarity of concepts, representativeness and relevance to the context?</li> <li>5) Explain if you feel that any dimension or factor is redundant or if it is necessary to integrate concepts that you think belong to the dynamics of operation of the innovation space.</li> <li>6) Explain if you think the model represents 100% of the structure of an innovation space and if you do not consider it so, explain what concept needs to be integrated.</li> </ol> </li> </ul>

Closure	<p>-The interviewee will be asked to express his point of view on issues that he recognizes as important and have not been integrated into the survey.</p> <p>-A free space is defined in which the interviewee feels free to propose or give additional information.</p>
End	<p>The meeting ends by thanking the interviewee and making a commitment to keep them informed of the research progress.</p>

Table 12: Structure of the interview. Source: own elaboration.

As for the data obtained, it is important to keep in mind that the results will be considered valid if the answers: are really accurate and capture what is happening in the case of each expert; are generalizable, that means there if the results are uniform through repeated interviewing of different experts in the different contexts (different universities) presented (Ehrmin & Pierce, 2021).

### **Improvement proposal**

After each interview, the information obtained is consolidated and analyzed individually. Subsequently, the results of all interviewees are contrasted to analyze coincidences and differences among the answers. In this way, an individual and collective analysis of the data obtained in the interviews is carried out with the aim of defining the validation conclusions.

The main findings obtained in this validation stage are the following:

- There is no clarity on the concept of innovation space. There is confusion among the definition of an innovation space, an applied research laboratory, an academic innovation project, and other initiatives or university spaces that aim to generate innovation.
- The university's missions were not considered in the design of innovation spaces in most cases. However, the interviewees agree on the importance of associating a mission with the space.
- The strategic dimension is recognized as a pillar for the creation and management of an innovation space. However, most of the interviewees claim not to have defined their own operational strategy. Therefore, the design and management of the innovation space has been done intuitively.
- Proposals for improvement of the model were directed to the strategic dimension, highlighting that this dimension is not at the same level as the other ones in terms of implementation and execution.
- Regarding the strategic dimension, experts describe it as a dimension that is managed individually, but that internally must have a link of connection with the other ones so there is coherence in the results.
- Regarding the other dimensions, the interviewees easily recognize the physical and technological dimensions and formally consider them in the design of the innovation space. The other ones were highlighted as an important part of the space, although it is recognized that, due to ignorance, so far these dimensions have been developed in a very superficial way and mainly intuitively.
- In most spaces, only the physical and technological dimension have been consciously implemented. The management of resources in universities has benefited the adaptation of spaces and the acquisition of technology linked to specific projects.

- The definitions of the dimensions are clear, in the sense that concepts related to the teaching work and the innovation context are recognized. The name of the dimensions represents their objective in a very concrete way.
- The importance of knowing the seven dimensions and managing innovation spaces as complex structures is highlighted, reinforcing the need to integrate these spaces into the dynamics of a university.
- There were no proposals of new dimensions or practices. In the same way, there are no dimensions or practices that are not considered important in the dynamics of innovation spaces and that could be omitted from the model.
- It is highlighted that there is a need to generate a definition from the model, one that clarifies the minimum conditions that a space must meet to be considered an innovation space.

In conclusion, the model presents a first learning outcome, since it defines the practices and dimensions to be considered in an ISU, which some of the interviewees had taken into account but not consciously or systematically.

The interviewees agree on the contribution of the proposed model, recognizing that they identify activities of their work in the different dimensions, affirming that the proposal is adapted in a coherent way to the structure of the ISU. The least known dimensions such as cognitive, emotional, and social arouse the interest of the interviewees, seeking to increase their understanding. However, they hold the view that the physical and technological dimensions are the basis of an innovation space. Although universities work in different geographical and administrative contexts, the model provides a good reference frame.

Once the model has been validated, and without evidence of changes that require a new analysis or restructuring of the defined proposal, the next step is to establish an evaluation method, based on the dimensions and the model of practices, that allows evaluating the capacity of the ISU. The development of this evaluation tool will allow us to delve even deeper into the proposed practices, going from having general definitions to setting concrete and measurable activities in each dimension.

### **3.5 Definition of an evaluation tool for innovation spaces in universities**

The proposed assessment tool is significant in terms of knowledge as it allows to visualize the complexity of the structure and the different dimensions and practices that compose an ISU. The practices represent activities that can be developed in the management of the ISU, so that resources can be allocated to it and its level of performance can be measured. In pursuit of this objective, there is a need to characterize the practices in terms of 'observable phenomena' in order to establish the basis of an evaluation model. In the business context, (Enjolras, 2016) considers that: "an observable phenomenon can be defined as the tangible and verifiable evidence(s) of an activity carried out routinely in the company (for example: presence of a data centralization tool, worksheet ...). If these observable phenomena are present in the enterprise, the activity they characterize can be considered controlled." Therefore, if an analogy is made with innovation spaces, it is considered appropriate to use observable phenomena as evidence to validate the mastery of the defined practices, using them as evaluation indicators. The objective is to be able to establish the level of maturity in ISU practices, so a progressive evaluation scale should be associated with these levels. Under this guideline, (Grant & Pennypacker, 2006) argue that the maturity grid is a method that can be applied to every process of all companies to evaluate their practices and seek greater performance.

The maturity grid is based on a sequence of discrete steps that contain elements to describe the process characteristics at a certain development level. The set of organized levels must have an upward progression that generates an evolutionary trajectory (Wendler, 2012), evidencing the maximum development degree of each level. In turn, the set of levels defines the optimal working conditions of an organization to achieve its objectives (Andersen & Jessen, 2003).

The definition of the maturity grid highlights its usefulness mainly in two aspects:

- To describe the progression of practices: defining a grid with different maturity levels to measure the effort or progress of practices.
- To support decision-making: from the evaluation of the current state, adopting improvement measures to evolve to the following levels defined in the grid.

In terms of implementation, the flexibility that the maturity grid has acquired has allowed its application to evaluate different types of processes (Colli et al., 2019). Some examples of application of the maturity grid were established to measure the maturity of open innovation and digitalization (Enkel et al., 2020); roadmaps in industry 4.0 (Colli et al., 2019); ideas generated (Gochermann & Nee, 2019); capacity for collaborative innovation in virtual organizations (Knoke, 2015); the evaluation of the small and mid-sized enterprises' (SMEs) capacity to export and innovate (Enjolras, 2016); the evaluation of the SMEs' ability to deploy Lean Six Sigma (Moya et al., 2019); etc. Similarly in terms of management, the maturity grid has been applied to project management, human resource management, change management, innovation management, and quality management (Ho et al., 2020).

In short, the maturity grid generates advantages by obtaining a much more detailed analysis of the institution or company's results. In the case of ISs, the maturity grid will be considered as an appropriate method to know both the current maturity level of the evaluated practices, and the different levels that will allow the practice to be better performed. In the examples of use presented above, it has been observed that the maturity grid is built using an iterative approach. In fact, the researchers elaborate a first version of the maturity grid, which is then presented for validation to the experts in order to reach its final version. In this case, the same procedure will be carried out in the search for a relevant and validated evaluation tool for the ISUs.

### 3.5.1 Construction of the maturity grid adapted to the ISU

The construction of the maturity grid will allow the generation of an ISU maturity level assessment questionnaire. The construction of this questionnaire will be through an iteration process, which will be composed of three stages 1) Definition of the evaluation question for each practice; 2) Definition of the maturity levels described as observable phenomena; 3) Validation with experts.

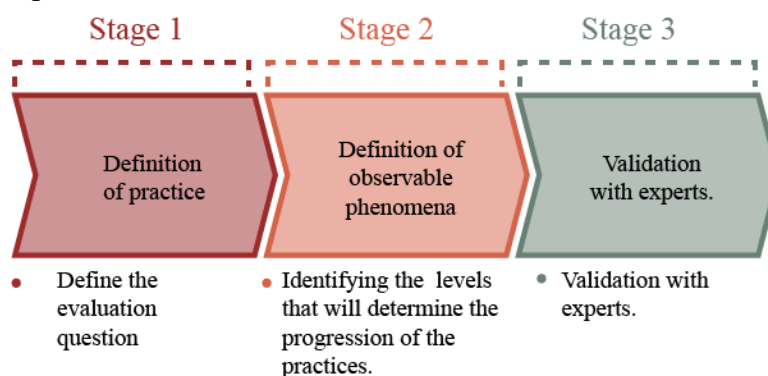


Figure 16: Process construction of the maturity grid. Source: own elaboration.

The development of Stage 1 is based on the literature analysis and expert validation presented in sections 2.3 and 2.4. Thus, the first step is to concisely define the practices in order to understand the ISU activity or process to be evaluated. In this way, each ISU practice will have an associated question to be evaluated. The practices to be evaluated depend on the mission of the university. An academic mission ISU will evaluate 13 practices (8 common to all ISUs and 5 particular to the mission) and a business mission ISU will evaluate 14 practices (8 common to all ISUs and 6 particular to the mission).

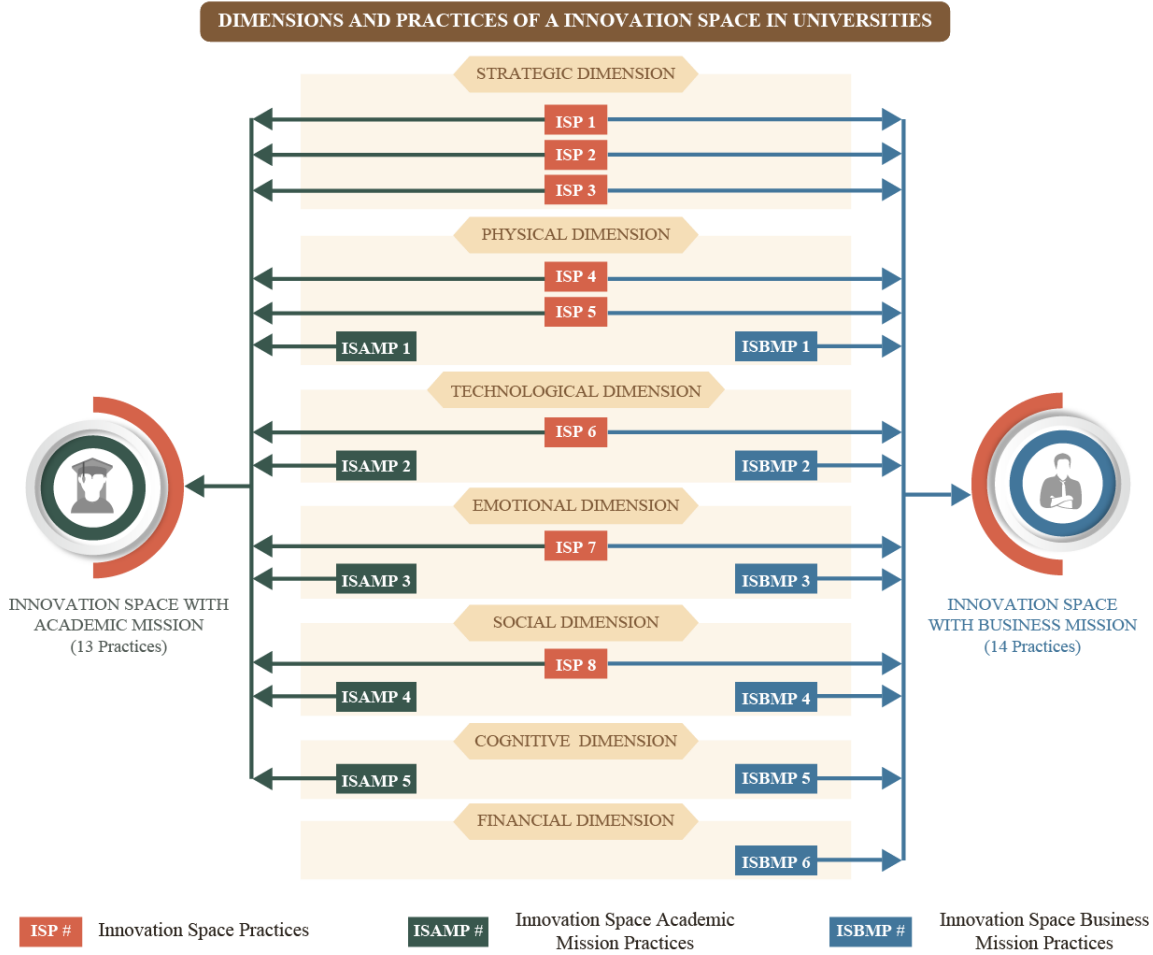


Figure 17: Common practices of an ISU and particular practices associated with the mission of the university. Source: own elaboration.

Figure 17 shows the distribution according to the dimensions of the 8 common practices of an ISU (orange), the 5 practices of the academic mission (green) and the 6 practices of the business mission (blue). In case an ISU is mixed, that is, it contributes to both missions of the University, the questionnaire will include 19 practices to be evaluated (8 common, 5 academic mission and 6 business mission).

Table 13 shows the evaluation question associated with each of the 19 practices that make up the questionnaire considering both missions.

DIMENSION	PRACTICE
STRATEGIC DIMENSION	<p><b>Performance and projection (ISP1):</b> Has the innovation space defined its own operational strategy that delimits and directs the activities and use of resources within the space, benefiting the measuring and evaluation of the expected results?</p>
	<p><b>Tangible institutional resources (ISP2):</b> Were the environment and the physical resources of the innovation space determined by the operational objective of the space, contributing positively to the activities that were executed in it?</p>
	<p><b>Innovation performance (ISP3):</b> Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?</p>
PHYSICAL DIMENSION	<p><b>Structure &amp; Architecture (ISP4):</b> Is the architectural structure of the innovation space flexible? Does it have zones that adapt to different activities properly?</p>
	<p><b>Interior design (ISP5):</b> Does the innovation space provide design elements that guide and benefit the creative process?</p>
	<p><b>Collaborative learning environments (ISAMPI):</b> Do the physical dimension and equipment of the innovation space support activities of collaborative learning?</p>
	<p><b>Business linkage environments (ISBMPI):</b> Do the physical space and equipment of the innovation space benefit the execution of entrepreneurial activities and/or technology transfer?</p>



TECHNOLOGICAL DIMENSION	<b>Manufacturing and communication (ISP6):</b> Does the innovation space have technological devices that support activities determined in the operational objectives of the space (machinery, technological equipment, software, apps)?
	<b>ICT for collaborative learning (ISAMP2):</b> Does the innovation space encourage the use of ICT to develop collaborative learning activities?
	<b>Technological infrastructure for R+D+I+e (ISBMP2):</b> Does the innovation space encourage activities that create a technological infrastructure of research and entrepreneurship?
EMOTIONAL DIMENSION	<b>Interaction and community (ISP7):</b> Do the structure and dynamics of the innovation space encourage interaction, communication, and relationship among different actors benefiting the sense of belonging to the space and the creation of community?
	<b>Team engagement (ISAMP3):</b> In the creation and development of academic activities within the innovation space, are the technical-professional-soft skills of each participant analyzed and valued to make effective teams?
	<b>Academic and commercial interests (ISBMP3):</b> Does the innovation space promote dynamics focused on encouraging business activities, generating a balance between the academic and business interests within the space?
SOCIAL DIMENSION	<b>Social and cultural influence (ISP8):</b> Does the management of the innovation space understand the importance of including the surroundings in its functioning dynamics? Does it develop community links and create projects that have a real impact on the territory?
	<b>Team relations (ISAMP4):</b> Within the academic activities developed in the innovation space, are strategies established to strengthen and reinforce the relationship among work teams?

	<b>Networking (ISBMP4):</b> Does the innovation space establish parameters to create networks with companies and other education institutions that strengthen the relationship between academia and industry?
COGNITIVE DIMENSION	<b>Knowledge transfer (ISAMP5):</b> Does the innovation space strengthen learning skills by using different methods in the development of projects?
	<b>Business and industry knowledge (ISBMP5):</b> Does the innovation space strengthen relationship skills of its staff (researchers, teachers, students and administrative personnel) with the market (marketing, finance agencies and operational competencies)?
FINANCIAL DIMENSION	<b>R&amp;D spending (ISBMP6):</b> Does the innovation space establish a financial structure that supports the expense on R&D?

Table 13: Definition of practices for the ISU. Source: own elaboration.

Once the practices have been defined, we proceed to step 2 with the objective of identifying the observable phenomena that will determine the maturity levels of progression of the practices. This is based on a 5-level maturity grid, which makes it possible to establish a clear difference in the performance progression of the practices. Each of the 19 practices will be evaluated by a customized 5-level maturity grid describing the resources and competencies associated with the implementation of each level. For this construction of the 5 levels, the first step is to determine the extreme values of each practice, defining the lowest tolerable level and the optimal level of implementation. Subsequently, the intermediate levels are defined, which should show the gradual increase of each practice to best represent the progressive performance. Table 14 presents as an example the maturity grid associated with the performance and projection practice associated with the strategic dimension of the ISU.

Dimension	Practice		Description		
Strategic Dimension	Performance and projection (ISP1)		The IS has to define an operational strategy based on a needs analysis to guide its activities and the use of resources.		
Maturity Level 1	Maturity Level 2	Maturity Level 3	Maturity Level 4	Maturity Level 5	Reference
The IS does not have a defined operational strategy.	The IS has an operational strategy intuitively defined by an assigned manager.	The IS has an operational strategy agreed by the team in which the assigned responsible and an expected	The IS has a clearly established operational strategy based on a study of the environment, defining the	The IS has a clearly established operational strategy, based on an internal and external study defining	(Moultrie et al., 2007) (Dupont, 2009) (Osorio, 2021)

		range are established.	assigned manager, the expected range, and the scheduled execution time.	the assigned manager, an expected range, scheduled execution time, and its own budget.	
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Table 14: Maturity grid levels of the ISU strategic dimension. Source: own elaboration.

Table 14 shows the structure of the maturity grid for practice 1 of the strategic dimension, which is also the first question of the ISU assessment questionnaire. Each question presents the associated dimension, the name of the practice, the evaluation question and the 5 progressive maturity levels that the practice can reach. These 5 levels represent an evaluation scale from 1 to 5, so that if the practice is evaluated at maturity level 1, its score will be 1, while if it is evaluated at level 3, the score assigned will be 3. The ISU evaluation questionnaire with the maturity grid for each of the 19 practices can be found in Annex 1.

Once the practices and levels for the entire ISU model have been defined, the first proposal of the maturity grid is considered complete, and its relevance and effectiveness are validated with the experts who were part of the validation of the ISU methodological model, thus moving to stage 3.

For the development of stage 3, it is proposed to carry out an evaluation that guarantees the validation of the following aspects: clarity of the concepts presented both in the questions and levels; consistent progression in the levels of each practice; and tool representativeness in terms of its activities and practices responding to the IS reality and being truly achievable in turn.

### 3.5.2 Maturity grid validation

For the maturity grid evaluation, 2 groups of experts were convened. The first group was with ISU managers, and the second group composed of teachers and professionals from the technology transfer office (TTO) of the University of Santiago de Chile. The variety of profiles allowed us to have a broad vision of the tool, validating it from both academic and business perception.

In this way, in the first iteration, the strategy was to establish individual meetings with each expert summoned for the maturity grid validation.

The meeting is not considered an interview format, since the proposal is to simulate the space evaluation by applying the tool developed to collect comments and observations progressively in each dimension. Once the innovation space evaluation is completed, open questions will be asked to complement the information obtained.

The expert validation methodology implemented is shown in Table 15.

MATURITY GRID VALIDATION ISU	
Introduction	A short presentation is made explaining the characteristics and principles of the maturity grid operation; the tool construction and the way it is proposed to validate it.

Validation parameters	<p>Experts are presented with the parameters they must take into account for validation:</p> <ul style="list-style-type: none"> <li>- Clarity and coherence in the question making.</li> <li>- Consistent progression in the levels.</li> <li>- Objectivity and coherence in the proposal of activities of each level.</li> <li>- Representativeness of practices and levels with the reality of ISs.</li> </ul>
Interview 1 (space evaluation using the maturity grid)	<p>The expert is encouraged to intervene freely in the development of the evaluation questionnaire application if he has any comments, doubts, contributions, etc. Or if there are unclear questions; poorly formulated; that do not respond to a real space activity; not much progressive or poorly formulated levels. The evaluation questionnaire is applied by reading the questions and levels of each dimension one by one. At the end of each dimension, a dialogue is started, encouraging the extraction of information from experts regarding positive and negative aspects of each practice portrayed in the maturity grid.</p>
Interview 2 (focused questions)	<p>As a complement to the information obtained through the application of the IS evaluation questionnaire, a short closing interview is established to point out conceptual aspects of the tool. For this stage, the following questions are established:</p> <ul style="list-style-type: none"> <li>- Do you consider that the practices are representative of the activities that are normally carried out in an IS?.</li> <li>- Could you quickly identify in the levels the activities in which your IS is located? Or did you have to adapt to an activity you do not consider to be carried out in your IS? If so, which one?</li> <li>- Do you think that the questions represent the activities that take place in the IS in a good way?</li> <li>- In the evaluation, do you think there is a lack of any daily developed activities in the IS?</li> </ul>
End	<p>The meeting ends by thanking the interviewee and making a commitment to present to them the results obtained through the evaluation tool.</p>

Table 15: Validation process of the maturity grid ISU. Source: own elaboration.

Once the evaluation with the 5 experts has been completed, the analysis of the results allows validating that, in general lines, the interview is understood in a good way and reflects the reality of the innovation spaces. The step from factors to practices generated with the maturity grid triggers an even more relevant interest of experts to delve into dimensions such as emotional and social, identifying again activities that have been carried out intuitively but have not been

maintained permanently. In this sense, the relevance of using a tool such as the maturity grid is highlighted, one that allows evidencing a total projection of the innovation space, describing its activities from the lowest to the optimal level. In addition to these general conclusions, some specific improvements emerged that will be presented below evidencing their previous (first version of the Maturity Grid) and subsequent stage (second version of the Maturity Grid).

- **Strategic dimension, (ISP2):** it is requested to add descriptive data to understand concepts such as "specific rules to promote a creative work culture." In this case, a text was added at the end that explains what is understood by specific rules like: "(written or unwritten rules on how to behave in space, instructions for closing doors, restriction on the use of equipment or spaces, limitation on access to the laboratory)". Additionally, there is evidence of an improvement in the question wording, specifying the action that is carried out.

First version	Second version
The space occupied by IS provides tools for knowledge generation and dissemination, and establishes specific rules to promote a culture of support for creative work and collaborative learning.	The innovation space uses tools for knowledge generation and dissemination, establishing specific standards to promote a culture of support for creative work and collaborative learning. (Written or unwritten rules on how to behave in space, instructions for closing doors, restriction on the use of equipment or spaces, limitation on access to IS).

- **Physical dimension, (ISP4):** it is requested to be more specific in expressions such as: "activities with a small number of participants", defining exactly what a small number of participants is, like: "reduced number of participants = 3 to 6 participants" Additionally, the possibility of activities that the level refers to in this paragraph was specified: "allows the execution of two different types of activities."

First version	Second version
The innovation space has limited areas, but its adaptation allows the execution of two different types of activities with a small number of participants.	The innovation space has limited areas, but its adaptation allows the execution of at least two different types of activities (collaborative activities, manufacturing, and / or individual work activities) with a small number of participants (from 3 to 6 participants).

- **Emotional dimension (ISAMP3):** The evolution of certain practices from one level to another is not evident, and the answer could be represented similarly in 2 levels in parallel as there is no greater difference, so the level is reformulated to show progress and ensure that the answer is at one or another level, but not at both at the same time.

First version	Second version
Level II The innovation space recognizes the importance of creating a multidisciplinary	Level II The innovation space recognizes the importance of creating multidisciplinary and

and effective team for the proper development of the learning process. It uses methodological tools that guarantee the assignment of appropriate roles within a team based on the person's qualities. Additionally, it evaluates and corrects aspects during the learning process, such as: the willingness to do the work, the presence of interest, enthusiasm, anger, anxiety, and boredom.	effective teams for the proper development of the learning process. It uses methodological tools that guarantee the assignment of appropriate roles within a team based on the person's qualities.
Level III The innovation space establishes a process of continuous improvement associated with the strengthening of work teams. Where the capabilities of each team member are evaluated to assign roles that meet the team's requirements in academic activities.	Level III The innovation space establishes a process of continuous improvement associated with the strengthening of multidisciplinary work teams. During the learning activities, the abilities of each person are evaluated, assigning roles and correcting aspects such as: the will to do the work, the presence of interest, enthusiasm, anger, anxiety, and boredom.

- Globally, much of the survey's wording was reformulated in such a way that the concepts presented were more precise and did not give space to interpretations, such as "it has appropriate and sufficient technology" = "it is equipped with medium and high-end technological equipment". This decision is made with the aim of establishing a clear standard at each level, considering that the reality of each IS is particular, and what is considered "appropriate and sufficient" for one IS may be "inappropriate and insufficient" for another one. In that sense, it is established that the basis of the appropriate is medium and high-end technology. In the case of the example presented, however, the same standardization was established in different practices.

First version	Second version
The innovation space has appropriate and sufficient technology for the development of projects that require manufacturing activities and usability testing. Communication technologies are a frequent support in the development and dissemination of projects. Besides, there is a technology acquisition plan that is aligned with the strategic objectives of the space.	The innovation space is equipped with medium and high-end technological equipment, benefitting the development of projects that require manufacturing activities and specialized usability tests. Communication technologies are a frequent support in the development and dissemination of projects. Besides, there is a technology acquisition plan that is aligned with the strategic objectives of the space (in the short or medium term).

Finally, the maturity grid validation by the experts allows reaching a second version of the tool, where a significant improvement is evidenced in terms of writing and pointing out concepts, being these the aspects that were unilaterally highlighted in the evaluation with the experts. There was no request for changes in terms of the proposal of practices, therefore the 19 practices initially presented are kept. In conclusion, the new tool structure consists of 19 practices, so the final evaluation survey consists of 19 questions (see the full evaluation questionnaire in Annex 1).

### 3.6 Diagnosis report on the maturity level of the innovation space in universities

The previous steps led to define the benchmark for evaluating the practices of an ISU. This benchmark allows a detailed analysis of the practices in ISs with an academic, business or mixed mission. By answering the survey of 19 questions, the IS managers can get to know the current situation and the possible levels of progress in the space practices, thanks to the consolidation of the information that originates from the result of the maturity grid.

The definition of these levels of progression, in addition to reducing the subjectivity of the evaluator thanks to the description of concrete observable phenomena for each level, makes it possible to assign an evaluation score to each level of maturity. The following table shows the score assignment to each maturity level of the grid, for all questions it is the same assignment.

Maturity level	Level 1	Level 2	Level 3	Level 4	Level 5
Score	1	2	3	4	5

This assignment then allows to have a direct evaluation for each of the practices from the maturity level stated in the questionnaire. Then, from the score of the practices it is possible to calculate the evaluation of the dimensions. Each dimension has a certain number of practices, so its evaluation is obtained by calculating the average score of the practices assigned to that dimension. For example, the strategic dimension has the first 3 practices associated with it, so the score of the strategic dimension will be the average of the evaluation of these first three practices. Finally, since the overall performance of the ISU is characterized by its dimensions, the overall assessment of the ISU will be determined by the average of the assessment of the dimensions.

Regarding the report type that originates through the space evaluation, the objective is to present results that benefit decision-making at different strategic levels, generally and particularly.

Thus, the presentation of results will be carried out through three types of evaluations:

- Overall evaluation of the ISU: overall average of all dimensions.
- Evaluation by dimension: result of the evaluation of each dimension.
- Post-practice evaluation: result of the evaluation of each practice.

The development of each evaluation and the contribution they generate for the innovation space is explained below.

#### 3.6.1 Overall evaluation of the ISU

To better understand the type of diagnosis and recommendations that can be obtained from the ISU maturity level assessment, an example of an innovation space assessed for the business mission will be presented. The following table shows a summary of the assessment obtained for this ISU:

BUSINESS MISSION			
DIMENSION	PRACTICE	EVALUATION	AVERAGE DIMENSION
	Performance and projection	3	3

Strategic Dimension	Tangible institutional resources	4	
	Innovation performance	2	
Physical Dimension	Structure & Architecture	3	3.7
	Interior design	4	
	Business linkage environments	4	
Technological Dimension	Manufacturing and communication	4	3.5
	Technological infrastructure for R+D+I+e	3	
Social Dimension	Social and cultural influence	3	2.5
	Networking	2	
Emotional Dimension	Interaction and community	3	2.5
	Academic and commercial interests	2	
Cognitive Dimension	Business and industry knowledge	2	2
Financial Dimension	R&D spending	1	1
AVERAGE TOTAL SPACE			2.6

Table 16: Summary of the assessment obtained for ISU. Source: own elaboration.

The third evaluation column shows the maturity level obtained for each of the practices that characterize the business mission ISU. This result is obtained directly from the answers given to the evaluation questionnaire. The fourth column shows the evaluation of each dimension, obtained from the average evaluation of the practices associated with each dimension. Finally, the last row shows the overall assessment of the ISU corresponding to the average assessment of the 7 dimensions that characterize the business mission.

It allows having an overview of the IS, categorizing it in a specific maturity degree. Its result arises from the average obtained in the dimensions evaluated, which generate an overall index of the space capacity that can range from 1 to 5, defining the level of general performance of the space and categorizing it into 4 groups that respond to the following criteria:

***Space index between 1-2, minimum maturity degree:*** the IS has not made any strategic or economic effort for its implementation. It depends on the resources and use of other physical spaces of the university for its operation. It does not have the maturity to develop projects. Its operation is based on the execution of transitory and simple activities (advice, mentorships, etc.).

***Space index between 2-3, low maturity degree:*** the IS shows a minimum effort in terms of investment. It has a basic physical workspace, a human team limited in number and capabilities.



The ability to develop projects depends on the complementarity that it can find in other spaces to cover its deficiencies; in other words, it does not have the ability to develop projects individually. The projects that can be developed in a complementary way are of low complexity or low degree of innovation. It has a total economic dependence on the university, which does not allow it to make decisions or manage projects autonomously.

**Space index between 3-4, average maturity degree:** the IS presents relevant differentiating factors in terms of physical structure, technological capacity, and human resources. It has the maturity and experience for the development of projects of low and medium complexity (incremental innovation). It has a constant flow of activities that responds to clear operational objectives. It has a hybrid economic dependence (own resources and centralized resources) that allows a minimum degree of autonomy in project management.

**Space index between 4-5, optimal maturity degree:** the IS has the appropriate maturity for the development of complex projects (incremental and radical innovation). Its physical structure and technological resource respond to clear operating criteria. It has a stable and trained work team in different areas. It has managed to establish economic dependence which allows it to apply and manage projects autonomously.

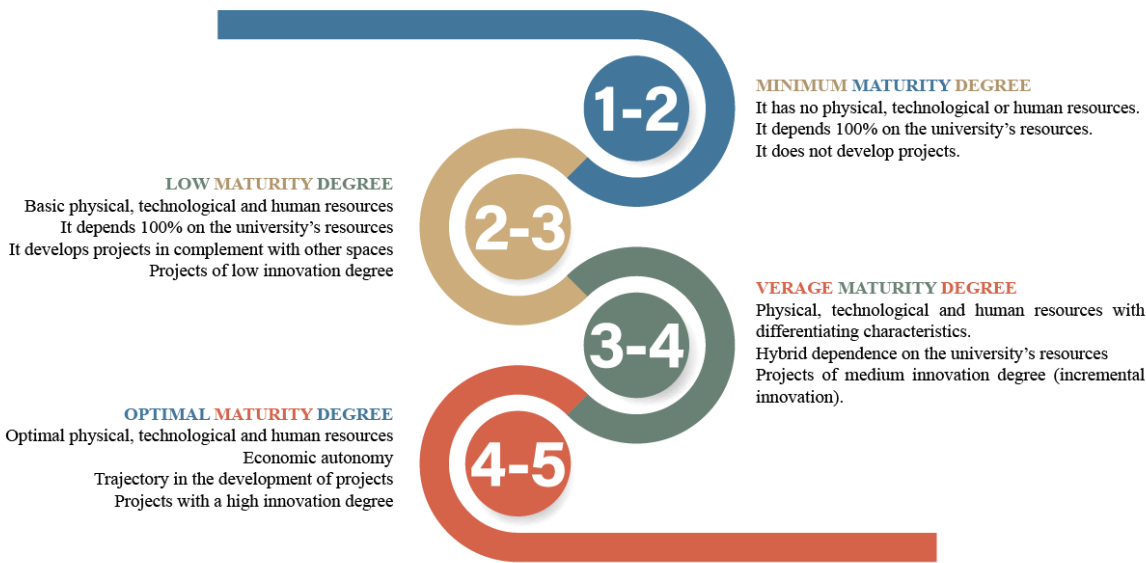


Figure 18: The criteria established for each maturity degree of an ISU. Source: own elaboration.

The information provided through this first evaluation allows us to define global strategic actions, focused mainly on establishing the type of activities or projects that the IS is able to develop, or the type of alliances that it should establish with other spaces to strengthen its capacities. In short, it allows managers to become aware of the efforts they are able to make in order to manage the space and the resources they have in a coherent way.

In the case of the example, an overall evaluation of 2.6 is obtained, which places it in the category of a low level of maturity.

### 3.6.2 Evaluation by dimension

It is a more concrete result that focuses on evaluating each dimension performance. It allows having a more structured vision of the strengths and weaknesses of the IS. Its result arises from the average obtained in the practices evaluated assigned to each dimension. The most representative graph is the radar one, as shown in the example in Figure 19, the results are presented individually for each ISU mission. In this case, the evaluation for the academic mission is added to the ISU of the example, becoming a mixed space.

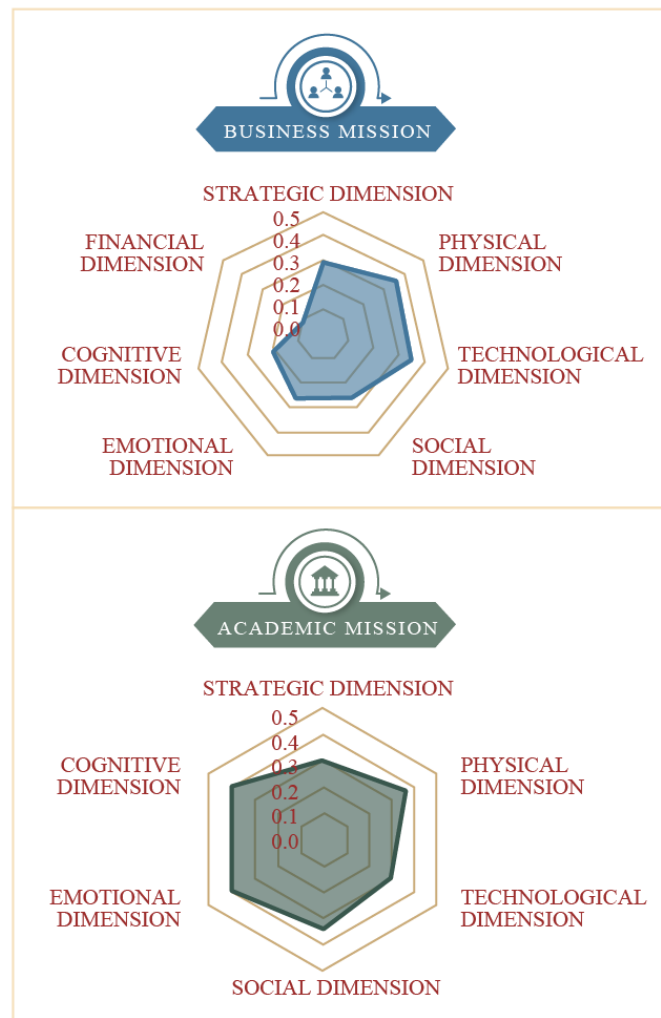


Figure 19: Example of the evaluation by dimension for both university missions. Source: own elaboration.

In turn, Figure 20 shows the consolidation of the 2 missions, where it is possible to visualize the best developed dimensions of each mission in a clearer way.

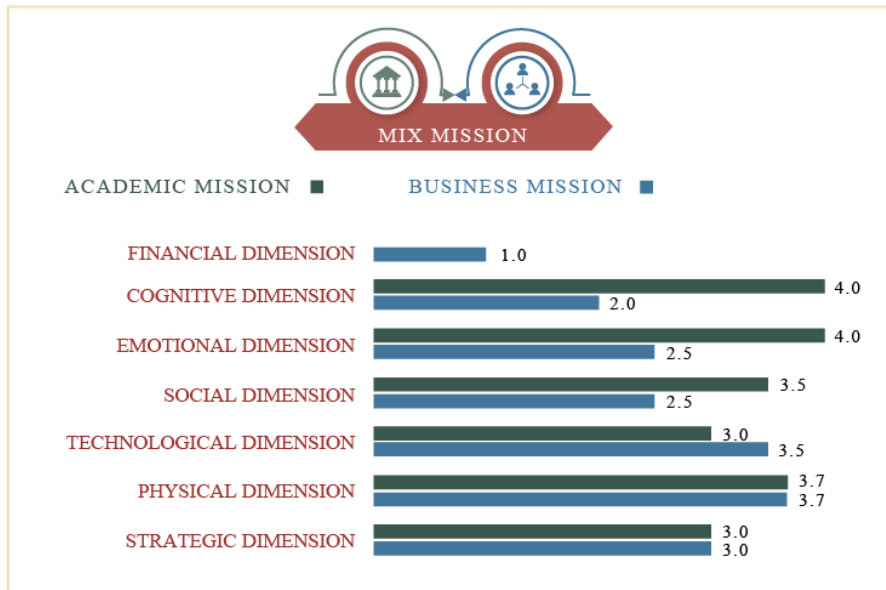


Figure 20: Example of comparison of the evaluation by dimensions between the academic and business missions. Source: own elaboration.

The information provided through this second evaluation allows determining the areas that require greater attention in the IS clearly, prioritizing strategic efforts in the worst evaluated dimensions. In the case of mixed innovation spaces, it can be clearly visualized which of the two missions (academic-business) has a better development or if both are being developed similarly.

As already mentioned above, the complementarity of the IS as an operational strategy is significant, especially in the university context (thanks to the different disciplinary areas that each institution houses). In this sense, this evaluation by dimension becomes more relevant, since the evaluation of a significant number of spaces could allow connecting spaces with different capacities that complement each other in the weakest dimensions. For example, a space that has good development of the technological dimension but little development of the cognitive one, could collaborate with a space that has good development of the cognitive dimension and transfer knowledge or associate in the execution of projects.

This result would benefit the management of innovation spaces from the direction of the university, and an institutional strategy generated from the rectory based on this complementarity of capabilities. In this way, joint strategies can be generated between the innovation spaces of the same university and synergy effects can be generated.

### 3.6.3 Evaluation by practice

This concrete result focuses on the evaluating the development of each practice. It allows to identify the strong and tweak a of the IS. Its result is obtained directly from the answer to each question (practice) of the IS assessment questionnaire according to the corresponding mission. For a mixed space, such as the example, the maturity level of 19 practices is answered directly. In that sense, each practice will be evaluated from 1 to 5 according to its degree of development, being 1 the most basic level and 5 the optimal one of each practice.

Figure 21 shows the representation of an IS practices evaluation in its academic and business mission separately.



Figure 21: Example of evaluation by practice of a mixed ISU. Source: own elaboration.

The information provided in this last evaluation allows us to define concrete actions focused on developing the evaluated practices to improve their level. In this sense, the maturity grid allows us to visualize the path that must be followed to reach the next level, the conditions that must be met in each practice to advance, and how to define the practices to which priority should be given.

The results obtained through the IS evaluation not only fulfill the function of diagnosing of the ISU, but they also define the criteria for proposing a plan of recommendations that positively supports the management work of the IS. They also allow delivering objective recommendations that can then be discussed internally in the IS in order to implement them.

### 3.7 Proposal for a plan of recommendations

Given the structure of the model that identifies where improvement efforts should be directed in a general way, the proposal of recommendations will be oriented to work at the lowest levels identified in the evaluation of the ISU.

As a result of the interviews conducted with the experts for the maturity grid validation, it was possible to reach a concession of two types of strategies that are interesting in terms of the results they can produce, and the execution feasibility. The proposal is to work on a plan of recommendations under the following parameters:

1. Overall improvement of the ISU: direct efforts to elevate the practices evaluated low with respect to the overall evaluation of the space. Recommendations are generated to improve practices that are below the overall IS average. This strategy aims to bring the IS to have a homogeneous profile where all dimensions are at the same level of maturity.
2. Improvement for each dimension: direct efforts to raise the practices evaluated low with respect to the evaluation of their associated dimension. Recommendations are generated to improve practices that are below the dimension average. This strategy is intended to lead the IS to have a homogeneous profile among the practices within the dimensions.

Under these two criteria, the development of each proposed strategy is explained below.

#### 3.7.1 Overall improvement of the ISU

The evaluation obtained in each practice allows consolidating the average by dimension and the total average of the innovation space in turn. This evaluation categorizes the space in one of the maturity degrees defined above, Table 17 presents the example of an IS that has an average of 2.6 in the general evaluation of IS, which positions it in the category of low maturity degree, the initial objective is to level the dimensions to later establish a strategy that jointly allows the IS to advance to a better maturity degree, strengthening all its dimensions in parallel.

BUSINESS MISSION				
DIMENSION	PRACTICE	EVALUATION	AVERAGE DIMENSION	RECOMMENDATION AVERAGE TOTAL SPACE
Strategic Dimension	Performance and projection	3	3	NO ACTION
	Tangible institutional resources	4		NO ACTION
	Innovation performance	2		RECOMMENDATION
Physical Dimension	Structure & Architecture	3	3.7	NO ACTION
	Interior design	4		NO ACTION
	Business linkage environments	4		NO ACTION

Technological Dimension	Manufacturing and communication	4	3.5	NO ACTION
	Technological infrastructure for R+D+I+e	3		NO ACTION
Social Dimension	Social and cultural influence	3	2.5	NO ACTION
	Networking	2		RECOMMENDATION
Emotional Dimension	Interaction and community	3	2.5	NO ACTION
	Academic and commercial interests	2		RECOMMENDATION
Cognitive Dimension	Business and industry knowledge	2	2	RECOMMENDATION
Financial Dimension	R&D spending	1	1	RECOMMENDATION
AVERAGE TOTAL SPACE			2.6	

Table 17: Recommendations for average total ISU. Source: own elaboration.

In this case, the average of the dimensions shows that the social, emotional, cognitive, and financial dimension are below the average of the IS. Therefore, the initial improvement efforts will be directed to work with those 4 dimensions as shown in table 16. The order of priorities is established from the worst evaluated dimensions, understanding that they are the ones that will require the greatest effort and surely the longest implementation time. In the case of the example, the established order will be the financial, followed by the cognitive, and ending with the emotional and social dimensions. Understanding that the recommendations are addressed punctually to the practices, table 17 shows how, in the case of the example, the social and emotional dimensions present recommendations for one of the two practices that compose them. However, for the financial and cognitive practices, the recommendations will be established for all the practices that compose it.

### 3.7.2 Improvement for each dimension

The second improvement strategy divides the IS into each of its dimensions to work the improvement plan in a segmented way. The spaces that opt for this strategy will direct their efforts to level the practices of each dimension, regardless of the maturity degree in which they are. Therefore, the result obtained will not be a homogeneous space profile, on the contrary, this strategy will lead the space to independently potentiate each of its dimensions. Thus, as shown in Table 18 in the proposed example, the financial and cognitive dimensions are at a minimum maturity degree, while the physical and technological dimensions are at a medium maturity degree. However, it is precisely these last two dimensions that will receive recommendations, since the average established for the dimension determines that one of its

factors is below it and must improve its evaluation. This analysis shows a limitation of the second strategy, and it is that the dimensions composed of a single factor will not be impacted on the improvement plan, because their evaluation will never be below the average. That is the case with the cognitive and financial dimensions.

BUSINESS MISSION				
DIMENSION	PRACTICE	EVALUATION	AVERAGE DIMENSION	RECOMMENDATION AVERAGE DIMENSION
Strategic Dimension	Performance and projection	3	3	NO ACTION
	Tangible institutional resources	4		NO ACTION
	Innovation performance	2		RECOMMENDATION
Physical Dimension	Structure & Architecture	3	3.7	RECOMMENDATION
	Interior design	4		NO ACTION
	Business linkage environments	4		NO ACTION
Technological Dimension	Manufacturing and communication	4	3.5	NO ACTION
	Technological infrastructure for R+D+I+e	3		RECOMMENDATION
Social Dimension	Social and cultural influence	3	2.5	NO ACTION
	Networking	2		RECOMMENDATION
Emotional Dimension	Interaction and community	3	2.5	NO ACTION
	Academic and commercial interests	2		RECOMMENDATION
Cognitive Dimension	Business and industry knowledge	2	2	NO ACTION
Financial Dimension	R&D spending	1	1	NO ACTION
AVERAGE TOTAL SPACE			2.6	

Table 18: Recommendations for average dimension. Source: own elaboration.

Under these implementation strategies, an attempt is made to cover the entire IS from different operational objectives. However, it is important to clarify that the proposed strategies are not exclusive; at one point they can become complementary to each other or with other types of strategies that are proposed. The important thing is to understand that the objective of establishing a plan of recommendations will always be to use the results obtained through the maturity grid in the best way to make decisions objectively and with the clear basis of a need.

### **3.8 Conclusion**

This chapter presents the proposal of a methodological model that defines the structure of an innovation space in universities. The analysis of the missions that govern the functioning of the universities allowed visualizing the behavior that these ISs must have. The association of the concepts like ‘collaborative learning’ and ‘academic entrepreneurship’ established the basis for defining the factors that must be considered in the IS implementation, ratifying the intersection between innovation spaces and the university’s missions, and validating the influence that ISs exert on the development of these missions.

Subsequently, a validation with experts allowed us to conclude that the model manages to characterize the reality of the ISU in a good way, benefitting the standardization of processes that have been carried out intuitively until now. This methodological model constitutes the first contribution of the research, being a contribution for the IS managers in terms of training and knowledge. Thus, the model seeks to be a useful tool to better manage the activities and resources involved in an ISU.

After that, the process of designing a tool to diagnose the capacity of an ISU is presented. Through the formalization of observable phenomena, based on the practices defined in the model, the proposal of 19 practices was reached, thus generating a tool that allows evaluating the capacity of an ISU. The methodology chosen for the tool design was the maturity grids.

The diagnostic tool has the following characteristics:

- The use of maturity grids as an evaluation method of each of the 19 practices, that allows knowing both the current maturity level of each practice, and the possible states of progress to reach a higher level.
- The maturity level is described by observable phenomena that allow managers to place themselves in one of the five levels of each practice, decreasing subjectivity in the evaluation, since each level represents a specific situation.
- The diagnosis allows obtaining a list of recommendations based on two strategies: practice levelling with respect to the average of the IS; and practice levelling with respect to each dimension average.

Thus, the maturity grid allows reducing the subjectivity in the IS evaluation by assigning to the observable phenomena a specific maturity degree. The evaluation result allows making precise recommendations on the actions that must be implemented to develop a certain practice or dimension.

It is important to understand that the proposed diagnostic tool model is a first approach, as it continues to be applied to a greater number of ISs, it will be necessary to make certain types of calibrations or improvements similar to those that arose in the validation stage, such as specifying concepts or definitions. However, in terms of structure and practices, the tool is relatively consensual.

The methodological model and the evaluation tool for the ISUs are important contributions in terms of IS design and management. The results of these improvement efforts must be reflected in the development of projects, since to a large extent, projects are the ones that precisely give life to the IS, and their success or failure allows validating the type of management that is



executed. From this perspective, the following chapters seek to connect the management of the ISU with the development of innovation projects, providing tools that benefit the selection of projects and their management based on the analysis of the maturity identified in each IS.

## **4 CHAPTER 3: PROJECT MANAGEMENT TOOL FOR INNOVATION SPACES IN UNIVERSITIES**

### **4.1 Introduction**

In the previous chapter, a model to characterize the structure of an innovation space in universities (ISU) was defined. The model identifies the key practices that should be taken into account in the creation and management of a space that responds to an academic mission, business mission or mixed mission. Subsequently, based on this model, an evaluation tool was proposed, using a maturity grid to evaluate the performance level of the ISU. Once the result of the maturity level of the space is obtained, a plan of recommendations is proposed to be implemented with the objective of strengthening the performance of the innovation space.

Up to this point, all research has focused on the characteristics and practices that determine the maturity level of an ISU; however, once the ISU has been designed and implemented, it is necessary to streamline its operation. The level of maturity required by the ISU depends on the type of project being executed, a more complex project will require a higher maturity in space practices. In this sense, this is where the management of innovation projects becomes relevant. Innovation projects represent a great challenge in any implementation area, and universities are no exception. The high degree of uncertainty that is normally associated with innovation makes it difficult and limits the real use of the resources available to higher education institutions. Because of the way they operate, they have a strong research and development capacity, but little experience managing industrial projects (development of new products, services, processes, etc.), this is one of the main barriers encountered in the operation of innovation spaces. From this perspective, this chapter proposes the development of a tool to support project management in the ISU. The objective of the tool is to determine if the ISU has the sufficient maturity level to pilot a project, and if not, to establish a plan of recommendations to reach the required level. The first step in the tool development is to characterize the innovation projects by defining criteria to assess their level of complexity. The objective of this step is to establish the requirements that must be taken into account when starting the project management. In this sense, the maturity level of the ISU (chapter 2) must respond to the requirements of the project. Thus, the second step is to link the maturity level of the ISU practices with the degree of complexity defined for the project. This cross-referencing of information will generate a minimum requirement profile on the ISU practices to allow a good project development, identifying practices that do not meet the minimum requirements of the project and raising an alert. All the information gathered in these two steps will constitute the basis for proposing a follow-up strategy based on the principle of the Stage-Gate methodology, generating a plan of recommendations and verifying their implementation throughout the development of the project in the ISU.

### **4.2 Typologies of projects in innovation spaces in universities**

Projects are usually defined as the arrangement of theoretical, material and human elements needed to obtain a specific product or service. One of the most representative definitions is provided by (Gaddis, 1959) in Harvard Business Review, where he states that a project is an organized unit dedicated to working towards the same purpose. In this sense, the demand for physical, technological and human resources is usually directly associated with the complexity of the project. No one definition of "project" is exclusive. It is necessary to understand that

projects evolve and incorporate new knowledge in their execution. Authors such as (Ekstedt et al., 2003) have analyzed this phenomenon, defining projects as empirical entities. As a result of this transformation, a varied typology of projects emerges.

In universities, the development of projects seeks to strengthen the activities of knowledge generation, research, technology transfer and link with the eco-system. Thus, the provision of resources and the structuring of management processes should be aimed at obtaining optimal results.

In order to establish adequate project management in universities, the first step in our proposed approach is to clearly define the type of projects that should be housed in the ISU.

In this regard, the literature shows the relevance that innovation has acquired in the field of project management. Authors have been interested in analyzing and defining different typologies to classify innovation. Among the most representative proposals are: Dichotomical classification; Multilayer classification of innovation; Classification of the degree of "strength" or "power" of innovation and "Multitype" classification (described in chapter 2). Among these proposals for the classification of innovation, the "Multitype" stands out, proposed by Schumpeter, who wrote in 1934 the book "Theory of Economic Development", proposing the existence of five types of innovation (Schumpeter, 1934):

- New products;
- New processes;
- New forms of industrial organization;
- New markets; and
- New sources of raw materials.

Subsequently, during the 1980s and 1990s, the Organization for Economic Cooperation and Development (OECD), which brings together 30 of the world's most important economies, developed a series of models and frameworks to support the study of innovation, materializing these concepts in "The Oslo Manual". The first version of the manual was presented in 1992 and its definitions were subsequently updated as the world and the concept of innovation evolved. In 2005, the third version of the manual was presented, which includes as a reference framework a classification based on four types of innovation (Oecd, 2005):

- **PRODUCT INNOVATION:** A product is the result of a manufacturing process, carried out by people who join efforts with the same purpose; to satisfy the needs and desires of a consumer, to obtain a good cost-benefit ratio, and to generate an aesthetic appeal. In these terms, product innovation refers to the development of a good or service that is new or significantly improved. This includes improvements in technical specifications, components and materials, software, user-friendliness of the interface between the user and the product, etc.
- **PROCESS INNOVATION:** Refers to the way in which a manufacturing process is carried out, each step of the process is intended to add value to the product/service that the consumer will receive. A process is a new or significantly improved method of delivery or production, the result of which may include significant changes in techniques, equipment and/or software.
- **MARKETING INNOVATION:** This innovation is aimed at satisfying the customer by means of a good relationship of price, place and promotion in the products or services. Thus, a new marketing method comprises significant changes in product packaging, product positioning, product promotion and/or pricing.
- **ORGANIZATIONAL INNOVATION:** Refers to new ways in which work can be organized and objectives achieved within a company to promote competitive advantage.

Organizational innovation seeks to encourage people to think independently and creatively in the application of personal knowledge to business challenges.

The classification proposed in the Oslo Manual aims to define different areas of action for innovation, which is totally opportune in the search for establishing parameters to evaluate the characteristics and complexity of projects.

On the other hand, from the perspective of universities, organizational innovation moves away from academic objectives. Since this type of innovation is an internal process that concerns the company and its structure, it does not favor the incorporation of other institutions in its development and implementation process. Although universities could provide support in certain stages or activities, the management and direction of this type of innovation should be the responsibility of the company and not of the university.

Under this criterion, the types of innovation most appropriate to the operation and scope of universities are: product innovation, process innovation and marketing innovation.

Table 19 presents the characteristics and differences between these three types of innovation, highlighting the application area and the resources required for their implementation.

	PRODUCT INNOVATION	PROCESS INNOVATION	MARKET INNOVATION
DEVELOPMENT AREA	Design area	Production and distribution areas	Marketing area
DEFINITION	New or significantly improved good or service in terms of their technical characteristics, use or other functionalities	Improvement of quality, production or distribution of products. New or improved techniques, equipment, and software used in ancillary support activities such as purchasing, accounting or maintenance	New marketing methods, which include improvements in product design or packaging, price, distribution and advertising
RESOURCES	Improvement is achieved with the development of knowledge or technology, with improvements in materials, components, or integrated computing	Improvement is achieved through significant changes in techniques, materials and/or software used	Improvement is achieved through the strategic use of competencies and technologies in new markets
EXPECTED RESULT	To lead the market of its sector	To reduce production and distribution costs	To increase sales

	PRODUCT INNOVATION	PROCESS INNOVATION	MARKET INNOVATION
ACTIVITIES	<ul style="list-style-type: none"> <li>• Engineering, design, and other creative work activities</li> <li>• Activities of transformation of inputs into goods or services</li> <li>• Activities to observe, identify, develop, or adapt products or services</li> </ul>	<ul style="list-style-type: none"> <li>• Training activities for employees</li> <li>• Software and database development activities</li> <li>• Transportation and delivery services</li> <li>• Storage</li> <li>• Order processing</li> </ul>	<ul style="list-style-type: none"> <li>• Marketing activities and brand image</li> <li>• IP-related activities</li> <li>• Marketing methods including advertising, direct marketing, trade fairs, market research, etc.</li> <li>• Pricing strategies and methods</li> <li>• Sales and after-sales activities</li> <li>• Creation of new sales channels</li> </ul>

Table 19: Innovation typologies according to area of application Oslo Manual 2005 (Oecd, 2005).

Although there is a greater variety of projects or activities that an innovation space can develop, such as: consultancies, workshops, services to companies, etc., the model will only consider projects based on these three types of innovation, since they mobilize the greatest amount of resources.

Thus, this classification makes it possible to identify the application sector and the key development activities. It also validates the hypothesis that not all innovation projects have the same degree of complexity. Depending on the scope of the project, its management requires less or more investment; execution time; and even the commitment of the actors involved. In this sense, it is necessary to define an evaluation method to determine the complexity of the project, which is directly related to the degree of novelty of the project.

### 4.3 Methodology for the construction of a project management tool

Chapter 2 proposes a method to evaluate the level of maturity of an innovation space in the University. The definition of dimensions and practices provides information regarding the activities that must be taken into account to develop a structure and configuration of the space that responds to the missions of the University. The evaluation tool determines the maturity level of each of the practices, considering the general strategy of operation of the ISU. However, the maturity profile of an ISU is directly influenced by the established mission (academic, business or mixed), the size of the space, the time of operation, the degree of investment and above all the type of projects to be developed. Therefore, the evaluation profile of ISU practices does not provide sufficient information to determine whether the ISU maturity level is appropriate. In this sense, to improve the management and use of space resources it is necessary to complement the ISU practices maturity assessment method with a characterization of the projects, assessing their degree of complexity to determine the minimum level of ISU practices maturity required to properly pilot the project. The objective is to propose a tool to follow-up ISU projects based on the level of complexity of the project to determine the requirement in terms of maturity of ISU practices. In this way, by comparing the maturity assessment profile

of the ISU practices versus the maturity profile of the practices required according to the complexity of the project, it will be possible to establish an action plan and recommendations to follow up the project, ensuring that the ISU has a sufficient level of maturity to successfully complete the project.

In this sense, we propose the creation of a tool to support project management in an ISU based on the following procedure (Figure 22):

1. Establish a method for evaluating the complexity of a project: Establish the different variables that characterize the complexity of an innovation project, in this case innovation projects are characterized by their degree of novelty. A scale of evaluation adapted to the levels of novelty of the characteristics of the projects of an ISU is determined.
2. Build a relationship matrix between the levels of complexity of a project and the degree of maturity of the ISU practices: Define the link between the levels of evaluation of the variables that characterize the complexity of a project and the levels of the maturity grid of the ISU practices presented in chapter 2. The relationship is established by determining the minimum maturity level required in each practice to correctly manage each level of complexity of the variables that characterize the project. From this relationship, a matrix is constructed that represents the maturity level requirements of the ISU practices for the different levels of complexity of the project.
3. Establish the maturity profile in the ISU practices required by an innovation project: Determine the procedure to evaluate the complexity of the project to be carried out in the ISU and using the requirements matrix as a basis to establish the maturity profile of the ISU practices for the particular project evaluated. In this way the requirement profile of the project is compared with the evaluation profile obtained by the ISU and it is determined if the space has the necessary maturity in all its practices to carry out the project or if an improvement plan must be generated.
4. Generate a follow-up plan and recommendations for ISU projects: Establish a plan of recommendations that will allow the ISU to reach the required level of maturity to develop optimally according to the stage of development of the project.

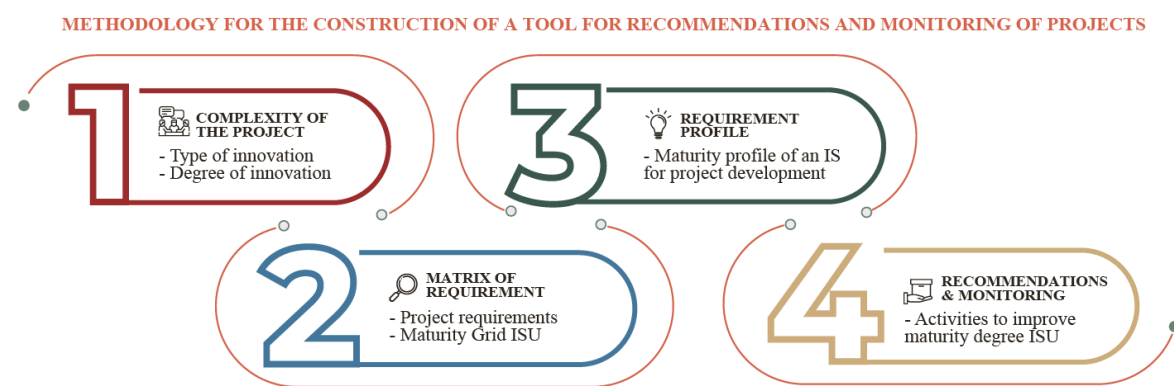


Figure 22: Methodology for the construction of a project management tool. Source: own elaboration.

Thus, the design of the tool for the generation of recommendations and follow-up of projects in an ISU involves four stages to establish the relationship between the ISU innovation projects and the maturity level of the practices of the space. This comparison allows to determine if the ISU maturity profile is appropriate to manage the complexity of the projects to be carried out,

and in case the required maturity level is not met, it allows to establish recommendations and follow up to support the management of the projects.

The steps to create the tool for managing innovation projects at ISU are presented below.

#### **4.3.1 Stage 1: Definition of the degree of complexity in innovation projects**

The degree of complexity is a key variable for the implementation of management tools in innovation projects, since it allows to define in an objective way the quality and quantity of resources to be made available to the project. The higher the degree of complexity, the greater the demand on resources. In this context, the first step in defining the degree of complexity is to identify the type of novelty that characterizes to the project. Thus, projects can be evaluated by three types of novelty:

- Technological novelty: Refers to the knowledge and degree of development of the technology required to carry out the project. It also considers the level of accessibility of this technology and its degree of maturity or development.
- Conceptual novelty: Refers to whether the project considers a major paradigm shift with respect to the existing problems and current solutions.
- Market novelty: Refers to the knowledge of the project's target market, and if they show a similar behavior to the usual public of the project developer.

Once the types of novelty have been established, the second step is to establish parameters to measure the degree of innovation of the project. In this context, the literature presents the proposal of (Freeman et al., 1982), one of the first authors to establish a complexity scale, in which they proposed five levels to differentiate the degree of innovation: systemic, important, minor, incremental and unrecorded. Subsequently, (Schumpeter & Swedberg, 2018), synthesizes the preceding information and proposes a new classification based on only two concepts: Incremental Innovation and Radical Innovation. This being the reference mostly used by the authors. In his classification, Schumpeter defines radical innovation as revolutionary, since through it, novel and totally different contributions are generated in society and the economy. However, this revolutionary result entails greater risk and investment in the process. On the other hand, incremental innovation is defined by Schumpeter as an improvement of a product, process or management system. With a result that do not break sharply with what has been defined so far, despite the degree of novelty that develops.

Authors such as (Damanpour & Gopalakrishnan, 2001; Knight et al., 1967) have proposed to unite the definition of the types of innovation of the OECD with the postulate of Schumpeter's degree of innovation, cataloguing within the concept of radical innovation the technological innovations of product and process.

Finally (Kleinschmidt & Cooper, 1991), analyze the degree of innovation from a perspective in which there is a direct logic between the innovation capability and the impact of results, i.e., "More innovative products should create more opportunities for differentiation and competitive advantage, generating a positive impact on results. Conversely, less innovative products are better known, less uncertain, may have greater synergies, and therefore have a higher success rate."

(Kleinschmidt & Cooper, 1991) proposes three degrees of novelty:

- High level of innovation: Consisting of new products around the world or new product lines that are innovative for the company.
- Medium innovation level: Consisting of new lines for the company, but where its products are not as innovative (not new to the market); and new items in existing product lines for the company.

- Low innovation level: Consisting of minor changes to existing products, services or processes. For example, products redesigned to achieve cost reductions, and repositioning.

This definition is very attractive to be taken as a reference in the construction of the criteria to evaluate the complexity of an innovation project, since it establishes a coherent and representative transition of the projects, proposing two extreme criteria and an intermediate transition point. In turn, it is an intermediate point between the proposal of (Freeman et al., 1982) with 5 levels and that of Schumpeter with 2. For this reason, it is expected that the definition of (Kleinschmidt & Cooper, 1991) will allow evaluating the complexity of the three different types of innovation projects, significantly reducing subjectivity. As an example, Table 19 presents a classification of different types of innovation projects proposed in the Oslo Manual 2005 (Oecd, 2005), which were subsequently classified according to the degree of novelty proposed by (Kleinschmidt & Cooper, 1991). This category assignment is established based on the degree of novelty of the expected results.

INNOVATION LEVEL LOW	INNOVATION LEVEL MEDIUM	INNOVATION LEVEL HIGH
Incremental	Me-too products:	Radical
When a part is added, removed, combined, subtracted, or replaced in a product or service.	New products for the company, but not for the market.	When a product or service is incorporated into the market that is capable of generating a category by itself.
	Line development	New products
	Products that are new to the market, but not to the company.	Products that are new, both for the company that develops them and the market that uses them.

Table 20: Types of innovation (Oecd, 2005) and degree of innovation (Kleinschmidt & Cooper, 1991).

Finally, the integration of the types of novelty with the degrees of innovation makes it possible to define the parameters for establishing the complexity that ISU projects can reach. Table 21 shows the integration of the concepts described above, making it possible to visualize the characteristics of each type of novelty and their corresponding degrees of innovation.

TECHNOLOGICAL NOVELTY		
Significant improvements in the technical specifications, components, and materials of a product. Improvement in computer programs incorporated in the: user-friendliness degree or other functional characteristics.		
LOW	MEDIUM	HIGH



<p>Incremental innovation</p> <ul style="list-style-type: none"> <li>- Product improvement</li> <li>- Design improvement</li> <li>- Material improvement</li> <li>- New uses</li> <li>- Maximum development time of 12 months</li> <li>- It does not generate new knowledge</li> <li>- It does not include R&amp;D projects</li> </ul>	<p>Incremental innovation</p> <ul style="list-style-type: none"> <li>- Improvement of existing products</li> <li>- Design improvement</li> <li>- Material improvement</li> <li>- Machinery development</li> <li>- New features.</li> <li>- New components.</li> <li>- Development time of 1-3 years</li> <li>- Use of external knowledge and resources</li> <li>- It includes R&amp;D projects in partnership with other ISs</li> </ul>	<p>Radical innovation</p> <ul style="list-style-type: none"> <li>- New products</li> <li>- New designs</li> <li>- New materials</li> <li>- Development of new equipment</li> <li>- Development of new machinery</li> <li>- High uncertainty</li> <li>- Development time of more than 3 years.</li> <li>- Generation of new knowledge</li> <li>- It includes R&amp;D projects</li> </ul>
<b>CONCEPT NOVELTY</b>		
Significant improvements in the use of technology for production and logistics. Development of production and distribution equipment and/or software.		
<b>LOW</b>	<b>MEDIUM</b>	<b>HIGH</b>
<p>Incremental innovation</p> <ul style="list-style-type: none"> <li>- Low innovation degree</li> <li>- Small changes in processes</li> <li>- Process improvement</li> <li>- Improvement of techniques</li> <li>- Improvement in services</li> <li>- Maximum development time of 12 months</li> <li>- It does not generate new knowledge</li> <li>- It does not include R&amp;D projects</li> </ul>	<p>Incremental innovation</p> <ul style="list-style-type: none"> <li>- Medium innovation degree</li> <li>- Process improvement.</li> <li>- Improvement of techniques</li> <li>- Improvement of services.</li> <li>- Introduction of modern techniques</li> <li>- New features</li> <li>- Development time of 1- 3 Years</li> <li>- Use of external knowledge and resources</li> <li>- It includes R&amp;D projects in partnership with other ISs</li> </ul>	<p>Radical innovation</p> <ul style="list-style-type: none"> <li>- New processes</li> <li>- New techniques</li> <li>- New services</li> <li>- High uncertainty</li> <li>- Development time of more than 3 years</li> <li>- Generation of new knowledge</li> <li>- It includes R&amp;D projects</li> </ul>
<b>MARKET NOVELTY</b>		
Creation of new markets; distribution and sales strategies; product promotion.		
<b>LOW</b>	<b>MEDIUM</b>	<b>HIGH</b>

<p>Incremental innovation</p> <ul style="list-style-type: none"> <li>- Low innovation degree</li> <li>- Development of management skills</li> <li>- Improvement of commercial strategy</li> <li>- Improvement of commercial management processes</li> <li>- Improvement in the supplier-customer relationship</li> <li>- Maximum development time of 12 months</li> <li>- It does not generate new knowledge</li> <li>- It does not include R&amp;D projects</li> </ul>	<p>Incremental innovation</p> <ul style="list-style-type: none"> <li>- Medium innovation degree</li> <li>- Improvement of the business model</li> <li>- Improvement of the commercial strategy</li> <li>- Improvement of commercial management processes</li> <li>- Introduction of modern techniques</li> <li>- Reduction of marketing costs</li> <li>- Development time of 1- 3 Years</li> <li>- Use of external knowledge and resources</li> <li>- It includes R&amp;D projects in partnership with other ISs</li> </ul>	<p>Radical innovation</p> <ul style="list-style-type: none"> <li>- New methods of commercial management</li> <li>- New marketing business strategy</li> <li>- New trading strategies</li> <li>- New markets</li> <li>- New business model</li> <li>- High uncertainty</li> <li>- Development time of more than 3 years</li> <li>- Generation of new knowledge</li> <li>- It includes R&amp;D projects</li> </ul>
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Table 21: Definition of the types of novelty and their degrees of innovation. Source: our research.

These three types of novelty characterize the complexity of a project. From the evaluation of the degree of novelty of a project, it is possible to associate a minimum maturity level required in the ISU practices to be able to correctly manage the complexity of the project. The next step will be to build a matrix that represents the level of maturity required for each of the ISU practices according to the type and level of novelty of the project to be carried out.

#### 4.3.2 Stage 2: Construction of the ISU practice maturity level requirements matrix according to the degree of complexity of the project

Every project requires, for its operation, both material resources (facilities, technological equipment, software, hardware, etc.) and human resources (people, knowledge). Therefore, the estimation of the use of resources in projects must be coordinated in advance, ensuring the availability of critical resources in the required time. The complexity of the project has a direct impact on the use of resources, since more complex projects will require greater use of knowledge, time, investment, etc. In the case of an ISU, the availability of resources is given by the level of maturity in its practices, remember that the level of maturity represents the performance achieved by the ISU in each practice and describes the resources it uses to achieve that performance. This is why we seek to relate the level of complexity of the project, which determines the resources needed to manage the project, with the maturity level of the practices that describes the resources available to the space. In this sense, the tool for the management of innovation projects seeks to coordinate the requirements of the project (according to type and degree of novelty) with the resources available in the ISU, establishing a matrix of requirements of the level of maturity of the ISU practices according to the degree of complexity of the project.

The construction of the matrix will be done in two stages:

- Propose a matrix establishing the relationship between the structure of the maturity grid (defined to evaluate the ISU practices), and project complexity based on the concepts of type of novelty and their respective degrees of innovation.
- Validate, with a group of experts, the relationship and impact on the ISU practices for each type of novelty and degree of innovation of the project.

As a first step, the ISU maturity grid proposed in chapter 2 will be used. Thus, the matrix will contemplate the 19 practices and the 5 maturity levels of each practice (rows of the matrix). Then, the matrix is crossed with the variables that determine the complexity of the project, i.e., with the 3 types of novelty with their respective levels: high, medium, low (columns). In this way, the matrix records the minimum maturity level required in each practice for each level of the three types of novelty, relating the ISU maturity level to the complexity of the project.

Figure 23 presents the matrix resulting from the relationship established between the three levels of technological novelty and the practice "Performance and projection (ISP1)", of the strategic dimension of the ISU.

In this case, for a project with a low level of technological novelty (Product improvement, Design improvement, Material improvement, etc.) the maturity level that ISU must guarantee is 2, where it is established that the operation strategy is only responsibility of the person in charge of the space. However, if the project is of medium technological novelty, the minimum maturity level in this practice is 3, since it is a project that contemplates the development of machinery, new components, a development time of 1-3 years and surely the use of external knowledge and resources, it is essential that the ISU has an operating strategy with clear objectives and agreed with the work team. Finally, a project of high technological novelty that contemplates developments of radical innovation and results of high component in R&D, will require a minimum maturity level of 4 where it is guaranteed that the ISU has an operation strategy based on a needs analysis that responds to the objectives of the University, which guarantees institutional support in the execution of projects of this type. Thus, it is evident that the greater the degree of novelty, the greater the availability and use of resources required, i.e., a higher level of maturity in the practice of ISU.

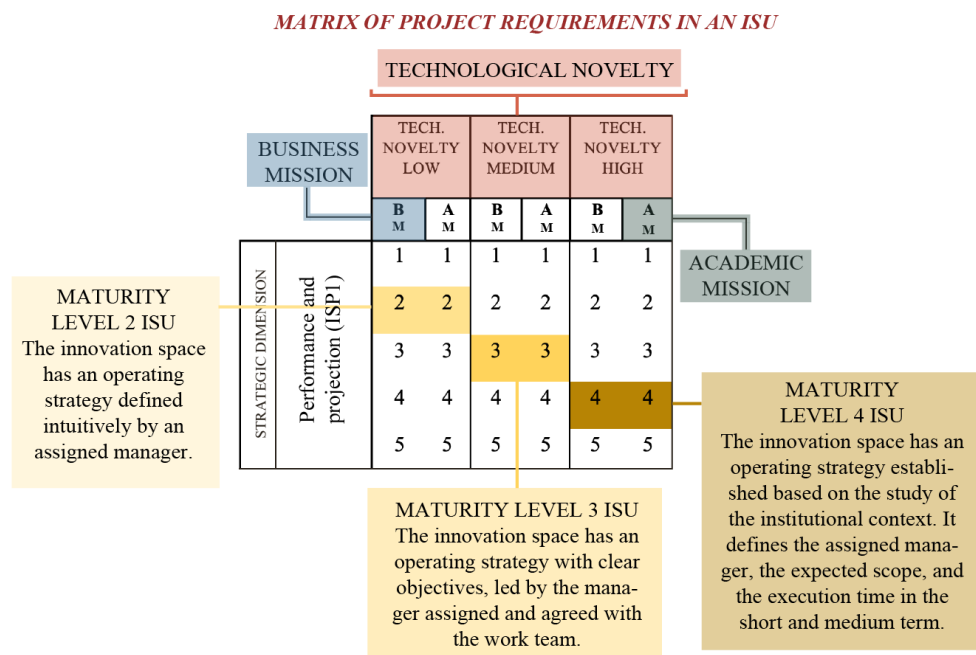


Figure 23: Matrix of the relationship between technological innovation and the practice "Performance and projection (ISP1)". Source: own elaboration.

The structure based on practices and maturity levels will be the basis for defining the type of resources required by a project according to its degree of complexity and novelty. Thus, in each of the practices, a minimum maturity level will be established as a parameter for project evaluation, so that the higher the ISU maturity level, the greater the possibility of developing projects with a high level of novelty.

The process was carried out with each of the 19 practices defined in the ISU maturity grid (Table 13, Chapter 2). The matrix proposed will be the basis for defining the type of resources a project requires according to its degree of complexity and novelty. The next step is to validate the matrix with a group of experts.

### Validation of the project requirement matrix in an ISU

For the construction and validation of the project requirement matrix in an ISU, we had the vision of professionals from technology transfer offices and professors from the University of Santiago, Chile. The group of professionals from the technology transfer office is composed of 5 people: 2 commercial engineers, 2 industrial engineers and 1 lawyer. The group of professors is composed of 4 people: 2 industrial engineering academics, 2 chemical engineering academics.

The elaboration of the matrix was carried out in two working sessions, the conformation of the groups of participants in the sessions was random, with the objective of having different profiles and promoting the discussion on the level to be established for each practice. Each of the practices was discussed under empirical and theoretical arguments, reaching a consensus on the minimum level required in each of the practices according to the degree and type of novelty of the project. As a result, a final matrix was obtained (Annex 2) that represents the vision of the experts with respect to the development of the project. Finally, Table 22 presents a summary of the matrix of project requirements in an ISU, for the business mission and the academic mission, in each of the three types of novelty evaluated.

		MATRIX OF PROJECT REQUIREMENTS IN AN ISU																	
		TECHNOLOGICAL NOVELTY						CONCEPT NOVELTY						MARKET NOVELTY					
		LOW		MEDIUM		HIGH		LOW		MEDIUM		HIGH		LOW		MEDIUM		HIGH	
		B M	A M	B M	A M	B M	A M	B M	A M	B M	A M	B M	A M	B M	A M	B M	A M	B M	A M
STRATEGIC DIMENSION	Performance and projection (ISP1)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Tangible institutional resources (ISP2)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Innovation performance (ISP3)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
PHYSICAL DIMENSION	Structure & Architecture (ISP4)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Interior design (ISP5)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Collaborative learning environments (ISAMP1) Business linkage environments (ISBMP1)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
TECHNOLOGICAL DIMENSION	Manufacturing and communication (ISP6)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
ICT for collaborative learning (ISAMP2) Technological infrastructure for R+D+I+e (ISBMP2)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
EMOTIONAL DIMENSION	Interaction and community (ISP7)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Team engagement (ISAMP3) Academic and commercial interests (ISBMP3)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
SOCIAL	Social and cultural influence (ISP8)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Team relations (ISAM4) Networking (ISBMP4)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
COGNITIVE D.	Knowledge transfer (ISAM5)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Business and industry knowledge (ISBMP5)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
FINANCIAL D.	R&D spending (ISBMP6)	1		1		1		1		1		1		1		1		1	
		2		2		2		2		2		2		2		2		2	
		3		3		3		3		3		3		3		3		3	
		4		4		4		4		4		4		4		4		4	
		5		5		5		5		5		5		5		5		5	

BM = BUSINESS MISSION

AM = ACADEMIC MISSION

Table 22: Matrix of project requirements in an ISU. Source: our research.

Project management usually involves different dimensions of development, so the project requirements matrix in an ISU will allow individual or parallel evaluation of projects that integrate technological novelty, concept novelty or market novelty in their development. The objective of the matrix is to guide the effective allocation of resources, which, in turn, will allow the development of activities in an efficient manner. In this sense, an ISU can define the use of its resources through the evaluation of its degree of maturity, guaranteeing in advance the availability of the necessary resources for the development according to the requirements of the project.

During the matrix validation process, the group of experts highlighted the importance of identifying in advance the resources needed to execute the project in the ISU. In general, they consider that this is a key information for decision making and to choose or prioritize the selection of projects to be carried out.

Additionally, valuable observations emerge to take into account in the generation of recommendations:

- Strategic Dimension: Unanimously, the experts consider it essential to involve the university authorities (rector, deans and directors) in the design of the ISU operating plan as key actors who validate the activities proposed annually and participate in them directly.
- Physical and Technological Dimension: The ease of access to different technological equipment, laboratories, offices, libraries, etc., typical of the operation of a university, is considered by experts as an advantage that allows generating partnerships with other areas of the university. Complementing the human, physical and technological resources of the different ISUs in the development of complex projects will make it

possible to reach a high level of maturity in these dimensions quickly and with a low level of investment, generating synergies between innovation spaces.

- Social dimension: The generation of networks through the integration of research laboratories and institutional projects under development is recognized as an opportunity to enhance existing relationships with industry. Additionally, it is an opportunity to integrate different disciplines in the realization of projects, strengthening multidisciplinary and collaborative work between the different specialties of the university.
- Social and Cognitive Dimension: The team of experts from the technology transfer office value the possibility of integrating the ISU as a key actor in the development of projects with industry. They express great interest in proposing training strategies to spread among professors the benefits generated in the academy by the integration of industrial and commercial projects.

Once the ISU practices requirements matrix has been validated, the next step is to establish the procedure to determine the requirements profile of a project according to its degree of complexity and thus define whether the ISU has sufficient maturity to manage the evaluated project.

#### **4.3.3 Stage 3: Establish the maturity profile in ISU practices required by an innovation project**

The objective is to determine the requirements that will represent the execution of a project within the ISU. The requirements that the execution of the project will demand from the ISU is determined by its complexity. A procedure is established to evaluate the complexity of the project, and then from this determine the requirements profile in the maturity level of the ISU practices.

Before choosing or prioritizing the projects to be carried out, the ISU conducts a study evaluating the project in terms of subject matter and relevance to the space. Once validated that the project is of interest to the space according to its objectives and characteristics, the following steps are proposed to determine whether the ISU has sufficient maturity in its practices to properly manage the project:

1. Evaluate the complexity of the project: ISU managers must evaluate the project according to the type of novelty it represents. According to the evaluation method presented in section 3.3.1, the complexity of a project can be characterized by three types of novelty and, if present, each novelty can be measured according to three degrees. Figure 24 shows a project that presents technological novelty and market novelty, both at a medium level of intensity, while it does not present concept novelty (marked with an “X” in red).
2. Determine the requirement profile of the project: Once the type and degree of novelty of the project has been evaluated, the requirement profile of the project is determined in the ISU practices. For this, the requirement matrix defined in the previous section is used as input, each type of novelty evaluated for the project generates a requirement level for each practice according to the level evaluated in this novelty. Then, to determine the overall requirements profile of the project in each practice, the highest level required is assigned, regardless of the type of novelty

it comes from. In the example, the columns marked in red represent the two requirement profiles generated by the medium level of technological novelty and the medium level of market novelty. Then the last column shows the overall project requirement profile, the level in each practice is determined by the highest level required between the two novelties evaluated for the project. For example, the academic and commercial interest practice (row in orange) presents an overall requirement level of 3, since the medium grade of the technological novelty requires a maturity level of 2 and the medium grade of the market novelty requires a level 3, therefore, the highest is level 3 which is the one assigned as the overall requirement for this practice.

TOOL FOR THE GENERATION OF RECOMMENDATIONS AND MONITORING FOR PROJECTS IN AN IEU WITH BUSINESS MISSION														
BUSINESS MISSION		TECHNOLOGICAL NOVELTY				CONCEPT NOVELTY				MARKET NOVELTY				
DIMENSION	PRACTICE	LOW	MEDIUM	HIGH	LEVEL OF DEMAND TECHNOLOGICAL FACTOR	LOW	MEDIUM	HIGH	LEVEL OF DEMAND CONCEPT FACTOR	LOW	MEDIUM	HIGH	LEVEL OF DEMAND MARKET FACTOR	OVERALL PROJECT REQUIREMENT LEVEL
			X							X				
STRATEGIC DIMENSION	Performance and projection (ISP1)	2	3	4	3	2	2	3	NO EVALUATION	1	1	1	1	3
	Tangible institutional resources (ISP2)	2	3	4	3	2	2	3	NO EVALUATION	2	2	2	2	3
	Innovation performance (ISP3)	2	3	4	3	2	3	4	NO EVALUATION	2	3	4	3	3
PHYSICAL DIMENSION	Structure & Architecture (ISP4)	2	3	3	3	2	2	3	NO EVALUATION	2	2	2	2	3
	Interior design (ISP5)	1	2	2	2	1	2	3	NO EVALUATION	1	2	2	2	2
	Business linkage environments (ISBMP1)	1	3	4	3	2	2	3	NO EVALUATION	1	2	2	2	3
TECHNOLOGICAL DIMENSION	Manufacturing and communication (ISP6)	2	3	4	3	2	2	3	NO EVALUATION	2	2	3	2	3
	Technological infrastructure for R+D+I+e (ISBM2)	2	3	4	3	2	2	3	NO EVALUATION	2	3	3	3	3
SOCIAL DIMENSION	Social and cultural influence (ISP8)	2	3	3	3	2	2	3	NO EVALUATION	2	2	3	2	3
	Networking (ISBM4)	2	2	3	2	2	2	3	NO EVALUATION	2	2	3	2	2
EMOTIONAL DIMENSION	Interaction and community (ISP7)	1	2	2	2	1	1	2	NO EVALUATION	1	2	2	2	2
	Academic and commercial interests (ISBM3)	2	2	3	2	2	2	3	NO EVALUATION	2	3	4	3	3
COGNITIVE DIMENSION	Business and industry knowledge (ISBM5)	2	2	3	2	2	3	4	NO EVALUATION	2	2	3	2	2
FINANCIAL DIMENSION	R&D spending (ISBM6)	2	3	4	3	1	2	3	NO EVALUATION	1	2	2	2	3

Figure 24: Example of requirement level. Source: our research.

- Comparison of the maturity level required by the project versus the maturity level assessed for the ISU: Once the maturity profile required by the project is defined according to its complexity, it is verified with the actual maturity assessment of the ISU to establish if it has the maturity level to properly manage the project. The comparison is made in each of the practices, then if in the practice the maturity level assessed by the ISU is higher than the maturity level required by the project, it means that in this practice the space has all the resources to manage the project. However, in the opposite case, in practices where the ISU maturity level assessment is lower than the maturity level required by the project, an alert is generated because in this practice the ISU does not have sufficient resources or competencies to manage the complexity of the project. The following figure compares the ISU maturity level assessment profile (in blue) versus the maturity level profile required by the project (in orange) generating 5 practices where the level required by the project is not satisfied.



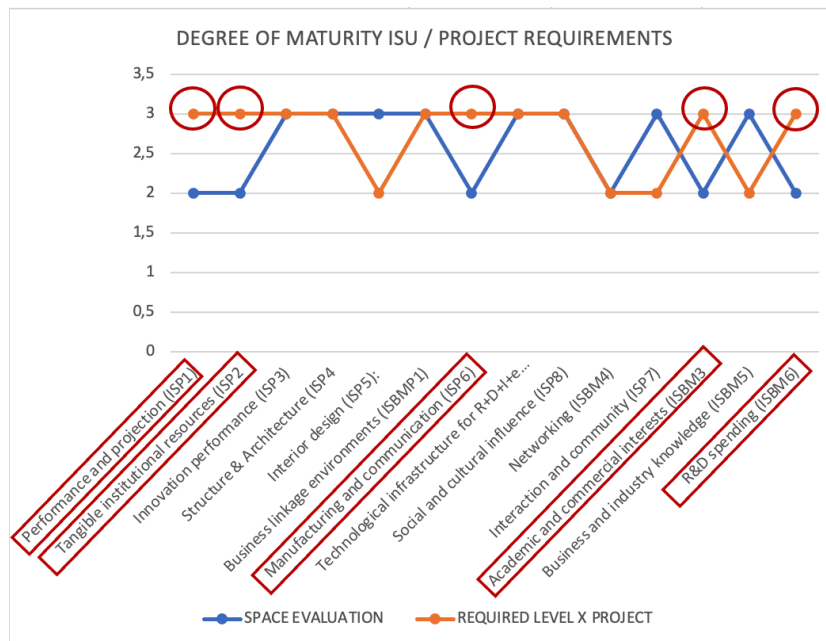


Figure 25: Example comparison of the maturity level required by the project versus the maturity level assessed for the ISU. Source: our research.

The identification of the practices where the level required by the project is not satisfied shows points of improvement of the space, generating a plan of recommendations. In this way, the innovation space can maintain the decision to execute the project, knowing that in order to manage it correctly it must improve in some particular practices. In case the existing gaps between the profile required by the project and the ISU's evaluation profile are too many or too complex to improve, the ISU may decide not to carry out the project or to refer it to another ISU that does have the maturity to manage the project.

An ISU that does not have the maturity level required by the project can follow the recommendations plan to reach the required maturity in its practices. To best carry out this recommendation plan, it is not only enough to identify the practices that do not meet the required maturity, but also to identify the stage of the project that supports each practice. In this way, **the recommendation plan must be aligned with the innovation process for project management, generating a follow-up tool** indicating at which stage of the project it is necessary to have the required maturity level in the practices supporting this stage. The following section presents the construction of the project management tool to implement the recommendations obtained from the comparison of the ISU assessment profile versus the profile required by the project, associating the improvement in the practices to the project development stages based on the Stage-Gate methodology.

#### 4.3.4 Stage 4: Project management tool

##### Project development process

For the implementation of an innovation project it is necessary to have the appropriate techniques, knowledge, skills and tools. The stages of the innovation process usually involve different resources in its execution, generating an important degree of complexity in decision making. Structured planning and the integration of follow-up methodologies are important for

obtaining good results. In this sense, project management is fundamental in the planning, monitoring and control of activities and the allocation of human and material resources involved in the development of a project. As a contribution to project management, project monitoring and control tools are usually implemented to minimize deviations from the plans proposed in the project. Its purpose is to identify and report the status of the project compared to the proposed plan, to subsequently analyze the drawbacks that may arise and implement corrective actions in a timely manner. One of the main benefits of monitoring tools is to provide the necessary inputs to make objective decisions about which projects should move forward, which should be stopped and what resources should be allocated. So that, an effective monitoring tool must clearly define monitoring parameters (what, how, where, when and who is the responsible); and intervention and control parameters. Complying with these parameters, one of the most widely used methodologies in innovation project management is the Stage-Gate. This methodology has become popular precisely because by defining a Stage-Gate approach, monitoring parameters (stages) and intervention and control parameters (Gates: deliverables, decision criteria and outputs) are integrated into the project.

The Stage-Gate methodology was proposed by Cooper, 1990, who introduced the idea of well-defined stages and decision points for conducting development projects (stage-gates). It was improved by (Cooper, 2008), proposing the development funnel model; this model represents an input with many potential ideas (divergence), followed by a channeling process that progressively selects projects (convergence).

The Stage-Gate methodology is designed to improve the speed and quality of execution of product innovation projects. Each process supports projects make the best possible decision by providing a roadmap with clear decisions, priorities and deliverables. The process incorporates initial pre-development activities where the business case is realized, development activities and commercialization activities where there is also a post-launch learning process. Each stage of the methodology is designed to gather the information necessary to keep the project moving forward and is defined by activities that progressively reduce uncertainty. In the typical Stage-Gate model, 5 stages are established with the addition of a previous ideation stage:

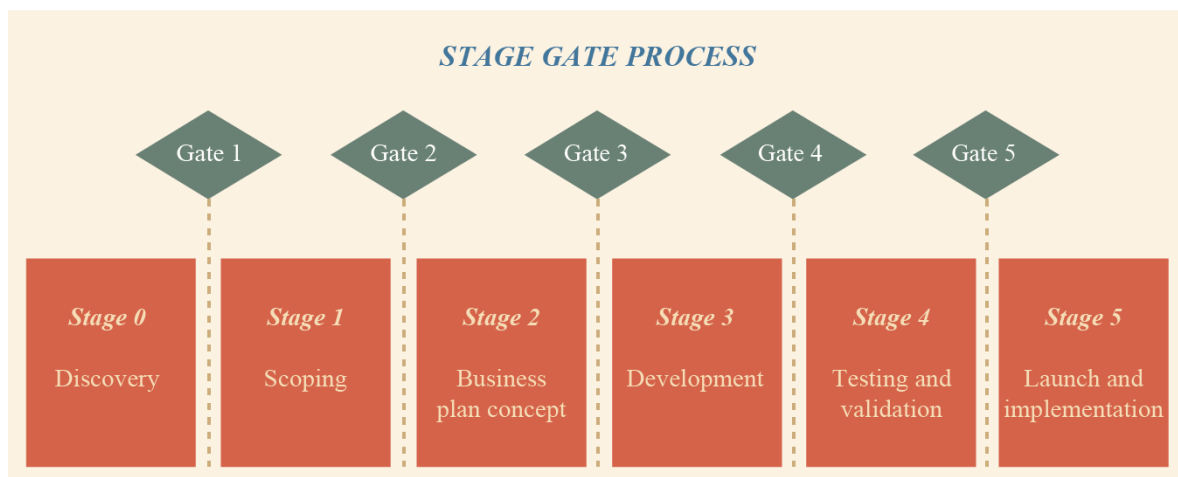


Figure 26: Stage-Gate model. Source: (Cooper, 2008).

- Stage 0 - **Discovery:** Pre-work designed to identify business opportunities and generate new ideas.
- Stage 1 - **Scoping:** preliminary research to determine the scope of the project.
- Stage 2 - **Business plan concept:** Market research including project definition and proposed plan for development.

- Stage 3 - **Development:** Detailed design of the operations and processes required to make full-scale production.
- Stage 4 - **Testing and validation:** Trials or tests to verify and validate the proposed new product, marketing and production plans.
- Stage 5 - **Launch and implementation:** the start of production, marketing and sales.

Additionally, gates are found before each stage and serve as checkpoints based on three objectives: evaluate business justification, ensure quality of execution and approve the project plan and resources. Each Gate has a different purpose; however, their structure is similar and is based on three parameters:

**Deliverables:** The Project leader and team provide the decision makers (Guardians or Gatekeepers) with the results of the activities completed during the previous stage.

**Decision Criteria:** Each project is measured against a clearly defined set of success criteria. The criteria should be robust to help identify the deliverables that will be most likely to be successful.

**Outputs:** A decision is made (Go/Stop/Wait/Recycle). If the decision is made to go with the project, then the necessary resources are made available to continue the project; the action plan for the next stage is approved; and the list of deliverables and date for the next gate is set.

Under these characteristics, the Stage-Gate methodology is incorporated in the development of the project management tool for ISU projects. The reason for this is the possibility of establishing control milestones based on the concepts developed by Cooper regarding the implementation of stages and gates as a monitoring and validation strategy. In other words, the tool seeks to establish stages to evaluate the innovation space in order to implement recommendations according to the progress of the project and at the same time set gates to validate the availability of resources needed to advance the project. In that sense, the 5 traditional stages of the Stage-Gate will not be taken into account, these will be adapted with the project management stages proposed by (Salerno et al., 2015) in Chapter 1, since it better represents the project management in an ISU.

Thus, the management processes and the Stage-Gate methodology will be integrated to generate a project management tool that evaluates the conditions of the innovation space in the development of projects. The information required and the decisions proposed to be taken are directed to the maturity level of the practices of the space and not of the project. This tool will help to correctly prepare the ISU with the appropriate level of resources in each gate.

### **Typology of project management process at ISU**

In Chapter 1, the research of (Salerno et al., 2015) was presented in which a typology of innovation processes was proposed based on the hypothesis that projects can assume different configurations. This hypothesis was validated through the comparative analysis of 132 product innovation projects, developed in 72 companies with different characteristics such as: sector (including hospitals, engineering consulting and R&D services), size, age and with or without a formal R&D department. A limitation of this study is that the sample does not include projects developed in universities specifically. Based on empirical research, (Salerno et al., 2015) proposes eight types of innovation processes:

- 1) Traditional process: from idea to launch;
- 2) Anticipating sales: the tailor-made approach (open order);
- 3) Anticipating sales from a given client specification (closed order);
- 4) Process started by a call;
- 5) Process with a stoppage: waiting for the market;

- 6) Process with a stoppage: waiting for the advance of technology;
- 7) Process with a stoppage: waiting for the market and for the advance of technology; and
- 8) Process with parallel activities.

Even though the traditional process established by (Cooper, 2008) is the most used for project management in companies, its stages have characteristics typical of business models not adapted to mission of universities (marketing and sales stage). Therefore, the contribution of (Salerno et al., 2015) is important to establish a type of process that is better suited to the operating characteristics of universities.

The interviews with the ISU managers allowed gathering information to define some criteria that delimit the activities and stages of the projects in the universities:

- **Service contracts:** In projects with commercial purposes (product or service development), universities are present mainly during the first stages (idea generation; proof of concept; business analysis), with research and the generation of new knowledge being their most significant contribution. In this case, companies involve universities in the development of the project through the contracting of services, establishing the objective of the generation of the knowledge required to increase the degree of R&D in the result (design, concept, materials, technology, etc.).

- **The universities do not participate in the marketing and commercialization stages:** The completion of the project for universities is through the delivery of the development, service or product for which it was contracted (defining clear the parameters of intellectual property and patents). The following stages are the responsibility of the companies, since the universities do not have the authority to participate in the production, marketing and commercialization of products. These activities are outside the mission and functions of educational institutions.

- **Collaborative work with the client:** The university seeks to contribute with its capabilities to the development of projects that have a high impact on the society. Therefore, the participation of external actors is key in the construction of solutions. A company, a government entity, a community, etc., is considered as a "client", and its participation begins since the construction of the project, remaining as a key actor throughout the development process.

- **Objectives associated with the generation of knowledge:** Uncertainty may cause the project to change of direction and to obtain results different from those expected, which are still equally valuable in terms of knowledge. However, this research and development process requires an investment in technology and human resources. That is why university projects have an initial financing (total or partial payment of the project from the ideation stage), where the client finances the development costs and does not only pay for the final product obtained.

- **Public procurement:** Governments establish in their administrative plans lines of action associated with the economy, the environment, the society, etc. Therefore, it is increasingly common to implement calls for proposals that invite companies and institutions (including universities) to participate in the search for solutions that have an impact on the country. In the case of calls for proposals, the budget, specifications and objectives of the project are established by the client or the entity financing the project. Although there is a previous research work to formulate the proposal to apply, the formal start of the project is established at the time the call is assigned.

The criteria defined by the experts make it possible to visualize a guideline based on three principles to which the project management process should respond:

- Active participation of the client in the creation and development of the project,
- No involvement of marketing and sales stages in the process,
- Making the generation of new knowledge an indispensable activity during the process.

By analyzing the proposal of (Salerno et al., 2015), it can be proposed that the following processes are the most relevant to the above explained criteria:

***Anticipating sales: the tailor-made approach (open order):***

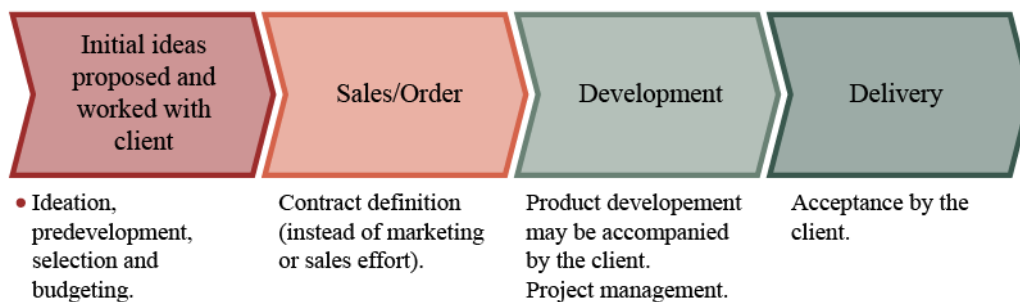


Figure 27: Management process: Anticipating sales: the tailor-made approach. Source: (Salerno et al., 2015).

- Without the customer there is no project because the product is developed on demand.
- The relationship with the client is the main contingency.
- It includes a large service component.
- The innovation idea is built with the client, there is a period of maturation of the idea and once the project specifications are defined, the contract is signed.
- The concept of "sales" is understood as the negotiation stage necessary to establish the contract and is carried out in the initial phases of the process.
- The contract is formalized prior to development.
- The development stage involves the use of a significant level of human and financial resources.
- The customer pays for the development prior to delivery of the product.
- The delivery of the product finalizes the process.

**Anticipating sales from a given client specification (closed order):**

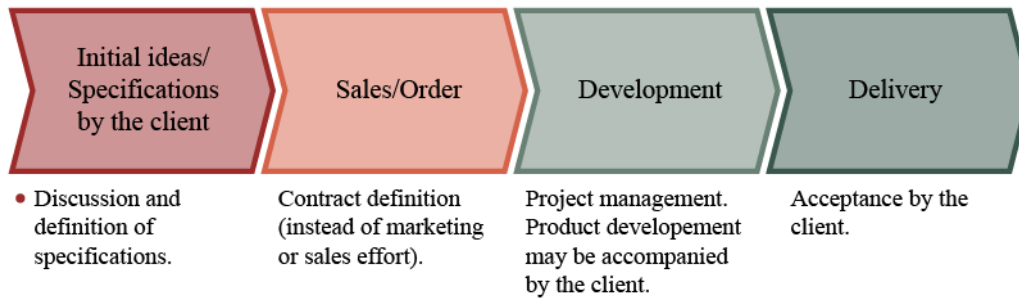


Figure 28: Management process: Anticipating sales from a given client specification. Source: (Salerno et al., 2015).

- The client defines the project specifications (functional requirements or form), so there is no construction period or maturation of the idea.
- The relationship with the client is the main contingency.
- The concept of "sales" is understood as the negotiation stage necessary to establish the contract and is carried out in the initial phases of the process.
- The contract is formalized prior to development.
- The development stage involves the use of a significant level of human and financial resources.
- The customer pays for the development prior to delivery of the product.
- Product delivery finalizes the process.

**Process started by a call:**



Figure 29: Management process: Started by a call. Source: (Salerno et al., 2015).

- The call for proposals usually defines the specifications and financial conditions of the project.
- It is usually financed by public resources.
- The feasibility analysis is performed prior to the signing of the contract and this stage requires a pre-allocation of internal resources.
- The development begins with an analysis of the feasibility of the project for the entity seeking to participate in the call (capabilities and resources to manage the project).
- The main activities of the innovation process occur after the call for proposals has been assigned.

It is important to highlight that the participation of the client during each stage in the development of the three processes promotes the link with the ISU. Those provide the potential for convergence between industry and academia, allowing the client to participate in a co-innovation process.

That is why the intersection between the type of project and the principles of operation of the Stage-Gate will allow to establish our proposal. In this proposal, the stages are defined to implement a plan of recommendations based on the results obtained in the evaluation of the project requirements. In the gates, the implementation of the recommendations is validated. The objective of the proposal that will be presented below is to implement all the recommendations in the stages prior to the development stage, in order to ensure that the ISU is prepared to develop the project in an effective manner.

The proposal is to establish a "zero" stage in which the project requirement tool is implemented to obtain a list of recommendations (Relationship between ISU diagnosis/project requirement matrix). Subsequently, the list of recommendations will be assigned to the following stages of the process according to their relevance. In this sense, the recommendations in the strategic, social, emotional and financial dimensions will be addressed in the stage corresponding to the construction of the project proposal. Subsequently, the recommendations arising in the physical, technological and financial dimensions will be implemented at the contract negotiation and signing stage. The implementation proposal for each of the three processes is presented below, explaining the implementation procedure based on an example for each process.

***Anticipating sales: the tailor-made approach (open order):***

In the first stage of this process, the client presents the need that gives rise to the project. Subsequently, the construction of the solution proposal starts together with the client. Once the solution proposal is defined, the objectives and specifications of the project are established. From that moment on, the necessary information is available to evaluate if the ISU has the adequate maturity in its practices to carry out the project. This evaluation is done by means of the project requirements tool presented above. The result obtained is a list of global recommendations regarding the ISU maturity to comply with the requirements established for the project. This final diagnosis will be considered as the first gate that can open or close the entrance to the next stage of the project.

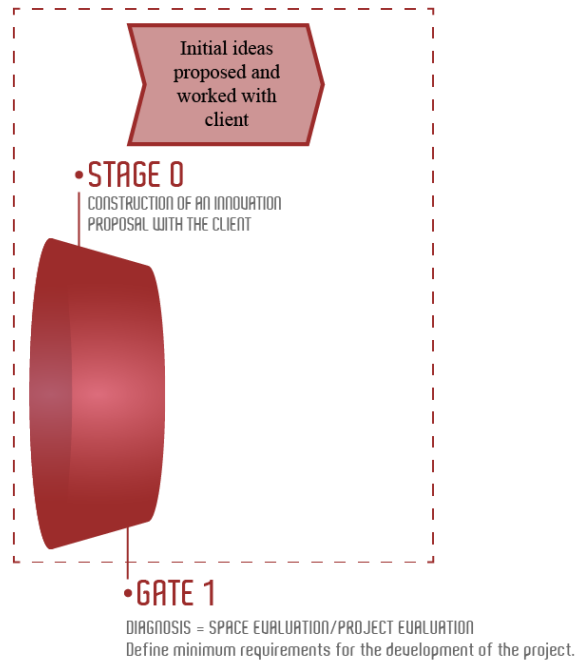


Figure 30: Stage zero of the adaptation of management process anticipating sales: the tailor-made approach with Stage-Gate Methodology, Source: our research.

Table 23 shows an example where the evaluation of the innovation space is shown in the third column "space evaluation", while the level required by the project to be carried out is shown in the fourth column "level required by project". When comparing both profiles, 5 ISU practices are identified that do not meet the maturity level required by the project, generating 5 recommendations. The other 14 practices meet the maturity level required by the project. Since the number of recommendations is low, the ISU decides to carry out the project, following the recommendations plan given to improve the 5 practices that present a level of maturity lower than the maturity level required by the project. Table 23 shows a summary of the recommendations given, indicating the current maturity level and the target maturity level, however, the tool also provides a recommendations plan detailing the concrete actions to be implemented by the ISU to achieve the recommended levels (see Annex 3).



BUSINESS MISSION					
DIMENSION	PRACTICE	SPACE EVALUATION	LEVEL REQUIRED BY PROJECT	STATUS	ACTION
STRATEGIC DIMENSION	Performance and projection (ISP1)	2	3	RECOMMENDATION	Establish a work team and together with the person in charge of the innovation space, design an operating plan in which the expected objectives of the space in the short term are evidenced.
	Tangible institutional resources (ISP2)	2	3	RECOMMENDATION	Define norms for the operation and use of the space that guarantee access to different actors in an equal but directed manner. Allow the use of equipment and machines under the supervision of a person in charge and establish schedules for the different activities established in the project.
	Innovation performance (ISP3)	3	3	OK	NO ACTION
PHYSICAL DIMENSION	Structure & Architecture (ISP4)	3	3	OK	NO ACTION
	Interior design (ISP5)	3	2	OK	NO ACTION
	Collaborative learning environments (ISAMP1)	3	3	OK	NO ACTION
	Business linkage environments (ISBMP1)	4	2	OK	NO ACTION
TECHNOLOGICAL DIMENSION	Manufacturing and communication (ISP6)	2	3	RECOMMENDATION	To acquire at least 2 different types of technology that allow the execution of manufacturing activities and / or usability tests. The choice on technology must respond to the operational objectives of the space.
	ICT for collaborative learning (ISAMP2)	3	3	OK	NO ACTION
	Technological infrastructure for R+D+I+e (ISBM2)	4	3	OK	NO ACTION
SOCIAL DIMENSION	Social and cultural influence (ISP8)	3	3	OK	NO ACTION
	Team relations (ISAM4)	2	2	OK	NO ACTION
	Networking (ISBM4)	4	3	OK	NO ACTION
EMOTIONAL DIMENSION	Interaction and community (ISP7)	3	2	OK	NO ACTION
	Team engagement (ISAM3)	2	3	RECOMMENDATION	To evaluate the technical and human competences of students through formal practical activities that benefit the creation of homogeneous teams.
	Academic and commercial interests (ISBM3)	4	2	OK	NO ACTION
COGNITIVE DIMENSION	Knowledge transfer (ISAM5)	3	2	OK	NO ACTION
	Business and industry knowledge (ISBM5)	4	2	OK	NO ACTION
FINANCIAL DIMENSION	R&D spending (ISBM6)	2	3	RECOMMENDATION	To carry out projects and activities that contemplate a budget that is designated directly to the innovation space for its services, and that complements the resources allocated by the university. To establish an investment plan for R&D from a low to medium scale.

Table 23: Example of a proposed recommendation plan for an innovation project. Source: our research.

Accepting the proposed recommendation plan (Table 23) the project can advance through Gate 1 to execute Stage 1. Progress in the following stages will determine when improvements should be applied to the 5 practices that do not meet the required level. Stage 1 is called "idea maturation period", in this stage, the proposed solution idea is analyzed in detail, giving priority to the definition of objectives, actors involved, activities, time and budget. In this sense, during stage 1, the dimensions involved are strategic, social, emotional and cognitive (Figure 31). Therefore, in this stage the recommendations associated with these 4 dimensions should be worked on.

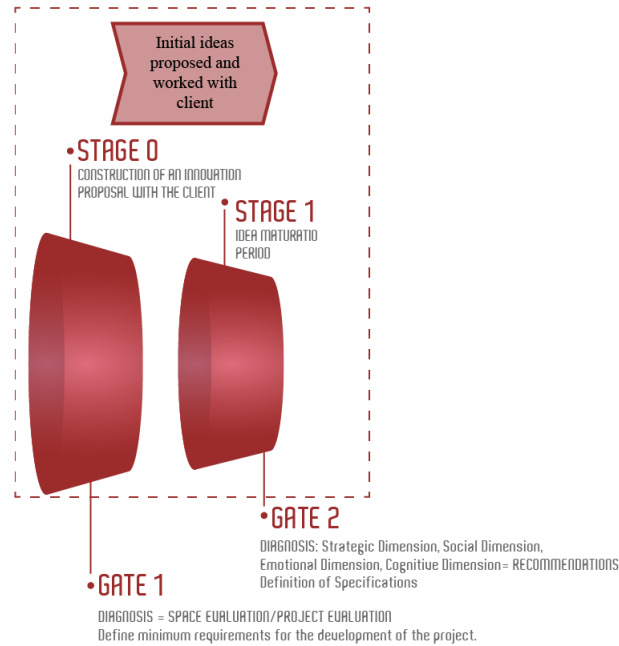


Figure 31: Stage one of the adaptation of management process anticipating sales: the tailor-made approach with Stage-Gate Methodology, Source: our research.

In the case of the example, the strategic dimension presents two recommendations, the emotional dimension presents one recommendation, while the social dimension and the cognitive dimension do not present any recommendations, since all their practices comply with the maturity level required by the project. Thus, gate 2 controls that the recommendations associated with these 4 dimensions are fulfilled, for the example that these three recommendations are fulfilled. The table 24 shows an assumption of realization of the recommendations, where two of the three proposed recommendations are realized. In practice 1 of the strategic dimension "performance and projection" the required maturity level 3 is reached, in practice 2 of the emotional dimension "team engagement" the maturity level 3 required by the project is reached, however, in the second practice of the strategic dimension "tangible institutional resources" the maturity level 2 remains lower than the level 3 required by the project (in red).

BUSINESS MISSION					
DIMENSION	PRACTICE	LEVEL REQUIRED BY PROJECT	ACTION LEVEL REQUIRED	VALIDATION	FINAL STATUS
STRATEGIC DIMENSION	Performance and projection (ISP1)	3	The innovation space has an operating strategy established based on the study of the institutional context. It defines the assigned manager, the expected scope, and the execution time in the short and medium term.	OK	GO
	Tangible institutional resources (ISP2)	3	The innovation space uses tools for the generation and dissemination of knowledge. It establishes rules for the access and use of resources, promoting a culture of support for creative and collaborative work (written or unwritten rules on how to behave in the space, instructions to close the doors, restriction on the use of equipment or spaces, limitation on access to the laboratory).	NO	STOP
	Innovation performance (ISP3)	3		OK	GO
SOCIAL DIMENSION	Social and cultural influence (ISP8)	3		OK	GO
	Team relations (ISAM4)	2		OK	GO
	Networking (ISBM4)	3		OK	GO
EMOTIONAL DIMENSION	Interaction and community (ISP7)	2		OK	GO
	Team engagement (ISAM3)	3	The innovation space establishes an analysis stage and technical-soft skill validation as input to make homogenous work teams in academic activities, assuring previously high levels of cohesion and decision making faster to improve the learning process.	OK	GO
	Academic and commercial interests (ISBM3)	2		OK	GO
COGNITIVE DIMENSION	Knowledge transfer (ISAM5)	3		OK	GO
	Business and industry knowledge (ISBM5)	4		OK	GO

Table 24: Example monitoring and validation of recommendations proposed for an innovation project, Stage 1. Source: own elaboration.

When a practice does not yet meet the required level, gate 2 raises an alert and suggests stopping the project until the missing recommendation is implemented. In this case, the tool makes a proposed decision to stop the project; however, it is the project manager who makes the final decision on the progress of the project. The project management tool evidences that a practice does not have sufficient maturity, and this may result in the ISU not being able to adequately manage the complexity of the project. Once the decision is made to move forward with the project, it is possible to continue with stage 2.

Stage 2 of the management process (sales/order) is also Stage 2 of the Stage-Gate (negotiation). At this stage, the physical, technological and financial resources needed to carry out the project are formalized. In this sense, the recommendations proposed for these dimensions should be implemented at this stage. The gate at the end of Stage 2 is the diagnosis of the physical, technological and financial dimensions, ensuring that all recommendations have been implemented and that the ISU has sufficient maturity to develop the project in an optimal manner.

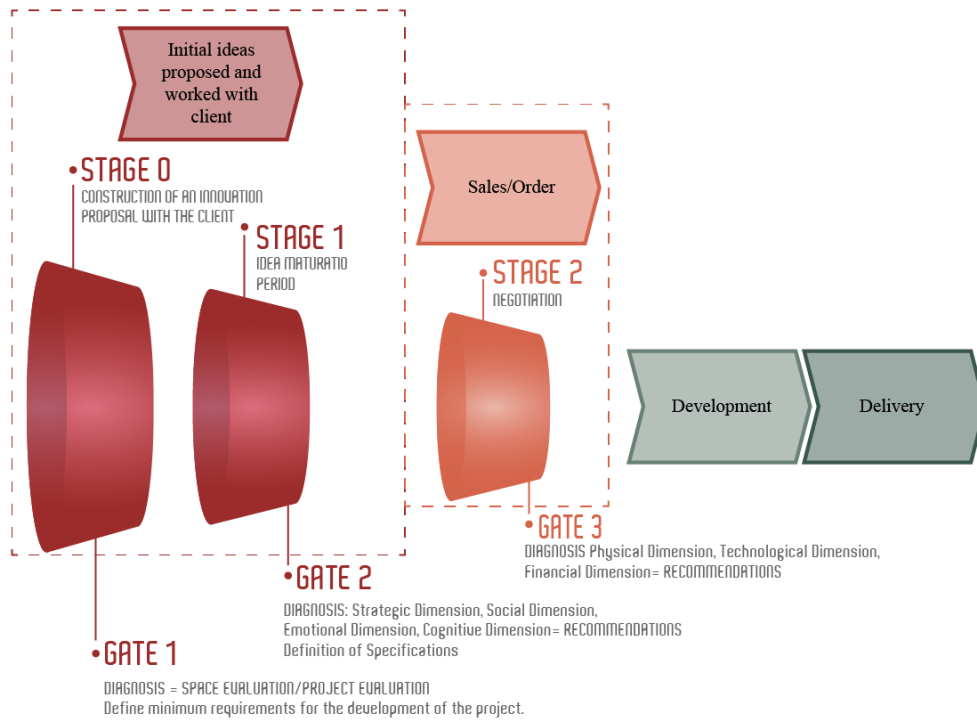


Figure 32: Adaptation of management process anticipating sales: the tailor-made approach with Stage-Gate Methodology, Source: our research.

In the case of the example, the technological and financial dimensions have one recommendation each, while the physical dimension meets the required maturity in all its practices. Therefore, in order for the project to pass through gate 2 and advance to stage 3 in the example, these two recommendations must be verified. The table 25 shows that in both practices the recommendation is fulfilled reaching maturity level 3.

BUSINESS MISSION					
DIMENSION	PRACTICE	LEVEL REQUIRED BY PROJECT	ACTION LEVEL REQUIRED	VALIDATION	FINAL STATUS
PHYSICAL DIMENSION	Structure & Architecture (ISP4)	3		OK	GO
	Interior design (ISP5)	2		OK	GO
	Collaborative learning environments (ISAMP1)	3		OK	GO
	Business linkage environments (ISBMP1)	2		OK	GO
TECHNOLOGICAL DIMENSION	Manufacturing and communication (ISP6)	3	The innovation space has at least 2 core technologies that allow it to perform manufacturing activities and/or usability testing in a limited way. To complement its shortcomings in the development of projects, it relies on other spaces of the university that have specialized technologies.	OK	GO
	ICT for collaborative learning (ISAMP2)	3		OK	GO
	Technological infrastructure for R+D+I+e (ISBM2)	3		OK	GO
FINANCIAL DIMENSION	R&D spending (ISBM6)	3	The innovation space has a mixed budget to invest in R&D. Part of the resources are centralized by the university and the other part respond to its own projects that are being executed. The level of investment is on a low and medium scale.	OK	GO

Table 25: Example monitoring and validation of recommendations proposed for an innovation project, Stage 2. Source: own elaboration.

At this point, if the ISU has implemented all the recommendations, the contract can be signed as an additional requirement to authorize entry into Stage 3 of the management process. Finally, the Stage-Gate process ends, giving flexibility from the development stage to implement other types of methodologies that are considered relevant for the development of the project.

It is important to note that the proposed process does not seek to intervene in the project development stage. Therefore, the proposal to integrate the Stage-Gate does not seek to manage the project, but to favor, thanks to the rigorousness of the stages and gates to ensure two elements prior to the signing of the contract:

- 1) the relevance of developing the project in the ISU (stage zero; global diagnosis);
- 2) the availability of physical and human resources in the ISU for the development of the project (Stage 1 and 2 implementations of recommendations and compliance with the required maturity level).

This prior definition and allocation of resources will allow parallel project management and optimizing the use of the ISU competencies.

***Anticipating sales from a given client specification (closed order):***

In contrast to the previous process, in this case the client defines the objectives and characteristics of the project in advance. Therefore, there is no maturation stage of the idea.

In this sense, the evaluation of the proposal is based on establishing the relevance and interest of the ISU to develop the project. In this case, it is proposed that Stage 0 of the Stage-Gate be located outside the project management process (Figure 33), so that the project requirement diagnosis will be implemented before the start of the first stage of the management process (ideas/client specification). The diagnosis and definition of recommendations is the same regardless of the process followed by the project, since it is built from the comparison of the evaluation of the maturity of the ISU practices versus the requirements of the project, which are independent of the type of process, so the generation of recommendations does not depend

on the type of process followed. The type of process only impacts the timing and stage of when to carry out the recommendations.

As in the previous process, Stage 1 of the Stage-Gate establishes the project requirements based on the customer's demands, in this stage the recommendations of the strategic, social, emotional and cognitive dimensions are implemented. The gate will be opened by validating the implementation of the recommendations in the corresponding dimensions.

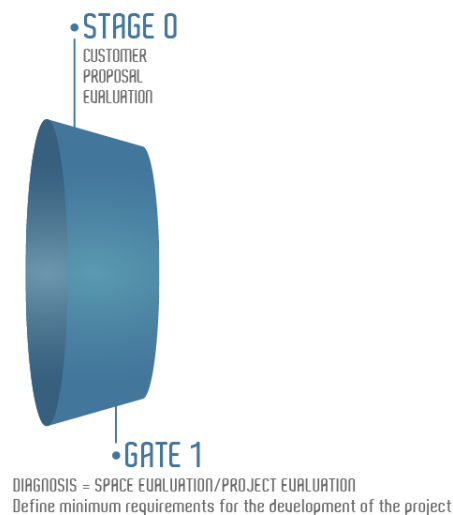


Figure 33: Stage 0 of the adaptation of management process anticipating sales from a given client specification with Stage-Gate Methodology, Source: our research.

Stage 2 of the management process (sales/order) is also Stage 2 of the Stage-Gate (negotiation). At this stage, the physical, technological and financial resources needed to carry out the project are formalized. As in the previous process, the recommendations proposed for these dimensions should be implemented at this stage. The deliverable to open Gate 3 is the diagnosis of the physical, technological and financial dimensions where the compliance with all levels required by the project for the ISU is validated. Subsequently, the contract can be signed and move on to Stage 3 of development as shown in Figure 34.

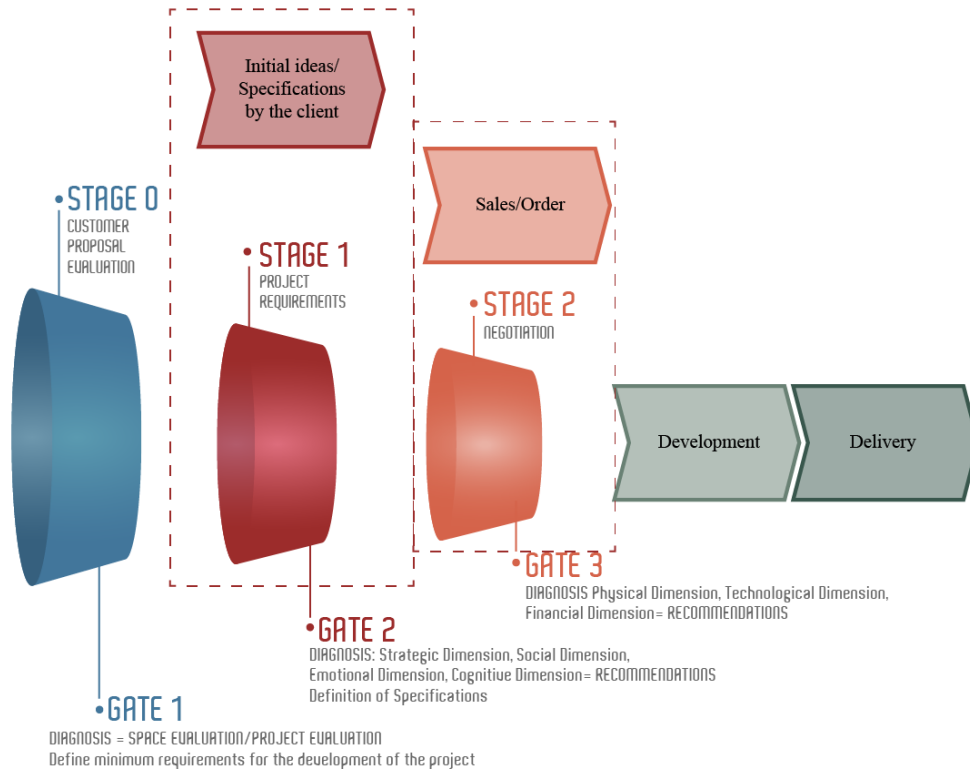


Figure 34: Adaptation of management process anticipating sales from a given client specification with Stage-Gate Methodology, Source: our research.

The management processes of "Anticipating sales" and "Anticipating sales from a given client specification" have a very similar behavior, so the implementation of the Stage-Gate shares many similarities.

***Process started by a call:***

In this last process the follow-up tool is simplified by establishing Stage 0 to execute the project requirement assessment and Stage 1 to implement all the recommendations generated for the ISU. Considering that the calls for proposals usually define the functional characteristics, objectives, budget and execution time of the projects, the first instance will be to evaluate the feasibility of applying to the call for proposals based on the requirements requested. In this sense, a diagnosis is made of the project's requirements according to its degree of complexity and a list of recommendations is obtained to move on to the next stage (Gate 0).

Subsequently, in Stage 1, we proceed with the construction of the proposal, implementing in parallel all the recommendations generated in Stage 0 (Figure 35). In other words, during the construction of the proposal, recommendations must be implemented to ensure that if the proposal submitted is assigned and the call for proposals is awarded, the ISU has sufficient maturity to develop the project in an optimal manner, considering the practices of all the dimensions.

The gate to move to the next stage will then be the formalization of the solicitation proposal. This puts the project in a state of waiting for the response if the project is assigned or not to continue with the development.

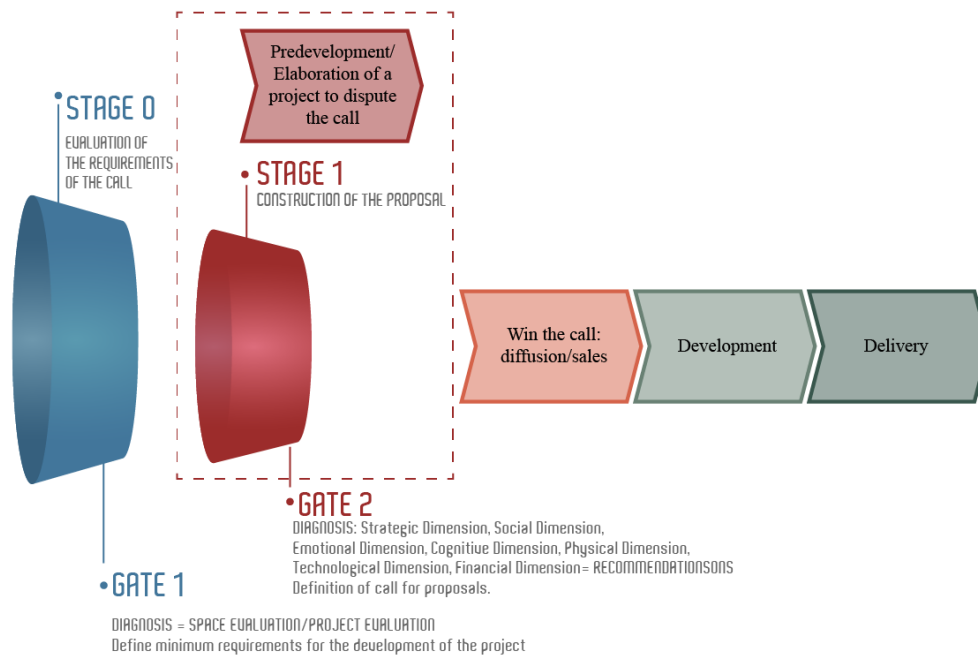


Figure 35: Adaptation of management process started by a call with Stage-Gate Methodology, Source: our research.

The integration of the Stage-Gate concept in the management of innovation processes in the three cases, aims to be rigorous at the beginning of the projects. This allows both the choice of which projects to carry out (relevance), as well as the availability of resources in advance of the project development. According to the group of experts interviewed for the validation of the requirement matrix, one of the greatest difficulties encountered in the management of projects in universities is to establish activities that require a significant extra use of resources. In practice, this leads to deviations from planning, increasing the execution time and cost of projects.

In addition, the ISU must guarantee the achievement of good results both inside and outside the universities, balancing the expectations of the academics with those of the industry. For universities, the success of a project is not measured simply in economic terms; there are equally relevant evaluation metrics such as knowledge generation and territorial impact in terms of research, innovation and development. In this sense, knowing the characteristics of the ISU, in order to subsequently establish an evaluation of project requirements that provides recommendations for project management, is attractive when currently many of the ISU manage the use of resources and project management through intuition.

#### 4.4 Conclusion

Once the structure of an ISU is understood by identifying the dimensions and practices that compose it according to its mission, the need arises to manage its available resources in the best possible way. Based on the experience of managers and academics in the universities, it is concluded that the projects give life to the ISU. These projects have different objectives and therefore different degrees of complexity. An ISU can develop academic, social, environmental,



or technological projects. However, these typologies are considered as the orientation of the project. Moreover, each one, in its development, involves different degrees of innovation, which allows characterizing the projects under parameters of demand and use of resources. Thus, three types of innovation are proposed: technological, concept and market, with their respective degrees of complexity (high, medium, low). Based on this classification, an assessment tool was proposed to evaluate the requirements of a project with respect to the minimum maturity necessary in ISU practices. In this way, a tool is established that alerts the ISU practices that do not meet the required maturity level to manage the complexity of the project, and thus establish an improvement plan. Subsequently, a plan of recommendations and a process based on stages and gates is proposed to ensure the availability, in the required time, of the necessary resources for the development of the project. The recommendations do not seek to individualize the ISU for each of the projects, i.e., it is not expected to create a physical and organizational structure for each project. The objective is to provide the ISU managers with a tool that allows them to visualize the maturity of their space and to direct the search and execution of projects towards the type of novelty that they are capable of managing. Recognizing the strengths and weaknesses of the space in the development of projects will allow establishing alliances with other ISUs. Working in an alliance network may be a strategy to generate more ambitious projects that in turn will lead the ISU to acquire a higher degree of maturity in its practices and therefore in its daily operation. With this approach, the recommendations are proposed as a search to strengthen the maturity of the space and a guarantee to successfully manage the projects.

## **5 CHAPTER 4: CASE STUDIES: INNOVATION SPACES IN CHILEAN UNIVERSITIES**

### **5.1 Introduction**

The previous chapters presented a model for characterizing innovation spaces, both in terms of their structure and dimensions (chapter 2) and their dynamics in project management (chapter 3). This model allows the evaluation of the space, determining its degree of maturity based on the performance of the practices that make up the innovation space in terms of the universities' missions. In addition, the model establishes the minimum level of performance required by a project, according to its complexity, in order to contrast it with the performance of the space and, if necessary, to establish recommendations to bring the project to a successful conclusion. This gives rise to two tools to support the management of innovation spaces in universities. One allows a diagnosis of the global maturity level based on the evaluation of practices and the other allows to establish whether a project is executable in a given innovation space and then proposes to follow up on it. Both tools are based on an exhaustive literature review and have been validated by a group of experts; however, it is important to test them on case studies. This empirical validation, in addition to reinforcing the conceptual and structural relevance of the tools, makes it possible to verify their applicability and usefulness in a real context.

This chapter presents the application of both tools to innovation spaces in Chilean universities. The case studies will be presented in two phases: first, the tool for diagnosing the global maturity level of the innovation space will be applied (chapter 2). In this phase, 5 innovation spaces in different universities will be evaluated in order to test the tool in different contexts and make a comparative analysis between the 5 cases. In the second phase, we will deepen the analysis of one of the spaces by integrating the project evaluation and monitoring, to see the scope and dynamics generated by the implementation of projects within the innovation spaces.

### **5.2 Case study: Diagnosis of the maturity of innovation spaces in Chilean universities**

The creation of innovation spaces in universities is clearly on the rise in recent years. Universities must play a more active role in the development of countries. Aware of this, Chilean universities have focused their efforts on forming an innovation ecosystem that integrates networking among academic institutions, but also articulates with the state, civil society and the private sector. The objective is to promote innovation and technology transfer in the country (Daruich, 2021). However, innovation and technology transfer is an area in the process of development. As shown by the ranking of R&D&I made by universities advanced studies<sup>12</sup>, where among the three factors evaluated, transfer and innovation is the one that shows the lowest degree of development for the 46 universities evaluated. The ranking evaluates three factors:

- Capability and productivity: It considers aspects such as the number of publications, number of projects and average years of accreditation in doctoral programs.
- Impact and quality: It focuses on the impact and number of citations of publications.

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<sup>12</sup> Ranking of R&D&I Chilean universities: <https://redg9.cl/2021/11/11/realizado-por-el-grupo-de-estudios-avanzados-universitas-ranking-idi-2021-muestra-el-dinamismo-que-estan-logrando-las-universidades-chilenas-en-desafios-clave-para-enfrentar-a-la-sociedad-del-conoc/>

- Transfer and innovation: It considers the number of patents applied for and research projects linked to innovation.

The first two factors have a degree of development in all universities, while the transfer and innovation factor has been worked on in only 22 of the 46 universities. This factor is becoming increasingly relevant; in fact, the first 15 universities in the ranking have worked to some extent on transfer and innovation.

This reality highlights the relevance of the model and tools proposed in the previous chapters, since many universities show interest in developing this area, but do not know how to design and implement innovation spaces.

As the objective is to test the proposed tools, in this first phase the diagnosis will be applied in universities that already have innovation spaces in operation. For the 5 cases, the evaluation was carried out through interviews with the persons in charge of the innovation space.

### 5.2.1 Diagnosis 1: University of Santiago de Chile

The entrepreneurship and innovation laboratory of the Industrial Engineering Department of the University of Santiago of Chile was inaugurated in 2015 with the objective of being a space to support the development of student entrepreneurship. Subsequently, the laboratory complemented the support to entrepreneurship with the acquisition of technological equipment to support the development of innovation projects. In this way the laboratory has two lines of work: consulting for student entrepreneurship at the University and the development of innovation projects with a technological dimension. These two lines of work, together with the academic activities of innovation classes of the Civil Industrial Engineering career, make it a mixed innovation space.

Currently, the LEIND laboratory (Figure 36) has a work team composed of three professionals, one professor, an industrial engineer with a PhD in innovation, responsible for promoting the academic area, directing the use of methodologies and leading the research process in the different projects. One graphic designer, with a master's degree in innovation, manages the resources of the IS and the projects. In addition, she provides support in the use of academic methodologies and research activities. One automation technician, in charge of the use of equipment for prototyping and technological development activities.

In 2019 LEIND had six student-led entrepreneurship projects. In 2020, it started a project of linkage with a medical rehabilitation institution integrating inclusive technologies to the rehabilitation procedures of patients, this project allowed the generation of new products and research

work. On average, each year, around 150 students from different specialties participate in the LEIND laboratory, either in training activities, consulting, formal projects, etc.

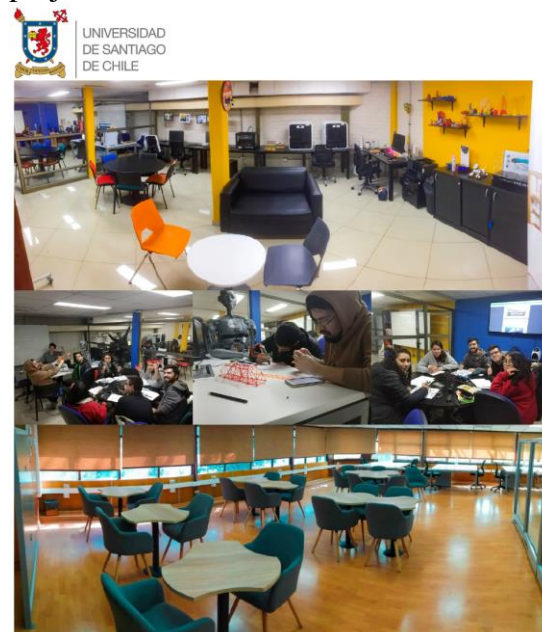


Figure 36: Entrepreneurship and innovation laboratory of the Industrial Engineering LEIND-USACH, Source: property of the university.

The application of the evaluation questionnaire of the space is conducted jointly with the academic responsible of the space. The level of maturity assigned to each practice is detailed in Annex 4 (LEIND laboratory evaluation profile). The LEIND laboratory is classified as a mixed innovation space, so its evaluation will integrate the practices of both the academic mission and the business mission. The evaluation profile of the business mission is presented below:

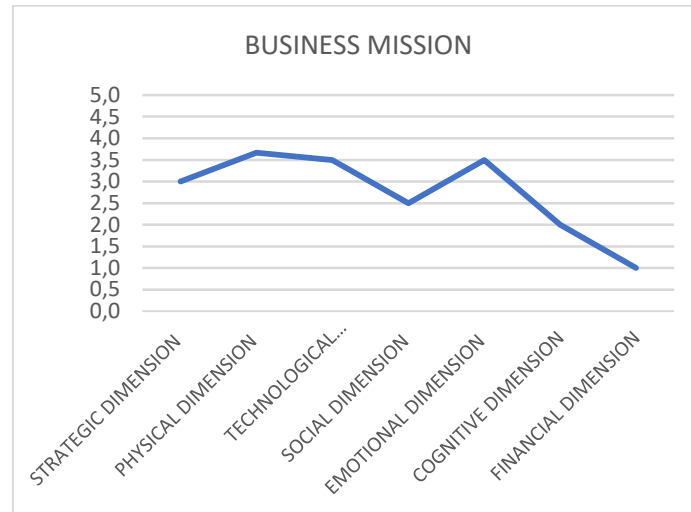


Figure 37: Evaluation profile for the dimensions of the business mission at LEIND, Source: own elaboration.

The space shows an overall evaluation of 2.7, highlighting the performance in the physical, technological and emotional dimensions, all with a performance higher than 3.5. The results in the technological and physical dimensions are to be expected, since they are the two most recognized dimensions when implementing an innovation space, giving it greater emphasis when designing a space. The good development of the emotional dimension is noteworthy, positioning itself as a distinctive factor of this laboratory that privileges the relationship with the industry in search of the realization of applied projects. On the other hand, the dimensions with the lower performance are the cognitive dimension and the financial dimension, with an evaluation of 2 and 1, respectively. In the cognitive dimension, the space, being located in a single campus university, relies on other spaces that are geographically close, so it has not developed this dimension autonomously. Something similar happens with the financial dimension, the space depends in this aspect on the Department of Industrial Engineering, not developing its own financial support that would allow it to make investments in R&D.

When advancing to the next level of aggregation and observing the evaluation of the practices, it can be seen that the best evaluation is in the practice of relationship with different actors. This reinforces the finding of this distinctive factor of this laboratory to carry out applied projects. The profile in the practices is quite homogeneous, with the great majority of practices evaluated between maturity levels 2 and 4. This is due to the time the space has been in operation, achieving a medium-high degree of maturity, and the progressive growth strategy that has been adopted. In this way, the space has been strengthening its performance in the different practices by carrying out projects with an increasing degree of complexity.



Figure 38: Evaluation profile for the practices of the business mission at LEIND, Source: own elaboration.

On the other hand, the academic mission shows the following evaluation profile:

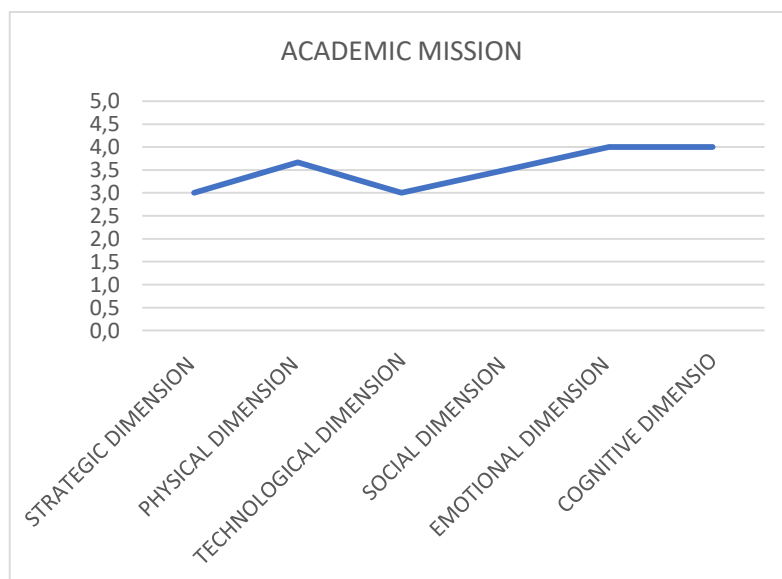


Figure 39: Evaluation profile for the dimensions of the academic mission at LEIND, Source: own elaboration.

In this mission, the profile shows a better evaluation of the global maturity with 3.5 and an even more homogeneous profile by dimension with performances between 3 and 4. For this mission the relationship with industry continues to be an important practice, to which is added the use of methodological tools. This can be explained by the profile of the laboratory managers who have post-graduate studies in innovation and are in charge of the classes in this line in the programs of the Department of Industrial Engineering.

When observing the evaluation profile by practices, it can be seen that only two practices are in a performance level lower than 3. The monitoring and evaluation plan of the results and the use of ICT tools appear as the practices to be improved in order to make the innovation space evolve in the academic mission.

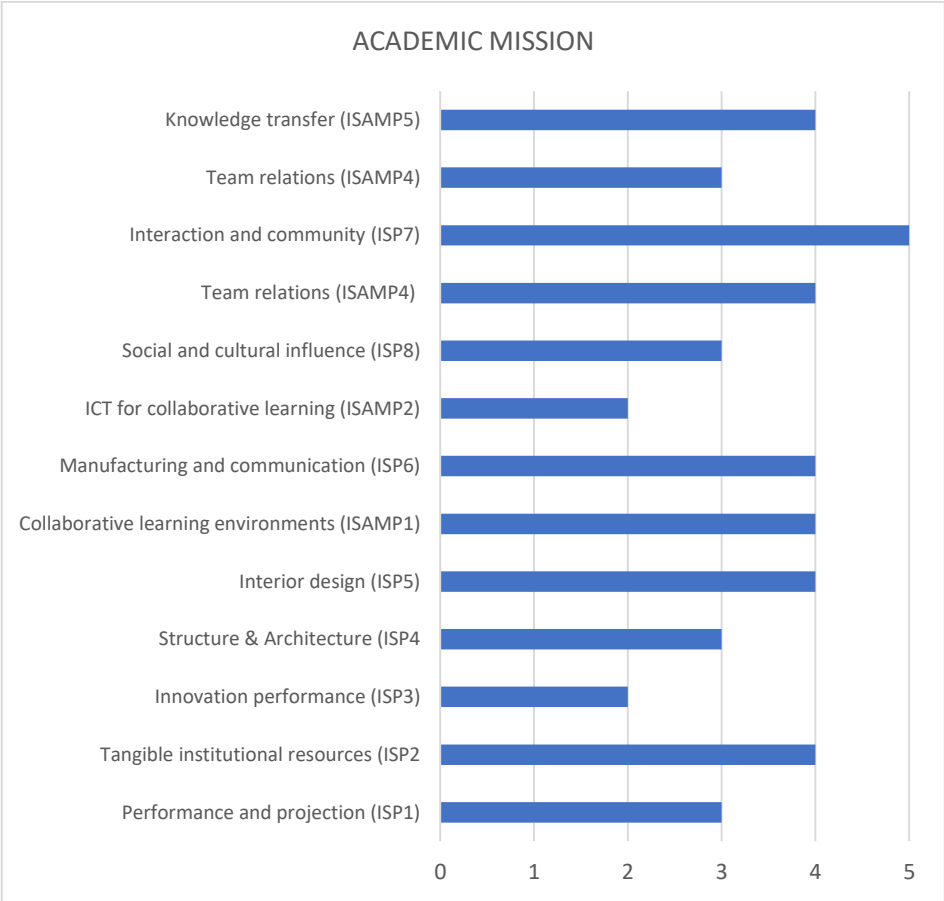


Figure 40: Evaluation profile for the practices of the academic mission at LEIND, Source: own elaboration.

Finally, when comparing both evaluation profiles by dimension for each mission, a higher degree of development can be seen in the academic mission.

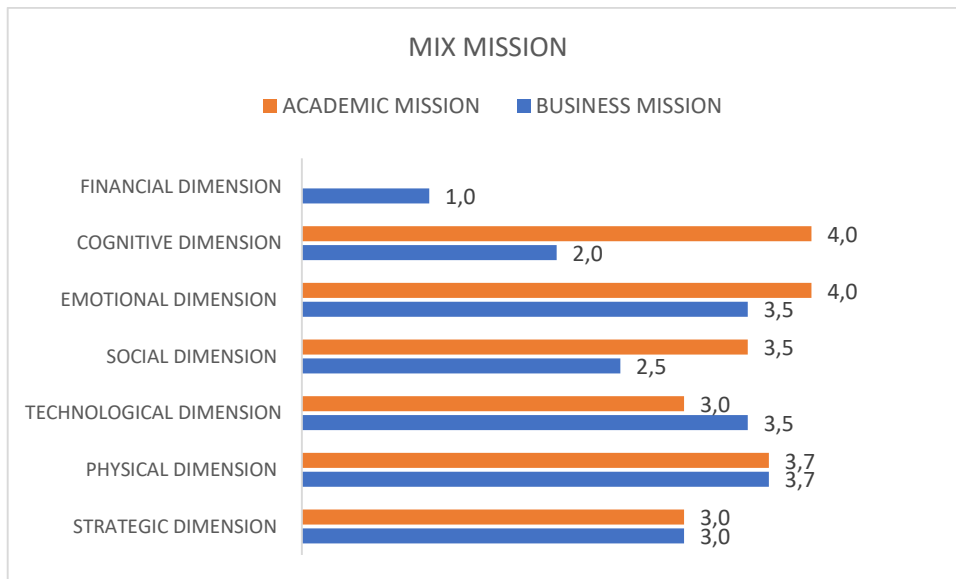


Figure 41: Evaluation profile for the practices of the Mix mission at LEIND, Source: own elaboration.

In general, the dimensions have a similar level of performance in both missions, except for the cognitive dimension where there is a notorious difference in favor of the academic mission. This is due to the fact that in the practice of market knowledge for the business mission, there is a low degree of maturity. The laboratory in this aspect is supported or derives the projects to another area of the university, in this case to the incubator. On the other hand, in the academic mission, the knowledge is developed due to the relationship of the laboratory with the classes mainly of the Industrial Civil Engineering program.

For the academic in charge of the LEIND laboratory, the evaluation profile obtained represents in a good way the reality of the space, evidencing and ratifying the strengths and weaknesses that were intuitively recognized in the laboratory. The diagnosis delivered is valued as it represents a good input to reinforce the decision making in the laboratory development plan.

The diagnostic report on the LEIND maturity level is presented below. The following table shows the recommendations proposed for both the academic and business missions. It is important to clarify that for ISUs with mixed mission the two missions are analyzed independently. Thus, table 25 shows the recommendations proposed for the evaluation by dimensions.

MIXED MISSION - EVALUATION BY DIMENSION						
DIMENSION	PRACTICE	ACADEMIC MISSION		BUSINESS MISSION		RECOMMENDATION OPTION 1 AVERAGE DIMENSION
		PE	AD	PE	AD	
STRATEGIC DIMENSION	ISP1	3	3,0	3	3,0	NO ACTION
	ISP2	4		4		NO ACTION
	ISP3	2		2		<b>Maturity level 2 to 3</b> The person in charge of the space must define an evaluation rubric for each activity to be carried out. This rubric must be defined according to the operational objectives of the

						innovation space and the characteristics of each project.
PHYSICAL DIMENSION	ISP4	3	3,7	3	3,5	<b>Maturity level 3 to 4</b> To establish open spaces that benefit adaptability to different numbers of users in a regulated manner. To distribute the physical space in differentiated areas for individual, collaborative, and manufacturing work. To define areas of socialization and debate that allow doing workshops and presentations.
	ISP5	4		4		NO ACTION
	ISAMP1	4		N/A		NO ACTION
	ISBMP1	N/A		4		NO ACTION
TECHNOLOGICAL DIMENSION	ISP6	4		4	3,5	NO ACTION
	ISAMP2	2	3,0	N/A		<b>Maturity level 2 to 3</b> To define the use of ICT as a basic tool for collaborative work to share files, communicate, debate, etc. To socialize and make presentations that allow publicizing the ICT available and used in the IS.
	ISBM2	N/A		3		<b>Maturity level 3 to 4</b> To propose technology development projects that are for internal use and allow potential entrepreneurship and research activities. To acquire or develop technology vigilance software.
SOCIAL DIMENSION	ISP8	3		3	2,5	<b>Maturity level 3 to 4</b> To design and manage impact projects on issues of territorial interest, integrating the user as a key actor in the work teams.
	ISAM4	4	3,5	N/A		NO ACTION
	ISBM4	N/A		2		<b>Maturity level 2 to 3</b> To define protocols and sign collaboration agreements with public and private institutions outside the university that respond to the operational objective of the innovation space.
EMOTIONAL DIMENSION	ISP7	5		5	3,5	NO ACTION
	ISAM3	3	4,0	N/A		<b>Maturity level 3 to 4</b> To evaluate the profile of students through methodological tools using the information to assign roles in the work teams. To do feedback activities for students to strengthen the different profiles during the collaborative learning process. To establish metrics to evaluate the performance of teams in terms of cohesion and complementarity.



	ISBM3	N/A		2		<b>Maturity level 2 to 3</b>	To define formal incentives associated with public recognition for teachers and students who develop business projects.
COGNITIVE DIMENSION	ISAM5	4	4,0	N/A	2,0	NO ACTION	
	ISBM5	N/A		2		NO ACTION	
FINANCIAL DIMENSION	ISBM6	N/A		1	1,0	NO ACTION	
<b>OVERALL AVERAGE OF ALL DIMENSIONS</b>			<b>3,5</b>		<b>2,7</b>		
PE = PRACTICE EVALUATION    AD = AVERAGE DIMENSION    N/A = NOT APPLICABLE							

Table 26: LEIND improvement plan results. Option 1, dimension average. Source: own elaboration.

In the preceding table the maturity assessment of each practice (column PE) is compared with the average of the corresponding dimension (column AD), if the assessment of the practice is lower than the average, a recommendation is generated. In this case, the recommendations seek to increase the current evaluation of the practice by one level of maturity. The last column shows which practices have a recommendation associated with them, showing the progression of the recommended maturity level (increase from the current level to the recommended level) and also defines the activities and resources involved to reach the recommended maturity level. For example, in the emotional dimension, the average of the dimension for the academic mission is 4.0, of the practices associated with this dimension only ISAM3 practice (team engagement) has an evaluation lower than 4, so this practice generates a recommendation. In this case, to advance from the current level 3 to maturity level 4, this recommendation seeks to improve team engagement using metrics, methodologies to define roles within the team and generate feedback to improve the relationship and collaborative work among members. Then, the same emotional dimension, but in this case for the business mission has an average evaluation of 3.5, generating a recommendation in the ISBM3 practice (academic and commercial interest), which should move from level 2 to level 3 maturity. In this case, the recommendation is to generate a better incentive system to increase the interest of academics and commercials to carry out projects at ISU. Thus, this strategy focuses on improving the weakest practices in each dimension.

Table 26 shows the proposed recommendations for a second improvement strategy, this time the recommendations will be applied to the practices that have a lower evaluation than the overall average ISU evaluation.

MIXED MISSION - OVERALL AVERAGE OF ALL DIMENSIONS							
DIMENSION	PRACTICE	ACADEMIC MISSION		BUSINESS MISSION		RECOMMENDATION OPTION 2 AVERAGE TOTAL SPACE	
		PE	OAD	PE	OAD		
STRATEGIC DIMENSION	ISP1	3	3,5	3	2,7	<b>Maturity level 3 to 4</b>	To carry out an internal study (context and institutional capacities) on which the strategy for the innovation space operation is based. To define activities agreed with the

					team that contemplate an assigned manager, objectives, and execution time (short and medium term).
	ISP2	4		4	NO ACTION
	ISP3	2		2	<b>Maturity level 2 to 3</b> The person in charge of the space must define an evaluation rubric for each activity to be carried out. This rubric must be defined according to the operational objectives of the innovation space and the characteristics of each project.
PHYSICAL DIMENSION	ISP4	3		3	<b>Maturity level 3 to 4</b> To establish open spaces that benefit adaptability to different numbers of users in a regulated manner. To distribute the physical space in differentiated areas for individual, collaborative, and manufacturing work. To define areas of socialization and debate that allow doing workshops and presentations.
	ISP5	4		4	NO ACTION
	ISAMP1	4		N/A	NO ACTION
	ISBMP1	N/A		4	NO ACTION
TECHNOLOGICAL DIMENSION	ISP6	4		4	NO ACTION
	ISAMP2	2		N/A	<b>Maturity level 2 to 3</b> To define the use of ICT as a basic tool for collaborative work to share files, communicate, debate, etc. To socialize and make presentations that allow publicizing the ICT available and used in the IS.
	ISBMP2	N/A		3	<b>Maturity level 3 to 4</b> To propose technology development projects that are for internal use and allow potential entrepreneurship and research activities. To acquire or develop technology vigilance software.
SOCIAL DIMENSION	ISP8	3		3	<b>Maturity level 3 to 4</b> To design and manage impact projects on issues of territorial interest, integrating the user as a key actor in the work teams.
	ISAMP4	4		N/A	NO ACTION
	ISBMP4	N/A		2	<b>Maturity level 2 to 3</b> To define protocols and sign collaboration agreements with public and private institutions outside the university that respond to the operational objective of the innovation space.
EMOTIONAL DIMENSION	ISP7	5		5	NO ACTION
	ISAMP3	3		N/A	<b>Maturity level 3 to 4</b> To evaluate the profile of students through methodological tools using the information to assign roles in the work teams. To do feedback activities for students to strengthen the different profiles during the

						collaborative learning process. To establish metrics to evaluate the performance of teams in terms of cohesion and complementarity.
	ISBMP3	N/A		2		<b>Maturity level 2 to 3</b> To define formal incentives associated with public recognition for teachers and students who develop business projects.
COGNITIVE DIMENSION	ISAMP5	4		N/A		NO ACTION
	ISBMP5	N/A		2		<b>Maturity level 2 to 3</b> To carry out training with national or international experts in the development of inventions in conjunction with academia / industry which can be patented, licensed or that allow an academic derivation.
FINANCIAL DIMENSION	ISBMP6	N/A		1		<b>Maturity level 1 to 2</b> To establish an investment plan in R&D that responds to the operational objectives of the innovation space, and that is aligned with the budget allocated by the university.
<b>PE = PRACTICE EVALUATION OAD = OVERALL AVERAGE OF ALL DIMENSIONS N/A = NOT APPLICABLE</b>						

Table 27: LEIND improvement plan results. Option 2, average total space. Source: own elaboration.

Although the recommendations are made independently for each mission, in the case of shared practices (e.g. ISP1, ISP2, ISP3, etc.), once the practice of one of the missions is improved, it will have an impact on the other, generating a synergy effect, improving the performance of the practice for both missions. The innovation space manager can decide to give priority to one of the dimensions or to execute the recommendations simultaneously in both missions. The decision depends on the operating strategy of the space.

### 5.2.2 Diagnosis 2: University of Concepción

The innovation space evaluated is located at the University of Concepción in southern Chile and corresponds to an incubator (Figure 42). In this case the space includes all the careers of the University being a great difference with the previous case (a laboratory of a particular academic department). This incubator has more than 20 years of operation supporting more than 6000 entrepreneurs. The University of Concepción has shown great interest in the development of innovation and entrepreneurship activities, configuring a strong ecosystem in this aspect.



Figure 42: Incubator at the University of Concepcion, Source: property of the university.

The incubator appears as a major player within this innovation ecosystem of the university and is recognized at national and Latin American level.

During their trajectory they have assisted more than six thousand entrepreneurs and created 70 companies of national impact. The incubator has managed to ensure a robust team of 17 professionals in different disciplines (7 commercial engineers, 3 industrial engineers, 1 biotechnology engineer, 1 business administrator, 1 marketing technician, 1 industrial designer, 2 journalists and 1 executive secretary).

Due to the type of space, only the business mission is evaluated, since its primary objective is to support entrepreneurship projects. The evaluation survey is applied in conjunction with a representative of the space, obtaining the following evaluation profile by dimensions. The level assigned to each practice is detailed in Annex 5 (evaluation profile of the Incubator Universidad de Concepcion). Figure 43 represents the evaluation profile obtained by dimensions:

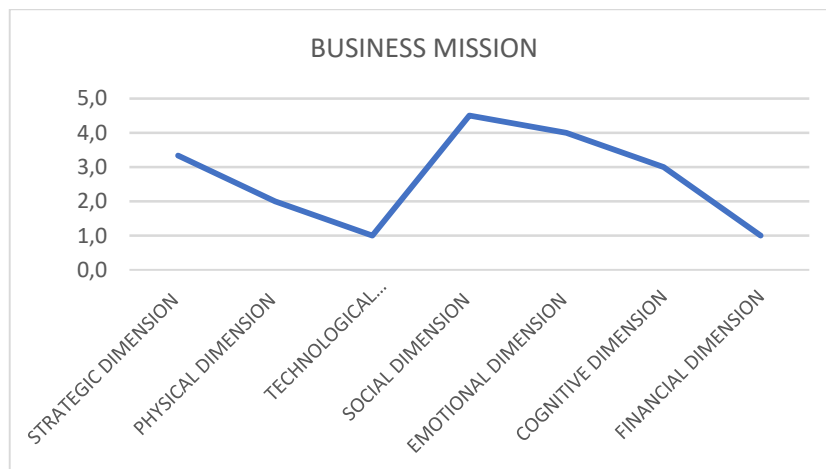


Figure 43, Evaluation profile for the dimensions of the business mission at UdeC, Source: own elaboration.

Due to the way the space operates, a greater disparity can be seen in the evaluation of the dimensions, showing a medium-high level of performance in the cognitive, emotional and social dimensions, since the focus of the incubator is oriented towards advising the entrepreneurs in order to integrate them into the market. From this point of view, it is not surprising that the physical and technological dimensions are not of important for this space and show a minimum performance level. As in the previous case, the minimum evaluation is obtained in the financial dimension, the reason is very similar, since by depending on the university, the innovation space has not seen the need to develop this dimension. In the profile by practices, the differences in performance are even more evident.



Figure 44: Evaluation profile for practices of the business mission at UdeC, Source: own elaboration.

The operational strategy, the relationship with the community and the integration of academics in the entrepreneurship stand out as important pillars in the development of the space. The last point is noteworthy because it allows the active integration of a very important actor within the university, such as professors. Regarding the technological infrastructure and support technologies, the incubator does not see it as a priority aspect since its focus is on consultancy from a commercial point of view and not on the technical development of the projects. The technical factor is worked by the laboratories associated with each departments of the university.

In this case, the evaluation profile obtained also manages to represent the reality of the incubator in a good way. In the conversation and analysis of the diagnosis carried out with the representative of the incubator, it is questioned whether the technological dimension should be evaluated in this type of spaces. It is determined that it is necessary, because although this particular space does not develop it autonomously. It uses it supported by the innovation ecosystem of the university, so it is a necessary dimension in this type of innovation spaces.

For the improvement strategy, the incubator manager opted for strategy 1, establishing a plan to improve the practices that have a lower than average evaluation of their dimension. In choosing this option, the incubator would be seeking to further consolidate its differential factor, reaching the maximum evaluation level (maturity level 5) in the social and emotional dimensions. However, the physical, technological and financial dimensions would remain at a much lower evaluation level (maturity level between 1 and 2) without receiving recommendations.

BUSINESS MISSION - EVALUATION BY DIMENSION				
DIMENSION	PRACTICE	PRACTICE EVALUATION	AVERAGE DIMENSION	RECOMMENDATION OPTION 1 AVERAGE DIMENSION
STRATEGIC DIMENSION	ISP1	5	3,3	NO ACTION
	ISP2	2		<b>Maturity level 2 to 3</b> To define space rules of operation and use, in which the access of different actors is guaranteed in an equal but directed way. To allow the use of equipment and machines under the supervision of a manager, and to establish opening hours for different activities.
	ISP3	3		<b>Maturity level 3 to 4</b> The person in charge of the space must schedule semi-annual and annual meetings with the work team to analyze the evaluation results that were applied to the activities carried out in that period. Consensually, the evaluation plan must be designed for the period that begins (short and medium-term objectives).
PHYSICAL DIMENSION	ISP4	2	2,0	NO ACTION
	ISP5	2		NO ACTION
	ISBMP1	2		NO ACTION
TECHNOLOGICAL DIMENSION	ISP6	1	1,0	NO ACTION
	ISBMP2	1		NO ACTION
SOCIAL DIMENSION	ISP8	5	4,5	NO ACTION
	ISBMP4	4		<b>Maturity level 4 to 5</b> To develop projects with industry and the environment that integrate development, research, and technology transfer into their objectives. To integrate technology transfer offices as a key actor in the development of projects with the industry.
EMOTIONAL DIMENSION	ISP7	3	4,0	<b>Maturity level 3 to 4</b> To carry out regular activities to disseminate projects and exchange ideas among different teams, disciplines, users, etc., without distinguishing positions or hierarchies.
	ISBMP3	5		NO ACTION
COGNITIVE DIMENSION	ISBMP5	3	3,0	NO ACTION

FINANCIAL DIMENSION	ISBMP6	1	1,0	NO ACTION
<b>OVERALL AVERAGE OF ALL DIMENSIONS</b>			<b>2,7</b>	

Table 28: Incubator at the University of Concepcion improvement plan results. Option 1, dimension average. Source: own elaboration

If the ISU is understood as a unit in which each dimension plays an important role for its growth, it can be concluded that improving the physical, technological and financial dimensions will allow the incubator to have greater autonomy, by not depending on the use of university resources to make up for its weaknesses in these aspects. In this sense, the possibility of applying improvement strategy 2 (recommendation on practices evaluated worse than the total average evaluation of the ISU) will lead the innovation space to progressively strengthen the worst evaluated dimensions (physical, technological and financial) supporting the current good performance of the social and emotional dimensions, generating a much more homogeneous evaluation profile among its practices and dimensions.

BUSINESS MISSION - OVERALL AVERAGE OF ALL DIMENSIONS				
DIMENSION	PRACTICE	PRACTICE EVALUATION	OVERALL AVERAGE OF ALL DIMENSIONS	RECOMMENDATION OPTION 2 AVERAGE TOTAL SPACE
STRATEGIC DIMENSION	ISP1	5	2,7	NO ACTION
	ISP2	2		<b>Maturity level 2 to 3</b> To define space rules of operation and use, in which the access of different actors is guaranteed in an equal but directed way. To allow the use of equipment and machines under the supervision of a manager, and to establish opening hours for different activities.
	ISP3	3		NO ACTION
PHYSICAL DIMENSION	ISP4	2		<b>Maturity level 2 to 3</b> To distribute the available physical space in differentiated areas that allow individual, collaborative, and manufacturing work activities in parallel. To promote open spaces that benefit the adaptability of work areas to guarantee access and comfort for users. To partner with another innovation space that supplies 1 or more services discussed above.
	ISP5	2		<b>Maturity level 2 to 3</b> To acquire furniture with colors and functional design, which is easy to move and allows adapting quickly to

				individual or group use. To customize color of walls and lighting to generate its own environment that benefit creativity (greater lighting, bright colors). To incorporate design elements that generate identity to the space and are associated with creativity and innovation activities.
	ISBMP1	2		<b>Maturity level 2 to 3</b> To enable at least one own work area that allows the use of computers and internet with the aim of carrying out entrepreneurial and / or technology transfer activities.
TECHNOLOGICAL DIMENSION	ISP6	1		<b>Maturity level 1 to 2</b> To guarantee the use of university spaces equipped with relevant technology for the execution of manufacturing activities and / or basic usability tests.
	ISBMP2	1		<b>Maturity level 1 to 2</b> To guarantee the use of university spaces equipped with computers, a secure internet network, access to virtual libraries, and relevant technology for the execution of entrepreneurial and / or research activities.
SOCIAL DIMENSION	ISP8	5		NO ACTION
	ISBMP4	4		NO ACTION
EMOTIONAL DIMENSION	ISP7	3		NO ACTION
	ISBMP3	5		NO ACTION
COGNITIVE DIMENSION	ISBMP5	3		NO ACTION
FINANCIAL DIMENSION	ISBMP6	1		<b>Maturity level 1 to 2</b> To establish an investment plan in R&D that responds to the operational objectives of the innovation space, and that is aligned with the budget allocated by the university.

Table 29: Incubator at the University of Concepcion improvement plan results. Option 2, average total space. Source: own elaboration

The decision of which strategy to implement will depend on the analysis made by the director of the innovation space and should respond directly to the operational objectives proposed for its operation. In the case of deciding to implement strategy 1 and not making efforts to improve the worst evaluated dimensions, the ISU will have to guarantee the commitment of other spaces and laboratories in the university to compensate for these weaknesses.



### 5.2.3 Diagnosis 3: University Católica de Valparaíso

Two different spaces will be evaluated at the University of Católica de Valparaíso: A pre-incubator “The Lift” and a makerspace “Makerspace Valparaíso” (Figure 45). The pre-incubator is a space associated with the Faculty of Engineering and it was created within the framework of the Engineering 2030 project in order to enhance the entrepreneurial skills of engineering students. The main objective of the space is to take the students' project ideas and turn them into enterprises. For this reason, its activities are focused on organizing innovation events in order to capture the interest of the students. Given this, the pre-incubator is positioned as a support space for the business mission.

The Lift is staffed by 3 engineers and 1 journalist, all external professionals to the academic staff of the University Católica de Valparaíso. Additionally, a team of mentors with extensive experience in the industry voluntarily participate in the pre-incubator. In 2019, the pre-incubator worked with 25

startups linking students, graduates and entrepreneurs from the community.



Figure 45: The lift pre-incubator and Makerspace at the University Católica de Valparaíso, Source: property of the university.

The evaluation is carried out in an interview with the academic in charge of the space (annex 6), and the following evaluation profile is obtained



Figure 46: Evaluation profile for the dimension of the business mission at The Lift – U. Católica de Valparaíso, Source: own elaboration.

Its overall evaluation is 2.2, showing as main strengths the strategic and emotional dimensions. As in the previous cases, the emotional dimension is favorably impacted by the degree of relationship with the exterior, having the focus on the industry. The degree of performance in the strategic dimension can be explained by the way in which the space is created, following the guidelines of a larger project such as "engineering 2030 project". A point of difference with the incubator of the University of Concepción (case 2), is the evaluation in the technological dimension. In this space, technology is established as a tool to support the generation of innovative solutions, showing a still low performance, but with a view to be enhanced. Regarding the financial dimension, the pattern found in the two previous cases is repeated, showing a low degree of performance resting on the financial structure of the Faculty of Engineering.

The evaluation profile by practices is presented below:



Figure 47: Evaluation profile for practices of the business mission at The lift – U. Católica de Valparaíso, Source: own elaboration.

In general, there is a low level of development, which can be explained by the few years of development of the space. The good performance in the operational strategy reflects the influence of the Engineering 2030 project in the creation of this space. It also shows the clarity

in the space's development plan; as more projects are worked on, the space will increase its performance in the other practices.

According to the person in charge of the space, the diagnosis is a good sample of how the space works currently, and allows confirming the areas identified as points of improvement.

Regarding the recommendations plan, strategy 1 presents a discrete proposal, in which recommendations are proposed for 5 practices distributed among the strategic, physical, social and emotional dimensions. On average, one practice will be improved for each dimension mentioned.

BUSINESS MISSION - EVALUATION BY DIMENSION					
DIMENSION	PRACTICE	PRACTICE EVALUATION	AVERAGE DIMENSION	RECOMMENDATION OPTION 1 AVERAGE DIMENSION	
STRATEGIC DIMENSION	ISP1	5	3,3	NO ACTION	
	ISP2	1		<b>Maturity level 1 to 2</b>	To incorporate physical elements that allow generating and exchanging knowledge among users in a natural way, such as whiteboards, sticky notes, informative posters, reference books, etc
	ISP3	4		NO ACTION	
PHYSICAL DIMENSION	ISP4	1	1,3	<b>Maturity level 1 to 2</b>	To adapt the architectural structure of the innovation space or to partner another innovation space to ensure the availability of at least 2 types of work areas (collaborative activities, manufacturing activities, and/or individual work activities) with a small number of participants (from 3 to 6 people).
	ISP5	1		<b>Maturity level 1 to 2</b>	To acquire basic furniture that is easy to move and allows adapting quickly to individual or group use.
	ISBMP1	2		NO ACTION	
TECHNOLOGICAL DIMENSION	ISP6	2	2,0	NO ACTION	
	ISBMP2	2		NO ACTION	
SOCIAL DIMENSION	ISP8	1	1,5	<b>Maturity level 1 to 2</b>	To promote and develop projects that integrate the community with the activities of the innovation space. To integrate local problems as an axis of experimental and applied work.
	ISBMP4	2		NO ACTION	
	ISP7	5	3,5	NO ACTION	

EMOTIONAL DIMENSION	ISBMP3	2		<b>Maturity level 2 to 3</b>	To define formal incentives associated with public recognition for teachers and students who develop business projects.
COGNITIVE DIMENSION	ISBMP5	2	2,0		NO ACTION
FINANCIAL DIMENSION	ISBMP6	2	2,0		NO ACTION
<b>OVERALL AVERAGE OF ALL DIMENSIONS</b>			<b>2,2</b>		

Table 30: The lift – U. Catolica de Valparaiso improvement plan results. Option 1, dimension average. Source: own elaboration

In contrast, strategy 2 proposes recommendations for 11 of the 14 practices composing the business mission. In that sense, this second option will require efforts in different areas. Under good management, implementing strategy 2 will allow the incubator to increase its overall assessment, strengthening the practices that fall between levels 1 and 2 of the maturity level, thus reducing the gap between the practices assessed at the maximum level (5).

BUSINESS MISSION - OVERALL AVERAGE OF ALL DIMENSIONS					
DIMENSION	PRACTICE	PRACTICE EVALUATION	OVERALL AVERAGE OF ALL DIMENSIONS	RECOMMENDATION OPTION 2 AVERAGE TOTAL SPACE	
STRATEGIC DIMENSION	ISP1	5	2,2	NO ACTION	
	ISP2	1		<b>Maturity level 1 to 2</b>	To incorporate physical elements that allow generating and exchanging knowledge among users in a natural way, such as whiteboards, sticky notes, informative posters, reference books, etc
	ISP3	4		NO ACTION	
PHYSICAL DIMENSION	ISP4	1		<b>Maturity level 1 to 2</b>	To adapt the architectural structure of the innovation space or to partner another innovation space to ensure the availability of at least 2 types of work areas (collaborative activities, manufacturing activities, and/or individual work activities) with a small number of participants (from 3 to 6 people).

	ISP5	1		<b>Maturity level 1 to 2</b>	To acquire basic furniture that is easy to move and allows adapting quickly to individual or group use.	
	ISBMP1	2		<b>Maturity level 2 to 3</b>	To enable at least one own work area that allows the use of computers and internet with the aim of carrying out entrepreneurial and / or technology transfer activities.	
TECHNOLOGICAL DIMENSION	ISP6	2		<b>Maturity level 2 to 3</b>	To acquire at least 2 different types of technology that allow the execution of manufacturing activities and / or usability tests. The choice on technology must respond to the operational objectives of the space.	
	ISBMP2	2		<b>Maturity level 2 to 3</b>	To acquire technological equipment that guarantees the good development of entrepreneurial and research projects from basic to medium development (computers, secure internet network, access to virtual libraries, etc.). To conduct training activities on basic technological vigilance with Internet search engines.	
SOCIAL DIMENSION	ISP8	1		<b>Maturity level 1 to 2</b>	To promote and develop projects that integrate the community with the activities of the innovation space. To integrate local problems as an axis of experimental and applied work.	
	ISBMP4	2		<b>Maturity level 2 to 3</b>	To define protocols and sign collaboration agreements with public and private institutions outside the university that respond to the operational objective of the innovation space.	
EMOTIONAL DIMENSION	ISP7	5		NO ACTION		
	ISBMP3	2		<b>Maturity level 2 to 3</b>	To define formal incentives associated with public recognition for teachers and students who develop business projects.	
COGNITIVE DIMENSION	ISBMP5	2	<b>Maturity level 2 to 3</b>	To carry out training with national or international experts in the development of inventions in conjunction with academia / industry which can be patented, licensed or that allow an academic derivation.		

FINANCIAL DIMENSION	ISBMP6	2	Maturity level 2 to 3	To carry out projects and activities that contemplate a budget that is designated directly to the innovation space for its services, and that complements the resources allocated by the university. To establish an investment plan for R&D from a low to medium scale.

Table 31: The lift – U. Catolica de Valparaiso improvement plan results. Option 2, average total space. Source: own elaboration

The second innovation space is a makerspace that aims to be a collaborative space for the development of creativity and technology based on the "do it yourself" philosophy. A multidisciplinary team is in charge of the space, with 1 commercial engineer, 1 electronic engineer and 1 product design engineer. The innovation space has created a series of programs to integrate students from both the university and nearby educational centers. To date, approximately 5,500 students have participated in different activities and projects. The makerspace had developed 20 R+D+i projects. In this case it is a mixed space, which develops both the entrepreneurial and academic mission.

The evaluation is carried out jointly with one of the makerspace managers. The makerspace evaluation profile is detailed in Annex 7. The result of the evaluation is as follows:

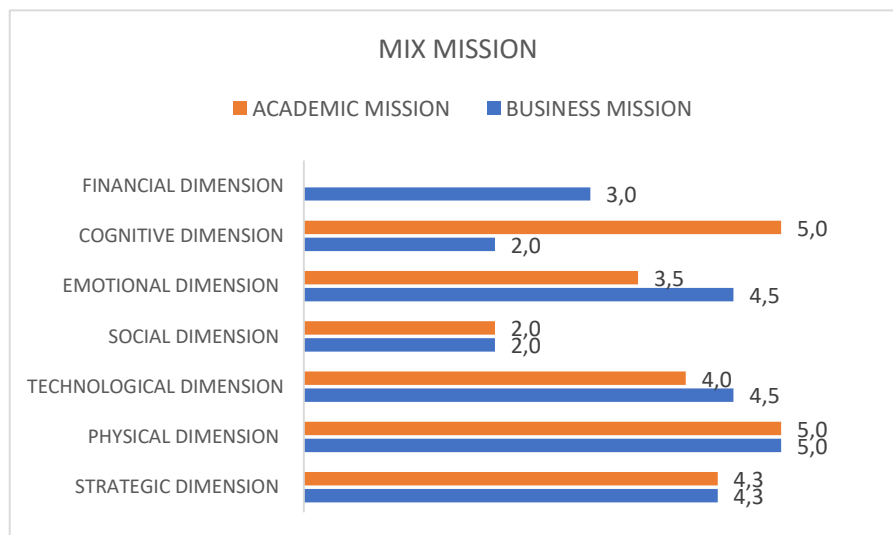


Figure 48: Evaluation profile for the dimension of the Mix mission makerspace at U. Catolica de Valparaiso, Source: own elaboration.

In both missions the space shows a high average performance, with an overall evaluation of 4.0 for the academic mission and 3.6 for the business mission. The pillar of both missions is the physical dimension that has been very important for the development of the activities of the space, receiving visitors. Another strong dimension is the strategic one, the space has clear objectives and the plan to achieve them, showing that the development has been well planned. Given the nature of makerspace, the technological dimension also has an outstanding

performance. On the other hand, the social dimension shows a weaker performance, since the space has been associated only to the closest environment to the University, being a little distant from the rest of the community and the territory. The cognitive dimension shows the highest performance in the academic mission and a low performance in the business mission, which ratifies the emphasis given to the university environment and collaborative learning. This space differs from the other cases in that it has greater autonomy from the associated university, forcing it to better develop the financial dimension in search of economic sustainability. The Makerspace has a good assessment of its maturity level, 80% of the recommendations presented in strategy 1 propose to reach the maximum possible maturity level, increasing from 4 to 5. Only the ISAMP3 practice has a different recommendation, proposing to move from level 2 to level 3 of maturity. In this sense, if the makerspace makes the decision to implement and comply with the recommendations plan proposed in the table 31, it will be able to reach the optimal maturity level in 4 of the 7 dimensions that compose the business mission. And in the case of the academic mission, it will be able to reach the maximum level of maturity in 3 of the 6 dimensions.

MIXED MISSION - EVALUATION BY DIMENSION						
DIMENSION	PRACTICE	ACADEMIC MISSION		BUSINESS MISSION		RECOMMENDATION OPTION 1 AVERAGE DIMENSION
		PE	AD	PE	AD	
STRATEGIC DIMENSION	ISP1	4	4,3	4	4,3	<b>Maturity level 4 to 5</b> To carry out an internal (institutional capacities) and external study (needs and opportunities of the community or environment) to define a strategy for the innovation space operation that is aligned with the university's mission. To involve academic and administrative authorities in the design of the operational plan, the ones responsible for the space and internal work team. To guarantee a budget according to the execution time and objectives of the activities (medium and long term).
	ISP2	5		5		
	ISP3	4	4	<b>Maturity level 4 to 5</b> The person in charge of the space, together with their work team and academic authorities (director or dean), must define KPIs that allow evaluating the execution of activities in a multifactorial way, complementing the strategic plan of the space and allocating resources in the medium and long term.		
PHYSICAL DIMENSION	ISP4	5	5,0	5	5,0	NO ACTION
	ISP5	5		5		NO ACTION
	ISAMP1	5		N/A		NO ACTION
	ISBMP1	N/A		5		NO ACTION
TECHNOLOGICAL DIMENSION	ISP6	4	4,0	4	4,5	<b>Maturity level 4 to 5</b> Based on a study of internal and external needs, responding to the long-term objectives of the IS, to

						acquire high-end technology that benefits the execution of academic projects with the industry. To establish a progressive technology acquisition plan that allows the space to have differentiating equipment as a technological seal of capacity.
	ISAMP2	4		N/A		NO ACTION
	ISBMP2	N/A		5		NO ACTION
SOCIAL DIMENSION	ISP8	2		2		NO ACTION
	ISAMP4	2	2	N/A	2	NO ACTION
	ISBMP4	N/A		2		NO ACTION
EMOTIONAL DIMENSION	ISP7	5		5		NO ACTION
	ISAMP3	2		N/A		<b>Maturity level 2 to 3</b> To evaluate the technical and human competences of students through formal practical activities that benefit the creation of homogeneous teams.
	ISBMP3	N/A	3,5	4	4,5	<b>Maturity level 4 to 5</b> To formalize, together with the university's board of directors, economic incentives and recognition in working hours for teachers who carry out activities associated with the link with companies and ventures. To promote and finance the participation of teachers in training and activities that benefit the relationship with the industry.
COGNITIVE DIMENSION	ISAMP5	5	5,0	N/A	2,0	NO ACTION
	ISBMP5	N/A		2		NO ACTION
FINANCIAL DIMENSION	ISBMP6	N/A		3	3,0	NO ACTION
<b>OVERALL AVERAGE OF ALL DIMENSIONS</b>			<b>4,0</b>		<b>3,6</b>	
PE = PRACTICE EVALUATION AD = AVERAGE DIMENSION N/A = NOT APPLICABLE						

Table 32: Makerspace at U. Catolica de Valparaiso improvement plan results. Option 1, dimension average. Source: own elaboration

Regarding strategy 2, this innovation space presents a particular characteristic in several of its practices. Due to the good evaluation obtained in the dimensions, the Makerspace has a total average of 4.0 for the academic mission and 3.6 for the business mission, which generates a very large gap with the practices evaluated at maturity level 2. In that sense, the recommendation cannot be established for the space to move from level 2 to level 4 directly. As shown in the table 32, the recommendations must be implemented progressively and in this case, even though the level to be reached is level 4, the recommendation will propose the necessary activities to move from level 2 to 3. Once this first plan of recommendations is



fulfilled, the innovation space will be re-evaluated and the corresponding practices will be able to propose recommendations to finally move from level 3 to 4.

MIXED MISSION - OVERALL AVERAGE OF ALL DIMENSIONS						
DIMENSION	PRACTICE	ACADEMIC MISSION		BUSINESS MISSION		RECOMMENDATION OPTION 2 AVERAGE TOTAL SPACE
		PE	OAD	PE	OAD	
STRATEGIC DIMENSION	ISP1	4	4,0	4	3,6	NO ACTION
	ISP2	5		5		NO ACTION
	ISP3	4		4		NO ACTION
PHYSICAL DIMENSION	ISP4	5		5		NO ACTION
	ISP5	5		5		NO ACTION
	ISAMP1	5		N/A		NO ACTION
	ISBMP1	N/A		5		NO ACTION
TECHNOLOGICAL DIMENSION	ISP6	4		4		NO ACTION
	ISAMP2	4		N/A		NO ACTION
	ISBMP2	N/A		5		NO ACTION
SOCIAL DIMENSION	ISP8	2	2	<b>Maturity level 2 to 3</b>	To allow internal and external community actors to access the innovation space, the ones who present problems according to the work axes proposed in the strategic objectives of the space. To promote projects that involve the participation of the community, academia, and industry in its development.	
	ISAMP4	2	N/A	<b>Maturity level 2 to 3</b>	To design and develop socialization activities to promote bonds, empathy, and trust among team members.	
	ISBMP4	N/A	2	<b>Maturity level 2 to 3</b>	To define protocols and sign collaboration agreements with public and private institutions outside the university that respond to the operational objective of the innovation space.	
EMOTIONAL DIMENSION	ISP7	5	5	NO ACTION		
	ISAMP3	2	N/A	<b>Maturity level 2 to 3</b>	To evaluate the technical and human competences of students through formal practical activities that benefit the creation of homogeneous teams.	
	ISBMP3	N/A	4	NO ACTION		
COGNITIVE DIMENSION	ISAMP5	5	N/A	NO ACTION		
	ISBMP5	N/A	2	<b>Maturity level 2 to 3</b>	To carry out training with national or international experts in the development of inventions in conjunction with academia /	

						industry which can be patented, licensed or that allow an academic derivation.
FINANCIAL DIMENSION	ISBMP6	N/A	3		<b>Maturity level 3 to 4</b>	To establish a medium scale investment plan in R&D involving its own financing and that is centralized.
<b>PE = PRACTICE EVALUATION OAD = OVERALL AVERAGE OF ALL DIMENSIONS N/A = NOT APPLICABLE</b>						

Table 33: Makerspace at U. Catolica de Valparaiso improvement plan results. Option 2, average total space. Source: own elaboration

The University Católica de Valparaiso with its two innovation spaces are a clear example of the good results generated by the synergy between different spaces. The incubator and the Makerspace work together complementing each other's worst evaluated dimensions. The benefit most highlighted by the director of the incubator is the possibility of using the physical structure and technological equipment of the Makerspace to support entrepreneurs. For its part, the Makerspace highlights the benefits generated by the relationship with the industry motivated by the entrepreneurship projects developed in the incubator. Thus, a complementary relationship is established between the two innovation spaces that allows optimizing the use of resources and developing ambitious projects for the benefit of users and the community.

#### 5.2.4 Diagnosis 4: University Arturo Prat

In this University, the area of innovation and entrepreneurship is in a stage of growth and it seeks to be developed. About one year ago, the University's innovation and development department was formally created (Figure 49) and within this framework it was decided to redirect an incubator space, reconditioning it into an innovation space for collaborative work with a mainly academic purpose, but still maintaining links with the industry. Currently, the innovation area has 2 industrial engineers, 1 fishery engineer and 1 administrative assistant in its work team. It does not have a defined number of projects in execution, since due to the restructuring it is going through a period of white march that allows structuring a plan

of activities to start managing projects again. In the future, this space seeks to become an innovation center that allows academic activities to be carried out and at the same time to be the source of innovation and entrepreneurship projects to launch on the market.



Figure 49: Innovation Space of the University Arturo Prat, Source: property of the university.

From this perspective, the space is evaluated from a mixed perspective, determining a profile for the academic mission and a profile for the business mission. The evaluation profile of the academic mission shows a relatively homogeneous development.

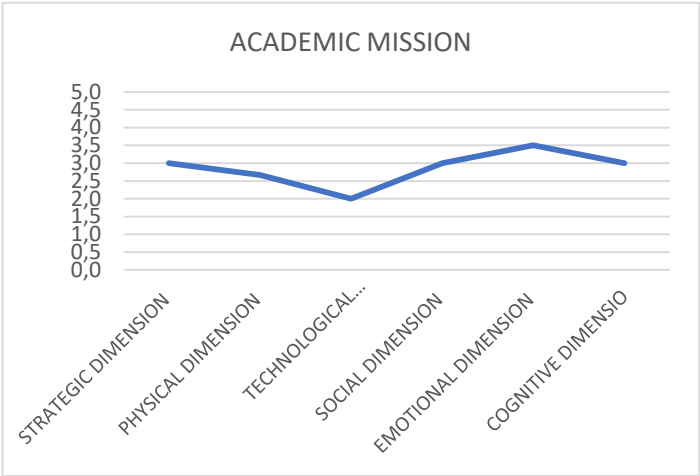


Figure 50: Evaluation profile for the dimension of the Academic mission at ISU. Arturo Prat, Source: own elaboration.

As with the previously evaluated spaces, the emotional dimension shows a good performance, mainly due to the good evaluation of the university-industry relationship. The even level in all dimensions can be explained by the new orientation given to the space, enhancing the support to the academic mission. In addition, this orientation is based on the guidelines given by the innovation and development department, allowing for greater clarity in the space improvement plan. The physical and technological dimensions have a lower degree of maturity mainly due to the short time of operation of the space and will be strengthened as new projects arise and new resources are assigned to the space. The overall evaluation of the space is average with an index of 2.9, showing a good potential for growth.

With respect to the evaluation oriented to the University's business mission, a profile with significant differences between the different dimensions can be appreciated.

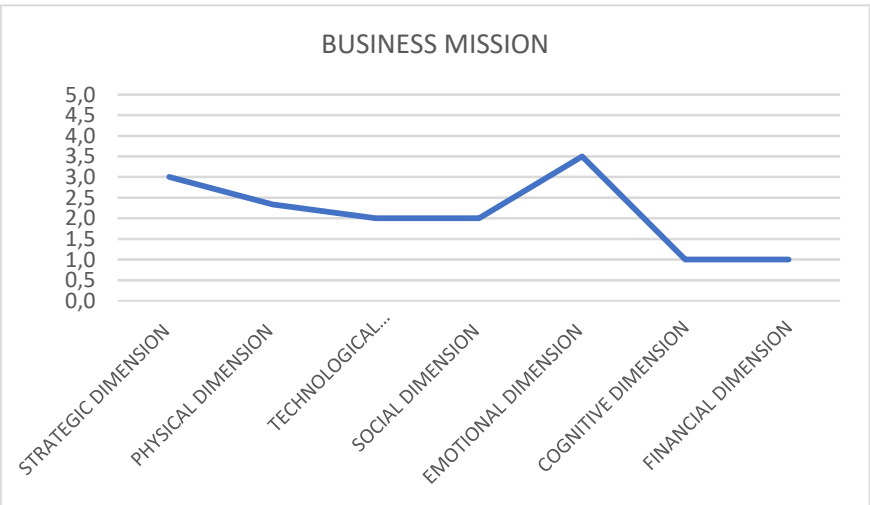


Figure 51: Evaluation profile for the dimension of the Business mission at ISU. Arturo Prat, Source: own elaboration.

The overall assessment for this mission is at a medium-low level with a score of 2.1. The dimensions that show the greatest development are the social dimension, based on the university-industry relationship, and the strategic mission thanks to the guidelines provided by the innovation and development department. On the other hand, it shows two dimensions at the lowest level of maturity, the cognitive and financial dimensions. These two dimensions are not impacted by the development of the academic mission, since in the cognitive dimension there is no knowledge of the market, and in the financial dimension the space is too new and dependent on the innovation department to be able to support itself financially in an autonomous way.

The person in charge of the space believes that the diagnosis obtained reflects in a good way the reality of the space and the orientation they are seeking to give it. In addition, he highlights the usefulness of the tool and the questionnaire as they allow her to understand in greater detail the activities that should be incorporated to achieve the results they have planned to have in the medium and long term.

The plan of recommendations of strategy 1 (Table 33) proposes to impact the best rated dimensions such as strategic, social and emotional to ensure that the practices evaluated in 2 can move up to level 3, achieving a homogeneous performance of these dimensions.

MIXED MISSION - EVALUATION BY DIMENSION						
DIMENSION	PRACTICE	ACADEMIC MISSION		BUSINESS MISSION		RECOMMENDATION OPTION 1 AVERAGE DIMENSION
		PE	AD	PE	AD	
STRATEGIC DIMENSION	ISP1	3	3,0	3	3,0	NO ACTION
	ISP2	4		4		NO ACTION
	ISP3	2	2	<b>Maturity level 2 to 3</b> The person in charge of the space must define an evaluation rubric for each activity to be carried out. This rubric must be defined according to the operational objectives of the innovation space and the characteristics of each project.		
PHYSICAL DIMENSION	ISP4	2	2,7	2	2,3	<b>Maturity level 2 to 3</b> To distribute the available physical space in differentiated areas that allow individual, collaborative, and manufacturing work activities in parallel. To promote open spaces that benefit the adaptability of work areas to guarantee access and comfort for users. To partner with another innovation space that supplies 1 or more services discussed above.
	ISP5	3		3		NO ACTION
	ISAMP1	3		N/A		NO ACTION
	ISBMP1	N/A		2		<b>Maturity level 2 to 3</b> To enable at least one own work area that allows the use of computers and internet with the aim of carrying out entrepreneurial and / or technology transfer activities.

TECHNOLOGICAL DIMENSION	ISP6	2	2,0	2	2	NO ACTION
	ISAMP2	2		N/A		NO ACTION
	ISBMP2	N/A		2		NO ACTION
SOCIAL DIMENSION	ISP8	2	3	2	2	<b>Maturity level 2 to 3</b> To allow internal and external community actors to access the innovation space, the ones who present problems according to the work axes proposed in the strategic objectives of the space. To promote projects that involve the participation of the community, academia, and industry in its development.
	ISAMP4	4		N/A		NO ACTION
	ISBMP4	N/A		2		NO ACTION
EMOTIONAL DIMENSION	ISP7	5	3,5	5	3,5	NO ACTION
	ISAMP3	2		N/A		<b>Maturity level 2 to 3</b> To evaluate the technical and human competences of students through formal practical activities that benefit the creation of homogeneous teams.
	ISBMP3	N/A		2		<b>Maturity level 2 to 3</b> To define formal incentives associated with public recognition for teachers and students who develop business projects.
COGNITIVE DIMENSION	ISAMP5	3	3,0	N/A	1,0	NO ACTION
	ISBMP5	N/A		1		NO ACTION
FINANCIAL DIMENSION	ISBMP6	N/A		1	1,0	NO ACTION
<b>OVERALL AVERAGE OF ALL DIMENSIONS</b>			<b>2,9</b>		<b>2,1</b>	
<b>PE = PRACTICE EVALUATION    AD = AVERAGE DIMENSION    N/A = NOT APPLICABLE</b>						

Table 34: Innovation Space of the University Arturo Prat improvement plan results. Option 1, dimension average. Source: own elaboration

For strategy 2, as a result of the total average obtained, the recommendations for the 2 missions will be between levels 2 and 3, however, this strategy will allow the gap between the business mission and the academic mission to be reduced in its overall evaluation. Under strategy 2 (Table 34), the business mission should implement recommendations in 8 of its 14 practices.

<b>MIXED MISSION - OVERALL AVERAGE OF ALL DIMENSIONS</b>						
DIMENSION	PRACTICE	ACADEMIC MISSION		BUSINESS MISSION		RECOMMENDATION OPTION 2 AVERAGE TOTAL SPACE
		PE	OAD	PE	OAD	
STRATEGIC DIMENSION	ISP1	3	2,9	3	2,1	NO ACTION
	ISP2	4		4		NO ACTION

	ISP3	2		2	<b>Maturity level 2 to 3</b>	The person in charge of the space must define an evaluation rubric for each activity to be carried out. This rubric must be defined according to the operational objectives of the innovation space and the characteristics of each project.
PHYSICAL DIMENSION	ISP4	2		2	<b>Maturity level 2 to 3</b>	To distribute the available physical space in differentiated areas that allow individual, collaborative, and manufacturing work activities in parallel. To promote open spaces that benefit the adaptability of work areas to guarantee access and comfort for users. To partner with another innovation space that supplies 1 or more services discussed above.
	ISP5	3		3	NO ACTION	
	ISAMP1	3		N/A	NO ACTION	
	ISBMP1	N/A		2	<b>Maturity level 2 to 3</b>	To enable at least one own work area that allows the use of computers and internet with the aim of carrying out entrepreneurial and / or technology transfer activities.
	ISP6	2		2	<b>Maturity level 2 to 3</b>	To acquire at least 2 different types of technology that allow the execution of manufacturing activities and / or usability tests. The choice on technology must respond to the operational objectives of the space.
TECHNOLOGICAL DIMENSION	ISAMP2	2		N/A	<b>Maturity level 2 to 3</b>	To define the use of ICT as a basic tool for collaborative work to share files, communicate, debate, etc. To socialize and make presentations that allow publicizing the ICT available and used in the IS.
	ISBMP2	N/A		2	NO ACTION	
	ISP8	2		2	<b>Maturity level 2 to 3</b>	To allow internal and external community actors to access the innovation space, the ones who present problems according to the work axes proposed in the strategic objectives of the space. To promote projects that involve the participation of the community, academia, and industry in its development.
SOCIAL DIMENSION	ISAMP4	4		N/A	NO ACTION	
	ISBMP4	N/A		2	<b>Maturity level 2 to 3</b>	To define protocols and sign collaboration agreements with public and private institutions outside the university that respond to the operational objective of the innovation space.

EMOTIONAL DIMENSION	ISP7	5	5	5	5	NO ACTION	
	ISAMP3	2		N/A		<b>Maturity level 2 to 3</b>	To evaluate the technical and human competences of students through formal practical activities that benefit the creation of homogeneous teams.
	ISBMP3	N/A		2		NO ACTION	
COGNITIVE DIMENSION	ISAMP5	3	3	N/A	3	NO ACTION	
	ISBMP5	N/A		1		<b>Maturity level 1 to 2</b>	To participate in activities that involve industry as a key actor and provide academics with knowledge about ideas that may be commercially valuable (tournaments, challenges, competitions, workshops, open calls).
FINANCIAL DIMENSION	ISBMP6	N/A	N/A	1	1	<b>Maturity level 1 to 2</b>	To establish an investment plan in R&D that responds to the operational objectives of the innovation space, and that is aligned with the budget allocated by the university.
<b>PE = PRACTICE EVALUATION    OAD = OVERALL AVERAGE OF ALL DIMENSIONS    N/A = NOT APPLICABLE</b>							

Table 35: Innovation Space of the University Arturo Prat improvement plan results. Option 2, average total space. Source: own elaboration

Taking into account that the innovation space of the Arturo Prat University is in the process of modification, the person in charge expresses a greater interest in implementing strategy 1. This decision responds to the fact that by having a smaller number of recommendations, it is possible to work on a progressive improvement.

### 5.3 Analysis of the results of diagnostics of the studied innovation spaces

Of the five innovation spaces evaluated, three are mixed, contributing to both missions of the university, while the other two are only intended to contribute to the business mission. An analysis by mission reveals some interesting findings.

Below is a comparative figure (Figure 52) of the evaluation by dimension of the three innovation spaces that contribute to its academic mission:

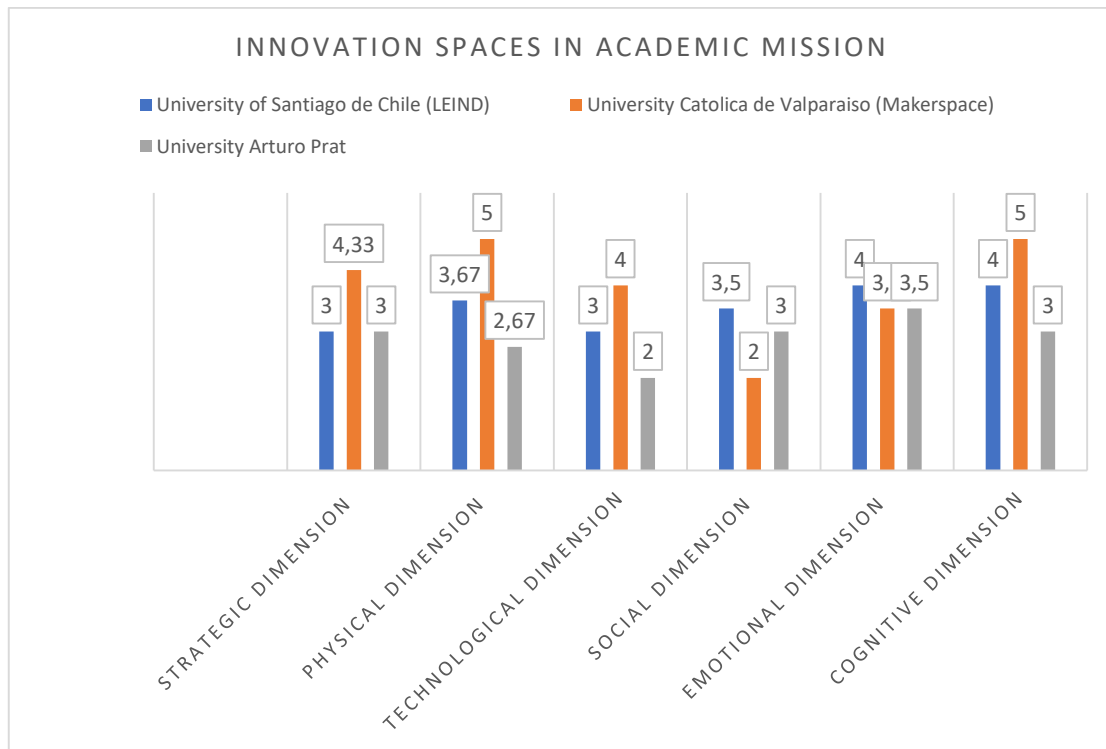


Figure 52: Comparing the evaluation by dimension of the innovation spaces in academic mission, Source: own elaboration

In general, the evaluation profiles in the academic mission show a medium-high global maturity, becoming a real support to collaborative learning. The three spaces integrate academic activities where students have the opportunity to put into practice the knowledge they acquire in their studies. The three spaces show a homogeneous performance among the different dimensions, this can be explained by the fact that the spaces are associated with academics, which means that there is a greater knowledge and experience of how to use it as a space to support learning. Another common characteristic is that the emotional dimension presents a high performance in the three spaces, based mainly on the relationship with the industry, the universities see it as an opportunity to establish contact with the companies from these innovation spaces. These innovation spaces work on the basis of projects applied to companies or in the analysis of case studies of innovative companies. The level of maturity of the physical, technological and cognitive dimensions is closely related to the time of operation of the space, the spaces with a longer trajectory showed a better evaluation in these dimensions. When comparing the evaluation profiles in the dimensions associated with the business mission, greater differences can be appreciated as shown in Figure 53.



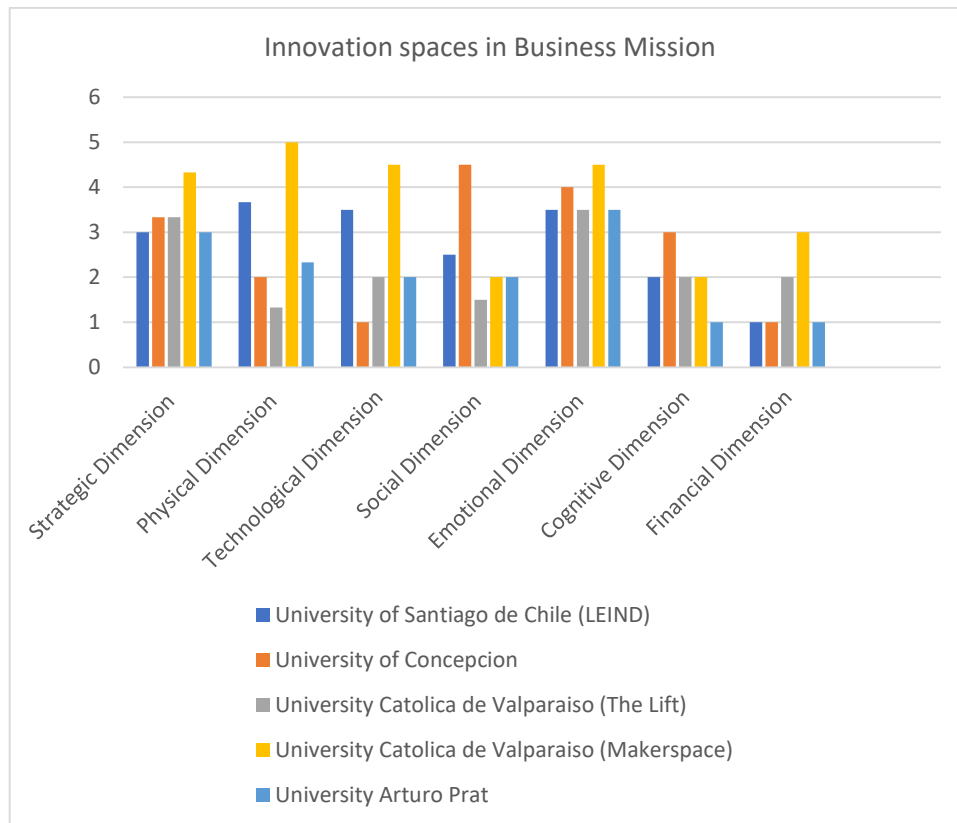


Figure 53: Comparing the evaluation by dimension of the innovation spaces in business mission, Source: own elaboration.

Although the evaluation profiles are heterogeneous, there are some points in common for all the spaces. In the first place, the emotional dimension appears as one of the strong pillars of the innovation spaces evaluated, as in the academic mission, this is explained by the strong university-business relationship that is established in these spaces, motivated in some way by the prestige of the universities. On the other hand, one of the dimensions with a lower degree of maturity is the financial dimension, 4 of the 5 spaces are immersed within the university, which means that they have an economic dependence on the larger unit (Department, Faculty or Vice-Rector), this is confirmed since the only space that shows a medium evaluation in this dimension operates as an external space supporting the university, therefore, it has a financial independence. Finally, the strategic dimension shows a medium or high evaluation in all the spaces, which shows that this type of spaces has a strategic importance for the development of the universities and their implementation is not being left to chance. However, the lack of a guide and the lack of knowledge mean that some decisions regarding this type of spaces continue to be intuitive. The level of maturity reached in the remaining 4 dimensions: physical, technological, emotional and cognitive depends on the orientation given to the space and the type of projects prioritized for development.

#### 5.4 Case study: Tool for evaluating and monitoring a project in the LEIND laboratory

In recent years, the convergence of scientific-technological factors has led to the consolidation of a chain of knowledge that goes from the creation of new scientific knowledge to its application in social and economic fields. In Chile, universities are positioned as the main way

to strengthen scientific production structures, because they are concentrated in much of the results achieved in innovation and development of scientific knowledge, as well as the necessary infrastructure and qualified personnel to the execution of R&D projects. However, one of the limiting factors of scientific development is the low level of investment in research, which limits the number of projects to be developed. As a growth strategy, we have sought to define management methodologies that involve the R&D&I processes and activities, to ensure the success of projects and continuously improve the quality of results.

In this perspective, a project management tool for innovation spaces in universities can be the first step towards consolidating working methodologies that benefit IS management and project development.

To present the proposed management tool, the following project will be taken as a case study: "multidisciplinary collaboration model for the development and implementation of accessible inclusion technologies that benefit the effectiveness of medical procedures in the inclusive rehabilitation of INRPAC patients". This project is developed in the entrepreneurship and innovation laboratory of the University of Santiago's Industrial Engineering Department (LEIND). Its general objective is to develop a collaboration model based on multidisciplinary teams that integrate professionals in the health and engineering area. This collaboration aims at developing of technological solutions applied to the processes of rehabilitation, inclusion, and well-being of people with disabilities that the Pedro Aguirre Cerda National Rehabilitation Institute (INRPAC) assists. INRPAC, the only public rehabilitation center in Chile, is dedicated exclusively to rehabilitation in health conditions of neurological origin. It has a multidisciplinary team of specialized health professionals that positions them as a national reference center in rehabilitation. In turn, their trajectory has allowed them to reflect what is happening at the country level in this area. Being aware of the significant growth that the development of technological solutions applied to health has had worldwide, INRPAC has the "Program of Inclusive Technologies and Alternative Augmentative Communication (TICAA)", which aims to enhance the processes of socio-educational and/or labor participation through the use of technology. The TICAA program has a disadvantage; the human resource that makes it up is 100% directed to the medical field, that is, there are no engineers or technicians to facilitate the materialization of the technical aids that are required in the Institute.

Thus, the project has two key actors: on one hand, INRPAC is the beneficiary entity of the solution, and in turn the TICAA seeks to establish a collaborative work project where professionals in the area of engineering participate in the materialization of technological aids. On the other hand, there is the University of Santiago and the innovation laboratory LEIND on its behalf, which will develop the project to deliver a solution that benefits both INRPAC and the university, generating new knowledge that has an impact on society.

Figure 54 shows the steps to be followed to develop the project using the management tool proposed in Chapter 3:

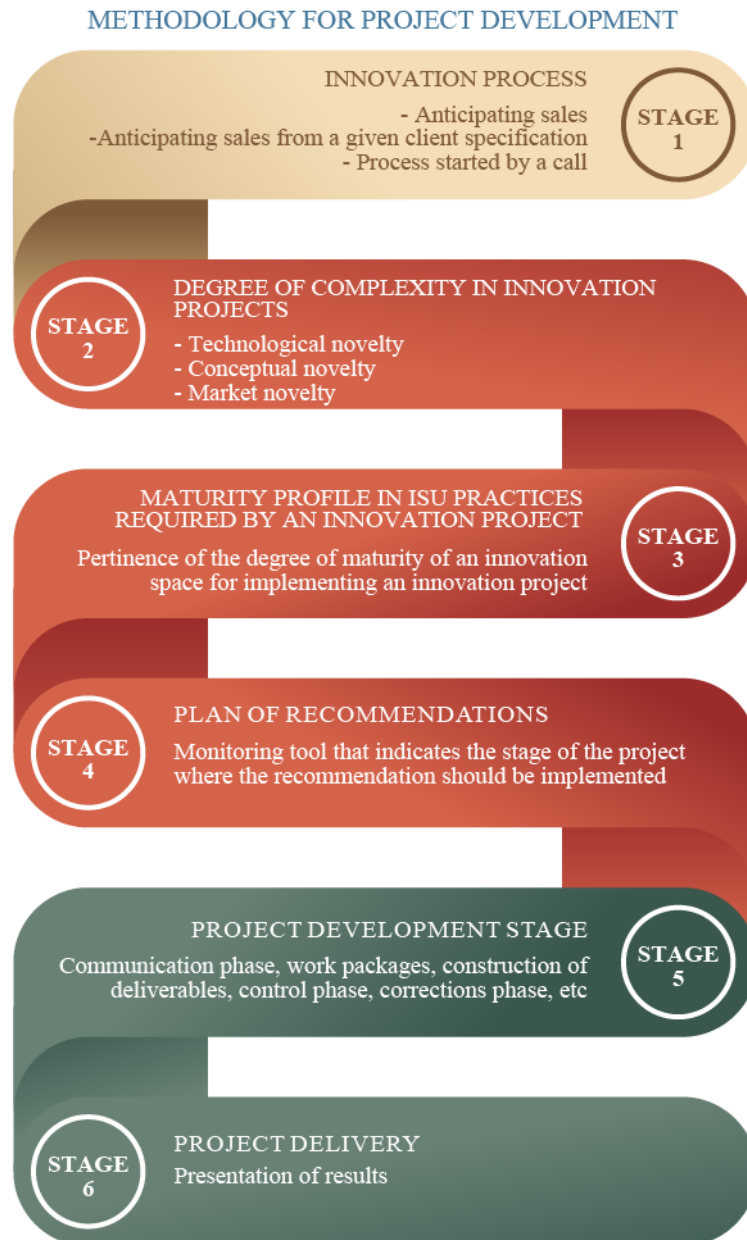


Figure 54: Methodology for Project development at ISU, Source: our research.

**Stage 1.** To analyze the general project characteristics to define the type of innovation process that best suits its development.

**Stage 2.** To analyze the objectives established for the project in order to establish its degree of complexity through the project requirement matrix.

**Stage 3.** To compare the result of the IS maturity evaluation with the requirement level of the project, to identify IS practices that are not mature enough to support project activities. The result of the comparison will allow establishing the IS pertinence to carry out the project (the greater the number of practices with the required level, the greater the pertinence to develop the project) and will determine the recommendations that are necessary for the practices that do not manage to obtain the level needed.

**Stage 4.** Based on the evaluation of the project pertinence, a series of recommendations are proposed that must be implemented in the corresponding stages of the process, validating the correct maturity degree of the IS prior to the beginning of the development stage of the process.

**Stage 5.** Once the recommendations have been implemented and validated, the project should move on to the development stage. It is expected that the execution of activities in this stage will consolidate the improvement of the practices that obtained recommendations previously.

**Stage 6.** As the last stage, the project should be delivered for finalization. At this point, the fulfillment of the project objectives will allow validating if there was an improvement in the management and use of resources, positively impacting the dynamics of the innovation space. This structure will allow presenting the project management tool with the real process that was carried out in the LEIND laboratory.

**5.4.1 Innovation Process**

As mentioned above, the project arises from the need of INRPAC to establish a strategic alliance with the LEIND laboratory in order to implement the technical aids that have arisen from the TICAA medical team. In that sense, it is considered that the ‘client’ does not present defined specifications, so the objectives of the project will be built in conjunction with the LEIND laboratory. The project management process that establishes a stage where the idea of innovation is built with the client, and there is a period of maturation of the idea is called *anticipating sales: the tailor-made approach (open order)*.

INNOVATION PROCESS		
Anticipating sales: the tailor-made approach (open order)	Initial ideas proposed and worked with client	X
Anticipating sales from a given client specification (closed order)	Initial ideas/ Specifications by the client	
Process started by a call	Predevelopment/ Elaboration of a project to dispute the call	

Figure 55: Innovation process parameters. Source: own elaboration.

This process proposes the construction of the project and the idea of innovation on request, that is, a general problem is identified, which in this case is to be able to combine the medical team of TICAA with the development team of LEIND to generate technological products to support rehabilitation. However, the specifications of these technological developments and the work methodologies are not pre-established, so the construction stage of the innovation idea is established to define these requirements clearly (See Figure 32, Chapter 3).

**5.4.2 Degree of complexity in innovation projects**

Even without having defined the technical specifications of the products that are expected to be realized in the project, the specific objectives proposed by the client (INRPAC) allow an evaluation of the project complexity. Thus, the specific objectives proposed in the project framework are the following:

- To establish the structure and modalities of multidisciplinary collaboration between INRPAC, and USACH (Faculty of Engineering, Faculty of Medicine, School of Psychology).
- To design and manufacture two solutions with technological development jointly between INRPAC professionals and the USACH.
- To implement and evaluate the impact of the two proposed technological solutions and capitalize on the knowledge acquired by formalizing the process of collaboration among institutions.
- To carry out technology transfer activities supporting the autonomous development of technologies developed at INRPAC.

The total project development time is 22 months between March 3, 2020, and January 30, 2022. Table 36 presents the criteria defined in Chapter 3 to categorize the project according to its degree and type of novelty.

TECHNOLOGICAL NOVELTY		CONCEPT NOVELTY	
MEDIUM		MEDIUM	
Incremental innovation	✓	Incremental innovation	✓
- Improvement of existing products	✓	- Medium innovation degree	X
- Design improvement	✓	- Process improvement.	✓
- Material improvement	X	- Improvement of techniques	✓
- Machinery development	X	- Improvement of services.	✓
- New features.	✓	- Introduction of modern techniques	✓
- New components.	✓	- New features	✓
- Development time of 1-3 years	✓	- Development time of 1- 3 Years	✓
- Use of external knowledge and resources	✓	- Use of external knowledge and resources	✓
- It includes R&D projects in partnership with other ISs	✓	- It includes R&D projects in partnership with other ISs	✓

Table 36: Criteria degree and type of novelty of the innovation project. Source: own elaboration.

As presented in Table 36, the project has a component of technological novelty of medium degree, considered so because the development time is greater than 12 months, but not more than 36 months; under this time parameter, it is expected to adjust existing products to adapt them to people with disabilities, that is, the development will involve the improvement of existing products and designs, incorporating new functions or components. In the same way, the LEIND will make use of knowledge external to the laboratory, integrating teachers and students of the occupational therapy program into the team.

Additionally, the project considers a component of concept novelty of medium degree, by integrating knowledge transfer and a new way of addressing medical challenges from engineering. The main objective is to establish a collaborative and multidisciplinary work protocol between INRPAC and USACH. These two institutions will participate in different stages of the process, incorporating new techniques that improve the TICA process in terms of the service they provide to their patients and, in turn, generate valuable knowledge to encourage applied research in the LEIND laboratory.

Finally, the project does not consider objectives associated with market novelty, being a project with a strong social component, no aspect associated with a possible commercialization is

integrated, in this stage of 2 years of development it is only considered that INRPAC acquires sufficient knowledge to manufacture the products that are developed autonomously, this is considered as a process improvement, but not as a development from the market point of view. Once the degree of complexity of the project has been established, it is evaluated in the complexity matrix developed in Chapter 3. Figure 42 presents the level of maturity that the LEIND innovation space must guarantee in order to execute the project.

DEGREE OF COMPLEXITY IN INNOVATION PROJECTS INRPAC - LEIND														OVERALL PROJECT REQUIREMENT LEVEL
MIXED MISSION		NEW TECHNOLOGY				NEW CONCEPT				NEW ON THE MARKET				
DIMENSION	PRACTICE	LOW	MEDIUM	HIGH	LEVEL OF DEMAND TECHNOLOGICAL FACTOR	LOW	MEDIUM	HIGH	LEVEL OF DEMAND CONCEPT FACTOR	LOW	MEDIUM	HIGH	LEVEL OF DEMAND MARKET FACTOR	
			X				X							
STRATEGIC DIMENSION	Performance and projection (ISP1)	2	3	4	3	2	2	3	2	1	1	1	NO EVALUATION	3
	Tangible institutional resources (ISP2)	2	3	4	3	2	2	3	2	2	2	2	NO EVALUATION	3
	Innovation performance (ISP3)	2	3	4	3	2	3	4	3	2	3	4	NO EVALUATION	3
PHYSICAL DIMENSION	Structure & Architecture (ISP4)	2	3	3	3	2	2	3	2	2	2	2	NO EVALUATION	3
	Interior design (ISP5)	1	2	2	2	1	2	3	2	1	2	2	NO EVALUATION	2
	Collaborative learning environments (ISAMP1)	2	2	3	2	1	3	4	3	1	1	2	NO EVALUATION	3
TECHNOLOGICAL DIMENSION	Business linkage environments (ISBMP1)	1	3	4	3	2	2	3	2	1	2	2	NO EVALUATION	3
	Manufacturing and communication (ISP6)	2	3	4	3	2	2	3	2	2	2	3	NO EVALUATION	3
	ICT for collaborative learning (ISAMP2)	2	3	2	3	2	2	3	2	2	2	3	NO EVALUATION	3
SOCIAL DIMENSION	Technological infrastructure for R+D+I+e (ISBMP2)	2	3	4	3	2	2	3	2	2	3	3	NO EVALUATION	3
	Social and cultural influence (ISP8)	2	3	3	3	2	2	3	2	2	2	3	NO EVALUATION	3
	Team relations (ISAMP4)	2	2	2	2	2	2	3	2	2	3	4	NO EVALUATION	2
EMOTIONAL DIMENSION	Networking (ISBMP4)	2	2	3	2	2	2	3	2	2	2	3	NO EVALUATION	2
	Interaction and community (ISP7)	1	2	2	2	1	1	2	1	1	2	2	NO EVALUATION	2
	Team engagement (ISAMP3)	1	2	3	2	1	2	3	2	1	2	3	NO EVALUATION	2
COGNITIVE DIMENSION	Academic and commercial interests (ISBMP3)	2	2	3	2	2	2	3	2	2	3	4	NO EVALUATION	2
	Knowledge transfer (ISAMP5)	2	2	2	2	2	2	3	2	2	2	2	NO EVALUATION	2
FINANCIAL DIMENSION	Business and industry knowledge (ISBMP5)	2	2	3	2	2	3	4	3	2	2	3	NO EVALUATION	3
	R&D spending (ISBMP6)	2	3	4	3	1	2	3	2	1	2	2	NO EVALUATION	3

Figure 56: Degree of complexity in innovation project INRPAC - LEIND. Source: own elaboration.

In this case, the LEIND innovation space must ensure a maturity level between 2 and 3 in its practices. Consequently, practices that do not meet the required level must implement the corresponding recommendation as appropriate.

### 5.4.3 Maturity profile of ISU practices required by an innovation project

Once the project is characterized according to the degree and type of novelty that involves the definition of its objectives, *The stage-made approach (open order)/Stage-Gate* is executed. Here, the maturity of the innovation space is evaluated against the project requirement level to establish the relevance and possible recommendations that the IS must implement to better execute the project.

The next step is to make a comparison between the results obtained from the maturity evaluation of the LEIND and the requirement matrix established for a project with a degree of medium technological novelty and a novelty degree of medium concept (required level of the project). Through this comparison, the IS practices that do not meet the requirement degree defined for the project will be identified (understanding that the requirement matrix is based on the same IS practices). Subsequently, the necessary recommendations are proposed to reach the level that is required (Table 37).

MIXED MISSION				
DIMENSION	PRACTICE	EIS	OPRL	RECOMMENDATION PROJECT
STRATEGIC DIMENSION	ISP1	3	3	NO ACTION
	ISP2	4	3	NO ACTION
	ISP3	2	3	<b>Maturity level 2 to 3</b> The person in charge of the space must define an evaluation rubric for each activity to be carried out. This rubric must be defined according to the operational objectives of the innovation space and the characteristics of each project.
PHYSICAL DIMENSION	ISP4	3	3	NO ACTION
	ISP5	4	2	NO ACTION
	ISAMP1	4	3	NO ACTION
	ISBMP1	4	3	NO ACTION
TECHNOLOGICAL DIMENSION	ISP6	4	3	NO ACTION
	ISAMP2	2	3	<b>Maturity level 2 to 3</b> To define the use of ICT as a basic tool for collaborative work to share files, communicate, debate, etc. To socialize and make presentations that allow publicizing the ICT available and used in the IS.
	ISBMP2	3	3	NO ACTION
SOCIAL DIMENSION	ISP8	3	3	NO ACTION
	ISAMP4	4	2	NO ACTION
	ISBMP4	2	2	NO ACTION
EMOTIONAL DIMENSION	ISP7	5	2	NO ACTION
	ISAMP3	3	2	NO ACTION
	ISBMP3	2	2	NO ACTION
COGNITIVE DIMENSION	ISAMP5	4	2	NO ACTION
	ISBMP5	2	3	<b>Maturity level 2 to 3</b> To carry out training with national or international experts in the development of inventions in conjunction with academia / industry which can be patented, licensed or that allow an academic derivation.
FINANCIAL DIMENSION	ISBMP6	1	3	<b>Maturity level 1 to 2</b> To establish an investment plan in R&D that responds to the operational objectives of the innovation space, and that is aligned with the budget allocated by the university.

**EIS** = EVALUATION OF INNOVATION SPACE      **OPRL** = OVERALL PROJECT REQUIREMENT LEVEL

Table 37: Plan of recommendations for the LEIND against INRPAC project. Source: own elaboration

The level of pertinence to carry out the project is established from the number of practices that meet the level required by the requirement matrix. In other words, the greater the number of practices that meet the requirement level, the greater the pertinence to develop the project. The reason is based on the fact that a high number of recommendations to be implemented will require a significant effort from the IS prior to the assignment of the project.

Continuing with the case study, the LEIND is considered an innovation space with a mixed mission, so the pertinence evaluation is carried out on the 19 practices that define its operation. Table 38 presents the maturity degree of the IS in each of its dimensions and then the requirement level defined for a project of technological novelty and medium concept.

The evaluation allows defining that the IS does not manage to have sufficient maturity to carry out the project without implementing recommendations. The result defines that the LEIND does not reach sufficient maturity in 4 of the 19 practices, therefore, it is established that the IS must implement the recommendations that correspond to the 4 practices to reach the required level and develop the project in a better way. With the premise of the Stage-Gate methodology, at this point the first decision must be made whether or not the project is admitted to open door '0' and allow its advancement to stage '1'.

Analyzing the results, it is established that the project is 'admissible', based on the fact that only recommendations were established for 4 of the 19 practices evaluated (minority), from which 3 require progressing a single level (going from level 2 to 3) and only the practice that corresponds to the financial dimension must advance 2 levels from level 1 to 3, which will require a greater effort, but is not considered decisive to reject the project. Therefore, the relevance of the IS to develop the project is validated and door '0' is opened with the warning and commitment to implement the recommendations in stage 1 and 2 of the process.

#### 5.4.4 Plan of recommendations

In the anticipating sales: the tailor-made approach (open order) process, it is established that in stage 1 of the Stage-Gate the idea of innovation must mature. That is, it is at this stage where the type of innovation requirements that will be developed in the project are defined. In parallel, the recommendations generated for the strategic, social, emotional, and cognitive dimension must be implemented.

For the case study, the social and emotional dimensions do not involve any recommendation (Table 38), so the improvements will be implemented in the strategic and cognitive dimension to obtain the required level. The proposed recommendations are:

**Strategic Dimension:** the activities carried out in the project must be measured through an evaluation rubric that defines criteria according to the objectives that strengthen the mission of the IS (generation of knowledge, research, link with the environment). The results should be considered as an input to support the continuous improvement of the activities and processes developed in the IS.

**Cognitive Dimension:** the project must define the participation of human resources in trainings as a key activity according to the developing theme, reducing the cognitive and cultural gap between academic and industrial human resources. Time and resources should be established for training with experts in user-centered methodologies.

Thus, the next step is the development of stage 1 of the Stage-Gate. Meetings were held between INRPAC and LEIND to define the project parameters to be developed (specification book). Through meetings, consensus was reached to develop an adapted Mouse as the first technical help (Figure 57).



Figure 57: Adapted Mouse, Source: own elaboration.



The main motivation is to obtain an object used in the daily life of people, which benefits access to computers for children and adults in work, academic, and social contexts. As a second technical aid, the development of adapted pushbuttons (Figure 58) that allow to turn on and off toys or electronic elements was validated, seeking to provide autonomy to users in daily activities.



Figure 58: Adapted Pushbuttons, Source: own elaboration.

The main objective of these two objects is to rehabilitate and develop the physical and cognitive abilities of patients, through frequent use of them.

Methodologically, it is defined that the project will combine three types of agile methodologies as a basis for the construction of technical aids and the collaborative model:

**Scrum:** it will give the structure and order of work through listing and organization of meetings with designation of daily tasks.

**Intermediary object:** through the participation of a multidisciplinary work team, it will benefit the creation of designs through experts in the area allowing standardization, communication, and development of knowledge.

**Lean Start Up:** in the prototyping process, it will set the parameters for testing, iterations, and improvements.

Under these parameters, the implementation of recommendations is integrated into the project as follows.

#### **Strategic dimension:**

- to establish in the project evaluation rubrics for monitoring the progress of the innovation process based on the proposed methodologies,
- To define evaluation standards for the products and for the processes to be carried out,
- To propose activities that benefit the obtaining of indicators in terms of knowledge generation and research, such as:
  - o The integration of students in the development processes as a strategy to generate applied knowledge (scholarships and internships).
  - o Supporting the research by integrating students who develop their degree thesis or scientific publications under the themes of the project (research metrics).

#### **Cognitive dimension:**

- To define an initial stage in the project to train teachers and students involved in the development, delivering tools for a better use of the proposed methodologies Scrum, Lean Start Up and Intermediate Object,
- To establish a training of the entire team involved in the project with the USACH technology transfer office to know policies of product certification and patenting.

Under the definition of these parameters, the level required by the IS in the two practices that presented recommendations is validated. Validation is done using the IS maturity grid. In that sense, if it is considered to have reached the level required by the project, gate 1 is opened and the advance to stage 2 of the Stage-Gate is allowed.

For the strategic dimension, it is considered to have reached the required maturity degree, since the integration of evaluation guidelines in the development of the project will allow objectively measuring the results and contributions of the project in the IS. The project integrates both technical evaluation criteria to measure the quality of the products to be developed, as productive to measure the efficiency of the working groups and the good integration among the different disciplines (through periodic meetings).

<b>VALIDATION OF THE RECOMMENDATION IN THE STRATEGIC DIMENSION</b>		
<b>REQUIRED LEVEL</b>	<b>VALIDATION</b>	<b>STATUS FINAL</b>
The result of the activities carried out in the innovation space is measured with the support of an evaluation rubric, defining the criteria that support the fulfillment of the objectives of the space.	YES	GO
	NO	STOP

Figure 59: Validation of the recommendation in the Strategic Dimension, Source: own elaboration.

Regarding the cognitive dimension, the LEIND has placed special emphasis on the knowledge generation that will arise during the project development. The aim is to strengthen the industrial profile of USACH teachers and students. Therefore, the proposal defines activities and budget for training with experts who contribute not only to the development of the project, but also to the strengthening of human resources. This new knowledge generated is considered as an intangible result that will remain in the IS once the project is finished. Consequently, the level required for the cognitive dimension is validated.

<b>VALIDATION OF THE RECOMMENDATION IN THE COGNITIVE DIMENSION</b>		
<b>REQUIRED LEVEL</b>	<b>VALIDATION</b>	<b>STATUS FINAL</b>
The innovation space establishes periodic training to strengthen the commercial and industrial knowledge of the environment in a technological and scientific context.	YES	GO
	NO	STOP

Figure 60: Validation of the recommendation in the Cognitive Dimension, Source: own elaboration.

Both technical specifications and recommendations are formalized in the project proposal where execution time, responsible agent, deliverables, and resources are assigned. Once the recommendations of the practices in the strategic and cognitive dimensions have been validated, the progress of the project to stage 2 of the Stage-Gate is authorized, where the negotiation and subsequent signing of the contract are initiated.

As established by the proposed methodology for the monitoring of projects in an IS, in stage 2 of the Stage-Gate the recommendations for the Physical, Technological, and Financial dimensions must be implemented. For the case study, the following recommendations were defined:

**Technological Dimension:** The innovation space must support the learning process through the use of ICT tools, benefitting the use of technological platforms so that the different actors of the project can share files, communicate, debate, and collaborate in different teams.

**Financial Dimension:** The innovation space sets a mixed budget for R&D investments proportional to the type and degree of innovation to be developed. Low and medium scale level of investment.

At this stage, the specifications of the project have already been defined and negotiations are entered with the client to reach a consensus that allows the signing of the contract. In this sense, the recommendations that are applied in this point must guarantee the maturity of the space to carry out the activities presented in the proposal. Thus, the implementation of the recommendations is guaranteed as follows:

**Technological dimension:** the use of ICT in the planning and development process of the project is established as a fundamental tool, mainly in the stage of creation and dissemination of the intermediary object. The physical distance between INRPAC and LEIND as well as the difficulty in coordinating the schedules of these institutions (INRPAC = HR shift work / LEIND = Students and teachers with different class schedules) promotes the use of ICT to benefit remote work seeking the optimization of time, and improving communication and the constant flow of information. Establishing a virtual information platform will allow both the INRPAC and LEIND teams to access information remotely at a time that is necessary and relevant to each team member. The new use of this information technology will allow the development of the ability to perform remote work in the LEIND as a natural activity, expanding its range of action to future projects that are proposed in different cities or countries.

**Financial dimension:** a mixed budget is established for the development of the project in which the university receives the resources allocated annually for the operation of the IS, and the hiring of the fixed HR (3 people). For its part, the project defines the allocation of resources to the LEIND to be used to finance the activities of teaching, research, and extension that involve the participation of actors from the community, the public world and/or the productive sector. In this context, the budget is established according to the development of two years, which will allow the payment of the activities established to meet the objectives of R&D concretely.

Finally, we proceed to validate whether the practices that received recommendation in the technological and financial dimensions meet the maturity requirement established by the project complexity. If the project is validated, it would be waiting for the signing of the contract to open gate 2 and authorize the advance to the development stage.

In this sense, for the technological dimension, it is considered to have reached the required maturity degree, since a remote planning of activities based on the use of virtual communication platforms will guarantee the use of resources, tools, equipment, computer programs, applications, networks, and media remotely. The use of ICT in the project will allow strengthening the activities of work and collaborative learning at a distance. In fact, the development of the first project stages were carried out virtually, the Covid 19 pandemic that began at the end of 2019 forced to strengthen teleworking, which was a strength for the project in the sense that the use of ICT was considered so as not to interrupt the planned activities.

<b>VALIDATION OF THE RECOMMENDATION IN THE TECHNOLOGICAL DIMENSION</b>		
<b>REQUIRED LEVEL</b>	<b>VALIDATION</b>	<b>STATUS FINAL</b>
The innovation space supports the collaborative learning process with ICT tools that allow users of the space to share files, communicate, debate, and collaborate in different teams through a technological platform	YES	GO
	NO	STOP

Figure 61: Validation of the recommendation in the Technological Dimension, Source: own elaboration.

As mentioned previously for the financial dimension, implementing recommendations requires a greater effort, since it must advance in 2 levels. To achieve this objective, it is made available to the project human and technological resources valued as a contribution of the IS (university budget), on the other hand, it is established in the budget of the project the direct allocation of resources to the LEIND to strengthen activities of teaching, research, and extension with community actors. When talking about financial resources that are directly linked to the type of project and that can hardly be standardized, it is the responsibility of the IS manager to validate whether the maturity degree is reached in the corresponding practice or not. In the case study, the decision is based in the activities proposed for the project and the financial projection that these require. The manager of the LEIND considers 'valid' the obtaining of the maturity level. However, the financial dimension is established as a critical aspect of the project. Understanding that R&D spending must be in constant observation and monitoring during the development stage, since having limited resources it has a low range of action in terms of expenses that have not been defined in the proposal that will be signed with the client.

<b>VALIDATION OF THE RECOMMENDATION IN THE FINANCIAL DIMENSION</b>		
<b>REQUIRED LEVEL</b>	<b>VALIDATION</b>	<b>STATUS FINAL</b>
The innovation space has a mixed budget for R&D investments. Part of the resources are centralized by the university and the other part respond to its own projects that are in execution. Low and medium scale level of investment.	YES	GO
	NO	STOP

Figure 62: Validation of the recommendation in the Financial Dimension, Source: own elaboration.

At this point, it is considered that the IS has sufficient maturity to manage the project "multidisciplinary collaboration model for the development and implementation of accessible inclusion technologies that benefit the effectiveness of medical procedures in the inclusive rehabilitation of INRPAC patients" in an optimal way.

The follow-up and recommendations tool has a direct impact on the stages preceding the project development stage. The objective is to strengthen the innovation space through the recommendations generated, guaranteeing the availability of resources demanded by the type of project. In this case, the LEIND laboratory complied with the 4 recommendations previously

identified. Consequently, once the recommendations are implemented and validated, the work of the tool is completed and the proposal is presented to the client. Finally, the validation of the proposal by the client allows the signature of the contract opening gate 2 of the Stage-Gate. Thus, the project advances to the “Development Stage”. During the implementation of the proposal (development stage) both the project and the innovation space will benefit from the previous implementation of recommendations. It is expected that the results of the project will reflect the maturity of the innovation space in the optimal fulfillment of the objectives.

#### **5.4.5 Project development stage**

The monitoring and recommendations tool was designed to support the first stages of the projects in which the optimal conditions of the innovation space for the management of a project must be planned and guaranteed. Once the contract is signed, the project will start to be executed and it is there where the previously implemented recommendations are expected to add value to the development of the project in terms of optimizing resources and improving results.

For this case study the process of development, preparation, evaluation, and delivery of a Technical Aid (TA) includes several stages. It starts by the organization with the team of the TICAA program of INRPAC for the survey of the needs and requirements, to the evaluation and testing of the product that allows providing feedback with improvement objectives.

To make good use of the resources and time allocated to the project, it is important that all members share the same goal and work flexibly, having as a common objective the manufacture of a product that has a positive impact on INRPAC. The benefit of establishing a motivation shared by the two institutions will have a direct impact on both good development of the project and practices that are part of the emotional dimension of IS. On the other hand, as a support to the exchange of ideas and activities that benefit synergy among organizations, the practices of the social dimension will establish the way to increase collaboration and communication among all project participants. The main objective of the project is to promote a collaboration agreement between the two institutions, which benefits bilaterally the rehabilitation processes of INRPAC, and the teaching, research, and innovation activities of USACH.

The first step of the development stage is to connect the two institutions (USACH and INRPAC) with the needs of the project. For this, a first meeting is held in which the requirements are defined, and the specifications of the technical aids to be developed are detailed, establishing as the basis of the development the user needs.

Under this criterion, it is defined to carry out a minimum of 2 technical aids using 3D printing according to the needs of INRPAC and the capabilities of the team members (professionals, academics, and students).

The following specifications are established for the development of the project's products:

1. Technical aids should be effective in carrying out day-to-day tasks.
2. It must be adapted to be used in different environments and physical conditions.
3. They must be easily transportable.
4. When used, they must be safe and resistant.
5. The instructions to use them should be easy to understand depending on the capabilities of the user.
6. Simple maintenance and replacement arrangement.

In conclusion, the design and manufacture of technical aids must contemplate favorable standards of design, efficiency, safety, durability, usefulness, and accessibility in relation to the environment of use. Ensuring a high degree of user satisfaction through the safety and comfort of the product.

Once the general specifications of the products to be developed have been discussed and approved, the technical aids that will be designed and manufactured are defined. The choice is made consensually between the two institutions, based on the experience of the INRPAC medical team and the needs of its patients. As a result, it is proposed that the first development is an adapted Mouse and the second development is an on and off button.

Both in the definition of general specifications of the project, and in the choice of the two technical aids, a great impact is generated in the emotional and social dimensions of the IS. In the same way, the strategic dimension is impacted since the guidelines that direct the decisions from the perspective of the IS must be aligned with the operational objectives and the distinctive seal that both the university and the IS have.

The next step is to define the methodologies that will guide the development process by assigning activities and roles to each actor in the project. A combination of agile methodologies with a constructive approach is proposed as follows:

**Scrum methodology:** it will be used to organize the activities of each team through a list of priorities. The methodology will benefit the monitoring of activities through the definition of meetings, where the team must present the designated tasks, receiving feedback from different professional criteria. Favoring continuous improvement through repetition in each cycle or sprint. The expected benefit of the methodology is to ensure that the recommendations are implemented in a good way, increasing the value of the final deliverable product.

**Intermediate object:** will be used to reinforce the design process by making a digital model of the object that will be subsequently evaluated through team meetings. The objective of the evaluation is to progressively improve the characteristics of the developed objects. Therefore, mediation will be used through team interaction (multidisciplinary) to advance the design of the object from an (analog) drawing to a 3D digital model.

**Lean Start Up Methodology:** it will be used to strengthen the process of learning, validation, and experimentation of each design. The methodology will allow the product to be iterated in short cycles, obtaining feedback from the different teams, especially INRPAC, giving them spatial importance since they are the ones who know the real needs of their users. The goal is to get the maximum value from the product by meeting the needs of users and using the minimum number of resources. The strategy is to validate each design digitally before manufacturing it, trying to eliminate bad manufacturing practices.

Finally, we proceed to model the process of construction of the adapted objects through the application of the proposed hybrid methodology. A total of 8 stages were planned in the process of making the adapted mouse, which were replicated for the adapted button. Below is a summary of the stages that were present in the preparation of both technical aids:

**Stage 1:** the objective is to define the technical characteristics of each product, in this part all the actors involved in the project participate, and the decisions are based on responding to the requirements delivered by INRPAC.

**Stage 1.1:** the technical and functional requirements are defined, the ones that the technical aids must have in order to meet their functional objective.

**Stage 1.2:** the materials and resources available for the development and preparation of technical aids are determined.

**Stage 2:** a process of research and analysis of existing products on the market is carried out, ones that resemble the interests and requirements agreed by the 'Benchmarking' team. The objective is to establish benchmarks, in order to compare the existing development, identify weak points, propose improvements to those weak aspects, and present a new design that meets a high standard of functionality. In this stage, both the management team (Industrial Engineers, designers, occupational therapists) and the development team (Designers, Occupational Therapists) from USACH participate; allowing each member to deliver suggestions and/or comments from their experience and knowledge.

**Stage 3:** the beginning of the ideation process of the first technical aid prototype through creativity sessions. The objective is to comply with the requirements delivered by INRPAC (based on the needs of patients), integrating the information collected in the previous stages and the knowledge of each member of the management and development teams. Finally, the characteristics to be met by the technical aid for this particular project are defined:

- Intuitive operation, easy to use and integration into the patient's routine and their environment.
- Ergonomic design.
- Adaptable to different contexts and physical environments.
- Affordable price.
- Safe and resistant.
- Fast manufacturing.

**Stage 4:** the development team is responsible for solving the technical and design aspects of the prototype through ideation processes; digital designs; evaluation of digital prototypes, and proposals for improvements. This process is iterative, it is carried out as many times as necessary until the design and the management team validate the result of the prototype model.

**Stage 5:** the development team carries out the 3D model of the validated prototype and proceeds to manufacture it by carrying out the first tests of functionality and ergonomics. This stage is iterative, and the development team has the faculty to implement improvements while maintaining the main features validated in the previous stage.








**Stage 6:** once the prototype has been materialized, a meeting is held with the INRPAC team with the aim of evaluating the operation and requirements of the object. The work at this stage seeks to collect suggestions, comments and new proposals from the INRPAC team.

**Stage 6.1:** in the case of receiving new suggestions regarding the object, the project returns to stage 4 to carry out the relevant studies, adaptations, design, manufacture, testing, and evaluation of the new prototype again. The objective of these improvements is to comply with the requirements agreed at the beginning of the process of developing technical aids from both the perspective of USACH and INRPAC.

**Stage 7:** once all the parties involved in the project reached an agreement, the manufacture of the technical aid begins to be subsequently delivered and tested by the users of INRPAC's TICAA program. At this stage, metrics for evaluating the functionality of the product are established.

**Stage 8:** finally, all the actors involved in the project meet to evaluate the design and manufacturing process of the technical aid. The operation of each equipment and relevance of the proposed hybrid methodology are evaluated. As well as the availability of resources of the LEIND laboratory, relevance of its contribution, response times, and compliance with the schedule and budget at the beginning of the project.

### Construction Process of the Adapted Mouse

Stage 3, 4		Stage 4, 5		Stage 6	
			<ul style="list-style-type: none"> <li>-Intuitive operation <span style="color: red;">✗</span></li> <li>-Ergonomic design <span style="color: red;">✗</span></li> <li>-Adaptable <span style="color: red;">✗</span></li> <li>-Affordable price <span style="color: green;">✓</span></li> <li>-Safe and resistant <span style="color: green;">✓</span></li> <li>-Fast manufacturing <span style="color: green;">✓</span></li> </ul>		
Stage 6.1			Stage 7		
			<ul style="list-style-type: none"> <li>-Intuitive operation <span style="color: green;">✓</span></li> <li>-Ergonomic design <span style="color: green;">✓</span></li> <li>-Adaptable <span style="color: green;">✓</span></li> <li>-Affordable price <span style="color: green;">✓</span></li> <li>-Safe and resistant <span style="color: green;">✓</span></li> <li>-Fast manufacturing <span style="color: green;">✓</span></li> <li>-Evaluating functionality <span style="color: green;">✓</span></li> </ul>		
Stage 8					
					

### Construction Process of the Adapted Pushbutton








Stage 3, 4		Stage 4, 5		Stage 6	
			<ul style="list-style-type: none"> <li>-Intuitive operation <span style="color: red;">✗</span></li> <li>-Ergonomic design <span style="color: green;">✓</span></li> <li>-Adaptable <span style="color: red;">✗</span></li> <li>-Affordable price <span style="color: green;">✓</span></li> <li>-Safe and resistant <span style="color: green;">✓</span></li> <li>-Fast manufacturing <span style="color: green;">✓</span></li> </ul>		
Stage 6.1			Stage 7		
			<ul style="list-style-type: none"> <li>-Intuitive operation <span style="color: green;">✓</span></li> <li>-Ergonomic design <span style="color: green;">✓</span></li> <li>-Adaptable <span style="color: green;">✓</span></li> <li>-Affordable price <span style="color: green;">✓</span></li> <li>-Safe and resistant <span style="color: green;">✓</span></li> <li>-Fast manufacturing <span style="color: green;">✓</span></li> <li>-Evaluating functionality <span style="color: green;">✓</span></li> </ul>		
Stage 8					
					

Figure 63: Stages of construction of the adapted objects, Source: own elaboration.



The overall evaluation of the project concludes the development stage, giving place to the delivery stage. The fulfillment of the project objectives and the performance of the innovation space at each stage will be analyzed.

#### **5.4.6 Project delivery**

As a condition for finalizing the project, INRPAC must evaluate the fulfillment of the proposed objectives. In this case, the institute validates the delivery by highlighting the quality of the products delivered in terms of functionality and design. Additionally, the learning acquired together with the professors and students who are part of LEIND is appreciated. A strong vocation for collaborative work and strengthening open innovation processes is recognized, as a result of a development process that involved constant iterations with multidisciplinary teams and knowledge transfer in a bidirectional manner.

The LEIND manager and his team recognize the use of the tool for generating recommendations and follow-up as a strength. The fulfillment of objectives is positively valued as a result of a planning of activities that responded to the availability of resources of the innovation space. The project significantly strengthened the social and cognitive dimensions. The strengthening of these dimensions is valued as a success factor of the project.

Finally, the two partners associated with the project (INRPAC and LEIND) expressed satisfaction with the result and validated its closure, positively evaluating the fulfillment of objectives, scheduled time and resource management.

### **5.5 Conclusion**

This chapter presents the validation of the tool for assessing the maturity of a university innovation space proposed in chapter 2. The validation was carried out in four Chilean universities which, due to their definition (public and private) and location (different regions of Chile), present different characteristics in their operation. Of the five innovation spaces evaluated, three are mixed, contributing to both missions of the university, and two have only a business mission. Similarly, the validation of the tool for monitoring and generating recommendations for projects in an ISU is presented (Chapter 3). This second validation was carried out in one of the innovation spaces evaluated: the LEIND).

The validation of the tool for assessing the maturity of the innovation space was carried out through the formulation of the questionnaire to the person in charge of the space. Subsequently, the results were analyzed and the following considerations were obtained:

- The managers of the innovation spaces that carried out the diagnosis, expressed an understanding of the practices that were evaluated. They recognize that the questions reflect the daily activities of the space and it was easy to position themselves in the level of maturity that reflects their reality. In addition, it allowed them to better understand the totality of activities that determine the dynamics of an innovation space.
- Regarding the results of the diagnostic, it is validated that it represents in a good way the perception of those in charge of their innovation space. They declare that the result represents the trajectory and the current functioning of the innovation space. They agree with the strengths and weaknesses of the space, as well as with the most developed and least developed practices.

- Finally, the managers of the innovation spaces recognize the benefit that the evaluation tool brings to the management of the space. Recognizing the current status and the strategies to follow to improve the weak points of the space is the first step to orient the operating strategy and to evolve in a more concrete way.

In general, mixed innovation spaces present a disparate result between the academic mission and the business mission. Thus, the academic mission shows a greater development as a consequence of the influence generated by being inside a university. This mission develops in a natural way by associating its practices to the traditional activities of a university; in fact, the evaluation profiles of the maturity of the academic mission are similar among the evaluated spaces. In contrast, the business mission is less developed, as it is a "new" mission and there is no clear guidance on the activities to be implemented. The academic focus of the university means that the importance of formalizing a business mission is not recognized, which is more evident in the cognitive and financial dimensions.

Regarding the validation of the tool for monitoring and generating recommendations for projects in an ISU, the person in charge of the innovation space that managed the evaluated project, highlights that the tool allows to order and prioritize the improvement actions to be implemented by the space to optimally manage a project. In this sense, the maturity diagnosis of the innovation space allows making general improvements on the space. However, by associating this diagnosis to a project to be developed, it is possible to complement the recommendations plan to focus the operation strategy on project development. Consequently, a relationship is established between the objectives of the space and the type of projects to be developed to align with those objectives. The result is an adapted plan of recommendations that responds to the profile of the space and to be implemented in the realization of projects.

## 6 CHAPTER 5: CONCLUSIONS AND PERSPECTIVES

In the academic-industrial context, studies on innovation spaces position them as an actor that has profound repercussions on key activities for the university, such as: the generation of links with industry, the development of projects with an impact on the territory, the capability to generate research and technology transfer, etc. Unfortunately, decision making for the design and operation of these spaces has been limited to conceiving them as a regular technological laboratory that focuses only on teaching and learning activities, missing their potential in the generation of projects based on collaborative work, the use of new methodologies and the incorporation of innovation processes that connect the academic sector with the industrial sector.

The general vision of the ISU is a physical environment that supports educational activities (similar to a classroom). In this sense, they are viewed administratively as a space that is part of the university's overhead, and limited resources are allocated to ensure their operation. This economic dependence on the university leads to wasteful administrative processes that make it difficult to invest in projects, limiting the decision-making autonomy of those responsible for the space. Although the ISUs fulfill a function of academic training and support for learning processes, they should be projected as a company within the university, which also fulfills the objective of developing projects. Therefore, they should have the capability to make technological and human capital investments in an agile manner, establishing strategies that allow them to be self-sustainable over time.

The erroneous vision of ISUs, which places them in inadequate management structures, may be due to the absence of standardized models. The study of the state of the art shows us a great variety of innovation spaces, leading to broad concepts, which are sometimes considered ambiguous. This opens the space to personal interpretation, making it difficult to generate operating models to guide their management processes. The current resource management of innovation spaces focuses mainly on two axes: the physical and the technological. However, research and collaborative work activities that involve innovation processes and methodologies make it necessary to view these spaces from a multidimensional perspective more complex. With the objective of modeling the functioning of innovation spaces, our research focused on responding to the following gaps:

- ***Lack of framework for innovation spaces in universities:*** the first difficulty to work on is the lack of precision in the definition of "innovation spaces" in the literature. The authors initially analyzed (see chapter 1, section 1.2.3) establish general parameters regarding the objectives and functioning that innovation spaces should have. However, the definitions do not present a particular characteristic that evidences the profile of the innovation spaces that arise in the context of educational centers. Therefore, it is not possible to validate whether or not there is a particular influence on the creation and operation of these spaces within a university. To resolve this question, we propose a characterization of the ISU, putting as a central axis the common space between the areas of development of the innovation spaces (Dimensions) and the activities of support to the missions of the universities (chapter 2 section 2.3). Under this approach, we managed to ensure that the theoretical characterization of the ISU considers in a relevant way the influence exerted by the university missions on the dynamics of the space and that in turn the space can contribute to the achievement of the university missions. As a result, we propose the definition of a structure that in its operation responds to criteria that directly benefit the university's academics, research and link with environment activities.

Thus, the proposed model provides resources to avoid two poor management practices that are common and hinder the growth of the ISU:

- The first is the creation of innovation spaces based on the intuition, vision, experience and needs of a single person (usually the manager of the space).
- The model promotes a multidimensional analysis in which not only technological and physical aspects are considered, but also strategic, social, emotional, cognitive and economic aspects. The second is the erroneous implementation of the innovation space that does not consider strategic aspects of operation, damaging its differentiating character and placing it at the same level of a traditional classroom laboratory. In this sense, dimensions such as cognitive and emotional propose the incorporation of new educational methodologies, focused on collaborative work and autonomous/self-taught learning. On the other hand, dimensions such as the social and economic encourage focusing teaching and administrative efforts on the development of activities that generate technological projects with social and economic impact.

- ***Need for an evaluation of innovation spaces in universities:*** in order to be successful in the implementation and operation of an ISU, it is necessary to define reference criteria that allow the establishment of monitoring processes that guarantee its progress, justifying the investment versus the expected result. As already mentioned, the lack of a framework for innovation spaces in universities makes the formalization of management support tools more complex. The result is management processes that are mainly based on the manager's experience. This intuitive vision makes it impossible to generate a global development plan for the space, since it usually fails to integrate all the dimensions necessary for the proper functioning of a good innovation space. Therefore, once the structure that makes up an ISU has been identified, it is necessary to establish an evaluation mechanism that provides an objective reference point for monitoring the different dimensions of the innovation space.

Those responsible for innovation spaces interviewed during our research (chapter 2 section 2.4) agreed that the social, cognitive and emotional dimensions are usually not among their priorities when establishing the space's development plan. This causes weaknesses and imbalance in the maturity and functioning of the innovation space. This is why, in chapter 2, section 2.5, we propose a model for evaluating the maturity of an innovation space in universities that will make it possible to establish a benchmark of the current state, considering all the dimensions and practices that characterize this type of space. The result is an objective evaluation of the innovation space that will help its managers to make decisions consistent with the expected results.

Thus, we consider that the evaluation model of innovation spaces in universities is a significant contribution to the generation of knowledge. It provides information to understand how a university innovation space should function and establishes a reference point for the creation of improvement plans. From this point of view, it was highly valued by those responsible for ISU as a learning tool, since it allowed them to better understand all the dimensions and activities involved in the operation and growth of an innovation space.

- ***Establishing the relationship between the capability of the innovation space and the projects to be developed:*** the dynamics of innovation spaces is based on the realization of projects. In the innovation spaces in universities, academic, research or linkage with the environment projects are carried out. The realization of projects is an opportunity for the development of the space, since the knowledge generated can be used to improve the maturity level of the space, acquiring and complementing the installed capabilities.

In this sense, once the degree of maturity of an innovation space is known, the choice of which projects to carry out must respond coherently to the objectives, resources, competencies and projection of the space. In Chapter 3 we propose an initial assessment of the complexity of the project to be carried out in order to determine whether the space actually meets the conditions for carrying it out. In this sense, the relationship between the requirement represented by the project and the degree of maturity of the space should ensure the relevance to carry out the project. We consider that currently the absence of a project relevance assessment that considers the characteristics of the innovation space generates a negative management dynamic in which decisions are made on an individual basis. Thus, the person in charge of the space rejects or accepts the realization of projects based on his or her intuition or personal needs. This type of decision making, characterized by the absence of planning, generates a poor distribution of resources and long-term problems in the development of projects. Therefore, for projects in innovation spaces in universities there should be a standardized method of monitoring and management that takes into account the relationship between the characteristics of the project and the maturity profile of the space. Ensuring the realization of projects that effectively favor the growth and development of the innovation space.

The detailed development of the three contributions of our research, which respond to the gaps presented above, is presented below.

## **6.1 Contribution**

### **6.1.1 Reference framework for characterizing innovation spaces in universities**

In Chapter 1 of this thesis we focused on analyzing the literature to identify the general parameters of innovation spaces in their operation. The literature review presents us with a variety of innovation spaces, mostly focused on the needs and characteristics of companies or private institutions. From the bibliographic information, we identified a group of recurring factors and activities from which 5 basic dimensions emerge that characterize innovation spaces: strategic, physical, technological, social and emotional. However, this characterization does not present any differentiating aspect that evidences the influence of the academic context in their creation or operation. Therefore, the next step was to analyze the particular context of the universities in order to understand the functioning of these educational institutions. We identified their main missions: academic and business. To understand how universities carry out these missions, we established an associated concept that allowed us to identify the factors and activities that support each mission, which we grouped into dimensions. Thus, on the one hand, we identified the dimensions that characterize the innovation spaces (chapter 2, section 2.2, Figure 5) and on the other hand the dimensions that characterize the university's missions (chapter 2, section 2.2, Figure 9 and Figure 10). We materialized the profile that emerged from the literature analysis by defining as a central axis the dimensions in common to characterize the ISUs. Identifying the dimensions that are found in the intersection zone is evidence of the bidirectional influence that innovation spaces have within universities (Figure 64).

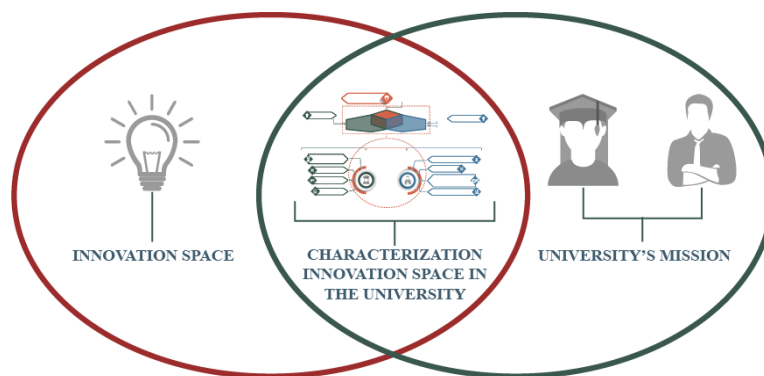


Figure 64: Intersection zone between IS and universities, Source: own elaboration.

The result is a conceptual model based on 7 dimensions (strategic, physical, technological, social, emotional, cognitive and financial) that defines the structure of an ISU (chapter 2, section 2.3, Figure 15). In this way, a first objective is achieved by understanding which dimensions are included in the functioning of an innovation space and a model for the conception of an innovation space in universities is formalized. This conceptual framework of the components of an ISU represents a significant support for the design of this type of space supporting the decisions of their responsible.

Our first contribution brings:

- Validate that innovation spaces play an important role in the development of universities by strengthening both the academic and business missions (the research mission being transversal to these two missions). The similarity and complementarity between the practices of the representative concepts of the university missions and the practice of the ISU allows them to mutually strengthen each other.
- Structuring a framework to guide the design of innovation spaces. This framework is also a learning tool that allows the space manager to know its structure and to have a global vision of the real dynamics of the space. In this way, it serves as a support for decision making when designing the space or distributing resources to improve its level of maturity, always taking into consideration a global vision of all the dimensions that characterize the functioning of an ISU.
- Establish profiles (Academic, Business or Mixed) to direct the efforts from the planning of the innovation space so that the results obtained respond in a timely manner to the objectives set by the manager. This allows to generate an ISU ecosystem relating them from their objective of supporting each of the missions of the university.

### 6.1.2 Model for evaluating innovation spaces in universities

The definition of a framework with the dimensions that characterize innovation spaces in universities provides general guidelines to their design and operation. However, it cannot be considered a management support tool, since decision making still depends a lot on the experience of the person in charge of the space. Therefore, it is necessary to generate a tool to support decision making and help in the establishment of ISU improvement plans. For the creation of this tool, and considering the experience in this type of models of the ERPI laboratory, we based ourselves on the hypothesis that in order to improve the management of a space we must first be able to evaluate its current maturity profile. Thus, in Chapter 2 we propose a model for evaluating the maturity level of the space using as a basis the conceptual model elaborated in the first contribution of this research. Thus, the proposed evaluation model

is structured in two levels of aggregation: first level of dimensions and second level of practices. The first level of dimensions is based on the literature study carried out and shows the lines of action to be considered by the ISU. These dimensions depend on several factors, so it is not advisable to evaluate them directly, which is why a second level of aggregation is carried out with the practices. The practices of the second level of aggregation have a direct relationship with the factors that describe the dimensions, since they seek to represent these factors described in the form of recurrent activities and processes, in such a way that they represent the good practices that an ISU carries out to strengthen these dimensions. The practices, being defined as activities, can be assigned the use of resources, and can be evaluated directly. Given their qualitative nature, the maturity grid method is used for their evaluation, thus defining observable phenomena that allow the evaluation to be objective (Annex 1). The observable phenomena are concrete situations, with a clear procedure and assigned resources that allow representing the different levels of maturity that each practice can reach. Thus, the proposed evaluation tool consists of a questionnaire where each question evaluates one of the practices of the model and the response options are constructed by maturity grids that describe the observable phenomena associated with the degree of maturity that can be reached in each practice (Figure 65).

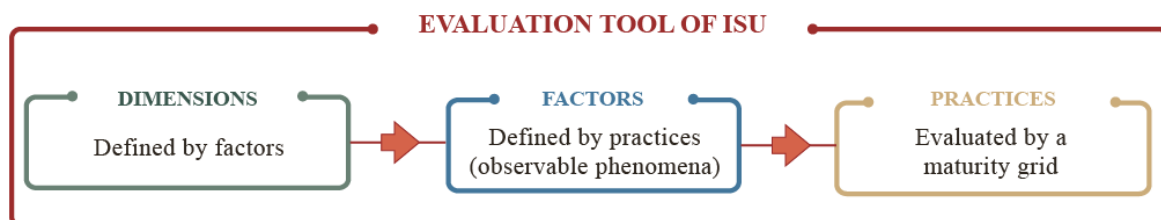


Figure 65: Process of designing an evaluation tool for an ISU, Source: own elaboration.

Finally, through the analysis of the literature and the experience of 5 Chilean universities that participated in the construction and validation stages, we arrived at our second contribution. An evaluation model of innovation spaces in universities, which by itself represents a significant contribution to the generation of knowledge, enabling manager of the space to better understand how an innovation space should function in the university and allowing to have a reference point (diagnosis) for the creation of improvement plans.

The characteristics of the evaluation tool represent two clear benefits: first, by using observable phenomena as criteria to evaluate the ISU, it is possible to reduce the degree of subjectivity in the answers, favoring the obtaining of an objective diagnosis close to reality. In terms of evaluation, the tool allows us to:

- Establish the degree of maturity of an innovation space without the result being influenced by the person evaluating it. This evaluation allows us to establish a reference point for possible improvements in the maturity of the space or comparison with other spaces in the university.
- Better identify the concrete actions to be taken by the innovation space to improve its degree of maturity based on the good practices that make up the evaluation model. The maturity grids serve as a guide to identify in a specific manner the actions to be taken to achieve a certain degree of maturity objective for the space.

Secondly, knowing the range of levels in the practices of an ISU makes it possible to generate a plan of recommendations that in its implementation progressively improves the level of maturity of the innovation space. Thus, from a strategic vision the tool achieves:

- Define the result of the degree of maturity as a reference point to propose strategies for strengthening the innovation space (evaluate to improve).
- Establish actions to follow based on the practices carried out by the innovation space and not on a black box model (resources VS result). Establishing precise plans, with resources, time and assigned responsibilities.
- Establish a common evaluation metric that allows comparing different innovation spaces under the same parameters, with the objective of favoring learning through benchmarking.
- Define complementary profiles between innovation spaces to promote synergic relationships that progressively generate the emergence of an ecosystem of innovation spaces within universities.

### 6.1.3 Tool for generating recommendations and monitoring innovation projects in an ISU

During the validation of the evaluation model for innovation spaces in universities presented in chapter 2, the group of experts who participated in the construction and validation of the model repeatedly expressed the importance of project development in the consolidation of the dimensions and practices proposed in the model. This generalized manifestation of the experts led us to recognize that once the ISU is structured, it is necessary to propose a tool that favors the management of projects within it. Innovation spaces depend on projects to remain active and grow. However, the choice of projects is currently subjective, based on the criteria and experience of the person in charge of the innovation space. In this context, a project management tool will make it possible to standardize decision-making, basing the choice on the relevance of the project and coherence with the mission and objectives of both the university and the innovation space. The result seeks to generate a win-win dynamic where the development of projects benefits the space through the acquisition of specialized knowledge, machinery and technical and human competencies that facilitate the evolution of the innovation space (Figure 66).

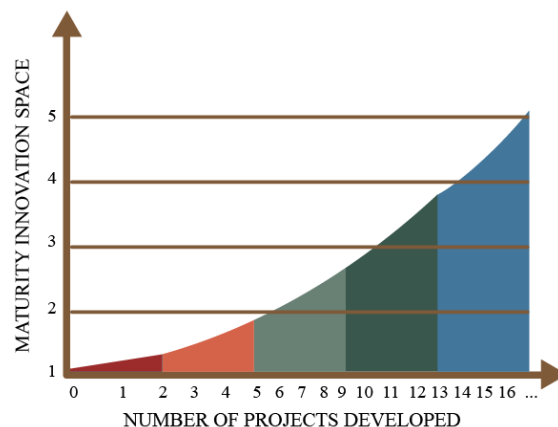


Figure 66: Win-win dynamic in the development of projects in an ISU, Source: own elaboration.

Recognizing that the projects developed in an innovation space should not only respond to the mission of the university, but should also be adapted to the degree of maturity of the innovation space. Our third contribution is a tool for generating recommendations and monitoring for the development of projects in an ISU. In chapter 3 we present how, based on the analysis of the



projects' requirements profile, we were able to propose a tool to generate a recommendations plan. Subsequently, we defined a follow-up strategy to establish the stage of the project in which the recommendations should be implemented, validating their correct implementation.

Thus, the first step was to define a typology of projects based on the literature; in our case this typology was defined under the following concepts: Technological Novelty, Conceptual Novelty and Market Novelty. These three concepts allow us to evaluate the complexity of each type of project using three criteria: low (incremental innovation: product improvement, process improvement, design improvement, etc.), medium (incremental innovation: new product versions, new components, introduction of new techniques, cost reduction, etc.) and high (radical innovation: new product, new technology, new business model, etc.), to finally establish a minimum requirement profile that guarantees the correct development of projects. The requirement profile obtained is evaluated against the result of the degree of maturity obtained from the innovation space and it is there where a profile that defines the practices that do not meet the requirement of the project is established, generating a plan of recommendations to strengthen the identified practices, to reach a valid profile to execute the project. Finally, based on the StageGate model, a follow-up plan is proposed, establishing for each stage a verification item that blocks or authorizes the progress of the project in the innovation space. The objective of the tool is to favor the correct execution of projects through the following aspects:

- Support in decision making through the evaluation of projects from a global vision in which the available resources and the concordance with the mission defined for the innovation space (academic, business or mixed) are analyzed.
- Knowledge management through the early identification of the learning associated with the project.
- Resource management through the generation of a project portfolio that defines criteria for the use of the innovation space in the event that different projects are carried out in parallel.
- Continuous improvement processes through the identification of dimensions that do not meet the degree of maturity required for the development of a project and the subsequent planning of actions to strengthen those dimensions.
- Collaborative project management through the association with internal or external innovation spaces that complement the poorly evaluated dimensions of an innovation space.

As a result, the tool achieves a significant contribution in the distribution of resources of the space; identification of activities that can be complemented by other spaces; planning in the use of resources, generation of alliances, networking, etc.

## **6.2 Research limitations**

The main limitations of our research work are related to the validation of the model for evaluating innovation spaces and the tool for generating recommendations and follow-up for projects. It should be remembered that the proposed model and tools correspond to a first approach to innovation spaces in universities, a field so far little explored, so it is necessary to expand the variety of experts and spaces studied to validate the proposed model and tools.

Although we have worked the different stages of the thesis with a strong base of literature and the validation of experts who have extensive experience with universities of different characteristics (public-private; single campus-separate campus, etc.), we were limited in the variety of specialties that host these innovation spaces. Therefore, all the spaces that participated in our research are part of engineering schools. Consequently, it is pertinent to state that the proposed model and tool is well adapted to the characteristics of an engineering school. However, our sample does not allow us to validate the level of adaptation that the model or the

tool can have in a school with a different specialty (medicine, architecture, etc.). In the same line, it is also considered a limitation that the sample responds only to universities in Chile. Since the model and the tool have not been validated in other countries, cultures or social contexts, the question remains as to what the level of compatibility will be under these new conditions.

However, this is a first model proposal. The objective of opening this area of research is to draw the attention of universities, who are more interested in the subject, to contribute to the validation through iteration in different contexts.

Another limitation of our research is that the dimensions defined in the evaluation model were assigned the same importance and, therefore, the same weight. In this sense, there is no dimension that is more important than another. However, we consider that the type of university, specialty, country and context in which the ISU is implemented can generate changes in the weighting of the dimensions. Thus, an ISU located in a school of humanities could attribute greater weighting to dimensions such as social, emotional and cognitive, since they are more related to their area of performance. In this sense, the model could evolve to adapt to different contexts and strategic approaches, defining different weighting vectors according to the ISU's work context.

Although the recommendation plans were well received by the ISUs in which they were tested, the sample presented was limited both in number and diversity of cases. In this sense, validating their functionality in other conditions may allow the emergence of new recommendation strategies that respond to other types of constraints. In our research we proposed the recommendation scheme based on 2 strategies (dimension mean and total ISU mean), however, it would be necessary to validate whether the flexibility allowed by the recommendation tool is conducive to adapting the schemes to different contexts.

## **6.3 Perspectives**

This work has opened different lines of research, and our first perspectives aim to strengthen the model and address the limitations mentioned above.

### **6.3.1 Theoretical and operational improvement of the model for evaluating innovation spaces in universities.**

The first perspective is related to proposing improvements to the model designed. The version presented in this paper includes 6 dimensions for the ISU with academic mission and 7 dimensions for the ISU with business mission. These dimensions were the result of the analysis of the literature and the definitions proposed by the authors cited in chapter 1 and 2. However, an evolution of the model in which context variables (geographical, political, economic, etc.) are analyzed, could validate the integration of new dimensions to the model, further evidencing the influence that the environment has on both universities and ISUs.

On the other hand, if we focus on the practices of each dimension, we consider that the iteration of the model in a larger number of ISUs, with different missions, operating time and characteristics, would favor the calibration of the maturity grid, allowing adjustments to be made between the proposed levels. In addition, technological and scientific advances that are part of the activities of universities can generate changes in the way in which certain practices are developed, so a continuous review of the grids allows them to be updated.

Finally, for this first version of the tool, all practices have been considered equally important. It is therefore necessary to weight each of the practices. To do this, multi-criteria analysis methods such as AHP (Analytic hierarchy process) can be used (Saaty, 1987). This type of method would make it possible to obtain the weights of each of the practices thanks to the opinion of the experts. However, the application of a single practice weighting configuration offers limited adaptability of our model to different contexts. Although the tool takes into account the characteristics of the university, it would be desirable to establish ISU profiles (example: associated the type of school, engineering, medicine, humanities, etc) and associate a specific weighting configuration to each of them. In this context, a theoretical-practical approach can be made through numerous case studies in different contexts.

### **6.3.2 Greater precision in the characterization of innovation projects**

With respect to the type of projects that were defined in the tool for generating recommendations for innovation projects, 3 types of novelty were defined that made it possible to characterize their complexity. These three types of novelty are: Technological novelty, concept novelty and market novelty. To the extent that the innovation space works in a more structured way by managing a greater number of projects in parallel, it can be considered that the characterization presented is very generic. A more detailed research of the projects that are executed in the universities could open space to further delimit the type of projects, categorizing them under different parameters such as:

1. Public or social projects: those that do not have a profit motive, but rather achieve an important impact on society or the population at different scales: local, regional, or even global.
2. Productive or private projects: those whose purpose is profitability. They are typical of the business, entrepreneurial or industrial sectors.
3. Research projects: those that involve educational activities, experiments or construction of models in one or more scientific disciplines.

This categorization can complement the one presented in our research, generating new criteria for the selection of projects to be executed and favoring the creation of much more detailed plans of recommendations, customized to the needs of the ISU.

### **6.3.3 Improvement of the recommendations obtained**

The use of the maturity grid as an evaluation tool provides many benefits by proposing concrete situations defined to evaluate the maturity level of practices in an objective way. In addition, the maturity grid allows recommendations to be established from the explanatory text with which its different levels are constructed.

Even if the target situation is well known, it may happen that the ISU manager does not know how to react in order to implement the relevant improvements. Thus, the integration of a list of complementary actions can improve the quality of the recommendations.

For example, in Chapter 4, Table 26 presents the recommendations plan for the ISU of the University of Santiago "LEIND". In practice "ISP4" of the Physical Dimension, the following recommendation is proposed:

Sub-practice	Actual level	Recommended level
Structure & Architecture (ISP4)	The innovation space is flexible and has areas that benefit the execution of individual work, collaborative, and manufacturing activities, adapting to both small groups and large groups in a good way (from 3 to 20 people).	The innovation space is flexible in type of areas and capacity, it has its own spaces that benefit the execution of collaborative, manufacturing, and individual work activities. At the same time, it incorporates presentation areas that encourage socialization and debate (spaces for talks, pitch, presentations, etc.).

Table 38: Example of recommended Physical Dimension ISP4. Source: own elaboration

Even if the recommended level seems clear enough, the ISU manager may be unsure of what actions to take to design and manage improvements to the space. Thus, a list of additional actions would help to clarify their doubts. An example of a list with the proposed complements is shown below:

To reach the recommended level you should:

- Define a standard protocol to establish the needs of the ISU that contemplates at least the following steps: analyze the user profile, define number of frequent users, analyze peak and off-peak times of users, analyze type of activities that are most frequently executed (group activities, manufacturing, socialization, individual work, etc), analyze characteristics and restrictions of the physical space to be intervened, definition of budget and implementation plan.
- Based on the information provided by the requirements analysis, define the priorities for implementation.
- Define the characteristics of each area, taking into account that it must comply with the condition of being flexible both in terms of purpose of use and adaptation to different number of users.

In the same way, a more detailed plan of recommendations in the project management tool will allow to advance in the indicated direction in a fast and efficient way.

This thesis is, therefore, a methodological contribution for the creation and management of innovation spaces in universities with theoretical, methodological and experimental contributions. It is part of the current dynamics of management of innovation spaces and development of innovation projects in universities and provides a basis that we consider necessary to continue working on the formalization of methodologies that standardize the operation of the ISU, favoring the development of projects within them.

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## ABSTRACT

Universities are a very important actor in contributing to the development of countries, not only from an academic and research point of view, but also from a linkage role with industry and society. Advances in science and technology make it possible to provide answers to different problems and needs in all areas of development. So, innovation and specifically innovation spaces (IS) represent an opportunity for collaboration between universities and their environment. However, the great diversity of types of innovation spaces presents a challenge in its implementation. Each type of space proposes a different configuration, objectives, operation and results, making it difficult to formalize a reference framework for their creation and management.

This thesis seeks to answer the question of how to design and manage an IS in a university to support the development of its missions. A conceptual model is proposed considering the intersection between the factors inherent to innovation spaces and the factors that represent the university's missions, represented in 7 dimensions (strategic, physical, technological, social, emotional, cognitive and financial). Based on the conceptual model, a tool is proposed to evaluate the maturity of the innovation space by obtaining a multidimensional diagnosis. Based on the diagnosis, a recommendations plan is generated that proposes two strategies to support decision-making in the definition of IS improvement plans. Finally, in order to work on the dynamics of the space, a management tool for project development is proposed. The tool analyzes the projects' needs profile and the result of the IS maturity assessment to define a follow-up plan based on the stage gate methodology.

The experimentation phase is carried out in two stages: first, the conceptual model is applied in different IS in universities in Chile to evaluate their level of maturity. Second, an innovation space is chosen among the universities studied and the management tool is implemented in the development of a project. For the managers of the innovation spaces studied, both the evaluation model and the project monitoring tool achieve their objective of supporting decision making for the planning and operation of the space, indicating to them what concrete actions they should adopt according to their development objectives.

**Keywords:** Innovation spaces, collaborative learning, entrepreneurial university, stage gate, evaluation tool.

## RÉSUMÉ ÉTENDU EN FRANÇAIS

### CONTEXTE ET PROBLÉMATIQUE DE LA RECHERCHE

Aujourd'hui, l'innovation est considérée comme un moyen efficace de stimuler la croissance économique et sociale. Plusieurs décennies de recherche en innovation dans les organisations ont été motivées par l'hypothèse selon laquelle les idées créatives doivent être mises en œuvre pour augmenter les profits ; renforcer l'avantage concurrentiel et assurer la survie de l'entreprise (Amabile & Pratt, 2016 ; Çekmecelioğlu & Günsel, 2013 ; George, 2007). En conséquence, l'innovation, qui était autrefois l'objectif de certaines organisations, est devenue un besoin généralisé. Cependant, le processus d'innovation est complexe, il implique de nombreux facteurs allant des aspects cognitifs (Nijstad et al., 2010), affectifs (Amabile et al., 2005) et sociaux (Amabile & Pratt, 2016), à l'un des plus importants qui est la créativité (Hennessey & Amabile, 2010). Cette dernière est la source d'innovation et de nouvelles opportunités commerciales. Le problème est que les organisations recherchent des personnes créatives, mais les espaces dont elles disposent pour développer cette activité ne sont pas idéaux, car il s'agit le plus souvent d'environnements homogènes, rigides, fermés et individualisés (Maurer et al., 2002). L'être humain est influencé par le contexte, l'environnement, les personnes qui l'entourent, le moment historique, etc. C'est pourquoi l'environnement de travail est aussi important dans la recherche de bons résultats (Akgunduz et al., 2018 ; Volery & Tarabashkina, 2021). Par conséquent, pour favoriser la créativité et générer une dynamique d'innovation, les espaces de travail doivent être ouverts permettant d'encourager le développement d'idées ; de motiver la connexion entre les personnes ; de favoriser la collaboration entre les différents membres de l'équipe ; et d'intégrer les technologies (Wu et al., 2016).

Dans cette perspective, les espaces d'innovation (EI) apparaissent comme une réponse à un besoin évident de changement et deviennent de plus en plus populaires dans les secteurs privés et publics. Les entreprises et les universités sont deux des organisations qui ont opté pour développer ces espaces sous des formats tels que : Fab Lab, Makerspace, Coworking, Living Labs, etc<sup>13</sup>. La croissance numérique des EI est évidente (Lena-Acebo & García-Ruiz, 2018). De 3 Fab Labs en 2003, le nombre est passé à 1 112 Fab Labs en 2017, dans le monde. Pour sa part, le Réseau Européen des Living Labs (ENoLL)<sup>14</sup> a publié sur son site web que: depuis sa création en 2006, il a labellisé plus de 440 Living Labs. Enfin, hackerspace.org<sup>15</sup> recense 2 426 Hackerspaces, dont 911 sont considérés comme actifs.

La motivation des entreprises à investir des ressources dans la création de ces espaces repose sur l'opportunité émergente de développer des projets innovants, intégrant l'utilisateur dans la création et la conception de nouveaux produits. Pour les universités, les avantages commencent par la création d'environnements favorables à l'enseignement et à la recherche. Cependant, l'objectif principal est de générer des relations avec le gouvernement, la société civile, le secteur privé, les entrepreneurs, entre autres, par le biais de projets.

L'évolution historique du rôle de l'université a donné naissance à un concept défini comme la « troisième mission », qui favorise la génération d'activités axées sur le développement économique, sans négliger la recherche et l'enseignement (Readings, 1996).

L'UNESCO<sup>16</sup> définit trois missions fondamentales dans la « Conférence mondiale sur l'enseignement supérieur, 2009 » : l'enseignement et l'apprentissage, la recherche et le service à la communauté dans des conditions d'autonomie institutionnelle et de liberté académique (UNESCO, 2009). En soutenant ces trois missions, les EI créés par les universités sont

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<sup>13</sup> <sup>13</sup> For definitions see (Morel & Le Roux, 2016); Fab Labs Innovative User 2016. Available at: <https://www.perlego.com/book/998508/fab-labs-pdf>

<sup>14</sup> Website ENoLL: <https://enoll.org/network/living-labs/>

<sup>15</sup> Website hackerspace: <https://hackerspaces.org/>

<sup>16</sup> Website UNESCO: <https://en.unesco.org/>

consolidés en tant qu'environnements d'apprentissage non formels. En effet, les étudiants, les professeurs, la communauté universitaire et les entreprises se rencontrent dans un contexte commun, interagissant et apprenant de manière constante et bidirectionnelle. Les étudiants ne sont pas les seuls à recevoir des connaissances, mais tous les acteurs qui sont impliqués. Ce nouveau modèle d'université entrepreneuriale donne à l'institution une participation active au niveau local et régional (Clark, 1998). En ce sens, les gouvernements ont décidé de développer des politiques de financement pour encourager la production de connaissances scientifiques pouvant être transférées à l'industrie, et bénéficier au développement technologique et à la commercialisation de produits et services innovants (Botchie et al., 2018 ; Meissner & Kergroach, 2019). Cet effort pour favoriser la connaissance scientifique répond en partie aux paramètres définis par l'Organisation Mondiale de la Propriété Intellectuelle (OMPI) dans le Global Innovation Index (2019)<sup>17</sup> qui mesure annuellement la qualité de l'innovation, selon les critères suivants : 1) la qualité des universités locales (classement QS des universités) ; 2) l'internationalisation des inventions brevetées ; et 3) la qualité des publications scientifiques (indice H des citations de documents), pour finalement obtenir le niveau de qualité de l'innovation de chaque pays.

Dans le contexte de l'Amérique latine, le développement des espaces d'innovation est lent et informel. La structure des universités latino-américaines, où les anciens plans d'éducation et méthodes d'enseignement sont toujours utilisés, freine la croissance des espaces qui nécessitent une gestion dynamique et active. En outre, la gouvernance, traditionnellement résistante au changement, ralentit les processus d'investissement et d'amélioration des espaces, en raison de barrières bureaucratiques et de systèmes administratifs rigides. Pour autant, la Banque Mondiale souligne que les établissements d'enseignement universitaire d'Amérique latine se sont considérablement améliorés sur certains aspects, notamment : l'extension à des régions plus vastes ; un plus grand investissement dans l'innovation ; une plus grande participation du secteur privé aux projets universitaires. Cependant, ces progrès contrastent avec une qualité académique faible, une durée et une adéquation discutables des programmes éducatifs, peu de progrès dans la recherche et une faible attraction des talents (Higher Education Expanding in Latin America and the Caribbean, but Falling Short of Potential). D'autre part, l'absence dans la littérature d'un modèle définissant la structure et les activités qui devraient constituer les espaces d'innovation dans les universités (EIU) est identifiée comme un obstacle à la gestion des EIU.

Dans ce cadre, différents auteurs ont travaillé sur l'établissement de modèles de gestion pour les espaces d'innovation sans approfondir le contexte (privé, public, académique, commercial, etc.), orientant leurs conclusions vers une approche commerciale. Ainsi, Moultrie et al. (2007) définissent 5 piliers pour l'EI : intention stratégique, processus de création, espace physique, processus d'utilisation et intention de réalisation. Par la suite, Osorio (2021) actualise ce modèle, en maintenant les cinq piliers, mais en intégrant des concepts associés à l'écosystème tels que : l'engagement des différents acteurs impliqués dans l'espace ; l'influence de l'environnement et de la vie réelle sur la dynamique du travail ; l'importance de l'utilisateur comme centre de l'innovation ; etc.

Sur cette base, notre recherche se concentre sur le domaine de la gestion de l'innovation dans les universités. L'intérêt spécifique est d'évaluer les capacités de l'EIU et d'établir comment un EIU devrait gérer ses ressources et ses compétences afin de développer avec succès des projets d'innovation. À cette fin, notre recherche vise à répondre aux questions suivantes : ***Quels sont les facteurs et les dimensions qui définissent les espaces d'innovation dans les universités ? Quelle devrait être la conception d'un espace d'innovation pour soutenir le développement des missions universitaires ? Quels sont les facteurs qui définissent le processus approprié***

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<sup>17</sup> Webside: <https://www.wipo.int/publications/es/details.jsp?id=4434>

*pour développer des projets dans les espaces d'innovation universitaires ? Comment gérer ces types de projets ?*

## QUESTIONS DE RECHERCHE

Comme nous l'avons mentionné ci-dessus, notre hypothèse principale est que le développement multidimensionnel d'un espace d'innovation influence positivement la bonne gestion des projets au sein des universités, renforçant ainsi leurs missions. Cette approche nous amène à explorer la possibilité de développer un outil qui aide les universités à mettre en œuvre des stratégies de gestion de l'espace et de développement de projets d'innovation. À cette fin, nous avons formulé ce projet de thèse en deux questions complémentaires, comme le montre la figure 1 :

1. *Comment définir un modèle d'évaluation qui soutient la conception d'un espace d'innovation basé sur les missions de l'université ?*
2. *Comment élaborer un diagnostic pour générer un outil de recommandations et de suivi des projets dans les espaces universitaires d'innovation ?*

Pour répondre à la première question, un cadre de référence a été défini qui intègre la caractérisation des espaces d'innovation et la caractérisation des missions de l'université, proposant ainsi un outil de diagnostic.

Quant à la deuxième question, un cadre conceptuel de la typologie des projets et des processus de gestion de projet est défini afin de proposer un outil qui évalue la complexité du projet. En outre, cet outil génère un profil des exigences minimales nécessaires au développement du projet et un plan de recommandations pour améliorer le niveau de maturité de l'EI. L'outil est testé et illustré par des cas réels d'universités chiliennes.

## STRUCTURE DE LA THESE

Afin de répondre à nos questions de recherche, une approche méthodologique est suivie, composée de différentes étapes, comme le montre la figure 1. Le présent document est structuré de la même manière.

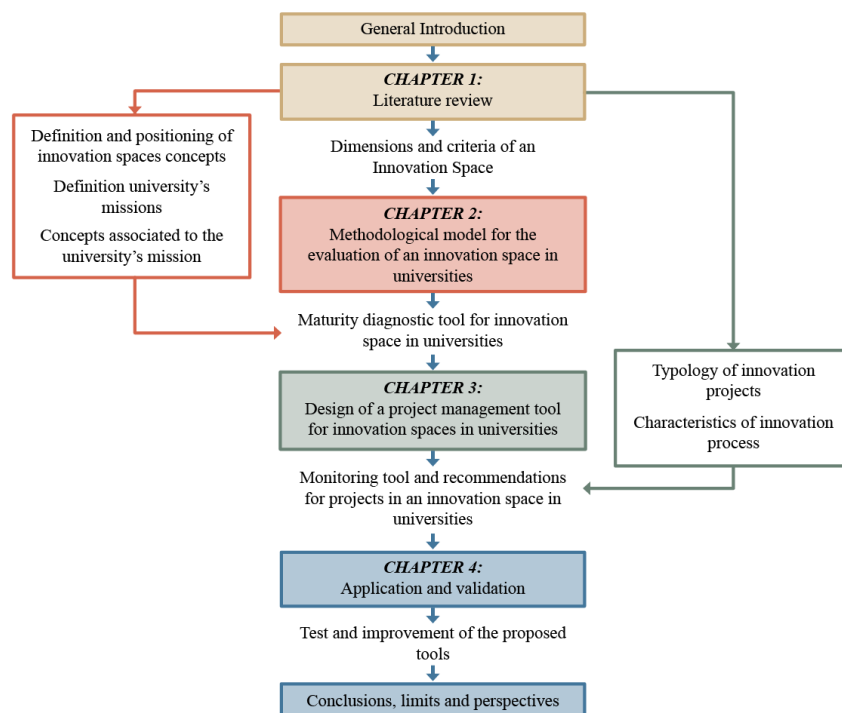


Figure 1 : Structure du manuscrit de la thèse. Source : élaboration personnelle.

Après l'introduction générale, cette thèse est divisée en 4 chapitres :

**Chapitre 1 :** La création d'espaces d'innovation dans les secteurs publics et privés est de plus en plus courante. Les universités sont des organisations qui ont consacré des ressources importantes à la création de tels espaces en tant que stratégie visant à encourager l'innovation dans le contexte universitaire. Cependant, dans de nombreux cas, l'investissement ne se reflète pas dans les résultats. Cela peut être dû au fait qu'il n'existe pas de modèles standardisés pour guider la création et la gestion de ce type d'espaces. Cela conduit à ce que les décisions soient prises sur la base de l'intuition de la personne responsable, sans suivre des paramètres mesurables qui bénéficieraient d'une amélioration continue. Dans ce chapitre, nous avons effectué une revue exhaustive de la littérature afin d'identifier les dimensions et les critères qui définissent un espace d'innovation. Les définitions associées aux universités ont été analysées afin d'identifier les concepts qui définissent actuellement leurs objectifs et leurs missions. En dernier lieu, notre recherche est focalisée sur les projets d'innovation, en étudiant les typologies existantes et les processus de gestion qui peuvent être mis en œuvre pour leur développement.

**Chapitre 2 :** La revue de la littérature présente différents modèles permettant d'identifier les dimensions d'un espace d'innovation. Le contexte des universités est particulier et nécessite un modèle adapté qui tient compte des missions de ce type d'institution. De ce fait, dans ce chapitre, un modèle est proposé pour évaluer la maturité d'un espace d'innovation dans une université. Ce modèle est basé sur une grille de maturité qui permettra d'obtenir un diagnostic multidimensionnel de l'espace d'innovation. Sur la base du diagnostic, un plan de recommandations est généré afin d'aider la personne en charge de l'espace à prendre des décisions pour améliorer le niveau de maturité de l'espace d'innovation.

**Chapitre 3 :** Le développement de projets est ce qui donne vie aux espaces d'innovation et leur bonne gestion peut favoriser leur croissance et leur consolidation. Dans ce chapitre, nous nous concentrons sur le développement d'un outil qui génère des recommandations et un suivi pour soutenir la gestion de projet dans les espaces d'innovation universitaires. Dans un premier temps, une typologie des projets est définie sur la base de la littérature, et des critères sont établis pour évaluer leur complexité. Cette caractérisation permet d'obtenir un profil du degré de maturité requis dans l'espace d'innovation pour assurer le développement du projet. Enfin, on obtient un plan de recommandations et une stratégie de suivi basée sur le principe du système Stage-Gate, qui vérifie la mise en œuvre des recommandations en établissant des critères d'évaluation qui bloquent ou autorisent la progression du projet dans l'EI.

**Chapitre 4 :** La phase d'expérimentation se déroule en deux étapes : tout d'abord, le modèle de gestion des espaces d'innovation dans différentes universités du Chili est évalué. Cette évaluation a été appliquée à un échantillon d'universités situées dans différentes régions du pays, comprenant à la fois des universités publiques et privées. Pour la deuxième étape de l'expérimentation, un espace d'innovation a été choisi parmi les universités de l'échantillon. Dans cet IE, l'outil de gestion de projet est mis en œuvre du début à la fin dans un projet d'innovation. Pour finir, les résultats ont été analysés pour vérifier la pertinence du diagnostic, la viabilité des recommandations données et la contribution à la gestion du projet.

Enfin, ce manuscrit de thèse présente la première version d'un modèle de gestion des espaces d'innovation dans les universités, ainsi qu'un outil de suivi pour le développement de projets dans ce type d'espace. Malgré les différentes étapes de validation, ce travail a ses limites et ses perspectives. Ces aspects sont développés dans la conclusion générale.

### **Problématiques de recherche**

Dans le contexte académique-industriel, les espaces d'innovation se positionnent comme un acteur important dans la possibilité de développer des projets collaboratifs. C'est pourquoi de plus en plus d'auteurs s'intéressent à la manière dont ces types d'espaces doivent être conçus et gérés. La grande diversité des types d'espaces d'innovation constitue un défi, car chaque type

d'espace a une configuration, des objectifs, un fonctionnement et des résultats différents. Dans ce cadre, notre recherche s'est concentrée sur les espaces d'innovation des universités, en analysant leur relation avec les missions de ces établissements d'enseignement. Les universités ont pour mission principale le développement d'activités académiques et de recherche. Toutefois, dans leur évolution, elles ont intégré une mission commerciale (lien avec l'écosystème) qui devient de plus en plus pertinente. Les espaces d'innovation dans les universités devraient donc soutenir ces missions.

Afin d'atteindre l'objectif de modélisation du fonctionnement des espaces d'innovation, le travail de recherche de cette thèse se concentre sur le traitement des problèmes suivants :

- Absence de cadre de référence pour les espaces d'innovation dans les universités : la première difficulté à résoudre est le manque de précision dans la définition des « espaces d'innovation » dans la littérature. La grande variété des espaces d'innovation qui existent actuellement conduit à des concepts généraux, qui peuvent parfois être considérés comme ambigus. Cette situation donne lieu à une interprétation personnelle des définitions, ce qui rend difficile la création de modèles opérationnels standardisés pour guider la gestion des EI. Néanmoins, la littérature existante associée aux espaces d'innovation parvient à établir des paramètres généraux en termes d'objectifs et de fonctionnement qu'ils devraient avoir. Le défi consiste à faire entrer les différents espaces d'innovation qui ont émergé dans les universités dans ce cadre général défini par les auteurs, en soulignant l'influence du contexte particulier de ces centres éducatifs. Les espaces d'innovation dans les universités n'ont pas de référence dans la littérature pour guider leur gestion ou leurs processus d'évaluation. Pour cette raison, afin de proposer une caractérisation claire et précise de l'EIU, nous avons travaillé à identifier l'espace commun entre les domaines de développement (dimensions) des espaces d'innovation et les activités qui soutiennent les missions des universités. Dans cette approche, la caractérisation théorique de l'EIU considère l'influence des missions de l'université sur la dynamique de l'espace. En outre, elle permet de définir une structure propre qui, dans son fonctionnement, répond à des critères qui bénéficient directement aux activités d'enseignement, de recherche et de vulgarisation de l'université.
- Évaluation arbitraire des espaces d'innovation dans les universités : L'absence d'un cadre de référence pour les espaces d'innovation dans les universités rend les outils d'aide aux gestions plus complexes. La gestion de ce type d'espaces repose principalement sur l'expérience du gestionnaire. En particulier pour les espaces d'innovation dans les universités, leur gestion est souvent effectuée en fonction des unités académiques qui hébergent l'espace. Toutefois, cette forme de gestion est biaisée, en raison de la vision que l'on a de l'espace d'innovation, principalement axée sur les facteurs liés aux infrastructures et à la technologie. Cette vision intuitive rend impossible l'élaboration d'un plan de développement global de l'espace, car elle ne parvient généralement pas à intégrer toutes les dimensions nécessaires au bon fonctionnement d'un espace d'innovation. Les responsables des espaces d'innovation interrogés au cours de cette thèse s'accordent à dire que les dimensions sociales, cognitives et émotionnelles ne font généralement pas partie de leurs priorités lorsqu'ils établissent le plan de développement de l'espace. Toutefois, cela entraîne des faiblesses et des déséquilibres dans la maturité et le fonctionnement de l'espace d'innovation. C'est pourquoi la génération d'un modèle d'évaluation de la maturité d'un espace d'innovation dans les universités permet d'établir un bilan de l'état actuel, en considérant toutes les dimensions et pratiques qui caractérisent ce type d'espace. Cela fournit une évaluation objective de l'EI qui permet



à ses administrateurs de prendre des décisions de gestion cohérentes avec les résultats qu'ils cherchent à obtenir.

Nous présentons ci-dessous les trois contributions de cette thèse qui répondent aux problèmes présentés précédemment.

## CONTRIBUTIONS

### Cadre de référence pour la caractérisation des espaces d'innovation dans les universités

La revue de la littérature présente une variété d'espaces d'innovation, principalement issus des entreprises ou des institutions privées. À partir de cette analyse de la littérature, il a été identifié un groupe de facteurs et d'activités récurrents qui caractérisent les espaces d'innovation. Cela a donné naissance à cinq dimensions fondamentales : stratégique, physique, technologique, sociale et émotionnelle. D'autre part, le contexte particulier des universités a été analysé afin de comprendre le fonctionnement de ces institutions éducatives. Leurs principales missions identifiées sont : académiques et commerciales. Pour comprendre comment les universités remplissent ces missions, un concept associé a été établi permettant d'identifier les facteurs et les activités qui soutiennent chaque mission en les regroupant en dimensions. Ainsi, nous avons identifié d'une part, les dimensions qui caractérisent les espaces d'innovation et d'autre part, les dimensions qui caractérisent les missions de l'université. L'identification des missions qui se trouvent dans la zone d'intersection permet de caractériser les espaces d'innovation dans les universités (figure 2).

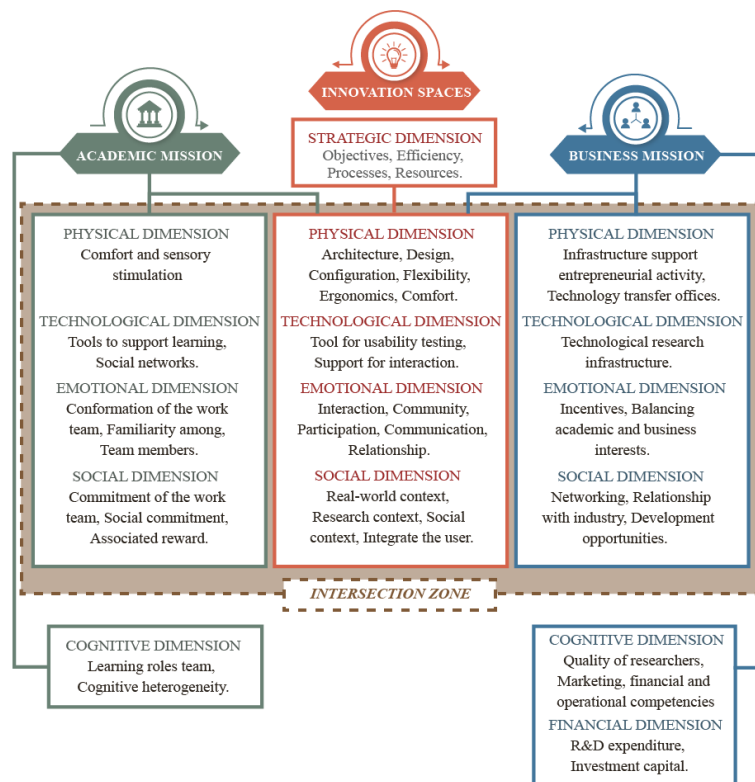


Figure 2 : Dimensions et pratiques consolidées d'une EIU Source : élaboration personnelle  
L'objectif était de valider l'existence d'un point d'intersection entre les espaces d'innovation et les missions de l'université représentées dans les 2 concepts associés (mission académique - apprentissage collaboratif et mission commerciale - entrepreneuriat académique). L'analyse de la littérature a permis de valider le point d'intersection, aboutissant à un modèle conceptuel basé sur 7 dimensions (stratégique, physique, technologique, sociale, émotionnelle, cognitive et

financière) qui définit la structure d'un EIU. De cette manière, le premier objectif qui consiste à comprendre quelles dimensions sont incluses dans le fonctionnement d'un espace d'innovation est atteint, ce qui permet de formaliser la conception d'un espace d'innovation dans les universités. Ce cadre conceptuel de référence des composantes d'un EIU est un support pour la conception et la gestion de ce type d'espace, appuyant les décisions des responsables de l'EIU. En effet, l'un des points soulignés par les gestionnaires interrogés est que l'identification des dimensions en fonction de la mission associée à l'espace leur permet d'élargir leur vision et de considérer des dimensions qui, principalement par manque de connaissances, n'avaient pas été prises en compte lors la conception de l'espace.

### **Modèle d'évaluation des espaces d'innovation dans les universités**

La définition d'un cadre de référence avec des dimensions qui caractérisent les espaces d'innovation dans les universités fournit des lignes directrices générales qui aident à leur conception et à leur fonctionnement. Cependant, il ne peut être considéré comme un outil d'aide à la gestion, car il dépend encore en grande partie de l'expérience de la personne en charge de l'espace. Il convient donc de développer un outil pour soutenir la prise de décision et aider à la mise en œuvre de plans d'amélioration pour l'EIU. L'amélioration de la gestion d'un espace nécessite d'abord, l'évaluation de son profil de maturité actuel. Ainsi, un modèle d'évaluation du niveau de maturité de l'espace a été proposé en utilisant comme base le modèle conceptuel développé dans la première contribution de cette recherche.

Le modèle proposé est donc structuré en deux niveaux d'agrégation : le premier niveau de dimensions et le second niveau de pratiques. Le premier niveau est basé sur l'analyse documentaire effectuée et il montre les lignes d'action à envisager par l'EIU. Ces dimensions dépendent de plusieurs facteurs et il n'est donc pas conseillé de les évaluer directement, c'est pourquoi un deuxième niveau d'agrégation est effectué avec les pratiques. Les pratiques, étant définies comme des activités, peuvent se voir attribuer l'utilisation de ressources, et peuvent être directement évaluées. Compte tenu de leur nature qualitative, la méthode de la grille de maturité est utilisée pour leur évaluation, en définissant des phénomènes observables qui permettent d'objectiver l'évaluation. Les phénomènes observables sont des situations concrètes, avec une procédure claire et des ressources assignées qui permettent de représenter les différents niveaux de maturité que chaque pratique peut atteindre. Ainsi, l'outil d'évaluation proposé (figure 3) consiste en un questionnaire où chaque question évalue une des pratiques du modèle et les options de réponse sont construites par des grilles de maturité qui décrivent les phénomènes observables associés au degré de maturité qui peut être atteint dans chaque pratique.

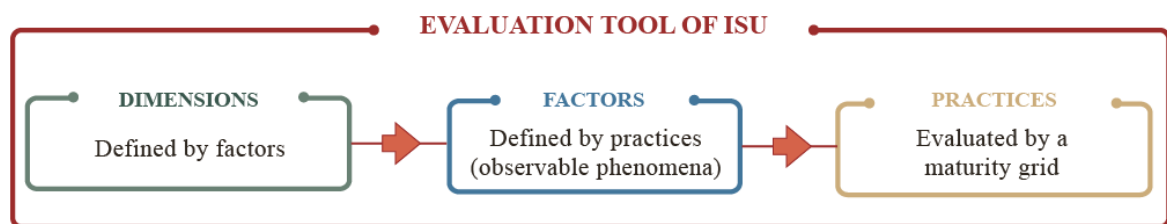


Figure 3 : Processus de conception d'un outil d'évaluation pour une EIU, Source : élaboration personnelle.

Les caractéristiques de l'outil d'évaluation ont généré deux avantages évidents : premièrement, en utilisant des phénomènes observables comme critères d'évaluation de l'EIU, le degré de subjectivité des réponses est réduit, ce qui favorise l'obtention d'un diagnostic objectif et proche de la réalité. Deuxièmement, la connaissance de l'éventail des niveaux dans les pratiques d'un EIU permet de générer un plan de recommandations qui, dans sa mise en œuvre, améliore progressivement le niveau de maturité de l'EIU.

Nous sommes donc parvenus à notre deuxième contribution grâce à une analyse approfondie de la littérature et de l'expérience de 5 universités chiliennes qui ont participé aux étapes de construction et de validation. Le modèle d'évaluation des espaces d'innovation dans les universités, constitue une contribution importante à la génération de connaissances, permettant aux responsables de l'espace de mieux comprendre comment un espace d'innovation doit fonctionner dans l'université et leur permettant d'avoir un point de référence (diagnostic) pour la création de plans d'amélioration.

En outre, le fait de disposer d'un référentiel commun permettra de comparer les EIU entre eux, fournissant des informations qui permettront d'établir les profils souhaités. Cela favorise l'apprentissage par des relations référentielles ou synergiques qui entraînent également l'émergence progressive d'un écosystème où les EIU se complètent.

### **Outil de génération de recommandations et de suivi des projets d'innovation dans un EIU**

Lors de la validation du modèle d'évaluation des espaces d'innovation dans les universités, le groupe d'experts qui a participé à la construction et à la validation du modèle a exprimé à plusieurs reprises l'importance de l'élaboration de projets dans la consolidation des dimensions et des pratiques proposées dans le modèle. Cette manifestation généralisée des experts a amené à considérer qu'une fois l'EIU structurée, il est nécessaire de proposer un outil favorisant la gestion des projets internes. Les EI dépendent des projets pour rester actifs et pour se développer. Cependant, le choix des projets est actuellement subjectif, basé sur le jugement et l'expérience du gestionnaire de l'EIU. Dans ce contexte, un outil de gestion (figure 4) permettra de standardiser la prise de décision, en basant le choix sur la pertinence du projet et sa cohérence avec la mission et les objectifs de l'université et de l'EI. Le résultat est le renforcement de la dynamique gagnant-gagnant où le développement du projet profite de l'espace grâce à l'acquisition de savoir-faire, de machines et de compétences techniques et humaines qui facilitent l'évolution de l'EI.

#### METHODOLOGY FOR THE CONSTRUCTION OF A TOOL FOR RECOMMENDATIONS AND MONITORING OF PROJECTS

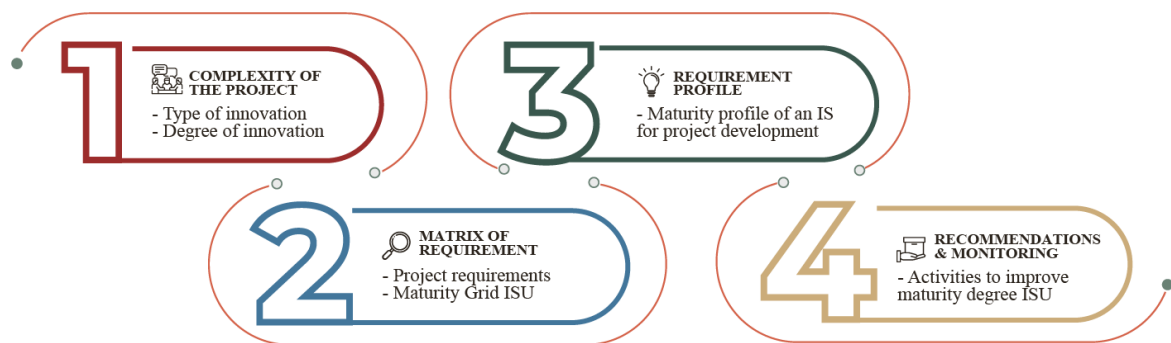


Figura 4 Méthodologie pour la construction d'un outil de gestion de projet. Source : élaboration propre.

Etant donné que les projets développés dans un EIU ne doivent pas seulement répondre à la mission de l'université, mais doivent également être adaptés au degré de maturité de l'EIU. Notre troisième contribution est un outil permettant de générer des recommandations et un suivi pour le développement de projets dans un EIU. Sur la base de l'analyse du profil des exigences, l'outil génère un plan de recommandations. Ensuite, une stratégie de suivi est définie pour établir le stade du projet auquel les recommandations doivent être mises en œuvre et pour valider leur correcte exécution.

Pour ce faire, la première étape a consisté à définir une typologie de projets sur la base de la littérature ; dans notre cas, cette typologie a été définie selon les concepts suivants : nouveauté technologique, nouveauté du concept et nouveauté du marché. Ces trois concepts nous permettent d'évaluer la complexité de chaque type de projet selon trois critères : faible

(innovation incrémentale : amélioration du produit, amélioration du processus, amélioration de la conception, etc.) ; moyen (innovation incrémentale : nouvelles versions du produit, nouveaux composants, introduction de nouvelles techniques, réduction des coûts, etc.) et élevé (innovation radicale : nouveau produit, nouvelle technologie, nouveau modèle commercial, etc.). Ainsi, nous établissons finalement un profil d'exigence minimum nécessaire pour garantir le développement correct des projets. Ce profil est évalué par rapport au résultat du degré de maturité de l'espace d'innovation, ce qui permet d'établir un profil des pratiques qui ne répondent pas aux exigences du projet. Ainsi, un plan de recommandations est généré pour renforcer les pratiques identifiées afin d'atteindre un profil valide pour l'exécution du projet. Enfin, sur la base de la philosophie Stage-Gate, un plan de suivi est proposé, établissant pour chaque étape un élément de vérification qui bloque ou autorise la progression du projet dans l'EI.

L'objectif de cet outil est de favoriser la bonne exécution des projets, d'améliorer la répartition des ressources dans l'espace, d'identifier les activités qui peuvent être complétées par d'autres espaces, d'envisager la possibilité d'établir des alliances, etc.

### **LIMITES DE LA RECHERCHE**

Les principales limites de ce travail de recherche sont liées à la validation du modèle d'évaluation des espaces d'innovation et de l'outil de génération de recommandations et de suivi des projets. Il est important de souligner que le modèle et les outils proposés correspondent à une première approche des espaces d'innovation dans les universités, un domaine peu exploré jusqu'à présent. Il est donc nécessaire d'élargir la variété des experts et des espaces étudiés afin de valider le modèle et les outils proposés.

Bien que nous ayons travaillé les différentes étapes de la thèse avec une solide base documentaire et la validation d'experts ayant une grande expérience dans des universités de différentes caractéristiques (public-privé ; campus unique-campus séparé, etc.), nous avons été limités dans la variété des spécialités qui accueillent ces espaces d'innovation. Tous les espaces qui ont participé à notre recherche font partie d'écoles d'ingénieurs. Par conséquent, il est pertinent d'affirmer que le modèle et l'outil proposés sont bien adaptés aux caractéristiques d'une école d'ingénieurs. Cependant, cet échantillon ne permet pas de valider le niveau d'adaptation que le modèle ou l'outil peut avoir dans une école avec une spécialité différente (médecine, architecture, etc.). En outre, le fait que l'échantillon ne réponde qu'aux universités du Chili est considéré comme une limitation. Le modèle et l'outil n'ayant pas été validés dans d'autres pays, cultures ou contextes sociaux, il reste à savoir quel est le niveau de compatibilité dans ces nouvelles circonstances.

Il s'agit toutefois d'une première proposition de modèle. L'ouverture de ce domaine de recherche a pour but d'attirer l'attention des universités, qui sont les plus intéressées par le sujet, afin de contribuer à la validation par itération dans différents contextes.

Une autre limite de cette recherche est que les dimensions définies dans le modèle d'évaluation ont reçu la même importance et donc le même poids. En ce sens, aucune dimension n'est plus importante qu'une autre. Cependant, nous considérons que le type d'université, la spécialité, le pays et le contexte dans lequel l'EI est mis en œuvre peuvent générer des changements dans la pondération des dimensions. Ainsi, un EI situé dans une école de sciences humaines pourrait attribuer une plus grande pondération à des dimensions telles que les dimensions sociales, émotionnelles et cognitives, car elles sont davantage liées à son domaine de performance. En ce sens, le modèle pourrait évoluer pour s'adapter à différents contextes et approches stratégiques, en définissant différents vecteurs de pondération en fonction du contexte dans lequel l'EIU fonctionne.

En ce qui concerne les plans de recommandation, bien qu'ils aient été bien accueillis par l'EIU dans lequel ils ont été testés, l'échantillon présenté était limité tant en nombre qu'en diversité de

cas. En ce sens, la validation de leur fonctionnalité dans d'autres conditions peut permettre l'émergence de nouvelles stratégies de recommandation répondant à d'autres types de contraintes. Dans cette thèse, nous avons proposé le schéma de recommandation basé sur 2 stratégies (moyenne de la dimension et moyenne totale de l'EIU), cependant, il serait nécessaire de valider si la flexibilité permise par l'outil de recommandation est propice à l'adaptation des schémas à différents contextes.

## **PERSPECTIVES**

Cette thèse a ouvert différentes pistes de recherche, et nos premières perspectives visent à renforcer le modèle et à remédier aux limites exposées ci-dessus.

### **Amélioration du modèle d'évaluation des espaces d'innovation dans les universités**

La première perspective est liée à la proposition d'améliorations du modèle conçu. La version présentée dans ce document comprend 6 dimensions pour l'EIU à mission académique et 7 dimensions pour l'EIU à mission commerciale. Cependant, une évolution du modèle dans laquelle les variables contextuelles (géographiques, politiques, économiques, etc.) sont analysées pourrait valider l'intégration de nouvelles dimensions dans le modèle. Soulignant davantage l'influence que l'environnement exerce à la fois sur les universités et sur les EIU qui émergent en leur sein.

En revanche, si l'on se concentre sur les pratiques de chaque dimension, nous considérons que l'itération du modèle dans un plus grand nombre d'EI, favoriserait le calibrage de la grille de maturité. Les différentes missions, temps de fonctionnement et caractéristiques présentes dans les EI, permettrait d'effectuer des ajustements entre les niveaux proposés. Par ailleurs, les avancées technologiques et scientifiques qui font partie des activités propres des universités peuvent faire évoluer la manière dont certaines pratiques sont développées, de sorte qu'une révision continue des grilles permet de les maintenir à jour.

Finalement, pour cette première version de l'outil, toutes les pratiques ont été considérées d'égale importance. Il est donc nécessaire de pondérer chacune des pratiques. Pour ce faire, des méthodes d'analyse multicritères telles que l'AHP (Analytic hierarchy process) peuvent être utilisées (Saaty, 1987). Ce type de méthode permettrait d'obtenir les poids de chacune des pratiques grâce à l'avis des experts. Cependant, l'application d'une seule configuration de pondération des pratiques offre une adaptabilité limitée de notre modèle à différents contextes. Bien que l'outil prenne en compte les caractéristiques de l'université, il serait souhaitable d'établir des profils d'EI (par exemple associés au type d'école : ingénierie, médecine, sciences humaines, etc.) et d'associer à chacun d'eux une configuration de pondération spécifique. À cette fin, une approche théorico-pratique peut être adoptée au moyen de nombreuses études de cas dans différents contextes.

### **Une plus grande précision dans la caractérisation des projets d'innovation**

En ce qui concerne le type de projets qui ont été définis dans l'outil de génération de recommandations pour les projets d'innovation, 3 types de nouveauté ont été définis qui ont permis de caractériser leur complexité. Ces trois types de nouveauté sont : Nouveauté technologique, nouveauté conceptuelle et nouveauté du marché. Dans la mesure où l'espace d'innovation fonctionne de manière plus structurée en gérant un plus grand nombre de projets en parallèle, la caractérisation présentée peut être considérée comme très générique. Une enquête plus détaillée sur les projets mis en œuvre dans les universités pourrait permettre de délimiter davantage le type de projets, en les classant sous différents paramètres tels que :

1. Projets publics ou sociaux : ceux qui ne sont pas à but lucratif, mais qui ont un impact important sur la société ou la population à différentes échelles : locale, régionale, voire mondiale.
2. Projets productifs ou privés : ceux dont le but est la rentabilité. Ils sont typiques de la sphère commerciale, entrepreneuriale ou industrielle.

3. Projets de recherche : ceux qui impliquent des activités pédagogiques, des expériences ou la construction de modèles dans l'une des disciplines scientifiques.

Cette catégorisation peut compléter celle présentée dans notre recherche en générant de nouveaux critères pour la sélection des projets à mettre en œuvre et en favorisant la création de plans de recommandation beaucoup plus détaillés et adaptés aux besoins de l'EIU.

### Affinement des recommandations obtenues

L'utilisation de la grille de maturité comme outil d'évaluation présente de nombreux avantages en proposant des situations concrètes définies pour évaluer le niveau de maturité des pratiques de manière objective. En outre, la grille de maturité permet de tirer des recommandations du texte explicatif avec lequel ses différents niveaux sont construits.

Même si la situation cible est bien connue, il peut arriver que le responsable de l'EI ne sache pas comment réagir pour mettre en œuvre les améliorations pertinentes. Ainsi, l'intégration d'une liste d'actions complémentaires peut améliorer la qualité des recommandations.

Par exemple, le tableau 1, cité dans le chapitre 4, présente le plan de recommandations pour l'EIU de l'Université de Santiago « LEIND ». Dans la pratique « ISP4 » de la dimension physique, la recommandation suivante est proposée :

Sous-pratique	Niveau actuel	Niveau recommandé
Structure et architecture (ISP4)	L'espace d'innovation est flexible et dispose de zones qui favorisent l'exécution d'activités de travail individuel, de collaboration et de fabrication, s'adaptant aussi bien aux petits groupes qu'aux grands groupes (de 3 à 20 personnes).	L'espace d'innovation est flexible en termes de types de zones et de capacité, il dispose de ses propres espaces qui favorisent l'exécution d'activités de collaboration, de fabrication et de travail individuel. Parallèlement, il intègre des zones de présentation qui encouragent la socialisation et le débat (espaces pour les discussions, les pitches, les présentations, etc.).

Tableau 1. Exemple de dimension physique recommandée ISP4.

Même si le niveau recommandé semble suffisamment clair, le responsable de l'EI peut ne pas être sûr des mesures à prendre pour concevoir et aménager les domaines de l'EI de manière satisfaisante. Ainsi, une liste d'actions supplémentaires permettrait de clarifier leurs doutes. Un exemple de liste de contrôle avec les ajouts proposés est présenté ci-dessous :

Pour atteindre le niveau recommandé, vous devez :

1. Définir un protocole standard pour établir les besoins de l'EI qui comprend au moins les étapes suivantes : analyser le profil des utilisateurs de l'EI ; définir le nombre d'utilisateurs fréquents ; analyser les heures de pointe et les heures creuses ; analyser le type d'activités les plus fréquemment réalisées (activités de groupe, fabrication, socialisation, travail individuel, etc.) ; analyser les caractéristiques et les restrictions de l'espace physique à intervenir ; définir le budget et le plan de mise en œuvre.
2. Sur la base des informations fournies par l'analyse des besoins, définissez les domaines à mettre en œuvre en priorité.
3. Définir les caractéristiques de chaque domaine, en tenant compte du fait qu'il doit respecter la condition de flexibilité tant en termes de finalité d'utilisation que d'adaptation à un nombre différent d'utilisateurs.

De la même manière, un plan de recommandations plus détaillé dans l'outil de gestion de projet permettra de progresser rapidement et efficacement.

Cette thèse est donc une contribution méthodologique à la création et à la gestion des espaces d'innovation dans les universités avec des apports théoriques, méthodologiques et expérimentaux. Elle s'inscrit dans la dynamique actuelle de la gestion des espaces d'innovation et du développement des projets d'innovation dans les universités. Elle fournit également ce que nous considérons comme une base nécessaire pour continuer à travailler sur la formalisation de méthodologies qui standardisent le fonctionnement des EI, favorisant le développement de projets internes.

## RÉSUMÉ

Les universités sont un acteur très important pour contribuer au développement des pays, non seulement du point de vue de l'enseignement et de la recherche, mais aussi du point de vue du lien avec l'industrie et la société. Les progrès de la science et de la technologie permettent d'apporter des réponses à différents problèmes et besoins dans tous les domaines du développement. Ainsi, l'innovation et plus particulièrement les espaces d'innovation (EI) représentent une opportunité de collaboration entre les universités et leur environnement. Cependant, la grande diversité des types d'espaces d'innovation représente un défi dans sa mise en œuvre. Chaque type d'espace propose une configuration, des objectifs, un fonctionnement et des résultats différents, rendant difficile la formalisation d'un cadre de référence pour leur création et leur gestion.

Cette thèse cherche à répondre à la question de savoir comment concevoir et gérer un EI dans une université pour soutenir le développement de ses missions. Un modèle conceptuel est proposé en considérant l'intersection entre les facteurs inhérents aux espaces d'innovation et les facteurs représentatifs des missions de l'université, représentés en 7 dimensions (stratégique, physique, technologique, sociale, émotionnelle, cognitive et financière). Sur la base du modèle conceptuel, un outil est proposé pour évaluer la maturité de l'espace d'innovation en obtenant un diagnostic multidimensionnel. Sur la base de ce diagnostic, un plan de recommandations est généré qui propose deux stratégies d'aide à la décision pour la définition de plans d'amélioration de l'EI. Enfin, afin de travailler sur la dynamique de l'espace, un outil de gestion pour le développement de projets est proposé. L'outil analyse le profil de besoins des projets et le résultat de l'évaluation de la maturité de l'EI pour définir un plan de suivi basé sur la méthodologie du " Stage Gate ".

La phase d'expérimentation se déroule en deux étapes: premièrement, le modèle conceptuel est appliqué dans différents EI d'universités chiliennes pour évaluer leur niveau de maturité. Ensuite, un espace d'innovation est choisi parmi les universités étudiées et l'outil de gestion est mis en œuvre dans le développement d'un projet. Pour les managers des espaces d'innovation étudiés, tant le modèle d'évaluation que l'outil de suivi de projet atteignent leur objectif d'aide à la décision pour la planification et le fonctionnement de l'espace, en leur indiquant quelles actions concrètes ils doivent adopter en fonction de leurs objectifs de développement.

**Mots clés:** Espaces d'innovation, apprentissage collaboratif, université entrepreneuriale, Stage Gate, outil d'évaluation.

## ANNEXES

### ANNEX 1. Maturity grid

#### STRATEGIC DIMENSION

The strategic dimension is the pillar where the innovation spaces must consider the operational objectives, space dynamics, evaluation standards, efficiency and efficacy of the processes and resources that are used.

#### STRATEGIC DIMENSION OF THE INNOVATION SPACE

Has the innovation space defined its own operational strategy that delimits and directs the activities and use of resources within the space, benefiting the measuring and evaluation of the expected results?				
I	II	III	VI	V
The innovation space does not have a defined operational strategy.	The innovation space has defined an operational strategy intuitively by a person in charge.	The innovation space has an operational strategy that the team agreed on, in which a person in charge and an expected range are established.	The innovation space has an operational strategy that is clearly established based on a solid study of the environment, defining a person in charge, expected range, and the scheduled execution time.	The innovation space has an operational strategy that is clearly determined based on a solid study of the internal and external environment, defining a person in charge, expected range, the scheduled execution time and its own budget.

Were the environment and the physical resources of the innovation space determined by the operational objective of the space, contributing positively to the activities that were executed in it?				
I	II	III	VI	V
The innovation space does not have nor develops tools that encourage the creation and exchange of knowledge between users.	The innovation space incorporates dissemination elements to encourage the creation and exchange of knowledge (notes on whiteboards, posters, pictures, books, etc.)	The innovation space uses tools for creating and disseminating knowledge, setting specific rules to encourage a support culture to creative work and collaborative learning (written or spoken rules on how to behave in the space, instructions on	The configuration of the innovation space is flexible, and its design stimulates the creation and exchange of knowledge allowing total access among users. The strategic location of the elements benefits the frequent use of social interaction	The configuration of the innovation space is flexible, and its design stimulates the creation and exchange of knowledge allowing total access among users. The strategic location of the elements benefits the frequent use of



		how to close doors, restrictions on the use of space and equipment, limitations on the access to the laboratory.)	zones. The use norms encourage creativity (strategic location of essential objects, like photocopiers or water fridges, informal meeting points like sofas of coffee places, transparent walls, etc.)	social interaction zones. The use norms encourage creativity (strategic location of essential objects, like photocopiers or water fridges, informal meeting points like sofas of coffee places, transparent walls, etc.)
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Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?				
I	II	III	VI	V
The results of the executed activities in the innovation space are evaluated by the personal point of view of the person in charge of the space.	The results of the executed activities in the innovation space are evaluated by the fulfillment of short-term objectives of the space.	The results of the executed activities in the innovation space are measured at the end of each activity with the support of an evaluation rubric, defining the criteria that supports the accomplishment of the objectives of the space.	The results of the executed activities in the innovation space are measured by a rubric that allows the evaluation of the main progress milestones of each activity, giving flexibility to the process and adapting it to the objectives of the space.	The results of the executed activities in the innovation space are measured with a monitoring system based on the definition of KPI that allows evaluating in a multifactorial way the progress of each activity's stage, assuring the accomplishment of the space objectives.

### PHYSICAL DIMENSION

The physical dimension of an innovation space considers the structure, and physical and design elements, which by their configuration must support creative processes.

#### PHYSICAL DIMENSION OF THE INNOVATION SPACE

Is the architectural structure of the innovation space flexible? Does it have zones that adapt to different activities properly?				
I	II	III	VI	V
The innovation space does not have zones that benefit the execution of collaborative activities (open and big zones.)	The innovation space has limited zones, but their adaptation allows the execution of at least two kinds of different activities (collaborative, manufacturing and/or individual activities) with a limited number of participants (from 3 to 6 people).	The innovation space is flexible and has zones that benefit the execution of collaborative, manufacturing, and individual activities. It adapts to small and big groups properly (from 3 to 20 people.)	The innovation space is flexible in terms of zones and capacity, it has spaces that benefit the execution of collaborative, manufacturing and individual activities. Meanwhile it incorporates presentation zones that encourage social interaction and debate (places to talk, pitch, presentations, etc.)	The innovation space has a variety of different zones to execute collaborative, manufacturing and individual activities. It has interruption zones (resting, coffee, game zones, etc.) and presentation zones (places to talk, pitch, presentations, etc.) that benefit social interaction, debate and communication..)

Does the innovation space provide design elements that guide and benefit the creative process?				
I	II	III	VI	V
The innovation space has not been intervened. It keeps its wall colors, lighting and furniture like a traditional university classroom.	The innovation space keeps its wall colors, lighting and furniture like a traditional university classroom. However, the furniture was acquired and adapted to respond to and support executed activities in a better way.	The furniture of the innovation space was chosen and acquired to guarantee a proper development of executed activities. Additionally, elements have been added to stimulate users and benefit creativity (lighting, colors, texture.)	The innovation space has furniture and a design of adapted zones that support the development of activities, stimulating users and benefiting creativity. Additionally, it has elements that benefit social interaction (sofas or coffee machines.)	The innovation space has a design that respond to strategic operational objectives. Its lighting, colors and texture benefit sensory stimulation. Furniture is flexible and comfortable. It has zones that encourage social interaction and the exchange of knowledge (libraries, reading zones.)

**PHYSICAL DIMENSION ACADEMIC MISSION:**

Do the physical dimension and equipment of the innovation space support activities of collaborative learning?				
I	II	III	VI	V
The configuration of the innovation space and its furniture are rigid, limiting the development of collaborative learning activities.	The configuration of the innovation space and/or its furniture are not so flexible, but they allow adapting zones to execute collaborative and basic learning activities (low number of participants, 3 – 6 people, and not much interaction.)	The configuration of the innovation space and its furniture are flexible and ergonomic, encouraging the execution of academic and collaborative activities and benefiting the wellbeing of students and teachers (medium interaction, 6 – 15 people.)	The innovation space was intervened to create a configuration and design that stimulate creativity and benefit collaborative learning activities. Its zones and furniture are flexible and ergonomic. It incorporates some elements that benefit sensory stimulation (colorful, light and bright places) (high level of interaction, 6 – 20 people.)	The innovation center was designed to do learning activities based on collaborative work that encourage creativity and the exchange of ideas, it has open zones, flexible and ergonomic furniture that benefits reconfiguration, adapting it to different activities and number of users. The wall colors, lighting and decoration respond to concepts that benefit the sensory stimulation and people’s creativity.

**PHYSICAL DIMENSION BUSINESS MISSION:**

Do the physical space and equipment of the innovation space benefit the execution of entrepreneurial activities and/or technology transfer?				
I	II	III	VI	V

The innovation space provides distant support to entrepreneurial activities and/or technology transfer, but it does not have physical space for these tasks.	The innovation space uses physical areas of other campus places that provide resources to develop entrepreneurial activities and/or technology transfer (teachers' room, computer room, etc.)	The innovation space has its own areas that encourage entrepreneurial activities and/or technology transfer, allowing joint use of basic ITC (computer zones provided with internet and office software.)	The innovation space has common areas that consider manufacturing and office zones provided with computer equipment with internet, basic software and developing software, which are available for executing entrepreneurial activities and/or technology transfer.	The innovation space has manufacturing zones, office zones, presentation rooms, and business rooms that encourage the relationship between industry and academy. It defines zones for personal use outside campus that take part in entrepreneurial projects and/or technology transfer.
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### TECHNOLOGICAL DIMENSION

The technological dimension of an innovation space considers two main points: technology as a manufacturing tool, development and usability testing; and technology as a support to interaction within the space.

#### TECHNOLOGICAL DIMENSION INNOVATION SPACE:

Does the innovation space have technological devices that support activities determined in the operational objectives of the space (machinery, technological equipment, software, apps)?				
I	II	III	VI	V
The innovation space does not use technological equipment in the development of entrepreneurial activities, innovation and research.	The innovation space does not have technological resources but uses other campus places to execute manufacturing activities and/or usability testing.	The innovation space has at least 2 basic technological resources that allow the execution of manufacturing activities and/or usability testing in a limited way. To make up its shortcoming in project development, it requires support from other campus places that have specialized technology.	The innovation space has a wide variety of technological tools (low and medium-end) that benefit the execution of manufacturing activities and/or usability testing, allowing it to manage different kinds of projects by itself. Additionally, it encourages the use of technology that facilitate interaction and communication among space users (web page, social media.)	The innovation space is provided with medium and high-end technological equipment, benefiting project development that require specialized manufacturing activities and usability testing. IT is a frequent support in the development and dissemination of projects. And there is a plan considering technology acquisition that

				is aligned with the strategic objectives of the space (short and medium-term.)
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### TECHNOLOGICAL DIMENSION ACADEMIC MISSION:

Does the innovation space encourage the use of ICT to develop collaborative learning activities?				
I	II	III	VI	V
The innovation space does not use ICT tools to develop activities related to collaborative learning.	The innovation space implements ICT tools in its academic activities in a basic way, using resources to organize work and share files (digital calendars, Dropbox, drive, etc.)	The innovation space supports the collaborative learning process with ICT tools that allow space users to share files, communicate, debate and collaborate in different teams through a technological platform (Blogger, WordPress, Tumblr, Wikia, Wikispaces Classroom, Remind, Google Hangouts, etc.)	The innovation space has implemented virtual work environments through free platforms to execute collaborative learning activities, offering training on the use of these tools to encourage their incorporation in the space dynamics (making, sharing and storing files online, chats, videoconferences, mails, calendars, and online office tools.)	The innovation space has determined the use of ICT tools as a rule to develop collaborative learning activities. It has licenses to implement its own virtual work environments. It benefits learning activities by gathering information on developed projects as a strategy to record a virtual project history that complements the internal enquiry database.

### TECHNOLOGICAL DIMENSION BUSINESS MISSION:

Does the innovation space encourage activities that create a technological infrastructure of research and entrepreneurship?				
I	II	III	VI	V

<p>The innovation space does not have nor use technological equipment in the development of entrepreneurial and/or research activities.</p>	<p>The space of innovation does not have technological equipment to develop entrepreneurial and/or research activities, so it uses other campus spaces provided with technology to execute these kinds of activities.</p>	<p>The innovation space has enough technological equipment to support entrepreneurial and/or research projects from basic to medium development without requiring external support. It incorporates basic technological vigilance activities using online browsers mainly.</p>	<p>The innovation space encourages incremental innovation projects, creating activities to develop new technology for internal use. It has high and low-end technological equipment that support entrepreneurship and research. It incorporates technological vigilance activities using specialized software (patent analysis, etc.)</p>	<p>The innovation center has a solid technological structure with medium and high-end technology that supports entrepreneurship and research. It encourages activities to create new technology for internal and external use. It creates radical innovation projects by linking academic and industrial spaces. It incorporates technological vigilance using specialized software frequently (patent analysis, etc.)</p>
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### EMOTIONAL DIMENSION

The emotional dimension responds to interaction and sense of community that must exist in an innovation space.

#### EMOTIONAL DIMENSION INNOVATION SPACE

<p>Do the structure and dynamics of the innovation space encourage interaction, communication, and relationship among different actors benefiting the sense of belonging to the space and the creation of community?</p>				
I	II	III	VI	V

There is a vertical structure among the different actors of the innovation space, establishing protocols of formal communication and private work areas that limit interaction among users with different positions or roles within the space.	The development of everyday activities within the innovation space shows a vertical structure. However, regular social interaction occasions are generated that allow users to have a limited communication channel with the different actors of the space.	The management and users of the innovation space avoid generating personal relationships in a vertical structure. Proper environments are provided to interact spontaneously; observation, reflection and/or generation of informal conversations among the different actors of the space.	The structure and dynamics of the innovation space benefit communication and the exchange of ideas, creating a proximity and visibility environment among the users of the space. During the development of activities, the distinction of hierarchical positions is avoided, encouraging interaction among different projects and disciplines (common work areas and social interaction places.)	The innovation space encourages horizontal work relationships and the creation of multidisciplinary teams. Users share the same vision of collaborative creation formalized in a community. The adopted interaction dynamics encourage the sense of belonging benefiting the execution and dissemination of projects.
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### EMOTIONAL DIMENSION ACADEMIC MISSION

In the creation and development of academic activities within the innovation space, are the technical-professional-soft skills of each participant analyzed and valued to make effective teams?				
I	II	III	VI	V
In the development of academic activities, team making is done intuitively, based on affinity criteria for the definition of responsibilities.	The innovation space evaluates people's individual skills (technical and human skills) and collaborative skills (coordination, communication, and cooperation) during the learning process, as feedback to improve team performance.	The innovation space establishes an analysis stage and technical-soft skill validation as input to make homogenous work teams in academic activities, assuring previously high levels of cohesion and decision making faster to improve the learning process.	The innovation space acknowledges the importance of making multidisciplinary and effective teams to develop a proper learning process. For that purpose, it uses methodological tools that guarantee the definition of proper roles in a team based on people's qualities (team building.)	The innovation space establishes a continuous improvement process linked to work team strengthening. During learning activities, each person's abilities are evaluated defining roles and correcting aspects such as: willpower to do a task, interest, enthusiasm,

				anger, anxiety and boredom.
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### **EMOTIONAL DIMENSION BUSINESS MISSION**

Does the innovation space promote dynamics focused on encouraging business activities, generating a balance between the academic and business interests within the space?				
I	II	III	VI	V
The innovation space does not generate dynamics that encourage business activities between teachers and users of the space.	The innovation space works with teachers and students to make strategies that motivate academia to be part of business projects, valuing teachers' opinion when delimiting objectives (doing tournaments, workshops, courses, etc.; things that involve the participation of an external company.)	The innovation space promotes encouragement associated with public teacher-student recognition for their participation in business projects. It generates activities regularly related to working with external companies and business ventures.	The innovation space establishes a work protocol with external business ventures and companies. In projects, teachers' work is protected to keep academic autonomy and incentives are determined recognizing working hours in the performance agreement.	The innovation space formalizes a work protocol with external business ventures and companies. It values teachers' work by giving clear incentives related to their contracts and/or performance agreement. It promotes and finances participation of work teams and teachers going through training and specialized training, attendance to events and seminars, and exchanges and international internships.

### **SOCIAL DIMENSION**

The social dimension places the innovation space in the real-world context, acknowledging the social and cultural influence that exists in the development of innovation projects.

### **SOCIAL DIMENSION OF THE INNOVATION SPACE**



Does the management of the innovation space understand the importance of including the surroundings in its functioning dynamics? Does it develop community links and create projects that have a real impact on the territory?				
I	II	III	VI	V
The innovation space does not generate interaction activities with the community. It does not manage projects to solve issues that affect the surroundings. Its function is based on learning and the use of technological tools only for business purposes.	The innovation space promotes the execution of events that allow presenting the real needs of the community and territory. It participates in the diagnosis of local issues based on learning and knowledge exchange, but it does not manage collaborative projects of territorial interest.	The innovation space provides a proper social-spatial structure to encourage interaction with the community and develop cohesion based on shared visions and motivations. It includes the surroundings and the social context needs in its activities. It sets up projects that involve the community, academia and industry's participation in their development.	The innovation space leads and manages collaborative projects of territorial interest, that involve academic and industrial agents' participation in their development. It includes users as a source of information and promotes the generation of networks that encourage knowledge exchange (formal/ informal and internal/ external.)	The innovation space formalizes collaboration strategies, achieving efficient results in the execution and finance of projects of territorial co-creation that involves teachers, students, administration personnel, and actors from the local surroundings. It manages and participates in collaborative projects of social and territorial impact that strengthen the university's mission.

### SOCIAL DIMENSION ACADEMIC MISSION

Within the academic activities developed in the innovation space, are strategies established to strengthen and reinforce the relationship among work teams?				
I	II	III	VI	V
The innovation space does not establish opportunities that allow the creation of social interaction activities within the collaborative learning process.	The innovation space does not incorporate social interaction dynamics frequently within the collaborative learning process. However. It has the capacity to generate activities that encourage dialogue when users request it.	The innovation space has established social interaction dynamics as a part of the collaborative learning process. It generates activities that strengthen dialogue and trust among different users of the space.	The innovation space promotes a dialogue and trust culture among different users of the space. It establishes positive feedback dynamics within the collaborative learning process that aim to strengthen tolerance and respect to different personalities and points of view.	The innovation space formalizes social interaction dynamics and collaboration among different projects. It establishes a communication and trust culture that allows the creation of debates based on tolerance and respect, as a contribution to strengthen collaborative

				learning activities.
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### **SOCIAL DIMENSION BUSINESS MISSION**

<b>Does the innovation space establish parameters to create networks with companies and other education institutions that strengthen the relationship between academia and industry?</b>				
<b>I</b>	<b>II</b>	<b>III</b>	<b>VI</b>	<b>V</b>
The innovation space does not establish internal nor external relationships with other innovation centers, education institutions and/or companies.	The innovation space promotes the participation of students and teachers in specialized entities inside and outside university informally. It encourages experiences and multidisciplinary-work activities (research labs, innovation spaces, institutional projects, etc.)	The innovation space defines an organizing structure to promote interaction between the public and private sector, establishing formal mechanisms of collaboration and/or technology transfer (signed agreements, protocols, official	Currently, the innovation space executes at least one formal project with university-industry characteristics. The relationship with external companies, public or private, is formalized by a contract or an agreement (including collaborative research, research by	The innovation space has a formal structure of university-industry relationship, in which at least 3 projects of direct collaboration between academics and industry have been developed. It has formal mechanisms for technology transfer (patents, license concession with

		participation in networks.)	contract, consultancy, etc.)	the collaboration of creators, university-industry's research centers, and collaborative research.)
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### COGNITIVE DIMENSION

The cognitive dimension is related to learning. It defines activities in which knowledge is spread through formal links among students, teachers, researchers, companies and the space.

#### **COGNITIVE DIMENSION ACADEMIC MISSION**

Does the innovation space establish a financial structure that supports the expense on R&D?				
I	II	III	VI	V
The innovation space does not establish learning methods guided by a teacher in the development of activities.	The innovation space establishes learning methods guided by a teacher in the development of academic and/or business activities.	The innovation space is a support to the execution of academic courses. It frequently integrates teachers in the operational activities of the space. The knowledge acquired by students is formally evaluated.	The innovation space is formally linked to university's academic activities. It participates in the development of academic courses, memoirs, thesis projects, and research projects led by teachers.	The innovation space takes part into the university's academic offer. Academic training activities are developed certified by teachers and the institution. Activities are set up to encourage research (thesis projects, courses, workshops, seminars, certification courses, etc.)

#### **COGNITIVE DIMENSION BUSINESS MISSION**

Does the innovation space strengthen relationship skills of its staff (researchers, teachers, students and administrative personnel) with the market (marketing, finance agencies and operational competencies)?				
I	II	III	VI	V
The innovation space does not establish any training activities that allow space users to get involved in activities with the industry.	The innovation space promotes participation in business activities that strengthen learning of norms and business skills (tournaments, challenges, contests, workshops, open meetings.)	The innovation space establishes regular training to strengthen industrial and business knowledge of the environment in a technological and scientific context (workshops with national or international experts in topics related to research commercialization, markets, and customers' needs.)	The innovation space defines incentives that support staff participation in specialized training linked to business skills development in an academic context (fundings for participating in counsel training and coaching for researchers and teachers, research commercialization terms.)	The innovation space establishes a training structure for space users in which certified skill training is executed related to the market. Additionally, it finances specialized training of its staff in business skills that allow success probability to increase and academia's interest in business projects as well.

### **FINANCIAL DIMENSION**

The financial dimension refers to the expense on R&D, both in human capital investment and ability development (equipment, training, incentives, etc.)

#### **FINANCIAL DIMENSION BUSINESS MISSION**

Does the innovation space establish a financial structure that supports the expense on R&D?				
I	II	III	VI	V
The innovation space does not have an established budget that allows it to invest in R&D autonomously.	The innovation space depends on a centralized budget that is run by the university, allowing to invest in R&D in a limited way according to external criteria. The level of investment is low.	The innovation space has a mixed budget to invest in R&D. Part of the resources are centralized by the university and the other part respond to its own projects that are being executed. The level of investment is on a low and medium scale.	The innovation space is regulated by a mixed financial structure. It manages a stable budget that allows it to have autonomy and finance its expense on R&D annually with its own projects. At the same time, it receives part of the resources from the centralized budget run by the	The innovation space has a stable financial structure that allows it to manage and participate in R&D projects autonomously. It has defined an investment plan in the short and long-term. The level of investment is on a high scale.

			university. The level of investment is on a medium scale.	
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## ANNEX 2. Roject requirement matrix

PROJECT REQUIREMENT MATRIX						
Performance and projection (ISP1)						
STRATEGIC DIMENSION	Has the innovation space defined its own operational strategy that delimits and directs the activities and use of resources within the space, benefiting the measuring and evaluation of the expected results?					
	<b>Maturity Level 1</b>	The innovation space does not have a defined operating strategy.				
	<b>Maturity Level 2</b>	The innovation space has an operating strategy defined intuitively by an assigned manager.				
	<b>Maturity Level 3</b>	The innovation space has an operating strategy with clear objectives, led by the manager assigned and agreed with the work team.				
	<b>Maturity Level 4</b>	The innovation space has an operating strategy established based on the study of the institutional context. It defines the assigned manager, the expected scope, and the execution time in the short and medium term.				
	<b>Maturity Level 5</b>	The innovation space has a clearly established operating strategy based on an internal (university needs) and external study (community needs) defining an assigned manager, scope, execution time (medium and long term) and its own budget.				
	TECHNOLOGICAL NOVELTY					
	LOW		MEDIUM		HIGH	
	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
	4	4	4	4	4	4
	5	5	5	5	5	5
	CONCEPT NOVELTY					
	LOW		MEDIUM		HIGH	
	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
4	4	4	4	4	4	
5	5	5	5	5	5	
MARKET NOVELTY						
LOW		MEDIUM		HIGH		
BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	

1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>Tangible institutional resources (ISP2)</b>					
Were the environment and physical resources of the innovation space defined in function of the operational objective, contributing positively to the activities carried out in it?					
<b>Maturity Level 1</b>	The innovation space does not have its own physical environment.				
<b>Maturity Level 2</b>	The innovation space makes use of its own physical environment incorporating elements of dissemination to promote the exchange and generation of knowledge (sticky notes, whiteboards, informative posters, images, books, etc.) .				
<b>Maturity Level 3</b>	The innovation space uses tools for the generation and dissemination of knowledge. It establishes rules for the access and use of resources, promoting a culture of support for creative and collaborative work (written or unwritten rules on how to behave in the space, instructions to close the doors, restriction on the use of equipment or spaces, limitation on access to the laboratory).				
<b>Maturity Level 4</b>	The innovation space is semi-directed and has a flexible configuration that allows the execution of different creativity activities, promoting the generation and exchange of knowledge. (flexibility=ability to switch from one type to another with minimal effort and time).				
<b>Maturity Level 5</b>	The configuration of the innovation space is flexible, and its design stimulates the exchange and generation of knowledge. Rules of commitment, responsibility, and behavior are defined for users that guarantee free access and use of resources. The strategic location of elements benefits the frequent use of areas of social interaction (strategic location of central objects, such as photocopiers or water coolers, informal meeting points such as sofas or coffee corners, transparent walls, etc.).				
<b>TECHNOLOGICAL NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>CONCEPT NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4

5	5	5	5	5	5
<b>MARKET NOVELTY</b>					
<b>LOW</b>		<b>MEDIUM</b>		<b>HIGH</b>	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>Innovation performance (ISP3)</b>					
Does the innovation space execute a constant monitoring plan in the development of the activities that are carried out and measure their results?					
<b>Maturity Level 1</b>	The result of the activities carried out in the innovation space is not evaluated.				
<b>Maturity Level 2</b>	The innovation space has an operating strategy The person in charge of the innovation space intuitively defines general objectives to evaluate the result of the activities carried out. intuitively by an assigned manager.				
<b>Maturity Level 3</b>	The result of the activities carried out in the innovation space is measured with the support of an evaluation rubric proposed by the person in charge of the space. The rubric defines criteria that support the fulfillment of the operational objectives of the space.				
<b>Maturity Level 4</b>	The activities carried out in the innovation space are measured by defining an evaluation rubric with objectives of the space proposed in the short and medium term. Its results are analyzed biannually and annually with the work team, who validate or propose a rubric for the period that begins.				
<b>Maturity Level 5</b>	The result of the activities carried out in the innovation space is measured with a monitoring system based on the definition of KPIs that allows evaluating the progress in each stage of the activity in a multifactorial way, ensuring the fulfillment of the space objectives (short, medium, and long term). This evaluation system must be defined jointly by the person in charge of the space, their work team, and an academic authority.				
<b>TECHNOLOGICAL NOVELTY</b>					
<b>LOW</b>		<b>MEDIUM</b>		<b>HIGH</b>	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>CONCEPT NOVELTY</b>					
<b>LOW</b>		<b>MEDIUM</b>		<b>HIGH</b>	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1



	2	2	2	2	2	2
	3	3	3	3	3	3
	4	4	4	4	4	4
	5	5	5	5	5	5
	MARKET NOVELTY					
	LOW		MEDIUM		HIGH	
	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
	4	4	4	4	4	4
	5	5	5	5	5	5
	<b>Structure &amp; Architecture (ISP4)</b>					
<b>PHYSICAL DIMENSION</b>	Is the architectural structure of the innovation space flexible? Does it have areas that are well suited to different activities?					
	<b>Maturity Level 1</b>	The innovation space does not have areas that allow the execution of collaborative activities (wide and open areas).				
	<b>Maturity Level 2</b>	The innovation space has limited areas, but its adaptation allows the execution of at least two different types of activities (collaborative, manufacturing, and / or individual work activities) with a small number of participants (from 3 to 6 people).				
	<b>Maturity Level 3</b>	The innovation space is flexible and has areas that benefit the execution of individual work, collaborative, and manufacturing activities, adapting to both small groups and large groups in a good way (from 3 to 20 people).				
	<b>Maturity Level 4</b>	The innovation space is flexible in type of areas and capacity, it has its own spaces that benefit the execution of collaborative, manufacturing, and individual work activities. At the same time, it incorporates presentation areas that encourage socialization and debate (spaces for talks, pitch, presentations, etc.).				
	<b>Maturity Level 5</b>	The innovation space has a variety of differentiated areas for the execution of collaborative, manufacturing, and individual work activities. It integrates intermission areas (rest areas, coffee areas, playground, etc.) and presentation areas (spaces for talks, pitches, presentations, etc.), which benefit socialization, debate and communication.				
	TECHNOLOGICAL NOVELTY					
	LOW		MEDIUM		HIGH	
	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
	1	1	1	1	1	1
	2	2	2	2	2	2
3	3	3	3	3	3	
4	4	4	4	4	4	
5	5	5	5	5	5	
CONCEPT NOVELTY						

LOW		MEDIUM		HIGH	
BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
MARKET NOVELTY					
LOW		MEDIUM		HIGH	
BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>Interior design (ISP5)</b>					
Does the innovation space provide design elements that guide and benefit the creative process?					
<b>Maturity Level 1</b>	The innovation space has not been intervened. It keeps the color of walls, lighting, and furniture like a traditional classroom at the university.				
<b>Maturity Level 2</b>	The innovation space keeps the traditional color of walls and lighting of a university classroom. However, the furniture was acquired and adapted to better respond to and support the activities being carried out.				
<b>Maturity Level 3</b>	The furniture of the innovation space was chosen and acquired with the aim of guaranteeing an adequate development of the activities that are carried out. Additionally, elements have been added that generate stimuli to users and benefit creativity (lighting, colors, textures).				
<b>Maturity Level 4</b>	The innovation space has adapted furniture and area design that supports the development of activities, generating stimulation in users and benefiting creativity. Additionally, it has elements that benefit social interaction (sofas or coffee machine).				
<b>Maturity Level 5</b>	The innovation space has its own design that responds to the strategic objectives of operation. Its lighting, colors, and textures benefit sensory stimulation. Furniture is flexible and comfortable. It has areas that encourage social interaction and the exchange of knowledge (libraries, reading areas).				
TECHNOLOGICAL NOVELTY					
LOW		MEDIUM		HIGH	
BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
CONCEPT NOVELTY					

LOW		MEDIUM		HIGH	
BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
MARKET NOVELTY					
LOW		MEDIUM		HIGH	
BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>Collaborative learning environments (ISAMP1)</b>					
Does the physical space and equipment of the innovation space support collaborative learning activities?					
<b>Maturity Level 1</b>	The configuration of the innovation space and its furniture is rigid, limiting the development of collaborative learning activities.				
<b>Maturity Level 2</b>	The configuration of the innovation space and /or its furniture is not very flexible, but it allows the areas to be adapted to carry out basic collaborative learning activities (low number of participants, 3-6 people, and little interaction).				
<b>Maturity Level 3</b>	The configuration of the innovation space and its furniture is flexible and ergonomic, promoting the execution of collaborative academic activities, and benefitting the well-being of students and teachers (medium interaction of 6 to 15 people).				
<b>Maturity Level 4</b>	The innovation space was intervened to generate a configuration and design that stimulates creativity and benefits collaborative learning activities. Its areas and furniture are flexible and ergonomic. It incorporates some elements that benefit sensory stimulation (colorful and bright places) (high interaction of 6 to 20 people).				
<b>Maturity Level 5</b>	The innovation center was designed to carry out teaching activities based on collaborative work that promote creativity and the exchange of ideas. It has open areas, flexible and ergonomic furniture that benefits reconfiguration, adapting it to different activities and number of users. The colors of walls, lighting, and decoration respond to concepts that benefit sensory stimulation and people's creativity.				
TECHNOLOGICAL NOVELTY					
LOW		MEDIUM		HIGH	
BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4

5	5	5	5	5	5
<b>CONCEPT NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>MARKET NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>Business linkage environments (ISBMP1)</b>					
Does the physical space and equipment of the innovation space benefit the execution of entrepreneurial activities and / or technology transfer?					
<b>Maturity Level 1</b>	The innovation space provides remote support to entrepreneurial and/or technology transfer activities, but it does not have its own physical space for this purpose.				
<b>Maturity Level 2</b>	The innovation space uses physical areas of other spaces of the university equipped with resources to develop entrepreneurship and / or technology transfer activities (teachers' room, computer rooms, etc.).				
<b>Maturity Level 3</b>	The innovation space has its own areas that promote entrepreneurship and/or technology transfer activities, allowing the joint use of basic information and communication technologies (areas with computers equipped with internet and office software).				
<b>Maturity Level 4</b>	The innovation space has common areas that include manufacturing and office areas equipped with computer devices with internet, basic software, and developer software, which are arranged for the execution of entrepreneurship and / or technology transfer activities.				
<b>Maturity Level 5</b>	The innovation space has manufacturing areas, office areas, presentation rooms and business rooms that promote the industry's relationship with academia. It defines areas for the use of external staff of the university that is part of entrepreneurship projects and / or technology transfer.				
<b>TECHNOLOGICAL NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2

3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>CONCEPT NOVELTY</b>					
<b>LOW</b>		<b>MEDIUM</b>		<b>HIGH</b>	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>MARKET NOVELTY</b>					
<b>LOW</b>		<b>MEDIUM</b>		<b>HIGH</b>	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5

**Manufacturing and communication (ISP6)**

<b>TECHNOLOGICAL DIMENSION</b>	Does the innovation space have technological devices that support activities defined in the operational objectives of the space (machines, technological equipment, software, applications)?	
	<b>Maturity Level 1</b>	The innovation space does not make use of technological equipment in the development of entrepreneurship, innovation, and research activities.
	<b>Maturity Level 2</b>	The innovation space does not have technological resources but makes use of other spaces of the university to execute manufacturing activities and / or usability tests.
	<b>Maturity Level 3</b>	The innovation space has at least 2 core technologies that allow it to perform manufacturing activities and/or usability testing in a limited way. To complement its shortcomings in the development of projects, it relies on other spaces of the university that have specialized technologies.
	<b>Maturity Level 4</b>	The innovation space has a wide variety of technological tools (low and medium end) that benefit the execution of manufacturing activities and / or usability tests allowing to autonomously manage different types of projects. Additionally, it promotes the use of technologies that facilitate interaction and communication among users of the space (website, use of social networks).
	<b>Maturity Level 5</b>	The innovation space is equipped with medium and high-end technological equipment benefitting the development of projects that require manufacturing activities and specialized usability tests. Communication technologies are a frequent support in the development and dissemination of projects. And there is a technology acquisition plan that is aligned with the strategic objectives of the space (in the short or medium term).
	<b>TECHNOLOGICAL NOVELTY</b>	
<b>LOW</b>		
<b>MEDIUM</b>		
<b>HIGH</b>		

BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>CONCEPT NOVELTY</b>					
LOW		MEDIUM		HIGH	
BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>MARKET NOVELTY</b>					
LOW		MEDIUM		HIGH	
BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>ICT for collaborative learning (ISAMP2)</b>					
Does the innovation space promote the use of ICT tools to develop collaborative learning activities?					
<b>Maturity Level 1</b>	The innovation space does not make use of ICT tools for the development of activities associated with collaborative learning.				
<b>Maturity Level 2</b>	The innovation space implements the use of ICT tools in its academic activities in a basic way. Using resources to organize work and share files (digital calendars, Dropbox, drive, etc.).				
<b>Maturity Level 3</b>	The innovation space supports the collaborative learning process with ICT tools that allow users of the space to share files, communicate, debate, and collaborate in different teams through a technological platform (Blogger, WordPress, Tumblr, Wikia, Wikispaces Classroom, Remind, Google Hangouts, etc.).				
<b>Maturity Level 4</b>	The innovation space has implemented virtual work environments on free platforms to execute its collaborative learning activities, training on the use of these tools to promote their incorporation into the dynamics of the space (to create, share and store files online, chat, video conferences, mail, calendar and online office automation tools).				

<b>Maturity Level 5</b>	The innovation space has defined the use of ICT tools as a norm for the development of collaborative learning activities. It has permissions and licenses for the deployment of its own virtual work environments. It benefits learning activities by collecting information of the projects developed, as a strategy to establish a virtual history of projects that complements the database of internal queries.					
	<b>TECHNOLOGICAL NOVELTY</b>					
	LOW		MEDIUM		HIGH	
	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
	4	4	4	4	4	4
	5	5	5	5	5	5
	<b>CONCEPT NOVELTY</b>					
	LOW		MEDIUM		HIGH	
	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
4	4	4	4	4	4	
5	5	5	5	5	5	
<b>MARKET NOVELTY</b>						
LOW		MEDIUM		HIGH		
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	
1	1	1	1	1	1	
2	2	2	2	2	2	
3	3	3	3	3	3	
4	4	4	4	4	4	
5	5	5	5	5	5	
<b>Technological infrastructure for R+D+I+e (ISBM2)</b>						
Does the innovation space promote activities that generate a technological infrastructure for research and entrepreneurship?						
<b>Maturity Level 1</b>	The innovation space does not have or make use of technological equipment in the development of entrepreneurship and / or research activities.					
<b>Maturity Level 2</b>	The innovation space does not have technological equipment for the development of entrepreneurship and / or research activities, so it makes use of other spaces of the university equipped with technology to execute this type of activities.					
<b>Maturity Level 3</b>	The innovation space has sufficient technological equipment to support entrepreneurship projects and / or research from basic to medium development without requiring the support of third parties. It incorporates basic technological vigilance activities using mainly internet search engines.					

	<b>Maturity Level 4</b>	The innovation space promotes incremental innovation projects by generating activities to develop new technologies for internal use. It has high- and mid-end technological equipment that supports entrepreneurship and research. It incorporates technology vigilance activities using specialized software for this work (patent analysis, etc.).					
	<b>Maturity Level 5</b>	The innovation center has a solid technological structure with medium and high-end technology that supports entrepreneurship and research. It promotes activities to create new technologies for internal and external use. It generates radical innovation projects linking academic and industrial spaces. It incorporates technological vigilance activities using specialized software on a recurring basis (patent analysis, etc.).					
<b>TECHNOLOGICAL NOVELTY</b>							
LOW		MEDIUM			HIGH		
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
<b>CONCEPT NOVELTY</b>							
LOW		MEDIUM			HIGH		
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
<b>MARKET NOVELTY</b>							
LOW		MEDIUM			HIGH		
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
<b>Interaction and community (ISP7)</b>							
<b>EMOTIONAL</b>	Do the structure and dynamics of the innovation space encourage interaction, communication, and relationship among different actors benefiting the sense of belonging to the space and the creation of community?						
	<b>Maturity Level 1</b>	There is a vertical structure among the different actors of the innovation space, establishing protocols of formal communication and private work areas that limit interaction among users with different positions or roles within the space.					



<b>Maturity Level 2</b>	The development of everyday activities within the innovation space shows a vertical structure. However, regular social interaction occasions are generated that allow users to have a limited communication channel with the different actors of the space.					
<b>Maturity Level 3</b>	The management and users of the innovation space avoid generating personal relationships in a vertical structure. Proper environments are provided to interact spontaneously; observation, reflection and/or generation of informal conversations among the different actors of the space.					
<b>Maturity Level 4</b>	The structure and dynamics of the innovation space benefit communication and the exchange of ideas, creating a proximity and visibility environment among the users of the space. During the development of activities, the distinction of hierarchical positions is avoided, encouraging interaction among different projects and disciplines (common work areas and social interaction places.)					
<b>Maturity Level 5</b>	The innovation space encourages horizontal work relationships and the creation of multidisciplinary teams. Users share the same vision of collaborative creation formalized in a community. The adopted interaction dynamics encourage the sense of belonging benefiting the execution and dissemination of projects.					
<b>TECHNOLOGICAL NOVELTY</b>						
LOW		MEDIUM		HIGH		
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	
1	1	1	1	1	1	
2	2	2	2	2	2	
3	3	3	3	3	3	
4	4	4	4	4	4	
5	5	5	5	5	5	
<b>CONCEPT NOVELTY</b>						
LOW		MEDIUM		HIGH		
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	
1	1	1	1	1	1	
2	2	2	2	2	2	
3	3	3	3	3	3	
4	4	4	4	4	4	
5	5	5	5	5	5	
<b>MARKET NOVELTY</b>						
LOW		MEDIUM		HIGH		
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	
1	1	1	1	1	1	
2	2	2	2	2	2	
3	3	3	3	3	3	
4	4	4	4	4	4	
5	5	5	5	5	5	
<b>Team engagement (ISAM3)</b>						

In the creation and development of academic activities within the innovation space, are the technical-professional-soft skills of each participant analyzed and valued to make effective teams?					
<b>Maturity Level 1</b>		The innovation space evaluates people's individual skills (technical and human skills) and collaborative skills (coordination, communication, and cooperation) during the learning process, as feedback to improve team performance.			
<b>Maturity Level 2</b>		The innovation space implements the use of ICT tools in its academic activities in a basic way. Using resources to organize work and share files (digital calendars, Dropbox, drive, etc.).			
<b>Maturity Level 3</b>		The innovation space establishes an analysis stage and technical-soft skill validation as input to make homogenous work teams in academic activities, assuring previously high levels of cohesion and decision making faster to improve the learning process.			
<b>Maturity Level 4</b>		The innovation space acknowledges the importance of making multidisciplinary and effective teams to develop a proper learning process. For that purpose, it uses methodological tools that guarantee the definition of proper roles in a team based on people's qualities (team building.)			
<b>Maturity Level 5</b>		The innovation space establishes a continuous improvement process linked to work team strengthening. During learning activities, each person's abilities are evaluated defining roles and correcting aspects such as: willpower to do a task, interest, enthusiasm, anger, anxiety and boredom.			
<b>TECHNOLOGICAL NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>CONCEPT NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>MARKET NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3

4	4	4	4	4	4
5	5	5	5	5	5
<b>Academic and commercial interests (ISBM3)</b>					
Does the innovation space promote dynamics focused on encouraging business activities, generating a balance between the academic and business interests within the space?					
<b>Maturity Level 1</b>	The innovation space does not generate dynamics that encourage business activities between teachers and users of the space.				
<b>Maturity Level 2</b>	The innovation space works with teachers and students to make strategies that motivate academia to be part of business projects, valuing teachers' opinion when delimiting objectives (doing tournaments, workshops, courses, etc.; things that involve the participation of an external company.)				
<b>Maturity Level 3</b>	The innovation space promotes encouragement associated with public teacher-student recognition for their participation in business projects. It generates activities regularly related to working with external companies and business ventures.				
<b>Maturity Level 4</b>	The innovation space establishes a work protocol with external business ventures and companies. In projects, teachers' work is protected to keep academic autonomy and incentives are determined recognizing working hours in the performance agreement.				
<b>Maturity Level 5</b>	The innovation space formalizes a work protocol with external business ventures and companies. It values teachers' work by giving clear incentives related to their contracts and/or performance agreement. It promotes and finances participation of work teams and teachers going through training and specialized training, attendance to events and seminars, and exchanges and international internships.				
<b>TECHNOLOGICAL NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>CONCEPT NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>MARKET NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1

	2	2	2	2	2	2
	3	3	3	3	3	3
	4	4	4	4	4	4
	5	5	5	5	5	5
<b>Social and cultural influence (ISP8)</b>						
<b>SOCIAL DIMENSION</b>	Does the management of the innovation space understand the importance of including the surroundings in its functioning dynamics? Does it develop community links and create projects that have a real impact on the territory?					
	<b>Maturity Level 1</b>	The innovation space does not generate interaction activities with the community. It does not manage projects to solve issues that affect the surroundings. Its function is based on learning and the use of technological tools only for business purposes.				
	<b>Maturity Level 2</b>	The innovation space promotes the execution of events that allow presenting the real needs of the community and territory. It participates in the diagnosis of local issues based on learning and knowledge exchange, but it does not manage collaborative projects of territorial interest.				
	<b>Maturity Level 3</b>	The innovation space provides a proper social-spatial structure to encourage interaction with the community and develop cohesion based on shared visions and motivations. It includes the surroundings and the social context needs in its activities. It sets up projects that involve the community, academia and industry's participation in their development.				
	<b>Maturity Level 4</b>	The innovation space leads and manages collaborative projects of territorial interest, that involve academic and industrial agents' participation in their development. It includes users as a source of information and promotes the generation of networks that encourage knowledge exchange (formal/ informal and internal/ external.)				
	<b>Maturity Level 5</b>	The innovation space formalizes collaboration strategies, achieving efficient results in the execution and finance of projects of territorial co-creation that involves teachers, students, administration personnel, and actors from the local surroundings. It manages and participates in collaborative projects of social and territorial impact that strengthen the university's mission.				
	<b>TECHNOLOGICAL NOVELTY</b>					
	LOW		MEDIUM		HIGH	
	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	2	2	2	2
	4	4	4	4	4	4
	5	5	5	5	5	5
	<b>CONCEPT NOVELTY</b>					
LOW		MEDIUM		HIGH		
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	
1	1	1	1	1	1	
2	2	2	2	2	2	
3	3	3	3	3	3	

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5	5	5	5	5	5
<b>MARKET NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
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3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>Team relations (ISAM4)</b>					
Within the academic activities developed in the innovation space, are strategies established to strengthen and reinforce the relationship among work teams?					
<b>Maturity Level 1</b>	The innovation space does not establish opportunities that allow the creation of social interaction activities within the collaborative learning process.				
<b>Maturity Level 2</b>	The innovation space does not incorporate social interaction dynamics frequently within the collaborative learning process. However, it has the capacity to generate activities that encourage dialogue when users request it.				
<b>Maturity Level 3</b>	The innovation space has established social interaction dynamics as a part of the collaborative learning process. It generates activities that strengthen dialogue and trust among different users of the space.				
<b>Maturity Level 4</b>	The innovation space promotes a dialogue and trust culture among different users of the space. It establishes positive feedback dynamics within the collaborative learning process that aim to strengthen tolerance and respect to different personalities and points of view.				
<b>Maturity Level 5</b>	The innovation space formalizes social interaction dynamics and collaboration among different projects. It establishes a communication and trust culture that allows the creation of debates based on tolerance and respect, as a contribution to strengthen collaborative learning activities.				
<b>TECHNOLOGICAL NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>CONCEPT NOVELTY</b>					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2

3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>MARKET NOVELTY</b>					
<b>LOW</b>		<b>MEDIUM</b>		<b>HIGH</b>	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>Networking (ISBM4)</b>					
Does the innovation space establish parameters to create networks with companies and other education institutions that strengthen the relationship between academia and industry?					
<b>Maturity Level 1</b>	The innovation space does not establish internal nor external relationships with other innovation centers, education institutions and/or companies.				
<b>Maturity Level 2</b>	The innovation space promotes the participation of students and teachers in specialized entities inside and outside university informally. It encourages experiences and multidisciplinary-work activities (research labs, innovation spaces, institutional projects, etc.)				
<b>Maturity Level 3</b>	The innovation space defines an organizing structure to promote interaction between the public and private sector, establishing formal mechanisms of collaboration and/or technology transfer (signed agreements, protocols, official participation in networks.)				
<b>Maturity Level 4</b>	Currently, the innovation space executes at least one formal project with university-industry characteristics. The relationship with external companies, public or private, is formalized by a contract or an agreement (including collaborative research, research by contract, consultancy, etc.)				
<b>Maturity Level 5</b>	The innovation space has a formal structure of university-industry relationship, in which at least 3 projects of direct collaboration between academics and industry have been developed. It has formal mechanisms for technology transfer (patents, license concession with the collaboration of creators, university-industry's research centers, and collaborative research.)				
<b>TECHNOLOGICAL NOVELTY</b>					
<b>LOW</b>		<b>MEDIUM</b>		<b>HIGH</b>	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>CONCEPT NOVELTY</b>					

		LOW		MEDIUM		HIGH		
		BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	
		1	1	1	1	1	1	
		2	2	2	2	2	2	
		3	3	3	3	3	3	
		4	4	4	4	4	4	
		5	5	5	5	5	5	
MARKET NOVELTY								
		LOW		MEDIUM		HIGH		
		BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	
		1	1	1	1	1	1	
		2	2	2	2	2	2	
		3	3	3	3	3	3	
		4	4	4	4	4	4	
		5	5	5	5	5	5	
COGNITIVE DIMENSION	<b>Knowledge transfer (ISAM5)</b>							
	Does the innovation space strengthen learning skills by using different methods in the development of projects?							
	<b>Maturity Level 1</b>	The innovation space does not establish learning methods guided by a teacher in the development of activities.						
	<b>Maturity Level 2</b>	The innovation space establishes learning methods guided by a teacher in the development of academic and/or business activities.						
	<b>Maturity Level 3</b>	The innovation space is a support to the execution of academic courses. It frequently integrates teachers in the operational activities of the space. The knowledge acquired by students is formally evaluated.						
	<b>Maturity Level 4</b>	The innovation space is formally linked to university's academic activities. It participates in the development of academic courses, memoirs, thesis projects, and research projects led by teachers.						
	<b>Maturity Level 5</b>	The innovation space takes part into the university's academic offer. Academic training activities are developed certified by teachers and the institution. Activities are set up to encourage research (thesis projects, courses, workshops, seminars, certification courses, etc.)						
	TECHNOLOGICAL NOVELTY							
			LOW		MEDIUM		HIGH	
			BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
		1	1	1	1	1	1	
		2	2	2	2	2	2	
		3	3	3	3	3	3	
		4	4	4	4	4	4	
		5	5	5	5	5	5	
CONCEPT NOVELTY								

LOW		MEDIUM		HIGH	
BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
MARKET NOVELTY					
LOW		MEDIUM		HIGH	
BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
<b>Business and industry knowledge (ISBM5)</b>					
Does the innovation space strengthen relationship skills of its staff (researchers, teachers, students and administrative personnel) with the market (marketing, finance agencies and operational competencies)?					
<b>Maturity Level 1</b>	The innovation space does not establish any training activities that allow space users to get involved in activities with the industry.				
<b>Maturity Level 2</b>	The innovation space promotes participation in business activities that strengthen learning of norms and business skills (tournaments, challenges, contests, workshops, open meetings.)				
<b>Maturity Level 3</b>	The innovation space establishes regular training to strengthen industrial and business knowledge of the environment in a technological and scientific context (workshops with national or international experts in topics related to research commercialization, markets, and customers' needs.)				
<b>Maturity Level 4</b>	training linked to business skills development in an academic context (fundings for participating in counsel training and coaching for researchers and teachers, research commercialization terms.)				
<b>Maturity Level 5</b>	The innovation space establishes a training structure for space users in which certified skill training is executed related to the market. Additionally, it finances specialized training of its staff in business skills that allow success probability to increase and academia's interest in business projects as well.				
TECHNOLOGICAL NOVELTY					
LOW		MEDIUM		HIGH	
BUSINESS	ACADEMIC	BUSINESS	ACADEMIC	BUSINESS	ACADEMIC
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4



		5	5	5	5	5	5
		CONCEPT NOVELTY					
		LOW		MEDIUM		HIGH	
		<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
		1	1	1	1	1	1
		2	2	2	2	2	2
		3	3	3	3	3	3
		4	4	4	4	4	4
		5	5	5	5	5	5
		MARKET NOVELTY					
		LOW		MEDIUM		HIGH	
		<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
		1	1	1	1	1	1
		2	2	2	2	2	2
		3	3	3	3	3	3
		4	4	4	4	4	4
		5	5	5	5	5	5
<b>FINANCIAL DIMENSION</b>	<b>Business and industry knowledge (ISBM5)</b>						
		Does the innovation space establish a financial structure that supports the expense on R&D?					
	<b>Maturity Level 1</b>	The innovation space does not have an established budget that allows it to invest in R&D autonomously.					
	<b>Maturity Level 2</b>	The innovation space depends on a centralized budget that is run by the university, allowing to invest in R&D in a limited way according to external criteria. The level of investment is low.					
	<b>Maturity Level 3</b>	The innovation space has a mixed budget to invest in R&D. Part of the resources are centralized by the university and the other part respond to its own projects that are being executed. The level of investment is on a low and medium scale.					
	<b>Maturity Level 4</b>	The innovation space is regulated by a mixed financial structure. It manages a stable budget that allows it to have autonomy and finance its expense on R&D annually with its own projects. At the same time, it receives part of the resources from the centralized budget run by the university. The level of investment is on a medium scale.					
	<b>Maturity Level 5</b>	The innovation space has a stable financial structure that allows it to manage and participate in R&D projects autonomously. It has defined an investment plan in the short and long-term. The level of investment is on a high scale.					
		TECHNOLOGICAL NOVELTY					
		LOW		MEDIUM		HIGH	
		<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
	1	1	1	1	1	1	
	2	2	2	2	2	2	
	3	3	3	3	3	3	
	4	4	4	4	4	4	

5	5	5	5	5	5
CONCEPT NOVELTY					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
MARKET NOVELTY					
LOW		MEDIUM		HIGH	
<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>	<b>BUSINESS</b>	<b>ACADEMIC</b>
1	1	1	1	1	1
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3	3	3	3	3	3
4	4	4	4	4	4
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### ANNEX 3. Recommendations innovation spaces

RECOMMENDATIONS FOR IMPROVING THE DEGREE OF MATURITY OF INNOVATION SPACES	
<b>Performance and projection (ISP1)</b>	
<b>Maturity level 1 to 2</b>	To define a person who proposes things and is responsible for the strategy of operation and use of the innovation space and its resources.
<b>Maturity level 2 to 3</b>	To establish a work team that, together with the person in charge of the innovation space, design an operational plan in which the expected objectives of the innovation space are evidenced in the short term.
<b>Maturity level 3 to 4</b>	To carry out an internal study (context and institutional capacities) on which the strategy for the innovation space operation is based. To define activities agreed with the team that contemplate an assigned manager, objectives, and execution time (short and medium term).
<b>Maturity level 4 to 5</b>	To carry out an internal (institutional capacities) and external study (needs and opportunities of the community or environment) to define a strategy for the innovation space operation that is aligned with the university's mission. To involve academic and administrative authorities in the design of the operational plan, the ones responsible for the space and internal work team. To guarantee a budget according to the execution time and objectives of the activities (medium and long term).
<b>Tangible institutional resources (ISP2)</b>	
<b>Maturity level 1 to 2</b>	To incorporate physical elements that allow generating and exchanging knowledge among users in a natural way, such as whiteboards, sticky notes, informative posters, reference books, etc
<b>Maturity level 2 to 3</b>	To define space rules of operation and use, in which the access of different actors is guaranteed in an equal but directed way. To allow the use of equipment and machines under the supervision of a manager, and to establish opening hours for different activities.
<b>Maturity level 3 to 4</b>	To acquire furniture and equipment that allows the reconfiguration of the space with the minimum effort and time for the execution of different activities. To allow the use of equipment and machines autonomously but regulated by rules of use.
<b>Maturity level 4 to 5</b>	To divide the space into different types of rooms with furniture and equipment that are easy to reconfigure (number of users/different activities). To establish one social interaction area at least (area with sofas, coffee area, playground, etc.) To establish free access to space, equipment, and machines, giving users the responsibility for the proper use of these elements.
<b>Innovation performance (ISP3)</b>	
<b>Maturity level 1 to 2</b>	The person in charge of the space must define general objectives prior to carrying out activities and must evaluate the fulfillment of those objectives subsequently.
<b>Maturity level 2 to 3</b>	The person in charge of the space must define an evaluation rubric for each activity to be carried out. This rubric must be defined according to the operational objectives of the innovation space and the characteristics of each project.

STRATEGIC DIMENSION

	<b>Maturity level 3 to 4</b>	The person in charge of the space must schedule semi-annual and annual meetings with the work team to analyze the evaluation results that were applied to the activities carried out in that period. Consensually, the evaluation plan must be designed for the period that begins (short and medium-term objectives).	
	<b>Maturity level 4 to 5</b>	The person in charge of the space, together with their work team and academic authorities (director or dean), must define KPIs that allow evaluating the execution of activities in a multifactorial way, complementing the strategic plan of the space and allocating resources in the medium and long term.	
<b>Structure &amp; Architecture (ISP4)</b>			
<b>PHYSICAL DIMENSION</b>	<b>Maturity level 1 to 2</b>	To adapt the architectural structure of the innovation space or to partner another innovation space to ensure the availability of at least 2 types of work areas (collaborative activities, manufacturing activities, and/or individual work activities) with a small number of participants (from 3 to 6 people).	
	<b>Maturity level 2 to 3</b>	To distribute the available physical space in differentiated areas that allow individual, collaborative, and manufacturing work activities in parallel. To promote open spaces that benefit the adaptability of work areas to guarantee access and comfort for users. To partner with another innovation space that supplies 1 or more services discussed above.	
	<b>Maturity level 3 to 4</b>	To establish open spaces that benefit adaptability to different numbers of users in a regulated manner. To distribute the physical space in differentiated areas for individual, collaborative, and manufacturing work. To define areas of socialization and debate that allow doing workshops and presentations.	
	<b>Maturity level 4 to 5</b>	To establish open spaces that benefit adaptability to different numbers of users in parallel. To distribute the physical space in work areas (individual, collaborative, manufacturing), socialization areas (spaces for presentations, talks, pitch) and intermission areas (rest areas, feeding, play, etc.).	
	<b>Interior design (ISP5)</b>		
	<b>Maturity level 1 to 2</b>	To acquire basic furniture that is easy to move and allows adapting quickly to individual or group use.	
	<b>Maturity level 2 to 3</b>	To acquire furniture with colors and functional design, which is easy to move and allows adapting quickly to individual or group use. To customize color of walls and lighting to generate its own environment that benefit creativity (greater lighting, bright colors). To incorporate design elements that generate identity to the space and are associated with creativity and innovation activities.	
	<b>Maturity level 3 to 4</b>	To define areas of social interaction such as spaces to drink coffee, play areas, rest areas. To prioritize design elements that add personality to the innovation space.	
	<b>Maturity level 4 to 5</b>	To design the work areas of the innovation space based on the operational objectives, so that each area is functional and contains differentiating elements that benefit the activity that is planned to be carried out. To acquire comfortable furniture that is integrated into the design of the space.	
	<b>Collaborative learning environments (ISAMP1)</b>		
	<b>Maturity level 1 to 2</b>	To define at least one collaborative work area that allows the integration of 3 users in parallel in the same activity.	

	<b>Maturity level 2 to 3</b>	To define at least one collaborative work area arranged for students and teachers' use, guaranteeing flexible and ergonomic furniture that benefits the redistribution of people.
	<b>Maturity level 3 to 4</b>	To define collaborative work areas that incorporate elements that stimulate creativity (psychology of colors), good lighting or texture management. To acquire furniture that can be moved easily and quickly to make it functional to groups with different number of users. To encourage the use of whiteboards and screens that allow the exchange of knowledge.
	<b>Maturity level 4 to 5</b>	To design areas that respond to characteristics of collaborative learning, benefitting group work in areas of discussion, socialization, rest, etc., as well as communication between different groups and the teacher. To acquire flexible and ergonomic furniture for carrying out activities among different numbers of people, and to promote work for prolonged periods of time.
	<b>Business linkage environments (ISBMP1)</b>	
	<b>Maturity level 1 to 2</b>	To guarantee the use of university spaces (even if they are not part of the IS) equipped with worktables, computers, and internet that allow the execution of entrepreneurial activities and / or technology transfer.
	<b>Maturity level 2 to 3</b>	To enable at least one own work area that allows the use of computers and internet with the aim of carrying out entrepreneurial and / or technology transfer activities.
	<b>Maturity level 3 to 4</b>	To enable at least one prototyping and testing zone for basic usability testing. Based on the operational objectives of the space, to acquire developer software and computer equipment that benefit entrepreneurial and / or technology transfer activities.
	<b>Maturity level 4 to 5</b>	To establish manufacturing areas, office areas, presentation rooms, and business rooms arranged for the use of teachers, students, graduates, and staff outside the university, who are part of entrepreneurial projects and / or technology transfer.
<b>Manufacturing and communication (ISP6)</b>		
<b>TECHNOLOGICAL DIMENSION</b>	<b>Maturity level 1 to 2</b>	To guarantee the use of university spaces equipped with relevant technology for the execution of manufacturing activities and / or basic usability tests.
	<b>Maturity level 2 to 3</b>	To acquire at least 2 different types of technology that allow the execution of manufacturing activities and / or usability tests. The choice on technology must respond to the operational objectives of the space.
	<b>Maturity level 3 to 4</b>	To acquire low- and medium-end technology that allows the execution of academic and business projects, responding to the medium-term operational objectives of the space. To create a website for project dissemination and establish the use of social networks as a resource for dissemination and communication.
	<b>Maturity level 4 to 5</b>	Based on a study of internal and external needs, responding to the long-term objectives of the IS, to acquire high-end technology that benefits the execution of academic projects with the industry. To establish a progressive technology acquisition plan that allows the space to have differentiating equipment as a technological seal of capacity.
	<b>ICT for collaborative learning (ISAMP2)</b>	
<b>Maturity level 1 to 2</b>	To promote collaborative work activities that incorporate the use of ICT to organize meetings and documents, share files, etc., among different users of the space.	

	<b>Maturity level 2 to 3</b>	To define the use of ICT as a basic tool for collaborative work to share files, communicate, debate, etc. To socialize and make presentations that allow publicizing the ICT available and used in the IS.
	<b>Maturity level 3 to 4</b>	To implement a virtual work environment based on free platforms that support collaborative learning activities, defining the mandatory use and conducting training in the use of tools to store files online, chat, video conferences, mail, calendar, and online office automation tools.
	<b>Maturity level 4 to 5</b>	To acquire licenses that allow establishing an owned and safe work environment for the execution of collaborative learning activities, in which users have tools and training in the use of these technologies. To rely on the security of its own virtual environment for the generation of IS databases.
	<b>Technological infrastructure for R+D+I+e (ISBM2)</b>	
	<b>Maturity level 1 to 2</b>	To guarantee the use of university spaces equipped with computers, a secure internet network, access to virtual libraries, and relevant technology for the execution of entrepreneurial and / or research activities.
	<b>Maturity level 2 to 3</b>	To acquire technological equipment that guarantees the good development of entrepreneurial and research projects from basic to medium development (computers, secure internet network, access to virtual libraries, etc.). To conduct training activities on basic technological vigilance with Internet search engines.
	<b>Maturity level 3 to 4</b>	To propose technology development projects that are for internal use and allow potential entrepreneurship and research activities. To acquire or develop technology vigilance software.
	<b>Maturity level 4 to 5</b>	To acquire high-end technology for the development of entrepreneurship and innovation activities integrating owned hardware and software development. To establish specialized technological vigilance as a key activity in the development of projects.
	<b>Interaction and community (ISP7)</b>	
	<b>EMOTIONAL DIMENSION</b>	<b>Maturity level 1 to 2</b>
<b>Maturity level 2 to 3</b>		To promote a management based on horizontal academic and labor relations by spontaneously establishing spaces for socialization and positive feedback between work teams and users of the space.
<b>Maturity level 3 to 4</b>		To carry out regular activities to disseminate projects and exchange ideas among different teams, disciplines, users, etc., without distinguishing positions or hierarchies.
<b>Maturity level 4 to 5</b>		To establish horizontal labor relations where multidisciplinary work is recognized as a pillar for the development of activities. To integrate the motivation and vision of the different actors in the choice and development of projects within the space. To promote the sense of belonging and the concept of community among users.
<b>Team engagement (ISAM3)</b>		
<b>Maturity level 1 to 2</b>		To define activities to evaluate the technical and human competences of students with the aim of strengthening different profiles in the integration of work groups.

	<b>Maturity level 2 to 3</b>	To evaluate the technical and human competences of students through formal practical activities that benefit the creation of homogeneous teams.
	<b>Maturity level 3 to 4</b>	To evaluate the profile of students through methodological tools using the information to assign roles in the work teams. To do feedback activities for students to strengthen the different profiles during the collaborative learning process. To establish metrics to evaluate the performance of teams in terms of cohesion and complementarity.
	<b>Maturity level 4 to 5</b>	To establish training activities and workshops that enhance each student's profile during the collaborative learning process. To assign roles in work teams that respond to an evaluation of interests and qualities. To carry out periodic activities to strengthen coordination, communication, and cooperation skills among team members.
	<b>Academic and commercial interests (ISBM3)</b>	
	<b>Maturity level 1 to 2</b>	To integrate teachers in the creation and development of activities that involve the participation of the industry.
	<b>Maturity level 2 to 3</b>	To define formal incentives associated with public recognition for teachers and students who develop business projects.
	<b>Maturity level 3 to 4</b>	To define a working protocol with ventures and external companies that delimits the teaching role and the industrial role. To define, together with the university's board of directors, the validation of working hours in the teachers' performance agreement as an incentive for the execution of activities with the industry.
	<b>Maturity level 4 to 5</b>	To formalize, together with the university's board of directors, economic incentives and recognition in working hours for teachers who carry out activities associated with the link with companies and ventures. To promote and finance the participation of teachers in training and activities that benefit the relationship with the industry.
<b>Social and cultural influence (ISP8)</b>		
<b>SOCIAL DIMENSION</b>	<b>Maturity level 1 to 2</b>	To promote and develop projects that integrate the community with the activities of the innovation space. To integrate local problems as an axis of experimental and applied work.
	<b>Maturity level 2 to 3</b>	To allow internal and external community actors to access the innovation space, the ones who present problems according to the work axes proposed in the strategic objectives of the space. To promote projects that involve the participation of the community, academia, and industry in its development.
	<b>Maturity level 3 to 4</b>	To design and manage impact projects on issues of territorial interest, integrating the user as a key actor in the work teams.
	<b>Maturity level 4 to 5</b>	To design, manage, and finance co-creation projects that respond to problems of territorial and academic interest, generating a significant impact inside and outside the university.
	<b>Team relations (ISAM4)</b>	
	<b>Maturity level 1 to 2</b>	To train and dispose of human resources of the innovation space to meet requests for dialogue from students, mediating work teams to encourage a good work environment in collaborative learning activities.
	<b>Maturity level 2 to 3</b>	To design and develop socialization activities to promote bonds, empathy, and trust among team members.

<b>COGNITIVE DIMENSION</b>	<b>Maturity level 3 to 4</b>	To carry out periodic socialization activities among actors of the space with defined topics that allow students to meet different people and participate in different projects according to their interests and motivations.
	<b>Maturity level 4 to 5</b>	To establish a policy of bilateral collaboration among work teams, where they share different experiences and knowledge benefitting the good development of projects. To generate debate activities in which tolerance and respect among different people are strengthened.
	<b>Networking (ISBM4)</b>	
	<b>Maturity level 1 to 2</b>	To generate links with research laboratories, innovation spaces, institutional projects that make up the entrepreneurship and innovation ecosystem of the university.
	<b>Maturity level 2 to 3</b>	To define protocols and sign collaboration agreements with public and private institutions outside the university that respond to the operational objective of the innovation space.
	<b>Maturity level 3 to 4</b>	To execute projects with university-industry characteristics formalized through an agreement or contract, integrating the participation of teachers and students in the development.
	<b>Maturity level 4 to 5</b>	To develop projects with industry and the environment that integrate development, research, and technology transfer into their objectives. To integrate technology transfer offices as a key actor in the development of projects with the industry.
	<b>Knowledge transfer (ISAM5)</b>	
	<b>Maturity level 1 to 2</b>	To integrate a teacher to guide and evaluate the learning acquired by students in the execution of collaborative learning activities.
	<b>Maturity level 2 to 3</b>	To arrange the innovation space for the execution of academic courses either partially or totally. To link teachers as a key actor to evaluate the type of knowledge generated in the innovation space.
	<b>Maturity level 3 to 4</b>	To formalize the integration of the innovation space into the academic structure of the university. To do workshops, extension courses, research projects, theses, etc., in its facilities with the direction of a teacher in charge.
	<b>Maturity level 4 to 5</b>	To propose services associated with the expertise of the innovation space in the academic offer of the university. To carry out activities that promote research in students and strengthen the link with teachers such as theses, seminars, diplomas.
	<b>Business and industry knowledge (ISBM5)</b>	
	<b>Maturity level 1 to 2</b>	To participate in activities that involve industry as a key actor and provide academics with knowledge about ideas that may be commercially valuable (tournaments, challenges, competitions, workshops, open calls).
	<b>Maturity level 2 to 3</b>	To carry out training with national or international experts in the development of inventions in conjunction with academia / industry which can be patented, licensed or that allow an academic derivation.
	<b>Maturity level 3 to 4</b>	To finance and support participation in advisory and coaching training for researchers and teachers in research commercialization policies, access to appropriate financing for ventures, patents and licenses.



	<b>Maturity level 4 to 5</b>	To design and develop certified training for users of the innovation space and members of the university community on topics that encourage the execution of projects with the industry from an academic perspective. To finance the specialized training of human resources in business skills.
<b>FINANCIAL DIMENSION</b>	<b>Business and industry knowledge (ISBM5)</b>	
	<b>Maturity level 1 to 2</b>	To establish an investment plan in R&D that responds to the operational objectives of the innovation space, and that is aligned with the budget allocated by the university.
	<b>Maturity level 2 to 3</b>	To carry out projects and activities that contemplate a budget that is designated directly to the innovation space for its services, and that complements the resources allocated by the university. To establish an investment plan for R&D from a low to medium scale.
	<b>Maturity level 3 to 4</b>	To establish a medium scale investment plan in R&D involving its own financing and that is centralized.
	<b>Maturity level 4 to 5</b>	To formalize the financial independence of the innovation space for the execution of projects. To establish and execute a high-scale R&D acquisition plan that responds to the characteristics and operational objectives of the innovation space.

## ANNEX 4. Evaluation profile of innovation space leind - university of santiago de chile

INNOVATION SPACE UNIVERSITY OF SANTIAGO DE CHILE						
DIS	BUSINESS MISSION			ACADEMIC MISSION		
STRATEGIC DIMENSION	<b>Performance and projection (ISP1)</b> Has the innovation space defined its own operational strategy that delimits and directs the activities and use of resources within the space, benefiting the measuring and evaluation of the expected results?	1		<b>Performance and projection (ISP1)</b> Has the innovation space defined its own operational strategy that delimits and directs the activities and use of resources within the space, benefiting the measuring and evaluation of the expected results?	1	
		2			2	
		3	X		3	X
		4			4	
		5			5	
	<b>Tangible institutional resources (ISP2)</b> Were the environment and the physical resources of the innovation space determined by the operational objective of the space, contributing positively to the activities that were executed in it?	1		<b>Tangible institutional resources (ISP2)</b> Were the environment and the physical resources of the innovation space determined by the operational objective of the space, contributing positively to the activities that were executed in it?	1	
		2			2	
		3			3	
		4	X		4	X
		5			5	
	<b>Innovation performance (ISP3)</b> Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1		<b>Innovation performance (ISP3)</b> Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1	
		2	X		2	X
		3			3	
		4			4	
		5			5	
PHYSICAL DIMENSION	<b>Structure &amp; Architecture (ISP4)</b> Is the architectural structure of the innovation space flexible? Does it have zones that adapt to different activities properly?	1		<b>Structure &amp; Architecture (ISP4)</b> Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1	
		2			2	
		3	X		3	X
		4			4	
		5			5	
	<b>Interior design (ISP5)</b> Does the innovation space provide design elements that guide and benefit the creative process?	1		<b>Interior design (ISP5)</b> Does the innovation space provide design elements that guide and benefit the creative process?	1	
		2			2	
		3			3	
		4	X		4	X
		5			5	
	<b>Business linkage environments (ISBMP1)</b> Do the physical space and equipment of the innovation space benefit the execution of entrepreneurial activities and/or technological transfer?	1		<b>Collaborative learning environments (ISAMP1)</b> Do the physical dimension and equipment of the innovation space support activities of collaborative learning?	1	
		2			2	
		3			3	
		4	X		4	X
		5			5	
TE CH		1			1	

	<b>Manufacturing and communication (ISP6)</b>	2		<b>Manufacturing and communication (ISP6)</b>	2	
	Does the innovation space have technological devices that support activities determined in the operational objectives of the space (machinery, technological equipment, software, apps)?	3		Does the innovation space have technological devices that support activities determined in the operational objectives of the space (machinery, technological equipment, software, apps)?	3	
		4	X		4	X
		5			5	
	<b>Technological infrastructure for R+D+I+e (ISBMP2)</b>	1		<b>ICT for collaborative learning (ISAMP2)</b>	1	
	Does the innovation space encourage activities that create a technological infrastructure of research and entrepreneurship?	2		Does the innovation space encourage the use of ICT to develop collaborative learning activities?	2	X
		3	X		3	
		4			4	
		5			5	
<b>SOCIAL DIMENSION</b>	<b>Social and cultural influence (ISP8)</b>	1		<b>Social and cultural influence (ISP8)</b>	1	
	Does the management of the innovation space understand the importance of including the surroundings in its functioning dynamics? Does it develop community links and create projects that have a real impact on the territory?	2		Does the management of the innovation space understand the importance of including the surroundings in its functioning dynamics? Does it develop community links and create projects that have a real impact on the territory?	2	
		3	X		3	X
		4			4	
		5			5	
	<b>Networking (ISBMP4)</b>	1		<b>Team relations (ISAMP4)</b>	1	
	Does the innovation space establish parameters to create networks with companies and other education institutions that strengthen the relationship between academia and industry?	2	X	Within the academic activities developed in the innovation space, are strategies established to strengthen and reinforce the relationship among work teams?	2	
		3			3	
		4			4	X
		5			5	
<b>EMOTIONAL DIMENSION</b>	<b>Interaction and community (ISP7)</b>	1		<b>Interaction and community (ISP7)</b>	1	
	Do the structure and dynamics of the innovation space encourage interaction, communication, and relationship among different actors benefiting the sense of belonging to the space and the creation of community?	2		Do the structure and dynamics of the innovation space encourage interaction, communication, and relationship among different actors benefiting the sense of belonging to the space and the creation of community?	2	
		3			3	
		4			4	
		5	X		5	X
	<b>Academic and commercial interests (ISBMP3)</b>	1		<b>Team engagement (ISAMP3)</b>	1	
	Does the innovation space promote dynamics focused on encouraging business activities, generating a balance between the academic and business interests within the space?	2	X	In the creation and development of academic activities within the innovation space, are the technical-professional-soft skills of each participant analyzed and valued to make effective teams?	2	
		3			3	X
		4			4	
		5			5	
<b>COGNITIVE</b>	<b>Business and industry knowledge (ISBMP5)</b>	1		<b>Knowledge transfer (ISAMP5)</b>	1	
		2	X		2	

	Does the innovation space strengthen relationship skills of its staff (researchers, teachers, students and administrative personnel) with the market (marketing, finance agencies and operational competencies)?	3		Does the innovation space strengthen learning skills by using different methods in the development of projects?	3	
		4			4	X
		5			5	
<b>FINANCIAL DIMENSIO</b>	<b>Business and industry knowledge (ISBMP5)</b>  Does the innovation space establish a financial structure that supports the expense on R&D?	1	X			
		2				
		3				
		4				
		5				

**DIS** = DIMENSION OF INNOVATION SPACES

## ANNEX 5. Evaluation profile of innovation space - university of conception

INNOVATION SPACE INCUBATOR UNIVERSITY OF CONCEPCION						
DIS	BUSINESS MISSION			ACADEMIC MISSION		
STRATEGIC DIMENSION	<b>Performance and projection (ISP1)</b>  Has the innovation space defined its own operational strategy that delimits and directs the activities and use of resources within the space, benefiting the measuring and evaluation of the expected results?	1		<b>Performance and projection (ISP1)</b>  Has the innovation space defined its own operational strategy that delimits and directs the activities and use of resources within the space, benefiting the measuring and evaluation of the expected results?	1	N/A
		2			2	N/A
		3			3	N/A
		4			4	N/A
		5	X		5	N/A
	<b>Tangible institutional resources (ISP2)</b>  Were the environment and the physical resources of the innovation space determined by the operational objective of the space, contributing positively to the activities that were executed in it?	1		<b>Tangible institutional resources (ISP2)</b>  Were the environment and the physical resources of the innovation space determined by the operational objective of the space, contributing positively to the activities that were executed in it?	1	N/A
		2	X		2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A
	<b>Innovation performance (ISP3)</b>  Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1		<b>Innovation performance (ISP3)</b>  Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1	N/A
		2			2	N/A
		3	X		3	N/A
		4			4	N/A
		5			5	N/A
PHYSICAL DIMENSION	<b>Structure &amp; Architecture (ISP4)</b>  Is the architectural structure of the innovation space flexible? Does it have zones that adapt to different activities properly?	1		<b>Structure &amp; Architecture (ISP4)</b>  Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1	N/A
		2	X		2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A
	<b>Interior design (ISP5)</b>  Does the innovation space provide design elements that guide and benefit the creative process?	1		<b>Interior design (ISP5)</b>  Does the innovation space provide design elements that guide and benefit the creative process?	1	N/A
		2	X		2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A
	<b>Business linkage environments (ISBMP1)</b>  Do the physical space and equipment of the innovation space benefit the execution of entrepreneurial activities and/or technological transfer?	1		<b>Collaborative learning environments (ISAMP1)</b>  Do the physical dimension and equipment of the innovation space support activities of collaborative learning?	1	N/A
		2	X		2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A

TECHNOLOGICAL DIMENSION	<b>Manufacturing and communication (ISP6)</b>	1	X	<b>Manufacturing and communication (ISP6)</b>	1	N/A
	Does the innovation space have technological devices that support activities determined in the operational objectives of the space (machinery, technological equipment, software, apps)?	2		Does the innovation space have technological devices that support activities determined in the operational objectives of the space (machinery, technological equipment, software, apps)?	2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A
		1	X		<b>ICT for collaborative learning (ISAMP2)</b>	1
	<b>Technological infrastructure for R+D+I+e (ISBMP2)</b>	2		Does the innovation space encourage activities that create a technological infrastructure of research and entrepreneurship?	2	N/A
	Does the innovation space encourage activities that create a technological infrastructure of research and entrepreneurship?	3			3	N/A
		4			4	N/A
		5			5	N/A
1			<b>Social and cultural influence (ISP8)</b>		1	N/A
<b>Social and cultural influence (ISP8)</b>		2		Does the management of the innovation space understand the importance of including the surroundings in its functioning dynamics? Does it develop community links and create projects that have a real impact on the territory?	2	N/A
Does the management of the innovation space understand the importance of including the surroundings in its functioning dynamics? Does it develop community links and create projects that have a real impact on the territory?	3		3		N/A	
	4		4		N/A	
	5	X	5		N/A	
	1		<b>Team relations (ISAMP4)</b>		1	N/A
	<b>Networking (ISBMP4)</b>	2		Within the academic activities developed in the innovation space, are strategies established to strengthen and reinforce the relationship among work teams?	2	N/A
Does the innovation space establish parameters to create networks with companies and other education institutions that strengthen the relationship between academia and industry?	3		3		N/A	
	4	X	4		N/A	
	5		5		N/A	
	1		<b>Interaction and community (ISP7)</b>		1	N/A
	<b>Interaction and community (ISP7)</b>	2		Do the structure and dynamics of the innovation space encourage interaction, communication, and relationship among different actors benefiting the sense of belonging to the space and the creation of community?	2	N/A
Do the structure and dynamics of the innovation space encourage interaction, communication, and relationship among different actors benefiting the sense of belonging to the space and the creation of community?	3	X	3		N/A	
	4		4		N/A	
	5		5		N/A	
	1		<b>Team engagement (ISAMP3)</b>		1	N/A
	<b>Academic and commercial interests (ISBMP3)</b>	2		In the creation and development of academic activities within the innovation space, are the technical-professional-soft skills of each participant analyzed and valued to make effective teams?	2	N/A
Does the innovation space promote dynamics focused on encouraging business activities, generating a balance between the academic and business interests within the space?	3		3		N/A	
	4		4		N/A	
	5	X	5		N/A	
	1		<b>Knowledge transfer (ISAMP5)</b>		1	N/A
	<b>Business and industry knowledge (ISBMP5)</b>	2		2	N/A	
COGNITIVE		1			1	N/A
		2			2	N/A

	Does the innovation space strengthen relationship skills of its staff (researchers, teachers, students and administrative personnel) with the market (marketing, finance agencies and operational competencies)?	3	X	Does the innovation space strengthen learning skills by using different methods in the development of projects?	3	N/A
		4			4	N/A
		5			5	N/A
<b>FINANCIAL DIMENSIO</b>	<b>Business and industry knowledge (ISBMP5)</b>  Does the innovation space establish a financial structure that supports the expense on R&D?	1	X			
		2				
		3				
		4				
		5				

**DIS** = DIMENSION OF INNOVATION SPACES

**N/A** = NOT APPLICABLE

## ANNEX 6. Evaluation profile of innovation space the lift - university catolica de valparaiso

INNOVATION SPACE PREINCUBATOR THE LIFT UNIVERSITY CATOLICA DE VALPARAISO						
DIS	BUSINESS MISSION			ACADEMIC MISSION		
STRATEGIC DIMENSION	<b>Performance and projection (ISP1)</b>  Has the innovation space defined its own operational strategy that delimits and directs the activities and use of resources within the space, benefiting the measuring and evaluation of the expected results?	1		<b>Performance and projection (ISP1)</b>  Has the innovation space defined its own operational strategy that delimits and directs the activities and use of resources within the space, benefiting the measuring and evaluation of the expected results?	1	N/A
		2			2	N/A
		3			3	N/A
		4			4	N/A
		5	X		5	N/A
	<b>Tangible institutional resources (ISP2)</b>  Were the environment and the physical resources of the innovation space determined by the operational objective of the space, contributing positively to the activities that were executed in it?	1	X	<b>Tangible institutional resources (ISP2)</b>  Were the environment and the physical resources of the innovation space determined by the operational objective of the space, contributing positively to the activities that were executed in it?	1	N/A
		2			2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A
	<b>Innovation performance (ISP3)</b>  Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1		<b>Innovation performance (ISP3)</b>  Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1	N/A
		2			2	N/A
		3			3	N/A
		4	X		4	N/A
		5			5	N/A
PHYSICAL DIMENSION	<b>Structure &amp; Architecture (ISP4)</b>  Is the architectural structure of the innovation space flexible? Does it have zones that adapt to different activities properly?	1	X	<b>Structure &amp; Architecture (ISP4)</b>  Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1	N/A
		2			2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A
	<b>Interior design (ISP5)</b>  Does the innovation space provide design elements that guide and benefit the creative process?	1	X	<b>Interior design (ISP5)</b>  Does the innovation space provide design elements that guide and benefit the creative process?	1	N/A
		2			2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A
	<b>Business linkage environments (ISBMP1)</b>  Do the physical space and equipment of the innovation space benefit the execution of	1		<b>Collaborative learning environments (ISAMP1)</b>  Do the physical dimension and equipment of the innovation	1	N/A
		2	X		2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A



	entrepreneurial activities and/or technological transfer?			space support activities of collaborative learning?		
TECHNOLOGICAL DIMENSION	<b>Manufacturing and communication (ISP6)</b>  Does the innovation space have technological devices that support activities determined in the operational objectives of the space (machinery, technological equipment, software, apps)?	1		<b>Manufacturing and communication (ISP6)</b>  Does the innovation space have technological devices that support activities determined in the operational objectives of the space (machinery, technological equipment, software, apps)?	1	N/A
		2	X		2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A
	<b>Technological infrastructure for R+D+I+e (ISBMP2)</b>  Does the innovation space encourage activities that create a technological infrastructure of research and entrepreneurship?	1		<b>ICT for collaborative learning (ISAMP2)</b>  Does the innovation space encourage the use of ICT to develop collaborative learning activities?	1	N/A
		2	X		2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A
SOCIAL DIMENSION	<b>Social and cultural influence (ISP8)</b>  Does the management of the innovation space understand the importance of including the surroundings in its functioning dynamics? Does it develop community links and create projects that have a real impact on the territory?	1	X	<b>Social and cultural influence (ISP8)</b>  Does the management of the innovation space understand the importance of including the surroundings in its functioning dynamics? Does it develop community links and create projects that have a real impact on the territory?	1	N/A
		2			2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A
	<b>Networking (ISBMP4)</b>  Does the innovation space establish parameters to create networks with companies and other education institutions that strengthen the relationship between academia and industry?	1		<b>Team relations (ISAMP4)</b>  Within the academic activities developed in the innovation space, are strategies established to strengthen and reinforce the relationship among work teams?	1	N/A
		2	X		2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A
EMOTIONAL DIMENSION	<b>Interaction and community (ISP7)</b>  Do the structure and dynamics of the innovation space encourage interaction, communication, and relationship among different actors benefiting the sense of belonging to the space and the creation of community?	1		<b>Interaction and community (ISP7)</b>  Do the structure and dynamics of the innovation space encourage interaction, communication, and relationship among different actors benefiting the sense of belonging to the space and the creation of community?	1	N/A
		2			2	N/A
		3			3	N/A
		4			4	N/A
		5	X		5	N/A
	<b>Academic and commercial interests (ISBMP3)</b>  Does the innovation space promote dynamics focused on encouraging business activities, generating a balance between the academic and business interests within the space?	1		<b>Team engagement (ISAMP3)</b>  In the creation and development of academic activities within the innovation space, are the technical-professional-soft skills of each participant analyzed and valued to make effective teams?	1	N/A
		2	X		2	N/A
		3			3	N/A
		4			4	N/A
		5			5	N/A
CO GNI		1		<b>Knowledge transfer (ISAMP5)</b>	1	N/A

	<b>Business and industry knowledge (ISBMP5)</b>	2	X	Does the innovation space strengthen learning skills by using different methods in the development of projects?	2	N/A
	Does the innovation space strengthen relationship skills of its staff (researchers, teachers, students and administrative personnel) with the market (marketing, finance agencies and operational competencies)?	3			3	N/A
		4			4	N/A
		5			5	N/A
<b>FINANCIAL DIMENSIO</b>	<b>Business and industry knowledge (ISBMP5)</b>	1				
	Does the innovation space establish a financial structure that supports the expense on R&D?	2	X			
		3				
		4				
		5				

**DIS** = DIMENSION OF INNOVATION SPACES

**N/A** = NOT APPLICABLE

## ANNEX 7. Evaluation profile of innovation space makerspace - university catolica de valparaiso

INNOVATION SPACE UNIVERSITY CATOLICA DE VALPARAISO						
DIS	BUSINESS MISSION			ACADEMIC MISSION		
STRATEGIC DIMENSION	<b>Performance and projection (ISP1)</b>  Has the innovation space defined its own operational strategy that delimits and directs the activities and use of resources within the space, benefiting the measuring and evaluation of the expected results?	1		<b>Performance and projection (ISP1)</b>  Has the innovation space defined its own operational strategy that delimits and directs the activities and use of resources within the space, benefiting the measuring and evaluation of the expected results?	1	
		2			2	
		3	X		3	X
		4			4	
		5			5	
	<b>Tangible institutional resources (ISP2)</b>  Were the environment and the physical resources of the innovation space determined by the operational objective of the space, contributing positively to the activities that were executed in it?	1		<b>Tangible institutional resources (ISP2)</b>  Were the environment and the physical resources of the innovation space determined by the operational objective of the space, contributing positively to the activities that were executed in it?	1	
		2			2	
		3			3	
		4			4	
		5	X		5	X
	<b>Innovation performance (ISP3)</b>  Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1		<b>Innovation performance (ISP3)</b>  Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1	
		2			2	
		3			3	
		4	X		4	X
		5			5	
PHYSICAL DIMENSION	<b>Structure &amp; Architecture (ISP4)</b>  Is the architectural structure of the innovation space flexible? Does it have zones that adapt to different activities properly?	1		<b>Structure &amp; Architecture (ISP4)</b>  Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1	
		2			2	
		3			3	
		4			4	
		5	X		5	X
	<b>Interior design (ISP5)</b>  Does the innovation space provide design elements that guide and benefit the creative process?	1		<b>Interior design (ISP5)</b>  Does the innovation space provide design elements that guide and benefit the creative process?	1	
		2			2	
		3			3	
		4			4	
		5	X		5	X
	<b>Business linkage environments (ISBMP1)</b>  Do the physical space and equipment of the innovation space benefit the execution of entrepreneurial activities and/or technological transfer?	1		<b>Collaborative learning environments (ISAMP1)</b>  Do the physical dimension and equipment of the innovation space support activities of collaborative learning?	1	
		2			2	
		3			3	
		4			4	
		5	X		5	X
TECH		1			1	

	<b>Manufacturing and communication (ISP6)</b>	2		<b>Manufacturing and communication (ISP6)</b>	2	
	Does the innovation space have technological devices that support activities determined in the operational objectives of the space (machinery, technological equipment, software, apps)?	3		Does the innovation space have technological devices that support activities determined in the operational objectives of the space (machinery, technological equipment, software, apps)?	3	
		4	X		4	X
		5			5	
	<b>Technological infrastructure for R+D+I+e (ISBMP2)</b>	1		<b>ICT for collaborative learning (ISAMP2)</b>	1	
	Does the innovation space encourage activities that create a technological infrastructure of research and entrepreneurship?	2		Does the innovation space encourage the use of ICT to develop collaborative learning activities?	2	
		3			3	
		4			4	X
		5	X		5	
<b>SOCIAL DIMENSION</b>	<b>Social and cultural influence (ISP8)</b>	1		<b>Social and cultural influence (ISP8)</b>	1	
	Does the management of the innovation space understand the importance of including the surroundings in its functioning dynamics? Does it develop community links and create projects that have a real impact on the territory?	2	X	Does the management of the innovation space understand the importance of including the surroundings in its functioning dynamics? Does it develop community links and create projects that have a real impact on the territory?	2	X
		3			3	
		4			4	
		5			5	
	<b>Networking (ISBMP4)</b>	1		<b>Team relations (ISAMP4)</b>	1	
	Does the innovation space establish parameters to create networks with companies and other education institutions that strengthen the relationship between academia and industry?	2	X	Within the academic activities developed in the innovation space, are strategies established to strengthen and reinforce the relationship among work teams?	2	X
		3			3	
		4			4	
		5			5	
<b>EMOTIONAL DIMENSION</b>	<b>Interaction and community (ISP7)</b>	1		<b>Interaction and community (ISP7)</b>	1	
	Do the structure and dynamics of the innovation space encourage interaction, communication, and relationship among different actors benefiting the sense of belonging to the space and the creation of community?	2		Do the structure and dynamics of the innovation space encourage interaction, communication, and relationship among different actors benefiting the sense of belonging to the space and the creation of community?	2	
		3			3	
		4			4	
		5	X		5	X
	<b>Academic and commercial interests (ISBMP3)</b>	1		<b>Team engagement (ISAMP3)</b>	1	
	Does the innovation space promote dynamics focused on encouraging business activities, generating a balance between the academic and business interests within the space?	2		In the creation and development of academic activities within the innovation space, are the technical-professional-soft skills of each participant analyzed and valued to make effective teams?	2	X
		3			3	
		4	X		4	
		5			5	
<b>COGNITIVE</b>	<b>Business and industry knowledge (ISBMP5)</b>	1		<b>Knowledge transfer (ISAMP5)</b>	1	
		2	X		2	

	Does the innovation space strengthen relationship skills of its staff (researchers, teachers, students and administrative personnel) with the market (marketing, finance agencies and operational competencies)?	3		Does the innovation space strengthen learning skills by using different methods in the development of projects?	3	
		4			4	
		5			5	X
<b>FINANCIAL DIMENSIO</b>	<b>Business and industry knowledge (ISBMP5)</b>  Does the innovation space establish a financial structure that supports the expense on R&D?	1				
		2				
		3	X			
		4				
		5				

**DIS** = DIMENSION OF INNOVATION SPACES

## ANNEX 8. Evaluation profile of innovation space - university arturo prat

INNOVATION SPACE UNIVERSITY ARTURO PRAT						
DIS	BUSINESS MISSION			ACADEMIC MISSION		
STRATEGIC DIMENSION	<b>Performance and projection (ISP1)</b> Has the innovation space defined its own operational strategy that delimits and directs the activities and use of resources within the space, benefiting the measuring and evaluation of the expected results?	1		<b>Performance and projection (ISP1)</b> Has the innovation space defined its own operational strategy that delimits and directs the activities and use of resources within the space, benefiting the measuring and evaluation of the expected results?	1	
		2			2	
		3	X		3	X
		4			4	
		5			5	
	<b>Tangible institutional resources (ISP2)</b> Were the environment and the physical resources of the innovation space determined by the operational objective of the space, contributing positively to the activities that were executed in it?	1		<b>Tangible institutional resources (ISP2)</b> Were the environment and the physical resources of the innovation space determined by the operational objective of the space, contributing positively to the activities that were executed in it?	1	
		2			2	
		3			3	
		4	X		4	X
		5			5	
	<b>Innovation performance (ISP3)</b> Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1		<b>Innovation performance (ISP3)</b> Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1	
		2	X		2	X
		3			3	
		4			4	
		5			5	
PHYSICAL DIMENSION	<b>Structure &amp; Architecture (ISP4)</b> Is the architectural structure of the innovation space flexible? Does it have zones that adapt to different activities properly?	1		<b>Structure &amp; Architecture (ISP4)</b> Does the innovation space execute a consistent monitoring plan in the development of activities and measure its results?	1	
		2	X		2	X
		3			3	
		4			4	
		5			5	
	<b>Interior design (ISP5)</b> Does the innovation space provide design elements that guide and benefit the creative process?	1		<b>Interior design (ISP5)</b> Does the innovation space provide design elements that guide and benefit the creative process?	1	
		2			2	
		3	X		3	X
		4			4	
		5			5	
	<b>Business linkage environments (ISBMP1)</b> Do the physical space and equipment of the innovation space benefit the execution of entrepreneurial activities and/or technological transfer?	1		<b>Collaborative learning environments (ISAMP1)</b> Do the physical dimension and equipment of the innovation space support activities of collaborative learning?	1	
		2	X		2	
		3			3	X
		4			4	
		5			5	
TECH		1			1	

	<b>Manufacturing and communication (ISP6)</b>	2	X	<b>Manufacturing and communication (ISP6)</b>	2	X
	Does the innovation space have technological devices that support activities determined in the operational objectives of the space (machinery, technological equipment, software, apps)?	3		Does the innovation space have technological devices that support activities determined in the operational objectives of the space (machinery, technological equipment, software, apps)?	3	
		4			4	
		5			5	
	<b>Technological infrastructure for R+D+I+e (ISBMP2)</b>	1		<b>ICT for collaborative learning (ISAMP2)</b>	1	
	Does the innovation space encourage activities that create a technological infrastructure of research and entrepreneurship?	2	X	Does the innovation space encourage the use of ICT to develop collaborative learning activities?	2	X
		3			3	
		4			4	
		5			5	
<b>SOCIAL DIMENSION</b>	<b>Social and cultural influence (ISP8)</b>	1		<b>Social and cultural influence (ISP8)</b>	1	
	Does the management of the innovation space understand the importance of including the surroundings in its functioning dynamics? Does it develop community links and create projects that have a real impact on the territory?	2	X	Does the management of the innovation space understand the importance of including the surroundings in its functioning dynamics? Does it develop community links and create projects that have a real impact on the territory?	2	X
		3			3	
		4			4	
		5			5	
	<b>Networking (ISBMP4)</b>	1		<b>Team relations (ISAMP4)</b>	1	
	Does the innovation space establish parameters to create networks with companies and other education institutions that strengthen the relationship between academia and industry?	2	X	Within the academic activities developed in the innovation space, are strategies established to strengthen and reinforce the relationship among work teams?	2	
		3			3	
		4			4	X
		5			5	
<b>EMOTIONAL DIMENSION</b>	<b>Interaction and community (ISP7)</b>	1		<b>Interaction and community (ISP7)</b>	1	
	Do the structure and dynamics of the innovation space encourage interaction, communication, and relationship among different actors benefiting the sense of belonging to the space and the creation of community?	2		Do the structure and dynamics of the innovation space encourage interaction, communication, and relationship among different actors benefiting the sense of belonging to the space and the creation of community?	2	
		3			3	
		4			4	
		5	X		5	X
	<b>Academic and commercial interests (ISBMP3)</b>	1		<b>Team engagement (ISAMP3)</b>	1	
	Does the innovation space promote dynamics focused on encouraging business activities, generating a balance between the academic and business interests within the space?	2	X	In the creation and development of academic activities within the innovation space, are the technical-professional-soft skills of each participant analyzed and valued to make effective teams?	2	X
		3			3	
		4			4	
		5			5	
<b>COGNITIVE</b>	<b>Business and industry knowledge (ISBMP5)</b>	1	X	<b>Knowledge transfer (ISAMP5)</b>	1	
		2			2	

	Does the innovation space strengthen relationship skills of its staff (researchers, teachers, students and administrative personnel) with the market (marketing, finance agencies and operational competencies)?	3		Does the innovation space strengthen learning skills by using different methods in the development of projects?	3	X
		4			4	
		5			5	
<b>FINANCIAL DIMENSIO</b>	<b>Business and industry knowledge (ISBMP5)</b>  Does the innovation space establish a financial structure that supports the expense on R&D?	1	X			
		2				
		3				
		4				
		5				

**DIS** = DIMENSION OF INNOVATION SPACES