Student entrepreneurship at TU/e
business model design for Innovation Space

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Award date:
2017

Eindhoven, January 2017

Student entrepreneurship at TU/e: Business model design for Innovation Space

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Student identity number 0935810

in partial fulfillment of the requirements for the degree of

Master of Science
in Innovation Management

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TUE. School of Industrial Engineering.
Series Master Theses Innovation Management

Subject headings: Open Innovation, Entrepreneurship, Universities, Design Science, CIMO logic, Business model

ABSTRACT

This master thesis comprises a *case study* of a new collaborative and open space at the Eindhoven University of Technology, in which innovative design, high technical level and entrepreneurial approaches are merged. The *Innovation Space*, in current development, aims to structurally facilitate multidisciplinary engineering projects, where the future entrepreneurs can touch the broad range of technologies and applications, where the dynamics between research, education and business become visible and where entrepreneurship can prosper.

The study uses a *design science* lens to connect the existing university's work structures with student entrepreneurship, via the development of design principles and the design of an artifact to be used by the Innovation Space core work team, in order to *further develop the strategy for the space*. The case reveals the difficulty of designing for fostering entrepreneurship, while at the same time considering the existing structures of a research focused university.

The study can be described in two major phases: *diagnosis and design*. In the diagnosis phase, the main barriers hindering the connection between the current work structures at TU/e and student entrepreneurship at the university were identified. In the design phase, an *artifact* to use as a *complement of the Business Model Canvas* of the Innovation Space was developed.

For the university, the study suggests that first, a university's Entrepreneurship and Innovation (E&I) strategy should be developed, always in line with the general strategy for the university. From the E&I strategy, the Innovation Space strategy should follow.

For the Innovation Space specific strategy, the study suggests to: a) Provide *key resources* via a central place; a strong university entrepreneurship related center, that would act as a Techno-starter factory, and that would provide shared resources. b) Facilitate *key activities* related to entrepreneurial experimentation and multidisciplinary projects; via the development of new incentives, and IP policies among others. c) Develop channels by providing a unified communications platform.

MANAGEMENT SUMMARY

Introduction

Nowadays, there is understanding of the *importance of entrepreneurs* for all nations' economies; with their innovations they increase the quality of our lives, they address important societal challenges our world faces, and they provide the jobs and economic conditions for our society to advance.

Universities, as knowledge and skills suppliers, are the places where this new entrepreneurial generation is cultivated. Recent research shows that university context in general and entrepreneurial learning, are important antecedents of student entrepreneurship. Therefore, universities are exploring how to better support students in their way to becoming entrepreneurs.

Nevertheless, there is not yet consensus on how to achieve this goal, though research has shown that *every university is immersed in a particular environment that provides it with unique characteristics*, that help or hinder entrepreneurial development.

Universities are either following one of two paths to *develop their entrepreneurial ecosystems*: a *top-down strategy* dictated by the *university's senior management*, or a *bottom-up approach* that raises from the very core of the *student entrepreneurial spirit*. However, the disconnection between this two strategies shows to be the main impediment for universities trying to develop their entrepreneurial environments.

This study intends to provide insights on how the Eindhoven University of Technology (TU/e) could bridge this gap, via the Innovation Space; a new experimental lab on campus. The research questions it aims to answer are:

> *RQ1: What are the barriers preventing the connectedness of student entrepreneurship with the formal work structures at TU/e?*
>
> *RQ2: How should the business model for the InnoSpace be complemented to take away the main barriers responsible for the disconnectedness of student entrepreneurship with the formal work structures at TU/e?*

Study approach

The study approach considered an *analytic strategy* given by the framework for new research on Open Innovation proposed by Bogers, et al., (2016), and a *design science lens* that implies using knowledge to create what should be, things that do not yet exist; changing existing situations into desired ones (Simon, 1996). Design science research privileges prescriptive knowledge, which can be expressed in the form of design propositions (Romme, 2003; Denyer, et al., 2008). As part of this project, design principles based on literature and on practice were developed.

Theoretical background

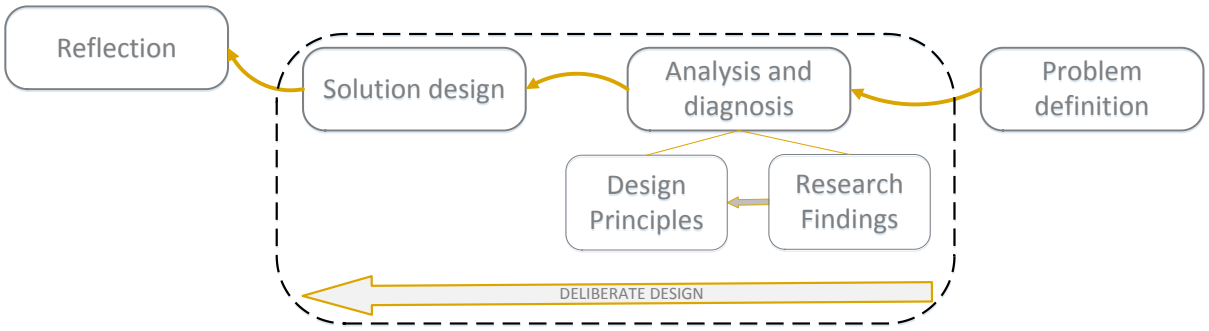
The theoretical background provided insights on how universities engage in practices related to *Open Innovation (OI), academic entrepreneurship, and technology commercialization*, while evolving to be *Third Generation Universities (3GUs)*. The reviewed literature provided some examples about how universities are approaching changes in their environment. It also provided examples of practices about collaborative innovation and how different and apparently disconnected initiatives contribute to innovation at universities.

Research methods

The basic structure of this project can be summarized as follows:

- The research design for this project started with a *problem definition.*
- Then, *design principles from literature* were developed.
- Afterward, a *case study* was developed by means of *secondary sources analysis, and semi-structured interviews*. *Design principles* were derived *from practice.*
- Next, a set of *final design principles* was defined. They were used as an input to generate a *design solution.*
- Finally, a *reflection* step is added to the research design.

A graphic representation of the methodology for this project can be seen in the next figure.



Results

Based on the problem diagnosis which yielded new disconnectedness dimensions and the inclusion of student-led entrepreneurial activity within an overarching general entrepreneurial aspect, and on the extensive literature underpinning this study, a *solution artifact was designed*. The artifact composed of a guide and a visualization tool, intends to bring attention to the most important aspects of the Business Model Canvas for the Innovation Space.

Conclusion and discussion

The *final diagnosis* of the situation suggested that the university's formal working structures are

not only disconnected from the student-led entrepreneurial activity at TU/e, but from the overall entrepreneurial activity in general.

The final disconnectedness dimensions, which resulted from the diagnosis phase, were embedded into the design principles that were used as input to design the artifact. By developing "CIMO-logic" design principles, the researcher was able to identify the main *key actions, key resources and channels* that need to be taken into account within the Innovation Space Business Model Canvas. These are the elements that need to be *addressed with more attention* in the severe time restricted context of the Innovation Space core work team.

Special recommendations were made by the researcher responsible for this study.

- Develop a comprehensive E&I profile of TU/e
- Use the artifact to prioritize
- Continuously update the artifact
- Choose a starting point and start an iterative process
- Expand understanding on knowledge valorization
- Put the InnoSpace at the center of the TU/e E&I ecosystem
- Trust more in students
- Designate champions within departments
- Bridge the gap

Finally, the reflection section is the connection towards emergent design (van Burg, et al., 2008). The results of the project were reflected upon considering contributions to academic literature and directions for future research.

The present research contributed to the *Open Innovation literature* by considering the university as the focal point of the Open Innovation Paradigm, and by researching a prototyping and experimentation space; a topic that addresses the strategic value of *design and design-led innovation*, and that facilitates the emergence of ideas at the intersection of different disciplines. As research in Open Innovation is changing to a more proactive perspective, a *design perspective* contributes to the Open Innovation literature by providing "how to" approaches.

In the field of *academic entrepreneurship and technology commercialization*, the *comparison of the main kinds of programs and institutions created to enhance and/or support spin-off and start-up creation, and technology commercialization at universities*, contributes not only to characterize and better understand what is the purpose of each of them, but it also can be used as an artifact to identify the services a university offers to (student) entrepreneurs. These initiatives are: a) University-based Incubators (UBIs). b). University Technology Transfer Offices (UTTOs). c) Proof of Concept Centers (PoCCs).

Moreover, this study is focused on the *context of a European public university*. Most of the literature reviewing academic entrepreneurship and technology commercialization investigates cases given within a US context. It is expected this study adds to this needed and nascent stream of research.

Lastly, This study contributes to academic research by generating knowledge about the new paradigm of the *Third Generation University*, and how universities can benefit the most from it. The "technostarter", "technostarter factory" and "technostarter team" were all concepts explored within this study.

In regards to future research, gaps were identified both by means of the literature review, and by performing a case study. Revenue generation models for the university experimental lab is a very interesting and also complex topic to study. Insights from the resulting artifact also provided future research directions, e.g. *"Community building" in the context of the Entrepreneurship and Innovation ecosystem of a university.* Other suggested topics include:

- The generation of more *flexible Intellectual Property* structures at universities.
- The development of *new incentives* schemes for cross collaboration, problem-based projects, and entrepreneurial activities at universities.
- The *role "Business-schools"* or similar could take in the development of an entrepreneurial university ecosystem.
- The mechanisms working behind *entrepreneurial experimentation at universities*, its challenges and best practices to apply.

Furthermore, it was found that universities are never the center of the Open Innovation model. *More studies considering the university as the focal firm* would be in synchronicity with the changes universities are experiencing worldwide.

The *comparison between UBIs, UTTO's, PoCCs* represents one of the main contributions of this research. This comparison could be *expanded* to consider other kinds of university-based programs or institutions.

Linked to this last point, the *development of a university E&I ecosystem assessment framework* could be of great benefit to all those universities experiencing rapid societal and budget changes that impulse them to get involved in knowledge valorization efforts.

ACKNOWLEDGEMENTS

This report represents the result of a hard and beautiful phase of my life: following the Master Program in Innovation Management at the Eindhoven University of Technology. This period represented for me not only an academic journey, but a complete life adventure.

The study described in this report was conducted at the TU/e, the university that has been my home since early 2015. I hope the results could be of significant aid to continue strengthening the position of the university worldwide, especially regarding its innovative capacity.

There are some very special people that I would like to thank, whose invaluable support helped me to learn, develop abilities and skills, and whose participation in many aspects of my life contributed to finally reaching this moment.

Firstly, I would like to express my sincere gratitude to *my first advisor, Dr.ir. Isabelle Reymen* who has been not only a dedicated academic mentor, but an exceptional enthusiast who motivates me to reach higher. Isabelle, your patience and immense knowledge helped me during all the time of research and writing of this thesis. I could not have imagined having a better advisor.

Besides my first supervisor, I would like to thank my *second supervisor, Dr. Wido Oerlemans* for his patience and flexibility given the changes this graduation project went through.

Moreover, I would like to thank my *third assessor, Dr. Frans van Eijnatten*, whose insightful comments and encouragement through the last two years have resulted invaluable for both my academic and my personal learning.

However, this study would have been impossible without *the Innovation Space core team*, that provided me an opportunity to join their team, and gave me full access their meetings and documentation. Special thanks for your precious time, trust, transparency and help, and for changing your meeting's language so I could understand.

Furthermore, I would like to thank my *family and friends*. To my parents, my sister, my grandmother, and my aunt in Mexico, thanks for supporting me morally my life. Finally, I would like to bring special thanks to my friends, the ones that are my new family in the Netherlands, and the ones that no matter the time difference, are always there for me.

Marisol Velasco Montañez

January 2017

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1. INTRODUCTION

The world is in the middle of a global technology revolution. For the past 30 years, advances in biotechnology, nanotechnology, materials technology, and information technology have been occurring at an accelerating pace, with the potential to bring about radical changes in all dimensions of life. Some applications of these technologies may help to address some of the most significant problems the world faces; those involving water, food, health, economic development, the environment, and many other critical sectors (Silberglitt, et al., 2006).

Universities are at the center of this revolution. Therefore, the external and the internal landscapes of universities as well as their ambitions are changing in important ways. Universities are transforming from knowledge generators to societal value originators, and from employees producers to entrepreneurs creators (Wissema, 2009).

However, these changes are not easy, and universities face different environmental and structural constraints to the development of their Entrepreneurship and Innovation (E&I) ecosystems (Graham, 2014). Thus, there is need of applicable knowledge about how these changes occur, knowledge that could be used as a guide to drive strategic actions at universities.

This research project aims to contribute to generate knowledge by focusing in the specific case of the "Innovation Space" (InnoSpace) at the Eindhoven University of Technology (TU/e), an initiative to promote entrepreneurship among students by means of awareness, structural enablement, experimentation and multidisciplinarity.

1.1. Project context

In this section, the context of this research project is described, including an introduction to the Eindhoven University of Technology (TU/e), an overview of Entrepreneurship at TU/e, and the introduction to the "Innovation Space" project. Finally, the student activity at TU/e is detailed.

1.1.1. TU/E

The Eindhoven University of Technology (TU/e) is a *university* based in the Netherlands, *specializing in engineering science and technology*, with a focus *on education, research, and knowledge valorization*. TU/e aims to contribute to society, industry and science development by focusing on three strategic areas: *Energy, Health and Smart mobility* (TU/e, 2016).

1.1.2. ENTREPRENEURSHIP AT TU/E

According to the strategic plan 2020 for TU/e, the *promotion of entrepreneurship* among students and staff remains a key objective in the coming years. In the *education* dimension, minors, special graduation programs, and workshops about entrepreneurship, among others are implemented. In the *science for industry* dimension, the university continues to collaborate with the main societal, governmental, and education institutions in the region, as well as *with the main industry actors* in order to enhance new business development in the region. In the *research* dimension, the R&D roadmaps, drawn up with external partners, focus as much as possible on the development of new

or innovative products and businesses (TU/e, 2011).

Specific attention is given to *encourage and support new business*, especially to the improvement and quality of start-up initiatives and their growth; improving the scouting of possible commercial inventions, and in the screening of inventions for their commercialization remains of main importance. Also the creation of physical facilities for university affiliated start-up companies are key components of the university's vision (TU/e, 2011).

1.1.3. THE "INNOVATION SPACE" PROJECT

As part of the before mentioned efforts, the current state of affairs was recognized in an internal document envisioning entrepreneurship at TU/e (Reymen, 2015). The document distinguishes *entrepreneurship as one of the fastest growing pillars of TU/e.* Relying on three core dimensions, i.e. *development of the ecosystem, entrepreneurial awareness, and entrepreneurship education*, the document also acknowledged the main challenges to overcome in order to create a *university-based entrepreneurial environment*. To connect entrepreneurship education at TU/e to the stakeholders in the entrepreneurial ecosystem, the document proposed to create a *Technology Commercialization Center* (not to be confused with a Technology Transfer Office, which already exists). The center would play a coordinating and facilitating role through matchmaking, optimizing the use of human capital and entrepreneurship education.

With this vision and with the intention to take advantage of the concentration of the many different departments on the same campus, the "Innovation Space" (InnoSpace) project was initiated (Reymen, et al., 2016).

The *InnoSpace wants to provide structures to enable students to work together in multidisciplinary teams.* To develop an *entrepreneurial ecosystem*, students would work on *real problems and challenges* relevant to the network of companies and institutes around the university.

The facilities contemplated in the project, would have their epicenter at the InnoSpace center facilitating *horizontal work via strategic areas rather than via academic silos* (Reymen, et al., 2016), enhancing *entrepreneurial awareness* and fostering *cooperation* among students with *different backgrounds.*

On the education dimension, the center would support *entrepreneurship education and Design-Based Learning (DBL).* DBL has been one of the key features of education at TU/e (Reymen, et al., 2016). It was introduced at the University in 1997. Nevertheless, it was not implemented following a uniform curriculum model shared by the departments, but adapted by every one of them (Gómez Puente, Jochems, & Eijck, 2014). The InnoSpace aims to support this educational innovation process by demonstrating how students can gain knowledge and practical skills while working in more open studio and lab contexts. In the words of the authors of the first version of the business case for the InnoSpace (Reymen, et al., 2016):

"The ambition of the university is to scale up and structurally facilitate multidisciplinary engineering student projects, based on the concept of the Student teams, and to keep highly motivated students as main selection criterion, but with more students and staff involved, with more vertical collaboration among students (from bachelor to Ph.D. students), and also partly offered in an educational setting. By giving students the opportunity to have inspiring experiences with multidisciplinary design projects early in their education program, the university will unlock the passion and potential of many more talented students for these kinds of activities than before and helps developing engineers for the future. This will increase the number of candidates from which the most talented and motivated students can be selected for challenging multidisciplinary project teams in the Innovation Space…The cooperation of student specialists from different disciplines and students with a broader, generalist approach will be the key towards the success of the Innovation Space".

The InnoSpace is thought to be a concept and a central platform, as well as a physical place on campus; an inspiring physical space, but also a community that connects all stakeholders (Reymen, et al., 2016).

According to Osterwalder, Pigneur, and Clark (2010), *a business model describes the logic of how an organization creates, delivers, and captures value*. The authors described business models in nine building blocks; the building blocks put together constitute the *"Business Model Canvas"*. The tool is meant to be filled with the elements that compose the business model of an organization. A brief description of the nine building blocks, and a visualization of the tool can be found in Appendix A.

The business model of the InnoSpace guides the core work team in the design of the whole concept, and is also the base for all strategic decisions for the project. The first conceptualization of a business model for the InnoSpace, can be found in Appendix B.

The list of people involved in the InnoSpace core team is found in Appendix C.

1.1.4. ENTREPRENEURIAL STUDENT ACTIVITY AT TU/E

As the InnoSpace is thought to be the house of multidisciplinary groups of students within TU/e, the core team for the project analyzed the target teams of *student stakeholders* from where the multidisciplinary student groups could originate. Results of the stakeholder analysis can be found on Table 1.

Student stakeholders for the InnoSpace

	University based Incubator (UBI)	University Technology Transfer Office (UTTO)	Proof of Concept Center (PoCC)
Activity type	Courses	Challenges	Start-ups
Goal	Formal education	Extra-curricular development	Entrepreneurship
Results	Ideas	Prototypes	Business models
Motivation	ECTS*	Awards/Sponsoring	Funding

* Credits from the European Credit Transfer and Accumulation System

Table 1 Student stakeholders for the InnoSpace

The projects can be both educational projects within the study programs, multidisciplinary final bachelor projects, multidisciplinary master projects or extra-curricular activities that support student's personal development and entrepreneurship, e.g. participation in Student teams or start-ups (Reymen, et al., 2016).

Next, the three groups of student stakeholders are described.

1.1.4.1. (Individual) Students

The Innovation Space aims to attract *interested students* from a pool of 15,000 students. It would offer final bachelor and master projects for students with ambitions to become entrepreneurs or intrapreneurs, as well as other activities as part of educational courses. At the professional doctorate and PhD levels, interested parties could propose and develop new projects, organize "hackathons" and other events, and find students and staff that would help with the development of projects. All involved students should have intrinsic motivation to get involved with a project at the InnoSpace (Reymen, et al., 2016).

1.1.4.2. TU/e Student teams

In recent years, *"Student teams"* have become a popular phenomenon at TU/e (Kockelkoren, 2015). These teams are not groups that are formed within a specific course, but *independent groups of students from different disciplines that get together to contribute to the solution to societal and technological problems via experimentation and product development.*

The teams are regarded as a positive development, since the type of tangible projects they manage make technology attractive and bring together different companies. "Student teams" are supported at various levels by TU/e (Kockelkoren, 2015):

- Financial contribution per team
- Professional support from the Communication Expertise Center at TU/e
- Common housing amenities for all Student teams
- Access to research knowledge and facilities

In addition, TU/e has set up a steering committee as an interface between the teams and the University. Communication between the steering committee and the "Student teams" is held via the coordinator of the "Student teams" appointed by TU/e. The teams are very active in bringing

in sponsorship money and entering into partnerships with external parties. In this aspect, they are completely independent (Kockelkoren, 2015).

For the InnoSpace, "Student teams" are *the most noticeable example of collaboration across disciplines at TU/e.*

> *"Next to personal development of the participating students, they deliver innovative prototypes that can be developed further by companies, which also helps to valorize TU/e knowledge and help to create funding for researchers, and last but not least they offer great exposure for TU/e via their awards and challenges"*
>
> Reymen, et al., 2016

Nevertheless, "Student teams" face structural issues that hinder their development. The multidisciplinary type of project the "Student teams" develop, does not fit into the silo-like formal structure of TU/e (Reymen, et al., 2016).

1.1.4.3. Techno-starters

Techno-starters are students or academics interested in *starting their own science or technology based firm* (Wissema, 2009). What distinguishes student entrepreneurs most from the average student is that they are *always looking for business opportunities* and that they are *intrinsically motivated*; they have a business instinct and are strongly result oriented (Reymen, et al., 2016). From this point on, within this report the term techno-starters refers to students techno-starters.

At TU/e, most *students who start their own company* are given support in form of flexible workspace, business guidance, and other typical incubator amenities. Most of the techno-starters at TU/e are developing software and web applications. Starting a company around a physical, technical product is uncommon because it is more costly to scale this kind of business than web applications (Reymen, et al., 2016).

1.2. Problem definition

The problem definition step drives the whole problem-solving project. In this section, the Perceived Problem (PP) will be analyzed to find if it reveals an underlying problem that should be solved (van Aken, et al., 2012). Following this process, the perceived problem is put in the context of the "problem mess", and then scoped down to define the Problem Statement (PS) for this research project. Subsequently, the Research Questions (RQ) and Sub-Questions (SQ) for this project are stated. Finally, the main assignment for the project is defined.

1.2.1. PERCEIVED PROBLEM

From the point of view of a "top-down" and university-led Entrepreneurship and Innovation (E&I) ecosystem development (Graham, 2014), TU/e is facilitating some of the structures the student entrepreneurial community needs. Nevertheless, the InnoSpace core team observes these efforts are not enough to catalyze entrepreneurship at TU/e; a "bottom-up" and student-led

approach is also needed. TU/e needs the empowered, cohesive, inventive, bold and well-connected student-led entrepreneurial community described by Graham (2014), and the InnoSpace wants to be the medium to bring the students together with the university-led efforts. Nonetheless, there is the perception that:

> *PP: THERE IS NOT ENOUGH UNIVERSITY SUPPORT TO ENTREPRENEURIAL STUDENT ACTIVITY AT TU/E[1].*

The initial information, acquired by means of secondary documentation study, informal conversations, and participatory observation of the InnoSpace core team meetings, suggests several issues to take into account. These issues were acknowledged to affect at least one of the three stakeholders groups for the InnoSpace: (Individual) Students, "Student teams" and Techno-starters. Following, the identified *issues* are listed.

1. *Not enough university support personnel (academics and staff) dedicated to student entrepreneurs*: Although TU/e has some personnel exclusively dedicated to supporting and promoting student entrepreneurship, they are almost completely committed to techno-starters, leaving "Student teams" and other students nearly unattended.
2. *Not enough help of external experienced coaches in partnership with TU/e*: Only techno-starters receive formal mentoring from external experts, and coaches provided by the university and associations related to TU/e.
3. *No use of shared and open spaces*: "Student teams" and techno-starters who are affiliated with the university share spaces with their colleagues (flexible workspace for the techno-starters, common housing for the Student teams). Nevertheless, there is no central place where an independent student who is not yet an entrepreneur could approach to get involved with the E&I environment at TU/e. There is no common meeting point where the three types of stakeholders could work and could be found.
4. *No use of own common equipment*: There is no shared equipment for the exclusive use of three stakeholder groups. However, there is the possibility to have access to the university equipment via the Innovation Lab and the Equipment & Prototype Center.
5. *Not enough relation with research*: Most of the student entrepreneurial activities are disengaged from the research bodies and from projects currently existing at the university, they are regarded as two completely different undertakings.
6. *Low cooperation across fields of expertise*: The only type of student-led activities that are multidisciplinary per se, are the projects developed by the "Student teams". At a techno-starter and individual student levels, cooperation between students from different

[1] Given the widely accepted perception that an entrepreneur is an intrinsically motivated and self-driven person, "Entrepreneurial student activity", "student-led entrepreneurial activity", and similar, have the same meaning for the purposes of this report.

departments is not usual. Nevertheless, some efforts are observed, e.g. an Engineering Design bachelor course, followed by all students in the bachelor college where teams must be multidisciplinary.

7. *No use of common communications platform*: There is not a common communication platform (supported by an information system) for student entrepreneurial activities.
8. *No use of common directory*: There is no common place where data about the different projects and students involved in entrepreneurship at TU/e could be found. This makes difficult to know who to contact when in need, and where to find people.
9. *Low consideration of entrepreneurial opportunities within education tracks, courses and final projects*: Education at TU/e is almost detached from the entrepreneurial activities within campus. Participating in an entrepreneurial endeavor, most of the time means leaving studies aside for some time.
10. *The major role of university Intellectual Property (IP) ownership*: A lot of importance is given to licensing and the creation of direct benefits for the university. The university owns IP rights of all that the students and staff develop while having a relationship with TU/e.
11. *No common mission*: There is no shared mission among the three groups of student stakeholders. The formal expressed goal from the university's side in order to support student entrepreneurs is to promote entrepreneurship, continue cooperating with partners and increase seed funding for start-ups and university spin-offs (TU/e, 2011). Nevertheless, there are not enough guidelines on how to achieve this goal, nor overarching vision to guide these efforts.
12. *No shared metrics (entrepreneurship aspects)*: Some basic metrics have been implemented and goals set for entrepreneurship aspects within the 2020 vision for TU/e (TU/e, 2011). Nevertheless, shared indicators to support a common objective are not yet set. These metrics could help TU/e to trace its own innovation pipeline, and to activate mechanisms in order to make the commercialization of ideas possible.
13. *Low level of contacts in the entrepreneurship regional ecosystem*: The dispersed state in which the stakeholders work now, does not allow to have an overview of the (potential) network of business contacts. All stakeholders could benefit from this.
14. *No feeling of community*: There is no feeling of a student-led entrepreneurial community at TU/e. Although each type of stakeholder identifies itself with a defined group, there is no shared feeling of belonging to something bigger.

Given these insights, a preliminary cause and effect diagram was created. The diagram can be observed in Figure 1.

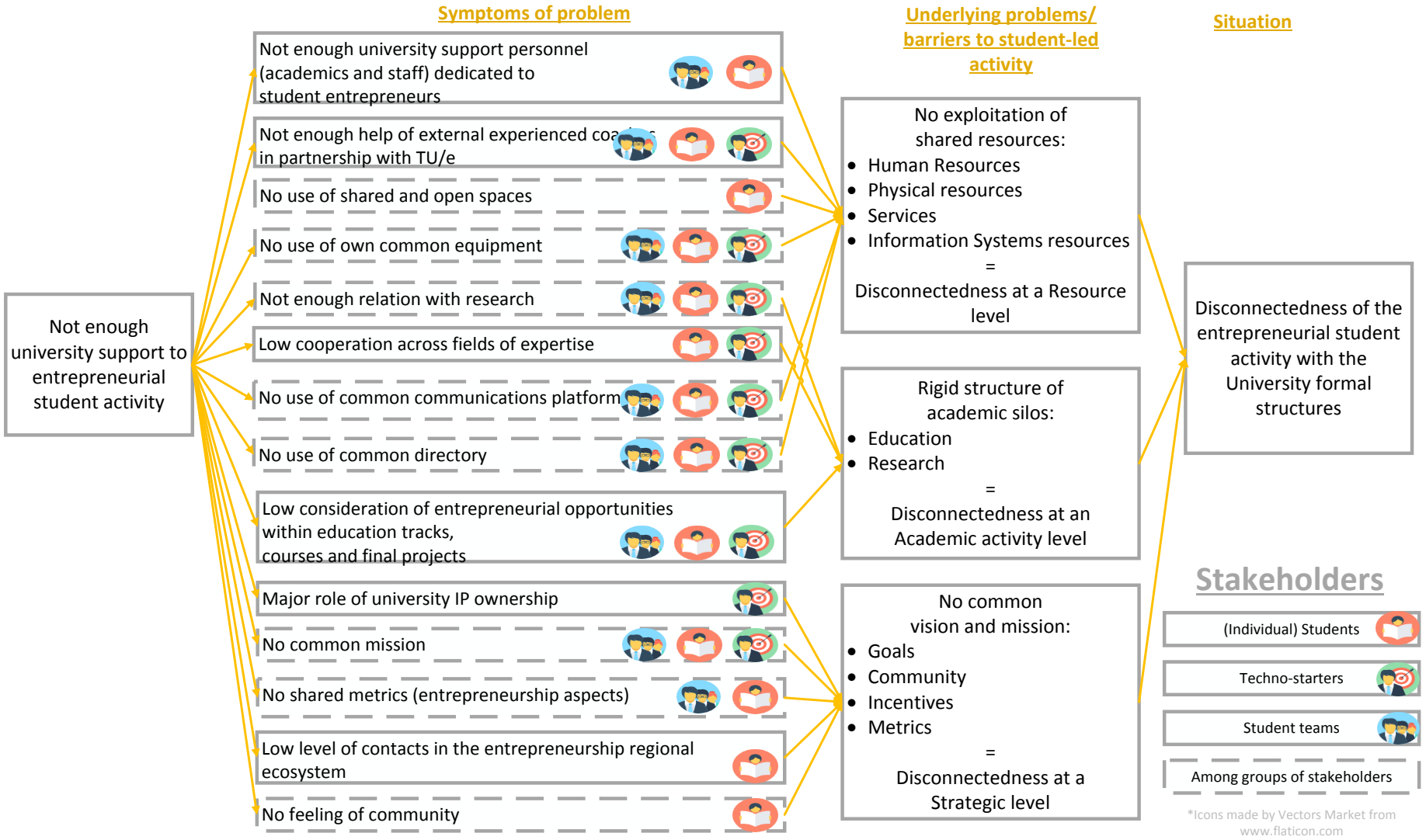

Figure 1 Cause and effect diagram for the Perceived Problem

1.2.2. UNDERLYING PROBLEMS

The problem's symptoms were further analyzed and put together into three categories of underlying problems. All categories are related to some level of disconnectedness between the formal working structures at TU/e and the student-led activity:

1. *No exploitation of shared resources*: namely, human resources, physical resources, services and information systems resources. This barrier was named *"disconnectedness in the support resources dimension"*.
2. *Rigid structure of academic silos*: It has consequences in education and research work structures. This barrier was named *"disconnectedness in the academic activity dimension"*.
3. *No common vision and mission*: It relates to the lack of common goals, community feeling, incentives structure, and metrics. This barrier was named *"disconnectedness in the strategic actions dimension"*.

Based on this information, the problem statement for this project is formulated:

> *PS: THE CURRENT FORMAL WORK STRUCTURES AT TU/E DO NOT SUPPORT ENTREPRENEURIAL STUDENT ACTIVITY ENOUGH AS A RESULT OF DISCONNECTEDNESS IN TERMS OF RESOURCES, ACADEMIC ACTIVITIES, AND STRATEGY.*

The problem definition is coherent with findings from the study on the *Emergent Leaders Group (EGL) in the Entrepreneurship and Innovation (E&I)* field (Graham, 2014), that the *disconnectedness* between the two mechanisms which impulse entrepreneurial development (i.e. student-led and university-led initiatives) is one of the main problems universities face to establish entrepreneurial ecosystems.

1.3. Research questions

Following, the problem statement is translated into the pertinent *research questions and sub-questions*. The general aim on how to achieve connectedness between the formal work structures at TU/e, and the student-led activity was divided into two main research questions.

Based on the problem analysis, it was inferred that there are "barriers" preventing the increment of student–led entrepreneurial activity. The *first research question* is related to a *confirmatory and explorative diagnosis* assignment about those barriers.

> *RQ1: WHAT ARE THE BARRIERS PREVENTING THE CONNECTEDNESS OF STUDENT ENTREPRENEURSHIP WITH THE FORMAL WORK STRUCTURES AT TU/E?*

To answer RQ1, *three sub-questions* were formulated. These sub-questions resulted from the categories of disconnectedness that originated from the problem analysis. All of the questions focus on E&I aspects that could contribute to student-led activity.

*SQ1.1: What instances of E&I **support resources** described in literature are present/absent at TU/e?*

*SQ1.2: What instances of E&I **academic activities** described in literature are present/absent at TU/e?*

*SQ1.3: What instances of E&I **strategic actions** described in literature are present/absent at TU/e?*

To ensure alignment with the general InnoSpace strategy, and to *design* a problem solution that could be easily understandable by the core work team, a smooth translation of the results of this project to the existing business model is necessary. Therefore, the second research question is expressed in terms of complements to the business model.

RQ2: How should the business model for the InnoSpace be complemented to take away the main barriers responsible for the disconnectedness of student entrepreneurship with the formal work structures at TU/e?

To answer RQ2, *three sub-questions* were formulated. To ensure a coherent and traceable solution design, these sub-questions also follow the categories of disconnectedness that resulted from the problem analysis. All of the questions focus on aspects that could contribute to the student-led activity.

*SQ2.1: What elements should be included in the Business Model to increase the connectedness between student entrepreneurship and the formal work structures at TU/e regarding **support resources**?*

*SQ2.2: What elements should be included in the Business Model to increase the connectedness between student entrepreneurship and the formal work structures at TU/e regarding **academic activities**?*

*SQ2.3: What elements should be included in the Business Model to increase the connectedness between student entrepreneurship and the formal work structures at TU/e regarding **strategic actions**?*

As this phase depends on the outcomes of the diagnosis phase, the final set of design sub-research questions is susceptible to change.

1.4. Assignment for the project

As design oriented master thesis, the main purpose of this research project is to design an artifact that would (help to) solve the stated problem. Therefore, the Main Assignment (MA) for this project is to:

MA: Increase the connectedness between the formal work structures and student entrepreneurial activity at TU/e by developing a design to aid the integration strategy.

2. STUDY APPROACH

2.1. Analytic strategy

One of the first steps to analyzing a case is to have a general analytic strategy to give a sense of direction when analyzing the data (Yin, 2014). For this project, data was analyzed following the *Open Innovation research framework* proposed by Bogers, et al., (2016), (see Appendix D). Addiotionally, a detailed research background on Open Innovation (OI) can be found in Section 3.1.

The information for this research project was analyzed at different levels of aggregation, and situated within the main research categories. Nevertheless, it is important to note that the main objective of the framework is to span across the different levels of aggregation and categories. The selection of two main levels of analysis (i.e. organizational and extra-organizational) and two main research categories (i.e. OI strategy & design, and OI stakeholders) helps to understand and navigate the complexity of the case, and therefore the complexity of this thesis project. A visualization of the levels and categories this project spans across can be observed in Figure 2.

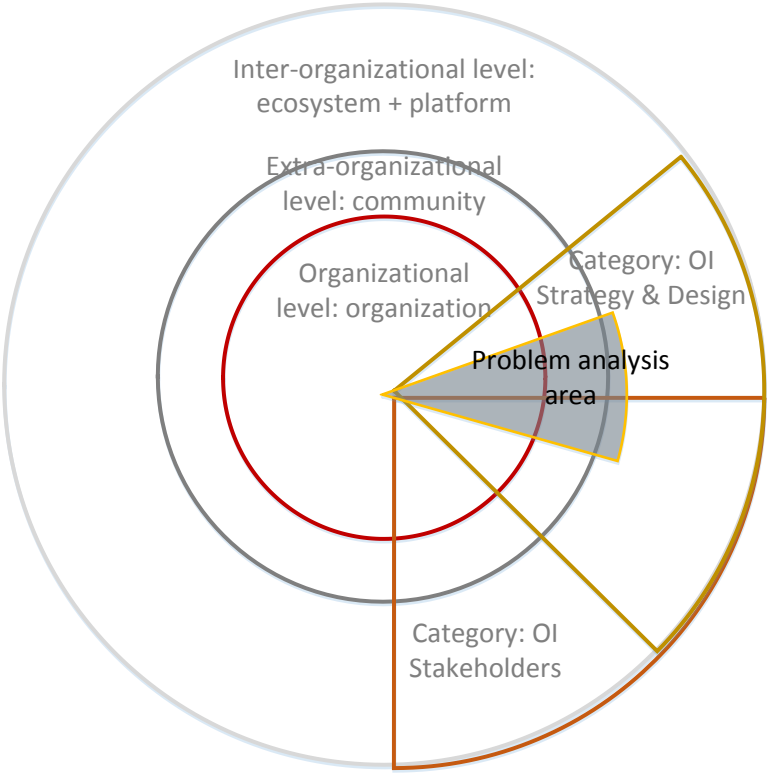

Figure 2 Visualization of the intersection of different levels of analysis and research categories for this project. Based on framework by Bogers, et al., (2016)

Next, a brief description of the levels of analysis and research categories is presented.

2.1.1. ORGANIZATIONAL LEVEL OF ANALYSIS

At the *organizational level of analysis*, OI is associated with *entrepreneurial opportunities, processes and outcomes*. Research focuses on examining organizational-level issues that overlap (or connect) OI and entrepreneurship involving theories and constructs from both fields (Bogers, et al., 2016). For

example, the InnoSpace core team, resources and spaces that could be considered in-house, are situated at this level. This is one of the main levels of analysis for this research project.

2.1.2. EXTRA-ORGANIZATIONAL LEVEL OF ANALYSIS

Communities increasingly represent an important external source of knowledge, practical experience and innovation. While they can be fully independent, there may also be a relationship between organizations and communities. An important research topic *is how to best interact with these communities in order to foster innovation and entrepreneurship, and to develop mutually beneficial relationships* (Bogers, et al., 2016). For instance, the entrepreneurial community surrounding the InnoSpace, which is part of the TU/e innovation and entrepreneurship ecosystem, belongs to this level. This is one of the main levels of analysis for this project.

2.1.3. INTER-ORGANIZATIONAL LEVEL OF ANALYSIS

This level relates to *innovation platforms, networks and ecosystems* that integrate a diverse set of innovation actors who create novel and useful solutions to innovation problems (Bogers, et al., 2016). For example, the TU/e innovation and entrepreneurship ecosystem, and the relying structures that make the ecosystem work (the platform) are situated on this level. This is only a complementary level of analysis for this project.

2.1.4. OI STRATEGY & DESIGN, AND OI STAKEHOLDERS

The category *"OI strategy and design"*, which includes *entrepreneurship and business models* as related concepts (Bogers, et al., 2016), is the most related category to this master thesis project, and therefore is the main category of research. With the objective of addressing the complexity of the case, the category *"OI stakeholders"* is also used as a research category, in order to understand the involvement of heterogeneous groups of stakeholders (e.g. users or communities).

2.2. Design science lens

Perhaps the best way to understand design science is by the words of one of its initiators:

> *"The function of what I call design science is to solve problems by introducing into the environment new artifacts, the availability of which will induce their spontaneous employment by humans and thus, coincidentally, cause humans to abandon their previous problem-producing behaviors and devices. For example, when humans have a vital need to cross the roaring rapids of a river, as a design scientist I would design them a bridge, causing them, I am sure, to abandon spontaneously and forever the risking of their lives by trying to swim to the other shore".*
>
> - Buckminster Fuller (1992)

Following this line, this project views Open Innovation, academic entrepreneurship and technology commercialization from a *design science lens*. This implies *using knowledge to create what*

should be, things that do not yet exist; changing existing situations into desired ones (Simon, 1996), and a much more active, engaged practice of organizational scholarship that pays more attention to actionable knowledge grounded in theory and evidence (Jelinek, Romme, & Boland, 2008).

From the point of view of knowledge creation, exploratory and explanatory research are complementary; the pragmatic and the academic approaches supplement each other. The advantage of the design science approach is its explicit focus on improving practice. Its challenge, lies in the ability to lead to new theoretical insights (Holmström, Ketokivi, & Hameri, 2009). To compensate for this situation, this project's research design includes a *reflection step.*

There are three main *reasons to use a design science lens* for this research project as a whole. First, there is recognized a *gap between theory and practice in organizational studies*, and a science-for-design perspective can bridge theoretical and practical significance, as this approach is pragmatic in nature (Romme, 2003; Jelinek, et al., 2008; Denyer, Tranfield, & van Aken, 2008). In this sense, van Aken (2004), states that there is a need to develop and test (alternative) solutions to problems; understanding the causes of problems is not enough in order to generate improvement.

Second, *designing gives components their meaning from the links and networks in which they are embedded* (Romme, 2003), and this approach matches the essential intersection of different areas of this research project, i.e. Open Innovation, technology commercialization and academic entrepreneurship, and their meeting point: the Third Generation University (3GU), as can be observed in Figure 3. These areas have dispersed and divergent streams of literature which need to be put in context in order for this case to be meaningful; the purpose of a design approach is creating a usable tool or artifact that supports the applied combination of these different streams of information leading to an integrated view (e.g. Romme & Damen, 2007). More information on the theoretical background of this research project can be found in Section 3.

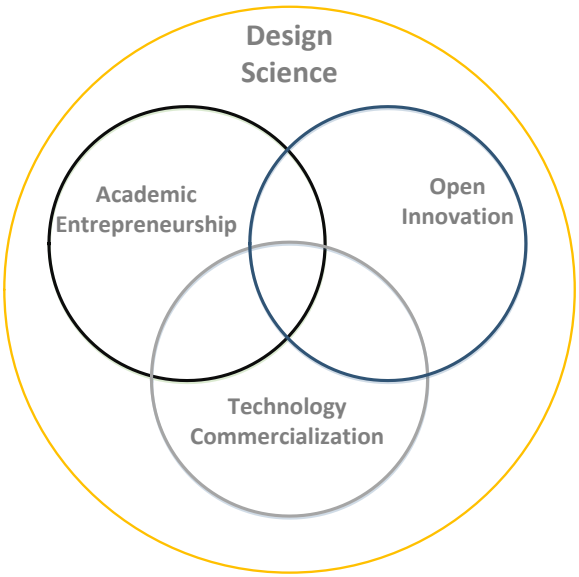

Figure 3 Intersection of different knowledge areas for this research project

Finally, the *prescriptive nature of design science*, represented by the creation of an *artifact*, focused on solving a problem (Romme, 2003; Denyer, et al., 2008) serves the overall purpose of this project; to use science in order to design a solution for the problem owners.

2.2.1. DESIGN PRINCIPLES

Design science research privileges prescriptive knowledge, which can be expressed in the form of *design propositions* (Romme, 2003; Denyer, et al., 2008). These propositions can result from empirical efforts in individual cases, but these produce conflicting findings due to the specificity of the particular circumstances. A complementary approach is to use the published research base to develop (prescriptive) design propositions. The propositions are not the final solution to problems, but an input to the designing of the specific solution (Denyer, et al., 2008).

As part of this project, *design principles based on literature and on practice* were developed.

Technological rules or design principles can be defined as a *"chunk of general knowledge, linking an intervention or artifact with a desired outcome or performance in a certain field of application"* (van Aken, 2004). These rules have certain characteristics; they are not specifically made for a specific situation, but a form of a more general prescription for a class of problems; they are not universal laws, their use being limited to a certain field of application; they are the central point between universal, generalized knowledge and the actual application of this knowledge to a specific situation; they are the connectors that drive the translation of theoretical knowledge into practice (Romme, 2003; van Aken, 2004; Jelinek, et al., 2008; Denyer, et al., 2008). Figure 4 depicts a graphical representation of the central place of design principles in design processes.

Figure 4 Design principles as the connectors that drive the translation of theoretical knowledge into practice

A special kind of design propositions that consider the context dependency of the outcomes are the ones following the *"CIMO-logic",* and they are constructed as follows: in this class of problematic *Contexts*, use this *Intervention* type to invoke these generative *Mechanism(s)*, to deliver these *Outcome(s)*; this way design propositions contain information on what to do, in which situations, to produce what effect and offer some understanding of why something happens (Denyer, et al., 2008). As part of this research project, design principles following the CIMO-logic were developed; they are the inputs to design a solution for the problem (see Section 5.1.4).

2.2.2. ARTIFACTS

Within the design science paradigm, *artifacts* are constructs, models, methods, and/or instantiations intended to solve real-world problems (March & Smith, 1995).

Winter (2014), elaborating on the four types of artifacts described by Chmielewicz (1970),

proposed an *"artifacts world quadrant model"* where the types of artifacts are conceptualized. The quadrants can be observed in Figure 5.

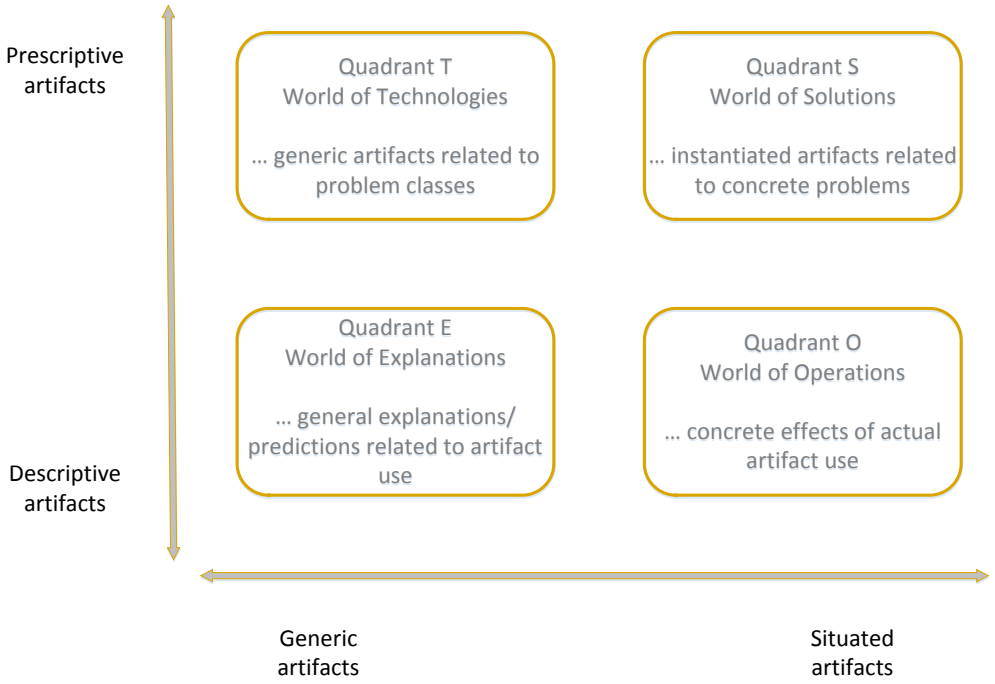

Figure 5 Artifacts world quadrant model by Winter (2014)

Among prescriptive artifacts, the ones that are of interest for this project, quadrant T describes artifacts that are abstract. *In quadrant S, artifacts are configured to solve a specific problem of a specific organization at a specific point in time* (Winter, 2014). This last, is the type of artifact this project provides.

3. THEORETICAL BACKGROUND

A literature review, in an independent document (Velasco Montañez, 2016), examined how universities engage in practices related to Open Innovation (OI), academic entrepreneurship, and technology commercialization, while evolving to be Third Generation Universities (3GUs). The reviewed literature provided some examples about how universities are approaching changes in their environment. It also provided examples of practices about collaborative innovation and how different and apparently disconnected initiatives contribute to innovation at universities.

Experimentation spaces at these universities, and the broader mechanisms behind their collaborative, technology and design-driven approach to entrepreneurship, represented an interesting research topic. The analysis of each reviewed research stream resulted in the identification of multiple gaps in the literature. The outcomes were related to the ways in which a university and its students, could start exploring viable business cases via the establishment of ecosystems, communities and/or spaces.

Understanding the current state of the meeting point between the reviewed literature streams provided important insights; mainly related to practices, configurations, and guidelines that may

be useful for the further development of entrepreneurship at universities and the communities around them.

3.1. Open Innovation

In the traditional model of innovation, firms generate, develop and commercialize their own ideas. This was the paradigm that ruled the innovation scene for most of the 20th century (Chesbrough, 2003b).

In 2003, Henry Chesbrough introduced the *Open Innovation (OI)* paradigm, in which firms commercialize external (as well as internal) ideas by deploying outside (as well as in-house) pathways to the market. This model is described in terms of companies commercializing internal developments via channels outside of their current business areas, or ideas originated outside the companies and being taken inside for commercialization (Chesbrough 2003a; 2003b). A graphical representation of the model is observed in Figure 6.

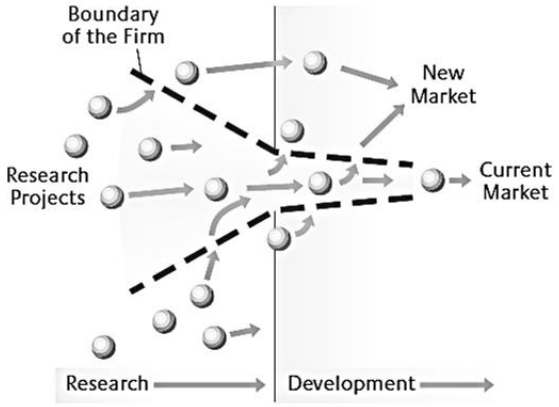

Figure 6 Open Innovation model (Chesbrough, 2003b)

In order to bring up such scenario, a landscape of abundant knowledge must be used to provide value for the organization that created it, this depends on a continued supply of useful ideas and technologies (Chesbrough 2003a; 2003b). Universities are considered as one of the main sources of these ideas, knowledge and technologies. Although university research is abundant and of high quality, the commercialization of that knowledge faces several obstacles while going through the academic silos, a process that discourages multi-disciplinary innovations (Chesbrough, 2003b).

The role of universities within the innovation landscape has changed and continues to change nowadays. Nevertheless, there is an aspect of the role that universities can take within the open innovation paradigm that has not been explored and has been constantly ignored: the university at the center of the picture, in other words, *the university as the "focal firm" in the open innovation model*. First, OI was only focused on large multinational companies, and just recently the role of SMEs was reviewed (Brunswicker & van de Vrande, 2014). Universities have not been researched as the focal firm of the paradigm, therefore leaving the possibilities of universities leading OI initiatives under-explored.

Another motivating topic, mentioned by Piller and West (2014), is the *hybrid Open Innovation and co-creation models* that combine the best of both approaches. This is related to the inside-out and coupled processes of OI, which are the less studied (Chesbrough & Winter, 2014). The evolved coupled process; a more collaborative and interactive approach (Piller & West, 2014), is a good example of these hybrid models.

Prototyping and experimentation spaces that address the strategic value of design and design-led innovation, and facilitate the emergence of ideas at the intersection of different disciplines, are a very interesting and specific example of practices that are becoming of interest in a number of fields. Within this context, p*rototypes* are the visualization of value propositions and they act as the link between operational and strategic activities (Brunswicker, Wrigley, & Bucolo, 2013). The *experimental business lab*, a network of outsiders from universities, research labs, start-ups and business partners, that become part of an innovation environment (Andersson, Formica, & Curley, 2009) is the best illustration of the link between experimentation spaces and entrepreneurship. With breakthrough ideas and insights emerging at the intersection of different disciplines, cultures, and entrepreneurial individuals, the *"lab"* is both a *physical and a logical setting that assists the formation of an idea and the early testing of its potential probability of success* (Curley & Formica, 2013a).

Finally, as research in OI is changing from a restrictive role, giving reviews of advantages and disadvantages to a more proactive one which provides with "how to" approaches*, a design perspective* contributes *to the Open Innovation literature.* Following suggestions from Vanhaverbeke, Chesbrough, and West (2014), to maintain alignment between research and practice, managers could benefit from the academic insights while academy could continue to offer research that is relevant to practice.

3.2. Academic entrepreneurship and technology commercialization

The before mentioned transition of the role of universities from knowledge generators to technology transferors, and the question on how to achieve this change has drawn universities to get involved in entrepreneurship (O'Shea, et al., 2004). But we cannot talk about entrepreneurship at universities without involving the commercialization of the technologies developed within them; therefore, in an effort to provide a richer view of the entrepreneurship panorama at universities, I reviewed these two topics together.

The university context in general and entrepreneurial learning at the universities in particular are important antecedents of entrepreneurial intent (Sieger, Fueglistaller, & Zellweger, 2014).

While licensing has been the dominant route for the commercialization of public sector intellectual property, the formation of university-based spin-off companies deserves no less attention (Lockett, Siegel, Wright, & Ensley, 2005). Research suggests that universities that have cultures that support commercialization activity will have higher levels of commercialization and

higher rates of spin-off activity. Yet, some universities perform better than others at their entrepreneurial activities, the reasons why this happens and the mechanisms needed to get better at it are a focal point of entrepreneurial research.

In an intent to illustrate how universities approach these topics, a comparison of the main kinds of programs and institutions created to enhance and/or support spin-off and start-up creation, and technology commercialization at universities was performed. The compared initiatives are, namely: 1. University-based Incubators (UBIs), 2. University Technology Transfer Offices (UTTOs), and 3. Proof of Concept Centers (PoCCs). See Appendix E.

The analysis yielded the following results:

- *No use of external sources of ideas* - All programs and institutions related to universities use only the ideas generated within the university, paying little or no attention at all to possible inputs from industry, external entrepreneurs or society as a whole.
- *Lack of collaborative efforts/mindset* - Following the previous point, as universities are (still) not seen as the focal point of the Open Innovation paradigm, their role is limited to a fraction of what it could be if they open themselves to collaboration, and most of all, lead these efforts.
- *Few funding schemes* - Public funding is still seen as the major contributor to university breakthroughs. While owning shares from the newly developed ventures has been recently used, the practice of this revenue model is not widespread among universities. Other streams of funding could supplement these sources as universities position themselves to lead innovation.
- *No clear "graduation" policies and duration of PoCCs processes* - Although the young literature about PoCCs mentions the benefits of not investing in projects that are commercially weak, it still does not consider the ways in which universities could screen these projects in a better way. It also does not contemplate guidelines through which supported projects could be evaluated to know if they have been successful and therefore if they can "graduate", nor the duration of these processes has been documented.

On the other side, the comparison itself bridged important gaps not previously revised in literature:

- The joint *consideration of these spaces as part of a bigger academic entrepreneurship and technology commercialization ecosystem at universities*, which allows to find the complementarities and still existing gaps within the efforts and strategies universities follow to commercialize their technology.
- The *characterization of the entrepreneurship and technology commercialization support programs and institutions across several dimensions* or variables, such as their mission or the type of

services they provide, could give practitioners, university boards, and investors a better understanding of their differences and similarities. This could help to shape a coherent, strong and focused technology commercialization strategy at universities. It could also help investors clearly identify the kind of projects they are supporting and what type of outputs to expect from them.

3.3. The Third Generation University

Universities are changing in a fundamental way, moving from the model of the science-based university into what is called *"Third Generation University"* or *3GU*. The 3GU is speculative model described by Wissema (2009). The third generation university is characterized as the center of a know-how hub, with an emphasis on transdisciplinary R&D, collaboration with enterprises and other external partners and an active policy for the creation of spinouts and *"technostarters"*.

Although still a descriptive model, the 3GU presents an interesting vision and initial guidelines for universities to further explore. The *"techno-starter", "techno-starter factory" and "techno-starter team"* concepts are especially interesting for universities to apply. Wissema (2009) described *techno-starters* as *"optimistic, perseverant and passionate people who are motivated by creating their own employment rather than being employed elsewhere. Techno-starters are students or academics who establish their own science- or technology-based firm". They need to be motivated and supported, with a thriving environment that would push them to pursue entrepreneurial activities. Good facilities for techno-starters, with their correspondent flows of support constitute the "techno-starter factory". The factory is managed by the "techno-starter team"*, responsible for activities related to new ventures and the assurance of influx of four "materials": 1. Flow of finance. 2. Flow of technology. 3. Flow of entrepreneurs. 4. Flow of support.

4. METHODS

4.1. Research design

This master thesis project involves the design of logical structures to facilitate the connection of student entrepreneurial activities with the formal university's work structures at the Eindhoven University of Technology (TU/e).

The project included both *pragmatic and academic objectives*. From a pragmatic point of view, the objective of this project is to *produce a solution* that would connect student-led activity at TU/e with the university's led-efforts. From an academic point of view the objective is to *generate scientific knowledge* about the empowerment and support of universities to student entrepreneurship, via the development of design principles.

In order to do so, a research design was developed combining approaches by van Burg, et al., (2008), and by van Aken, et al., (2012), -see Appendixes F and G-. This project worked on the

deliberate design dimension (van Burg, et al., 2008). Nevertheless, a reflection step was added at the end of the process in order to facilitate the eventual transition to the emergent design dimension; the reflection step acted as a bridge towards the translation of specific knowledge to more generally applicable rules (see Appendix F and Figure 7).

The basic structure of this project can be summarized as follows:

- The research design for this project started with a *problem definition*.
- Then, *design principles from literature* were developed.
- Afterward, a case study was developed. *Design principles* were derived from *practice*.
- Next, a set of *final design principles* was developed. They were used as an input to generate a *design solution*.
- Finally, a *Reflection step* was added to the research design.

A graphic representation of the combined approaches and resulting methodology for this project can be seen in Figure 7.

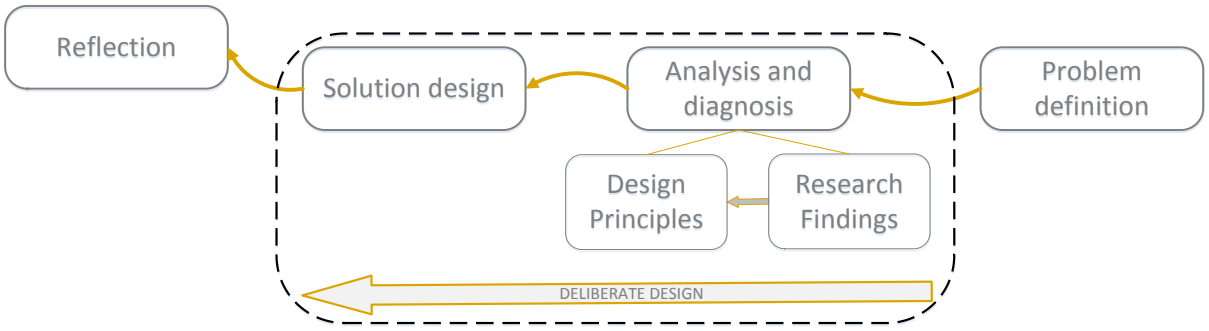

Figure 7 Research design based on combined approaches by van Burg, et al., (2008), and van Aken, et al., (2012)

4.1.1. ANALYSIS AND DIAGNOSIS

The Analysis and diagnosis step is the analytical part of the project (van Aken, et al., 2012). In this section, first the selected general research method with its units of analysis, data collection approaches, and quality criteria are described. Next, the process to derive design principles for this project is explicated.

Multiple sources of evidence aim to strengthen findings through the convergence or triangulation of the data (Yin, 2014). This master thesis project followed this advice by generating design principles from literature as well as from practice. Understanding of the context of the project is enhanced by the ample access granted to the researcher responsible for this master thesis project from the beginning; from workshops held even before the project was formally started, to full access to the new information that is generated for the InnoSpace on a daily basis.

4.1.1.1. Findings from literature

The *literature review study* -in an independent document (Velasco Montañez, 2016)-, was re-

examined to derive design principles for the main problem of this master thesis project. This step was intended to derive general knowledge, that could be applicable to solve the defined problem (see Section 1.2) through *open, collaborative, co-designing, entrepreneurial experimentation spaces or hubs.*

A complementary, more focused literature analysis was also performed. This second analysis was intended to enhance understanding of the entrepreneurial context by the researcher, and to help give structure to the InnoSpace case information analysis (next section).

4.1.1.2. Findings from practice

The second method, followed the *case study* methodology. According to Yin (2014), a case study is an empirical inquiry that:

- Investigates a contemporary phenomenon (the "case") in depth and within its real-world context, especially when…
- The boundaries between phenomenon and context may not be clearly evident.

The phenomenon studied in this case, *the connectedness between universities' formal structures and entrepreneurial student activity*, is both contemporary and its boundaries with the context are not well defined because of the nature of the phenomenon itself, which is dependent on the context.

A *single case* study is an appropriate design under several circumstances, being the *"common case"* one of them. The objective of studying a common case is to capture the circumstances and conditions of an everyday situation, because of the lessons it might provide about the social processes related to some theoretical interest (Yin, 2014). In this case, the study of a university developing its Entrepreneurship and Innovation strategy, provided insights about the processes it goes through, the challenges it faces, and finally, how to overcome them.

The selected case for this study was the TU/e (via the "InnoSpace"). This case study was also characterized as an *embedded case study*, as it considered two levels of analysis previously mentioned; the organizational level and the extra-organizational level.

4.1.1.2.1. Units of analysis

The characterization of this project as an embedded two-case study, resulted in two units of analysis. At the organizational level, it focused on the InnoSpace (in-house). At the extra-organizational level, it focused on the entrepreneurial TU/e community around the InnoSpace. A graphic representation of the units of analysis can be observed in Figure 8. Observe that the boundaries between the case and the context are not sharply defined.

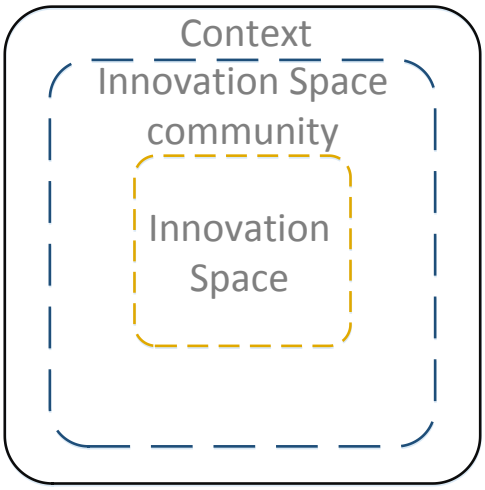

Figure 8 Units of analysis for the case study

4.1.1.2.2. Data collection and analysis

Data collection and analysis were performed in four stages each one, corresponding to the four sources of information for the case: 1. TU/e context information. 2. InnoSpace internal documents. 3. Field notes. 4. Interviews. Note that these stages were not necessarily linear.

1. Data collection
    a. Revise available TU/e information
    b. Revise InnoSpace internal documents
    c. Take and revise field notes
    d. Perform interviews
2. Content analysis
    a. Get main insights from available TU/e information
    b. Get main insights from InnoSpace documents
    c. Get main insights from field notes
    d. Code and get insights from interviews

The three data collection methods that were selected for this case-study are *semi-structured interviews, participatory observation, and secondary data analysis*. Next the information sources for the data collection steps are described.

- *Secondary data analysis* is data that was previously collected and tabulated by other sources (Bhattacherjee, 2012). For this study, secondary data is used to generate a preliminary profile addressing data about E&I supporting resources, academic activities and strategic activities both at the organizational and extra-organizational level. One of the main goals of the secondary data analysis was to identify practices, strategies, paths and resources that foster the connectedness between the university's formal work structures and student entrepreneurial activity at the before mentioned levels of analysis. The resulting identified instances were used as a base to develop semi-structured interviews. For this project, two

types of secondary data were used:

  - *Information on TU/e's E&I context*: A preliminary E&I profile was developed for TU/e. Information was gathered mainly from the University's official website and from other websites related to the university or other institutes.
  - *Internal InnoSpace project documents*: Complete access was granted to the researcher conducting this study to search for relevant information. This step complemented the information gathered from external cases.

- *Participatory observation* was used as a complementary method to get information on the InnoSpace specific case. Participant observation allowed the researcher to check definitions of terms that participants used in interviews, to observe events that informants were unable or unwilling to share, and to observe situations informants had described in interviews, thus making the researcher aware of distortions or inaccuracies in the description provided by those informants (Marshall & Rossman, 2011). These observations contributed to the study mainly by providing insight into the community-related matters relevant to the InnoSpace context. Is important to mention that the researcher responsible for this research project, actively participated during the InnoSpace core work team meetings, giving the observation its participatory characteristic, and enriching the understanding of the context for the project.
- *Semi-structured interviews* (shorter case-study interviews) remained open-ended and assumed a conversational manner, while following a protocol (Yin, 2014). Interview questions were created to gather data that would allow identifying connectedness strategies. These interviews were organized according to the three defined disconnectedness categories (support resources, academic activities and strategic actions), and to the two main levels of analysis for the project (organizational and extra-organizational. Semi-structured interviews were held with 6 people representative of the main University-based stakeholders. The interviewees were selected considering access to a particular subset of people (related to E&I at TU/e, and specifically to the InnoSpace). To select them, a basic profile was developed:
  - Participants should be experts on one or more topics contained in the interview protocol
  - Participants should be able to give answers to the questions
  - Participants should be related or have knowledge about the InnoSpace project

  With help of Isabelle Reymen, InnoSpace coordinator and front-runner of Entrepreneurship Education at TU/e, the best people to participate in this study were chosen. The selection was not a hard task, since there is still only a few, very identifiable group of people involved in E&I initiatives at TU/e. Questions were based on the literature

review and the problem analysis. More attention was paid to the topics the interviewees were experts on. A list of interviewees can be found in Appendix H.

Content analysis is the systematic analysis of the content of a text. First, from the available TU/e information, main insights were taken. This lead to developing the TU/e E&I preliminary profile.

Next, main insights were derived from the InnoSpace internal documents, and from the researcher's field notes.

Then, from the interview transcriptions, different *entities of analysis were identified* (for example assumptions, effects, enablers, and/or barriers). Then, an open *coding and reduction* scheme was used. The coded data was analyzed to determine which themes occurred most frequently, in what contexts, and how they are related to each other (Bhattacherjee, 2012). Interviews were coded using substantive open coding. The work was performed directly on the gathered data, fracturing and analyzing it, for the emergence of a core category and related concepts, until the point of theoretical saturation was achieved (Holton, 2007). The process included filtering those categories that were mentioned only once, because of little quantitative support, and that were mentioned not to be very relevant by all, or almost all of the interviewees reflecting little qualitative relevance. (See Appendix I for the interview protocol).

The *validity and reliability* of the data will be taken into account to guarantee quality for this research project. Following Yin's criteria for judging the quality of research designs (Yin, 2014), the following tests will be considered:

- *Construct validity*, refers to the accuracy with which a case study's measures reflect the concept being studied.
- *Internal validity*, refers to the strength of a cause and effect link made by a case study.
- *External validity*, refers to the extent to which the findings from a case study can be analytically generalized.
- *Reliability*, refers to the consistency and repeatability of the research procedures used in a case study.

To address the four mentioned "tests", tactics proposed by Yin (2014) will be followed. Table 2 depicts the four tests and the case study tactics chosen to deal with them.

Validity and reliability tests and the case study tactics to deal with them

	Case study tactic
Construct validity	Use multiple sources of evidence Establish chain of evidence
Internal validity	Do explanation building Use logic models
External validity	Use theory in single-case studies
Reliability	Use case study protocol

Table 2 Tests and the case study tactics chosen to deal with them, adapted from Yin (2014)

4.1.1.3. Development of design principles

Design principles following the "CIMO-logic" were derived from the resulting information from secondary data analysis, observation and interviews. Both the *literature and the practice derived design principles* were used to develop a *final set of design principles* as inputs for the design solution process. These principles represent the link to the prescriptive nature of this design science endeavor. They were used as inputs to design a solution for the problem (see next section).

4.1.2. SOLUTION DESIGN

This step involved *the design of the solution itself* and the development of *recommendations for implementation*. This phase was of a very different nature from the previous ones, as design ultimately involves the creative jump of abduction, for which there are far fewer systematic approaches available (van Aken, et al., 2012).

4.1.2.1. Solution design process

In order to design a solution for the stated problem (see Section 1.2), the general design process proposed by van Aken, et al., (2012), was followed. The process can be visualized in Figure 9.

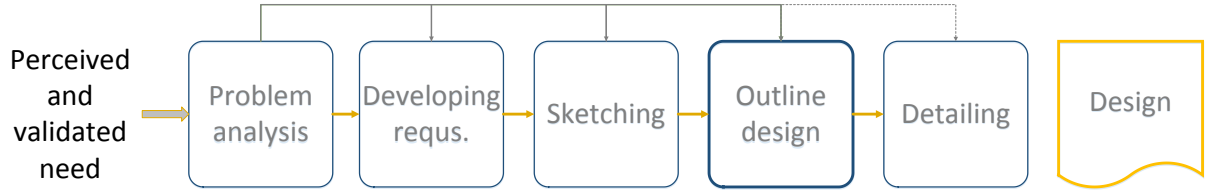

Figure 9 General design process, by van Aken, Berends, and van der Bij (2012)

The process is divided into a number of process steps. The arrows above the sub-processes refer to *iterations and explorations*; iterations, by going to a previous step, as, for example, if more information is needed from that step; and explorations, by briefly jumping to a step further on in the process to explore possible design solutions. The used model was not a phase model where phases follow a fixed sequence and each phase has to be concluded before starting a new phase (van Aken, et al., 2012).

4.1.2.2. Design requirements

The design principles resulting from the Analysis and diagnosis phase, and the design requirements are an important part of the solution-related input.

According to van Aken, et al., (2012), these requirements are divided into four categories:

1. *Functional requirements*, which constitute the core of the requirements, in the form of performance demands on the object to be designed.
2. *User requirements*, which are the specific requirements from the viewpoint of the user.
3. *Boundary conditions*, which are to be met unconditionally.
4. *Design restrictions*, which comprise the solution space preferred by the problem owner.

4.1.2.3. Artifact design

A *solution artifact*, was developed for this project. This type of artifact can be created by combining or refining solutions, or by applying existing technologies to new problems (Winter, 2014).

4.1.3. REFLECTION

This last step of the research design constitutes the connection towards emergent design (van Burg, et al., 2008). The results of the project were reflected upon considering *contributions to academic literature and directions for future research*. The objective of this phase is contributing to the different research bodies related to the project, and especially to multidisciplinary research by generating knowledge from the performed design exercise.

4.1.4. LIMITATIONS

The limitations of the study are those characteristics of design or methodology that impacted or influenced the interpretation of the findings from the research (Price & Murnan, 2004). Following, both the methodological and the researcher's limitations are acknowledged.

Lack of prior research studies on the topic: Even though based on three solid research streams (Open Innovation, Academic entrepreneurship and Technology commercialization), collaborative and open spaces at universities in which innovative design, high technical level and entrepreneurial approaches are merged, are not yet explored exhaustively in academic research. Most of the sources that could be found, are secondary sources, e.g. non-academic reports, websites, project reports, etc.

Self-reported data: Self-reported data, such as data gathered from interviews is limited by the fact that it rarely can be independently verified. In other words, what people say has to be taken at face value (University of Southern California, 2017).

Restriction to a single case: Although a single case study provided very valuable insights from the specific TU/e entrepreneurial environment, it restricts the generalizability of findings and therefore, of the solution design.

Lack of information in the English Language: Some information, especially information previous to 2012 was found to be difficult to find in the English language. This represents a limitation especially in the sense that search engines do not translate automatically and some information could be lost in translation.

Time: The time available to investigate the research problem at hand was constrained by the due date of the master Thesis assignment. A more extensive and deep approach to the problem, and therefore a scope expansion could have resulted from having more time to develop this project.

5. RESULTS

5.1. Analysis and diagnosis

The analysis was held at two different levels. The data gathered from the literature study,

interviews, document study, and participatory observation focused on both the organizational and the extra organizational level. As the InnoSpace is still a project in the (late) development phases and close to start the pilot stage, most of the collected information was dedicated to the organizational level of analysis. Nevertheless, the categories of the theoretical framework (Bogers, et al., 2016), were explored as much as possible at the extra-organizational level, especially by means of the interviews.

First, findings regarding practices, configurations, and guidelines that are related to connectedness between the formal work structures at universities, and student entrepreneurial activity are presented, these findings were drawn both from literature and from practice. Next, an analysis in form of a diagnosis of the current situation for the InnoSpace case is detailed. Following, Design Principles from both literature and practice are described. Lastly, a final set of design principles is defined.

5.1.1. FINDINGS FROM LITERATURE

5.1.1.1. Literature review

As mentioned before, *the strategic vision of the University at the center of the Open Innovation model, and the ecosystem around it*, which is not yet explored, was found to be helpful to bridge the gap between knowledge generation and technology commercialization. When considering a wide lens to E&I at universities, and the ecosystem importance, distributed responsibility for E&I across multiple University agencies becomes also important to permeate an E&I vision through the whole university. As the entrepreneurial mindset becomes more visible, the student-led efforts gain momentum and could be facilitated in a more structured way.

Within this paradigm, the coupled process of Open Innovation, that refers to *co-creation with (mainly) complementary partners through alliances, cooperation, and joint ventures* during which give and take are crucial for success (Gassmann & Enkel, 2004; Enkel, Gassmann, & Chesbrough, 2009; Chesbrough, et al., 2014). Specifically, the interactive coupled process, a collaborative and *interactive approach where innovative outputs are produced by all those who are involved* and that is similar to co-creation (Piller & West, 2014) resulted of interest for this research project; this process leads to *sharing resources ranging from spaces and staff to knowledge*. It represents an example of a *cross-disciplinary research topic*, and considered at a strategic level, it could guide the university's *strategy* in broad terms, by giving enhanced importance to the alliances and cooperation previously mentioned. The interactive coupled process is one of the founding stones of the InnoSpace and it intrinsically considers the further development of an entrepreneurial *community*, consisting of academics, staff and students, participating in the environment, cooperating and sharing.

The concept of *co-creation* is extensively studied in the open innovation literature (Enkel, et al., 2009; Prahalad & Ramaswamy, 2004a; Prahalad & Ramaswamy 2004b; Vargo, Maglio, & Akaka, 2008; Hoyer, Chandy, Dorotic, Krafft, & Singh, 2010; Zwass, 2010; Grönroos, 2011; Romero &

Molina, 2011; Han, et al., 2012; Perks, Gruber, & Edvardsson, 2012; Lee, Olson, and Trimi, 2012; Gassmann & Enkel, 2004; Barczak, 2012; Frow, Nenonen, Payne, & Storbacka, 2015). When analyzed from many different angles, the literature yielded a common denominator among the reviewed examples: the perception of *co-creation as a mean to co-innovate*. This collaborative type of innovation involves *cooperation across fields of expertise* (Bruns, 2013), and it constitutes an interesting focal point as it entails ambiguous organizational boundaries and new interested parties (Jelinek, Romme, & Boland, 2008).

Entrepreneurial experimentation, a process involving different disciplines, "that relates a business concept to an experiment" where the designer builds on the concept by experimenting in the laboratory (Curley & Formica, 2013b); was found to acts as a bridge where business ideas change from an embryonic state to full manifestation in the form of new ventures. The *prototyping and experimentation spaces* where entrepreneurial experimentation takes place, known as *experimental business labs*, were found to show the strategic value of *design and design-led innovation*. The *"lab"* or *design innovation hubs* are both *physical and logical settings that assist the formation of an idea and the early testing of its potential probability of success* (Curley & Formica, 2013a; Designregio Kortrijk and Lancaster University, 2014). They may include some of the following *facilities*:

- Fabrication laboratories
- Co-design spaces
- Exhibition space
- Seminar and educational facilities
- Incubator space for start-up creative businesses

The Third Generation University model (Wissema, 2009), described a *Technostarter team, in charge of a Technostarter factory*: a fully equipped *center for marketing and know-how commercialization*. The concept of the factory became helpful to conceptualize *good facilities and a thriving environment* that would attract and push university technostarters to pursue entrepreneurial activities.

Top down and bottom up approaches to E&I, are two strategies that arose in several examples, suggesting that both ample support from the University's senior management for the entrepreneurship and innovation agenda, and an empowered, cohesive, inventive, bold and well-connected student-led entrepreneurial community, working together towards the same objective (Graham, 2014).

Support and incentives for cross collaboration were mentioned as an important point to acknowledge and act upon towards the further internalization of E&I at universities. These points refer to the tangible actions the university can take to *make room for E&I at a strategic level*, and to make the whole organization *aware* that it is not only possible, but rewarded to collaborate and co-create (Graham, 2014).

5.1.1.2. External examples

Some examples have been described in the academic literature, and in secondary sources that are examples of *success regarding Entrepreneurship and Innovation*. A very important topic is how to assess this success. Internationally, there are concerns about E&I performance metrics, as there is a strongly-held expert view that standard measures work against the university entrepreneurship that they are designed to incentivize and capture (Graham, 2014).

Worldwide, there are three universities constantly cited as leaders in entrepreneurship: MIT (USA), Stanford University (USA), and the University of Cambridge (GBR). On the other side, there are highly-regarded universities operating in more challenging conditions, these include: Technion (ISR), Aalto University (FIN), University of Michigan (USA), KAIST (KOR), and the University of Auckland (NZL). The *challenging environments* where these universities thrive were described as cultures that did not support entrepreneurship and innovation, geographic isolation and/or a lack of venture capital (Graham, 2014).

From this last group, more interesting are the universities that had played an active, positive role in establishing and/or growing a vibrant and strengthening Entrepreneurship and Innovation ecosystem, regardless of the national growth and development levels their context provides.

Those universities also had some elements in common that made them even more interesting to analyze:

- Their entrepreneurial development is still in its "startup phase".
- Their entrepreneurship and innovation policies are responsive to the barriers faced in their environment.
- They have a significant focus on engineering and technology in their entrepreneurship activities.
- As a result of the last point, universities that were further studied all have an important science and technology base.

For the purposes of this research, these examples were selected to help the researcher gain understanding on how to analyze the actual case study. These universities are currently developing an entrepreneurship and innovation environment within them, thus knowledge regarding their current actions and challenges towards developing a new entrepreneurial and technology commercialization mindset are of utter importance.

Following, information from four selected examples is presented. All of the examples were described in Graham's report "Creating university-based entrepreneurial ecosystems: evidence from emerging world leaders" (2014).

5.1.1.2.1. Aalto University

There were two main factors that aided this ecosystem's early success: a dynamic student-led entrepreneurship movement and a university leadership supportive to the entrepreneurial ecosystem.

The *student-led entrepreneurship movement*, born out of frustration with the lack of regional and university support for entrepreneurship, adopted an approach *open* to all those engaged at any stage of the entrepreneurial process in Northern Europe and Russia, regardless of their nationality and background. A student-led society, the Aalto Entrepreneurship Society (AaltoES), is reported to be the beating heart of the movement and it harnesses the talents of the regional startup community to support and *make visible* the vision to establish Aalto as a key hub for high-growth technology-driven entrepreneurship. As a result, the student-led movement was the catalyst for a wider cultural change in national attitudes towards startup activities and entrepreneurship more generally.

The *university's senior management*, guided by a *"support but not direct"* strategy provides public endorsement, financial help and physical space for the students' activities. The environment created was one where groups of passionate individuals, in a very short time period, could develop ideas and easily *adapt them to the changing needs of the emerging ecosystem*.

On the background of this example, Aalto University's investment in regional rather than institutional capacity, and the *intentional deemphasizing on IP ownership and startup affiliation*, aided to create an environment where the university is not directly, but indirectly obtaining benefits from its contributions.

Regarding challenges, it was stated that the university is aware that it must take steps to *embed entrepreneurship within its schools* to provide a more stable base for future ecosystem growth. Besides, the university's *policies and procedures, incentives and curricula* are currently aligned with its research mission, and the need to *adapt them to the new entrepreneurial developments* within Aalto is every time more accepted.

5.1.1.2.2. Imperial College London

Imperial College, constantly placed in the top ten of the world university rankings, is located in London, in the South Kensington. The university describes itself as the *"only UK university to focus exclusively on science, technology, engineering, medicine and business, and the only one to have had the application of its work to industry, commerce and healthcare central to its mission since its foundation"*. It is house to highly renowned excellence researchers and students, resulting in a *world-class science and technology base*. In addition, its *inter-disciplinary* attitude to research and innovation is emphatically endorsed and *supported by the university at the highest level*.

The *culture and priorities* of this university have been focused on Technology transfer from the beginning. As a result, Imperial College has two *well-stablished university centers* to support this process: 1. Imperial Innovations, which has two core functions: *technology transfer*, providing services exclusively for Imperial College; and *venturing*, building and investing in technology and healthcare businesses emerging from the University of Cambridge, the University of Oxford, University College London and Imperial College. 2. The Imperial College *Business School*, whose status has grown during the last years. The Business School is the main *entrepreneurship research*

center, and has contributed a lot to the university's good reputation.

Regarding university structures, the university is perceived to be *quick to react to changes* in the external and internal environment.

Nevertheless, Imperial College also has identified *challenges* to overcome. People engaged with Imperial Innovations is only a small proportion of the staff and students. Moreover, the university's entrepreneurial strategy and governance seem not to provide guidance, there was no identified *top-down entrepreneurship strategy* at Imperial College. With no strategy in place, the policies of Imperial Innovations and the policies of Imperial College were perceived to be the same, leading to *support only university-owned IP*, and to university relationships with the external entrepreneurial community being managed by the same center, without creating *informal opportunities for entrepreneurs to mix with staff and students*. Furthermore, student IP ownership rights were not clear, which led to ideas going out from the university's ecosystem. Finally, the presence of a *key employer in the region*, *has led to limiting perceptions* that entrepreneurship is a path only for finance students, while science and technology students do not pursue entrepreneurial careers.

5.1.1.2.3. TUSUR

Tomsk State University of Control Systems and Radio-electronics (TUSUR) is a small, specialist IT and robotics university located in Tomsk, western Siberia. Its focus, the *"military and space exploration"* sectors, required a *"closed culture of strict confidentiality"*. Nonetheless, several *context shifts* led the university to look for alternative and stable sources of revenue. By *exploiting their high technological capabilities*, they created not only that, but a *unified platform* from which the town was able to successfully bid for federal funding to establish its E&I infrastructure.

The establishment of a *strategic informal partnership of mutual support and collaboration with university-affiliated startups*, the resulting consortium of startup enterprises, referred to as 'UNIC' was born. Is worth to note that even though the university *high levels of support for startup creation* by its staff, student and alumni, in most cases *the university "gives the IP to the inventor".*

This example, regarded as impressive, presented very interesting characteristics to analyze:

- The establishment of widespread engineering *project-based learning* within the undergraduate curriculum.
- The *quality of the relationship* between the university and the start-up's companies
- An *evolving E&I university strategy* that is informed by both international best practice and critical self-analysis
- The *level of investment that received from the university-affiliated startups*. By 2012, the university attracted an annual income of $14 million USD from those companies, *through the contracting of R&D services, infrastructure investment and the purchase of equipment for the university's laboratories, departments and research centers*.

However, TUSUR also faced *challenges*. Many of its startups struggled to have an impact in the

international market. Apparently this is caused by the *lack of multidisciplinarity*: a narrow skill base within the TUSUR startup teams, where *technical knowledge was abundant, but strong English language skills, management understanding of the international market needs were absent* or almost absent.

5.1.1.2.4. University of Auckland

The University of Auckland is the largest university in New Zealand.

While the country enjoys high living standards, geographical isolation usually means distance from other world markets, affecting its entrepreneurial environment. Moreover, there is a low national and private investment in research and development (R&D).

Regardless of this situation, the University of Auckland's E&I infrastructure grew during the last 30 years, thanks to two strategic guidelines: the *formalization of the university's technology transfer and commercial research activities*, and a *university-led drive to improve the national E&I capacity;* and to a *design responding directly to the constraints of the environment*.

This strategy was reflected in four main features:

- The university took the strategic decision to play an *explicit role in building the E&I national capacity, on the basis that strengthening the university's performance and reputation on a world stage would only be possible when positioned within a vibrant, innovative and growing economy.*
- The establishment of UniServices, the first *university-based technology transfer center* in Australasia. This led to the *creation of synergies that lead to new inventions and ideas.*
- On the other side, the "Spark" initiative, provides *students* with entrepreneurship events, courses and competitions, helped by 140 members of the local *entrepreneurial community* to mentor, judge and support these activities. Students responded by further developing the entrepreneurial environment at Auckland and beyond.
- Last but not least, the university's *Business School* inspires and supports entrepreneurial talent emerging *from both within and outside the university*.

Nevertheless, *challenges* faced by Auckland are mainly related to *identifying and investing in emerging research fields*.

5.1.2. FINDINGS FROM PRACTICE: SINGLE-CASE STUDY

5.1.2.1. TU/e E&I environment

5.1.2.1.1. University-led E&I

The Strategy 2020 for TU/e resulted of vital importance for this study. Several findings were gathered from the document (TU/e, 2011).

First of all, the university expressed its plans to have a leading position in the world as an *international research university in engineering science & technology*. To be known for its considerable scientific and societal impact and for the major impact it has on the competitiveness of Brainport

and the Dutch knowledge economy. As part of this vision, *interdisciplinary and interdepartmental cooperation was highlighted. Education, research and knowledge valorization core tasks were instructed to be strongly interrelated*.

a) Support resources

On the other side, the TU/e Science Park (in development) was also found to be part of the strategy of the university to be an attractive place for students, researchers and entrepreneurs to meet, with excellent facilities and amenities (TU/e, 2016).

Analysis of published available information suggested that currently, most of the Entrepreneurship and Innovation support resources are orchestrated around the Innovation Lab. Following, an explanation of the services provided by the Innovation Lab is detailed.

TU/e Innovation Lab is the *expert center that helps to translate knowledge into business at TU/e*. The center acts mainly as a *University Technology Transfer Office*. Nevertheless, through derived programs and partnerships, it delivers services of *University-Based Incubator (UBI),* and *accelerator* (TU/e, 2016).

Many options for students were found to be related to the student incubator activities, which central meeting point is the flexroom, a place with special office hours and specialists help for: pitch and presentation techniques, master classes and brainstorm sessions, business development, IP, accountancy, etc. (TU/e, 2016). The Innovation lab has multiple collaboration schemes for partners and allies. Among them the following were found (TU/e, 2016):

- *Eindhoven Student Business Club*: See Section 5.1.2.1.2.2.
- *Industry and SMEs*: It is TU/e's ambition to create an ecosystem around the university focusing on sustainable relations with SMEs and bigger companies. To achieve this, TU/e develops "Joint roadmaps" and "Living labs" in cooperation with *big companies*. SME's can be involved in the research projects TU/e does with large companies. It is also possible to find answers to questions of SMEs with the knowledge already available at the university or by starting applied research projects.
- *STARTUP/Eindhoven* is the business *incubator* of the TU/e. It aims to give starting entrepreneurs a soft landing in the market by providing everything they need to start and grow a business.
- *Bright Move* offers *early phase financing* for promising initiatives through a pre-seed fund (personal loan of maximum €100.000) and a proof-of-concept fund.
- The *IMPULS instrument* aims to increase the number of scientific research projects in the strategic areas Health, Smart Mobility and Energy: For every PhD student that TU/e provides, industry adds one. In return the industrial partner gets "Easy Access IP" meaning that patents that are filed during the research are handed over to the industrial partner without many restrictions (TU/e, 2016).
- *Valorization Academy* is a special training program focused on the knowledge transfer process. It offers (TU/e, 2016):
    - Workshops and courses for scientific staff on how to collaborate effectively with industry.

- Workshops for successfully writing a grant application.
- Workshops, masterclasses and summer schools in Entrepreneurship: What's the essence of entrepreneurship and what skills are needed?
- "Science for dummies" sessions: TU/e Innovation Lab invites researchers to explain their work to non-researchers.
- Workshops and seminars on request.

- *Reconfirm-TU/e* constitutes a consortium for Erasmus traineeship and Erasmus for Young Entrepreneurs Mobility.
- *SURE Innovation* matches companies and high-potential master students.

b) Academic activities

- Education

Education findings within the TU/e E&I environment are related to *a minor in the Bachelor programs* and *a special graduation program in the Master programs* This is supplemented by *information and PhD activities*, *programs and workshops about entrepreneurship* (TU/e, 2011).

- Research

Research on entrepreneurship at TU/e was found to be mainly developed by the *Innovation, Technology Entrepreneurship & Marketing (ITEM) group*. The group is part of the department of Industrial Engineering & Innovation Sciences (Innovation Technology Entrepreneurship & Marketing Group, 2016).

The research on technology entrepreneurship and new venturing focusses on means and measures for improving the quality and quantity of entrepreneurial efforts along four main research themes (Innovation Technology Entrepreneurship & Marketing Group, 2016):

- Technology commercialization, incubators, and university knowledge transfer
- Managing alliances and ecosystems as part of (open) innovation
- Business model innovation
- Decision-making in new business development (e.g., effectuation and emotions)

c) Strategic actions

As mentioned before, TU/e is committed to ensuring that its research results are translated into successful innovations and new companies.

Regarding start-ups, it was found that *TU/e cooperates with* the NV BOM, Brainport Development, the Design Academy Eindhoven, Fontys Hogescholen, Philips Technology Incubator, Rabobank Eindhoven-Veldhoven, Syntens and TNO Science and Industry in Brightmove.

Besides cooperation with external parties, plans for *establishing a Venture Capital Fund* to fund successful start-ups in the growth phase, as well as facilitating young companies in the broader sense in the growth phase were mentioned.

- Technology Transfer

In this regard, the *"Manual of Knowledge Valorization" at TU/e* was consulted. It was found that it *considers only technology transfer in the form of licensing of technology and intellectual property to third parties* (including spin-offs) (TU/e Innovation Lab, 2014).

Within the licensing scheme, revenues (e.g. royalties, shares, etc.) received by TU/e from licensees are distributed equally to the inventors (who in the case of being more than one, share these component), Faculties and the TU/e patent fund to fund additional education, research and technology transfer. As a general rule, it was noted that *TU/e owns inventions made by its employees* while working under a grant or contract to TU/e or using TU/e resources. Per TU/e policy, a share of any financial return from a license is provided to the inventor(s) (TU/e Innovation Lab, 2014).

- Metrics

TU/established knowledge valorization targets for 2020 (TU/e, 2011). All of *the targets are expressed in terms of numbers or percentages*, for example: Number of TU/e related spin-offs and startups per year, or Number of successful MSc entrepreneurship track participants per academic year. None of the available information suggested any other kind of metrics.

However, it is very important to note that, in practice, the *TU/e outstripped its initial vision and support for knowledge valorization*, by investing and giving support to new initiatives that are currently further developing the E&I environment of the university (e.g. The Innovation Space). In other words, there are more activities occurring than what is written in the formal vision documents.

- Incentives

Research suggests that some researchers are more than willing to work with and for industry, and efficient incentives should address that group to get them (even more) engaged in knowledge transfer (Bekkers, 2010). As was mentioned before, *some monetary incentives were found to be in place for technology commercialization in the form of licensing*. Nevertheless, no published information about incentives regarding entrepreneurship at TU/e could be found.

- IP Strategy

As for IP strategy, it was found that from the moment they sign the enrollment form, *all students agree to concede all intellectual property rights to the TU/e* concerning their work, models, drawings or inventions created in the context of their studies. If the TU/e determines at a later date that certain (formal) procedures must be instigated in order to ensure that the TU/e is or remains the rightful claimant, then the TU/e may ask students to cooperate. In such cases they are obliged to cooperate unconditionally. Any additional agreements take precedence over the general TU/e agreement on intellectual property rights (TU/e, 2016). Although in this way there is the possibility to be flexible over IP ownership, these rules apply mostly to cooperation with big companies, and the default university IP rights seemed to have discouraged nascent entrepreneurs.

For employees, the Innovation Lab was found to be the main office to offer guidance and

support regarding IP management.

5.1.2.1.2. Student-led activities

From all the available information, it was suggested that the student-led activities cluster around the Student teams, groups and the network of individual techno-starters.

a) TU/e Student teams

As was mentioned before, "Student teams" have become a popular phenomenon at TU/e (Kockelkoren, 2015). The multidisciplinary kind of project the "Student teams" develop, is every day more appreciated at the university.

b) Entrepreneurship groups and associations

Eindhoven Student Business Club was found to be the only formal, mainly entrepreneurship-focused student association It originated from the *wish among entrepreneurs to have a TU/e-wide platform*. By means of this organization, entrepreneurs can get in touch with other entrepreneurs through various events. By inviting speakers from industry, young entrepreneurs are inspired. The organization is also available for students who are thinking about starting up (StartUp Eindhoven, 2014).

c) Techno-starters

Techno-starters are students or academics interested in starting their own science or technology based firm (Wissema, 2009). What distinguishes student entrepreneurs most from the average student is that they are always looking for business opportunities and that they are intrinsically motivated; they have a business instinct and are strongly result oriented (Reymen, et al., 2016).

It was found that at TU/e*, techno-starters are given support via the Innovation Lab*, and most of them are developing software and web applications. Starting a company around a physical, technical product is uncommon because it is more costly to scale this kind of business than web applications (Reymen, et al., 2016).

5.1.2.2. InnoSpace internal documentation

5.1.2.2.2. Philosophy

As was mentioned before, the InnoSpace is a project in current development at the TU/e. Its philosophy was found to be highly related to the university strategy to promote entrepreneurship.

The core Message of the Innovation Space which revolves around *Innovation through collaboration, learning by doing, and a dynamic community with top facilities*, was found to be supported by the following main elements within its vision (Reymen, et al., 2016):

- A desire for an *open and transparent space*, the place to meet "partners in innovation".
- A place where the *dynamics between research, education and business become visible*.
- *A concept supported by a community*, of experienced Student teams, new Student teams, student entrepreneurs and local companies.
- Students working *on Multi-disciplinary engineering design courses and other educational*

projects

5.1.2.2.3. Support resources

Among the resources the InnoSpace was found to be planning to provide, are the following ones (Reymen, et al., 2016).

- For "Student teams"
  - Easy, nearby *access to technical equipment* for prototyping
  - *Support and advice from technical staff and scientific staff* to bring the first prototypes faster to a level that makes it interesting for companies to participate.
  - *Connection to companies* that can supply parts, materials and access to equipment, that want to sponsor, invest, or be a launching customer.
  - Close *involvement with TU/e entrepreneurial community in-house;* other good Student teams, educational multidisciplinary engineering project teams, and student techno-start-ups in order to interact and learn from them.
  - An *overview of competitions and challenges*.
  - An *overview of funding possibilities* and support to increase the chances of getting funded.
- For techno-starters
  - *Prototyping facilities* to experiment proof of concept, validate the technology (in and out of the space) and test the viability of the product by means of customer research.
  - A *tailor-made development program* for each start-up team (equivalent to R&D maps with bigger companies).
  - A *network of professionals, coaches and experts* in the field to provide student entrepreneurs with the proper information and advice. In cooperation with the TU/e Innovation Lab, for areas such as product development, intellectual property and finance, and outstanding external coaches for unbiased advice.
  - Innovation Space offers an *overview of funding possibilities* and support to increase the chances of getting funded.
  - Matchmaking opportunities facilitated both *a virtual platform and non-virtual community*.

5.1.2.2.4. Academic activities

A strategy to attract students to the InnoSpace was found to be drawn from its description (Reymen, et al., 2016). First the InnoSpace aims to *attract students interested in working on multidisciplinary teams*. Subsequently, interested students would be enabled to continue these collaborations in *design projects, which may be part of courses* from the bachelor's college or the graduate school (Reymen, et al., 2016). Some of these courses are currently identified, nevertheless the

mechanisms to bring those courses to the InnoSpace, and to further tailor them to the InnoSpace philosophy, is still in development phase. Finally, selected *final bachelor and master projects*, an *alternative to the purely academic projects,* can be offered to students in collaboration with Student teams, industry and/or start-ups. Various Master Programs could offer dedicated projects (within a free electives range) that require multi-disciplinary collaboration within the Innovation Space (Reymen, et al., 2016).

Furthermore, the InnoSpace plans to organize *extra-curricular activities* such as multi-disciplinary Hackathons or Summer Schools for Master students, PDEng trainees or PhD candidates (Reymen, et al., 2016).

However, it is important to note that, as not all design based nor all hands-on education qualifies for the InnoSpace. The current *challenge was found to be identifying the right courses* for the InnoSpace (Reymen, et al., 2016).

5.1.2.2.5. Strategic actions

a) Metrics

Initiatives within the InnoSpace core work team to develop *metrics for the development of the space were found to be documented*. Specifically, for each one of the defined outcomes for the InnoSpace, i.e. Engineers for the future, Multidisciplinary designed innovative prototypes and solutions, Student awards and exposure, and Research valorization and funding opportunities, several goals were defined. To measure whether these goals are accomplished, or at least improvements have been made, key performance indicators (KPI's) were proposed.

The *KPI's are expressed in different formats: (1) an amount, (2) a percentage, (3) a score, or, (4) an open question.* The *proposed metrics were found to represent a broad range of elements present within the space*. However, it is important to note that, by means of the interviews, it was known that *the main sources to develop the KPI's were external reports.*

b) IP policy and incentives

IP policies and incentives structures are two pending topics with the InnoSpace project. It was observed that both are planned to be addressed in the near future.

5.1.2.3. Interviews

The data gathered by means of the interviews provided the richer information in order to gain a better understanding of the current situation of the InnoSpace project, as well as its contexts and the circumstances around it. A was mentioned before, a scheme of open *coding and reduction* was used, which included filtering those categories that had little quantitative support, and little qualitative relevance. At the end, four main groups of interrelated topics were derived from the coded interviews. Next, they are described.

5.1.2.3.2. Strategy

The strategic dimension was the most discussed one throughout the majority of the interviews. However, from the data analysis it was deducted that it would be appropriate to divide the Strategy

category from the previous stages of this research project into two different categories:

- Strategy: Referring to the Universities strategic planning; mission, vision and goals.
- Governance: Referring to all those mechanisms that are put in place to assure the strategy is being followed.

Within this section, only the "new" Strategy dimension is addressed.

The need of a stronger, more E&I focused and more flexible strategy was suggested by almost all of the interviewees.

Among the main recommendations, the following ones were found to be aligned both with the literature suggestions and with the TU/e Strategic Plan 2020.

- The *development of a specific Entrepreneurship and Innovation strategy for TU/e*. Deriving from the university's general strategy, this specific strategy would represent the entrepreneurial arm of the university. It was also suggested by the interviewees that it would not only be a strategy to commercialize the available technology, but to look further and envision a future where the TU/e would develop whole innovations ecosystems.
- The need to *"make room" for entrepreneurial intent and activities* across several of the university components; governance structures, education, research projects, budgeting, and several more. This concept was found over and over again to be mentioned by all of the interviewees. It is intended to provide opportunities to explore, to make available time, physical and logical spaces to pursue entrepreneurial activities, both for the students as for staff.
- The creation of *entrepreneurial awareness* at different levels at the university. This could be by means of entrepreneurship-related courses, but also by means of exposure and "making entrepreneurship visible at the university".

5.1.2.3.3. Education

The education dimension was naturally mentioned by all the interviewees. It was deducted by means of the data analysis, that there are two main topics to address when referring to entrepreneurial education.

- *Entrepreneurship related courses*, which introduce students to entrepreneurship and to entrepreneurship focused research.
- *Project-based-learning,* which was mentioned to develop important entrepreneurial skills, by the way students work during the development of the courses that follow this methodology. It was noted that students cultivate abilities that allow them to easily follow an entrepreneurial career, as could be working in multidisciplinary teams, designing an artifact, managing budget, creating a product development plan, and much more.

5.1.2.3.4. Governance

As it was already mentioned, this category arose while referring to all those mechanisms that are put in place to assure the strategy is being followed.

The main topic that was discussed regarding this dimension was the *university incentives, and the current evaluation mechanisms for researchers*, which were found to be *only related to education and research, not "making room" for knowledge valorization*.

5.1.2.3.5. Community building

A very interesting topic that was mentioned during the interviews is that one of *"community building"*. Even though some of the interviewees mentioned that the current environment at TU/e is conductive of entrepreneurship and fosters the development of an entrepreneurial community, one person made the following statement "I don't think there is a single entrepreneurial community, but several entrepreneurial communities". The interviewee proceeded to explain how every office, interested department, or association has its own closed entrepreneurial community, and how it would be beneficial for the university to get all those communities together to share knowledge, networks, resources and experience.

5.1.3. FINAL DIAGNOSIS

After obtaining and analyzing all the pertinent information, the initial problem perception was reframed to gain better insights on the situation around the InnoSpace and the connections between university-based knowledge valorization activities and the student-led entrepreneurial activity. A visualization of this reframing activity can be observed in Appendix J.

The diagnosis of the situation can be interpreted as follows.

The *strategic vision of the University at the center of the Open Innovation model*, and the *ecosystem* around it play an important guiding role when in place. Without this vision, the university ownership of the development of the ecosystem is not followed by actions and structures that would facilitate entrepreneurial development. Successful examples of E&I thriving ecosystems consider both t*op down and bottom up approaches to E&I*. While the university could take the *"support but not direct"* approach towards student-led entrepreneurial activity, *making room for E&I at a strategic level* remains of utter importance. This would allow making *current efforts more visible*, aiding the objective of promoting entrepreneurship at TU/e.

As the TU/e strategic plan for 2020 expresses, TU/e is an international *research* university in engineering science & technology. The formal work structures of the university are in majority organized to follow specific discipline silos, hindering *interdisciplinary and interdepartmental cooperation* where *education, research and knowledge valorization could be strongly interrelated*.

This *silo-like structure* is underpinned by two situations: *not sharing resources and the rigid governance structures of the university*. Both seem to be inherited structures from when universities performed better by deep specialization only. It is very important to mention that from all success examples, their accomplishments were backed up by strong, world-class technology and research capabilities.

This suggests universities should facilitate both deep specialization, and also a more generalist, multidisciplinary and interconnected way of working.

There are three main consequences that were identified from the described situations. First, the *lack of visibility of E&I at the university*, where a lot of initiatives are taking place, but where there is no communication and exposure structure to make the whole university aware of it. Second, the *lack of a community feeling among all entrepreneurs and people involved with entrepreneurship* at the university. As it was explained before, there are different small communities, which are not in constant communication and that could be even duplicating efforts. Finally, the resulting structures do *not* allow to *make room for entrepreneurial experimentation*; this is especially influenced by the governing structures guiding all incentives, evaluations and different policies at the university.

At the end, the result is the perception of disconnectedness between the influx of entrepreneurial activity (including student-led activities), and the university structures.

But what does this mean for the InnoSpace?

The InnoSpace is thought to be the place where these barriers can be overcome by means of *co-creation with (mainly) complementary partners through alliances, cooperation, and joint ventures, using an interactive approach where innovative outputs are produced by all those who are involved*, *sharing resources ranging from spaces and staff to knowledge*, *cooperating across fields of expertise* and developing a unified *community*. It is also the place for e*ntrepreneurial experimentation*, a *prototyping and testing space*, *with a strong focus on design-led innovation*; a *physical and logical setting that assists the formation of an idea and the early testing of its potential probability of success*.

To help achieve this vision, a solution design was developed for the InnoSpace, based on design principles derived from both theory and practice.

5.1.4. DEVELOPMENT OF DESIGN PRINCIPLES

"CIMO-logic" design principles were derived from literature and from practice. First, both sets of principles are mentioned. Then, a final set of design principles is developed.

CIMO-logic principles are constructed as follows: in this class of problematic *Contexts*, use this *Intervention* type to invoke these generative *Mechanism(s)*, to deliver these *Outcome(s)* (Denyer, et al., 2008). For this project, the Context and the Outcome are already defined, therefore:

(C) In the Context of a new collaborative and open "space" in which innovative design, high technical level and entrepreneurial approaches aim to be merged…

(O) … In order to decrease the main barriers of lack of visibility of E&I, lack of community feeling, and lack of "room" for experimentation, in order to increase the university's connectedness with the student-led entrepreneurial.

Next, the Interventions (I) and Mechanisms (M) will be detailed. First, design principles from literature can be found on Table 3. Next, design principles from practice are summarized on Table 4. Lastly, the final set of design principles can be found on Table 5.

5.1.4.1. Design principles from literature

These design principles were derived from an extensive literature review, including the identified relevant examples.

Interventions (I) and Mechanisms (M) for the CIMO-logic design principles derived from literature

	Intervention (I)	Mechanisms (M)
1	Develop an Entrepreneurship and Innovation university strategy	Vision unification Strategic guidance Awareness creation Ecosystem integration
2	Provide the physical space for entrepreneurial experimentation	Tools provisioning Community building Communication facilitating Awareness creation
3	Develop more flexible IP policies	Talent preservation Motivation enhancement Cooperation increment Knowledge access
4	Promote and provide multidisciplinary projects	Cooperation increment Awareness creation
5	Form a Technostarter team to manage a Technostarter factory	Responsiveness boosting Ecosystem integration
6	Develop new incentives for cross collaboration, problem based projects, and entrepreneurial activities	Awareness creation Motivation enhancement Talent conservation Cooperation increment
7	Nurture relationship with start-ups	Awareness creation Motivation enhancement Cooperation increment Coaching and advice access Community building
8	Define the role of the "Business-school" in fostering the university's entrepreneurial ecosystem	Awareness creation New skills formation Knowledge access Knowledge development
9	Support the formation of a strong student entrepreneurial association	Community building Awareness creation Talent preservation Motivation enhancement Cooperation increment Ecosystem integration
10	Provide informal opportunities for internal and external entrepreneurs to mix with staff and students	Community building Communication facilitating Awareness creation Motivation enhancement
11	Foster the quality of the relationship between the university and the start-ups companies in the region	Community building Communication facilitating Cooperation increment Coaching and advice access

12	Establish strong university entrepreneurship related centers	Responsiveness boosting Ecosystem integration Awareness creation Talent conservation Cooperation increment Knowledge development Knowledge access Community building Strategic guidance provisioning New skills formation Tools provisioning Communication facilitating` Motivation enhancement Coaching and advice access
13	Adopt an explicit role in building the E&I national capacity	Awareness creation Vision unification

Table 3 Interventions (I) and Mechanisms (M) for the CIMO-logic design principles derived from literature

5.1.4.2. Design principles from practice

These design principles were derived from secondary data analysis –InnoSpace internal documents-, from participatory observation of the InnoSpace core team meetings, and finally from interviews with experts within the university. The resulting data provided information on the university's formal statements regarding Entrepreneurship and Innovation, on the context the InnoSpace is developing, and finally, on the opinions and insights the experts provided regarding the InnoSpace and the E&I ecosystem at TU/e.

Interventions (I) and Mechanisms (M) for the CIMO-logic design principles derived from practice

	Intervention (I)	Mechanisms (M)
1	Develop more flexible policies regarding IP and start-up affiliation	Talent preservation Motivation enhancement Cooperation increment Knowledge access Community building
2	Embed entrepreneurship within policies and procedures, incentives and curricula	Awareness creation Motivation enhancement Talent conservation Cooperation increment Knowledge development
3	Develop an entrepreneurship specific university strategy	Vision unification Strategic guidance provisioning Awareness creation Ecosystem integration
4	Establish strong university entrepreneurship related centers	Responsiveness boosting Ecosystem integration Awareness creation Talent conservation Cooperation increment Knowledge development Knowledge access Community building Strategic guidance provisioning New skills formation

		Tools provisioning Communication facilitating Motivation enhancement Coaching and advice access
5	Design ecosystem – university feedback structures	Communication facilitating Responsiveness boosting Cooperation increment
6	Define the role of the "Business-school" in fostering the entrepreneurial ecosystem	Awareness creation New skills formation Knowledge access Knowledge development
7	Provide the physical space for entrepreneurial experimentation	Tools provisioning Community building Communication facilitating Awareness creation
8	Promote and provide multidisciplinary projects	Cooperation increment Awareness creation
9	Provide a unified communications platform	Ecosystem integration Communication facilitating Community building Awareness creation
10	Generate shared resources structures	Tools provisioning Community building Cooperation boosting

Table 4 Interventions (I) and Mechanisms (M) for the CIMO-logic design principles derived from practice

5.1.4.3. Final set of design principles

The final design set of design principles was formed in the base of saturation among the different information sources this research study reviewed. Both literature and practice, yielded principles that coincided in many cases.

Interventions (I) and Mechanisms (M) for the CIMO-logic final design principles

	Intervention (I)	Mechanisms (M)
1	Develop an Entrepreneurship and Innovation university strategy, adopting an explicit role in building the E&I national capacity	Vision unification Strategic guidance Awareness creation Ecosystem integration
2	Provide the physical space for entrepreneurial experimentation	Tools provisioning Community building Communication facilitating Awareness creation
3	Support the formation of a strong student-led entrepreneurial association	Community building Awareness creation Talent preservation Motivation enhancement Cooperation increment Ecosystem integration
4	Promote and provide multidisciplinary projects	Cooperation increment Awareness creation

5	Form a Technostarter team to manage a Technostarter factory	Responsiveness boosting Ecosystem integration
6	Develop new incentives for cross collaboration, problem based projects, and entrepreneurial activities	Awareness creation Motivation enhancement Talent conservation Cooperation increment
7	Nurture relationship with regional start-ups, providing informal opportunities for internal and external entrepreneurs to mix with staff and students	Awareness creation Motivation enhancement Cooperation increment Coaching and advice access Community building Communication facilitating
8	Define the role of the "Business-school" in fostering the university's entrepreneurial ecosystem	Awareness creation New skills formation Knowledge access Knowledge development
9	Establish strong university entrepreneurship related centers with shared resources structures as center of the E&I environment	Responsiveness boosting Ecosystem integration Awareness creation Talent conservation Cooperation increment Knowledge development Knowledge access Community building Strategic guidance provisioning New skills formation Tools provisioning Communication facilitating Motivation enhancement Coaching and advice access
10	Provide a unified communications platform	Ecosystem integration Communication facilitating Community building Awareness creation
11	Develop more flexible policies regarding IP and start-up affiliation	Talent preservation Motivation enhancement Cooperation increment Knowledge access Community building

Table 5 Interventions (I) and Mechanisms (M) for the CIMO-logic final set of design principles

5.2. Solution design

5.2.2. DESIGN REQUIREMENTS

Following, the requirements for the development of the solution artifact are listed.

5.2.2.1. Functional requirements

These constitute the core of the requirements, in the form of performance demands.

- The design should decrease barriers to connect student-led entrepreneurship with the university structures
- The design should help shape a university culture that reinforces entrepreneurship

5.2.2.2. User requirements

These are the specific requirements from the viewpoint of the user.

- The design should be related to the university's strategy
- The design should be easy to use
- The design should consider TU/e context and
- The design should not take a lot of time to use
- The design should provide visualizations

5.2.2.3. Boundary conditions

These are to be met unconditionally.

- The design should be delivered by mid-January

5.2.2.4. Design restrictions

These comprise the solution space preferred by the problem owner.

- The design should be related to the Business Model Canvas (BMC)

5.2.3. ARTIFACT

5.2.3.1. First concept iteration

After organizing the information, and adapting to requirements, including relating to the Business Model Canvas, a preliminary artifact conception was obtained. A visualization of the preliminary artifact, can be found on Appendix K. The analysis produced the following outcomes.

First, the *need for an Entrepreneurship and Innovation university strategy* was found to be of vital importance for the further development and success of the InnoSpace. Nevertheless, its importance is not constrained to this project; it is suggested that developing a specific E&I strategy for the whole university, steaming from the general university strategic planning is one of the most important steps to develop entrepreneurial capacity at universities.

Although the E&I strategy should help to define the InnoSpace strategy, the process can also run in the opposite direction; *happenings at the InnoSpace be the starting point* and catalyze a series of actions and feedback loops between the E&I university strategy and the InnoSpace itself, shaping the E&I ecosystem at the university.

For the InnoSpace, four main blocks were identified to be at the heart of the case.

- *Key Activities*: resources to configure and provide at the InnoSpace.
- *Key Resources*: activities to facilitate at the space, and activities to arrange as grounding to ease the functioning of the space and remove barriers to entrepreneurship.
- *Channels*: channels to develop in order to allow smooth activity and communication within the space and with the ecosystem.
- *Actors (Customers & Partners):* the lines between customers and partners become blurred. Actors from within the university and also from the surrounding ecosystem are considered.

Next, the resulting final artifact will be explained.

5.2.3.2. Final artifact

The artifact is composed of a *guide and a visualization tool*. The visualization tool is used to give more clarity to the concepts and the relationships among them.

The artifact is intended to complement the already developed Business Model Canvas (see Appendix B), and to give guidance on what to focus first, on the context of a highly time-constrained situation.

The visualization tool can be found in Appendix M.

Next, the guide is described.

1. DEVELOP AN ENTREPRENEURSHIP SPECIFIC UNIVERSITY STRATEGY.

This strategy derives from the general University strategy and can be used to develop more specific, operational guidelines for specific offices/departments/associations, etc. involved within the TU/e entrepreneurial environment. Happenings at the InnoSpace are taken as the starting point towards catalyzing a series of actions and feedback loops with the E&I university strategy. In the resulting artifact visualization, borders between the E&I university strategy and the InnoSpace are dashed to symbolize constant feedback.

2. FOCUS ON THE INNOSPACE GUIDING PRINCIPLES.

A series of principles was identified (from literature and practice) to be helpful to guide the organization of the InnoSpace. These principles can be observed in the upper part of the artifact visualization, and are related to the BMC value proposition.

3. FORM A TECHNO-STARTER TEAM.

The team is in charge of maintaining the influx of the four inputs the "techno-starter factory" needs: 1. Flow of finance. 2. Flow of technology. 3. Flow of entrepreneurs. 4. Flow of support.

It is formed by representatives of the main Actors in the ecosystem, and is the responsible for the organization of the InnoSpace. It is assumed that the first version of the techno-start team, is integrated by the InnoSpace core work team. Nevertheless, it should consider both permanent members and rotating members with the purpose of assuring continuity of the strategy, as well as incorporating new feedback and further developing the InnoSpace.

4. WORK ON THE "HEART" OF THE BMC.

Besides from the guiding principles which represent the value proposition block of the Business Model Canvas, specific key activities, key resources and channels were identified to be crucial to work on.

- Key Resources (to provide)
    - A central place, a strong university entrepreneurship related center, acting as Techno-starter factory
    - Shared resources structures
- Key Activities

    - … to facilitate
        - Entrepreneurial experimentation
        - Multidisciplinary projects
    - … to prepare/organize
        - Development of new incentives
        - Informal opportunities for meeting and mixing
        - Definition of the role of the "Business-school"
        - Development of more flexible IP and start-up affiliation policies
        - Formation of Techno-starter team
- Channels (to develop)
    - Unified communications platform
    - A central place, a strong university entrepreneurship related center, acting as Techno-starter factory

The core message of the artifact can be read as follows:

AT THE INNOSPACE, A TECHNO-STARTER TEAM THAT INVOLVES AND IS FORMED BY ACTORS (CUSTOMERS & PARTNERS), PROCURES KEY ACTIVITIES, BY USING KEY RESOURCES, VIA PARTICULAR CHANNELS.

6. CONCLUSION AND DISCUSSION

This section focuses how the research questions were answered through this study.

> *RQ1: WHAT ARE THE BARRIERS PREVENTING THE CONNECTEDNESS OF STUDENT ENTREPRENEURSHIP WITH THE FORMAL WORK STRUCTURES AT TU/E?*

At the beginning of this research, an analysis of the main barriers causing disconnectedness between the formal work structures and the student-led entrepreneurial activity at TU/e was performed.

In addition to the qualitative case study, this research was heavily underpinned literature relevant to the case, which allowed the researcher to have a deeper understanding of the issues being investigated and provided guidance towards structuring the analysis and diagnosis.

The *first analysis* pointed towards three main *categories of disconnectedness: 1. Support resources, 2. Academic activities, and 3. Strategic actions.*

By means of interviews, informal conversations, participatory observation, and internal InnoSpace documents, a broad view of the main barriers was developed. The gathered information seemed to confirm most of the previously perceived issues. A series of lists used as tools to assess the presence or absence of E&I support resources, academic activities, and strategic actions can be found on Appendix L.

Nevertheless, the first situation analysis did not consider levels of influence and causality relationships among the disconnectedness categories (e.g. the precedence the Strategy takes over the other categories). Moreover, the profound examination of the information was able to identify two categories that were perceived as one in the initial analysis: Strategy and Governance.

Given these changes, the problem was *reframed*, resulting in a more comprehensive diagnosis of the situation. *Lack of visibility of E&I, lack of community feeling, and lack of "room" for experimentation* resulted the main real barriers to connect the university working structures with student entrepreneurship. The barriers were given by four disconnectedness categories, in different influence levels: 1. *Disconnectedness at the Strategic dimension, 2. Disconnectedness at the Academic activity dimension, 3. Disconnectedness at the support Resources dimension, and 4. Disconnectedness at the Governance dimension.*

It is important to note, that the final diagnosis of the situation suggested that the university's formal working structures are not only disconnected from the student-led entrepreneurial activity at TU/e, but from the overall entrepreneurial activity in general.

A visualization of the diagnosis can be found in Appendix J. A complete description of the diagnosis is described in Section 5.1.3.

> *RQ2: How should the business model for the InnoSpace be complemented to take away the main barriers responsible for the disconnectedness of student entrepreneurship with the formal work structures at TU/e?*

Based on the problem reframing diagnosis which yielded new disconnectedness dimensions and the inclusion of student-led entrepreneurial activity within an overarching general entrepreneurial aspect, and on the extensive literature underpinning this study, a solution artifact was designed. The artifact composed of a guide and a visualization tool, intends to *bring attention to the most important aspects of the BMC for the InnoSpace.* The description of the artifact can be found in Section 5.2.2. The visualization tool can be found in Appendix M.

The final disconnectedness dimensions resulting from the diagnosis phase, were embedded into the *design principles* that were used as input to design the artifact. By developing CIMO logic design principles, the researcher was able to identify the main key actions, key resources and channels that need to be taken into account within the InnoSpace BMC. This does not imply that the BMC for the InnoSpace on its current version does not these elements at all, it indicates that based on literature and on the case study, these are the elements that need to be addressed with more attention in a severe time restricted context.

Furthermore, the Mechanisms (M) the design principles provided, constitute the *"guiding principles"* for the InnoSpace. These guiding principles are aspects that are very important to be taken into consideration when enabling activities, resources and channels.

6.1. Recommendations

This section focuses on some important aspects that have not been explicitly mentioned in the previous sections. These aspects constitute special recommendations made by the researcher responsible for this study.

6.1.2. DEVELOP A COMPREHENSIVE E&I PROFILE OF TU/E

As part of this study, a preliminary E&I profile was developed. It was observed, that the university promotes and is open to support entrepreneurs. Nevertheless, it was also perceived that the E&I entrepreneurship ecosystem is highly fragmented. This leads to some activities being offered/performed by two or more parties, while others remain unattended. A complete profile would not only help to determine the current state of E&I at TU/e, but it could be the main input to strategically organize activities and resources (including financial resources), and to identify the main opportunity areas that need to be attended.

6.1.3. USE THE ARTIFACT TO PRIORITIZE

As it was explained before, the artifact does not imply that all of the suggested activities, resources and channels are not included on the current BMC for the InnoSpace, but is highly recommends that these elements are the ones attended with high priority.

6.1.4. CONTINUOUSLY UPDATE THE ARTIFACT

It would be natural that, after using the artifact, or after some time the InnoSpace is functioning, the context could change. Therefore, the artifact would need constant "recalibration" to generating value.

6.1.5. CHOOSE A STARTING POINT AND START AN ITERATIVE PROCESS

Is a commonly heard phrase within the entrepreneurial community, that "You'll never be ready, but you can be prepared". The point is that, while waiting for the conditions to be in perfect place, no actions are taken, and nothing gets done.

Especially in highly time constrained teams like the InnoSpace core work team, work should start somewhere and be continuously expanded by incremental contributions.

6.1.6. EXPAND UNDERSTANDING ON KNOWLEDGE VALORIZATION

As a research-focused university, TU/e has been historically oriented to knowledge generation. When knowledge valorization was added as a third university objective, some understood it as continuing the collaboration with big companies, disclosing inventions and licensing research results. However, there is also a wider view of knowledge valorization, which also includes as well entrepreneurship (by students and staff), skills generation via problem-based education and even more informal knowledge transfer processes.

6.1.7. PUT THE INNOSPACE AT THE CENTER OF THE TU/E E&I ECOSYSTEM

The information analysis provided insights on how the TU/e E&I ecosystem is currently fragmented. While developing an E&I profile would help understand the state of the ecosystem, providing a central platform to approach entrepreneurship at TU/e would make the E&I university efforts immediately visible. This does not mean that the InnoSpace would be the only or most important element within the ecosystem, it suggests to provide a central place from where to start entrepreneurial endeavors, and when needed, be directed to other instances of entrepreneurship support at TU/e.

6.1.8. TRUST MORE IN STUDENTS

Several examples of highly motivated students accomplishing impressive results were mentioned during the case interviews. Nevertheless, it seems students are acting in a parallel world, without being actively and strategically involved in the development of the E&I ecosystem of the university, which would highly benefit them. It is suggested that the InnoSpace makes an effort to identify those individuals and groups, and invite them to actively participate in the further development of the InnoSpace concept, not only involving them with the strategic planning, but also in the everyday activities.

6.1.9. DESIGNATE CHAMPIONS WITHIN DEPARTMENTS

As a new concept within TU/e, is possible that the InnoSpace will face change resistance. It is recommended that the InnoSpace identifies and designates "champions" at every academic department. Just like ambassadors, these champions should be highly trusted and respected individuals who demonstrate intrinsic motivation to participate in the InnoSpace activities.

6.1.10. BRIDGE THE GAP

The InnoSpace is situated between two traditionally separate worlds: Research and Business.

Prototypes act as the bridge between these two words. Developing and showcasing prototypes built within the InnoSpace, making emphasis on the contributions they (can) make to research and business development is an important step towards bridging the gap between these two worlds.

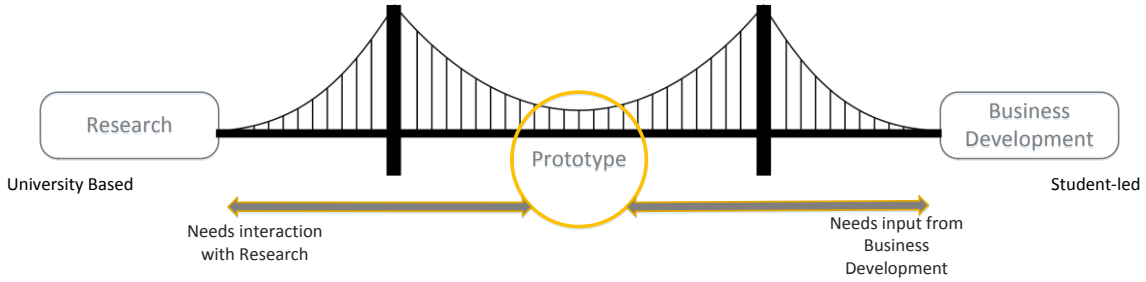

Figure 10 Visualization of the Research-Business gap

6.2. Reflection

This last section constitutes the connection towards emergent design (van Burg, et al., 2008). The results of the project are reflected upon considering *contributions to academic literature and directions for future research*.

6.2.2. CONTRIBUTIONS TO ACADEMIC LITERATURE

As was discussed in Section 3, this research study is based on two main research streams, and a speculative model: the 3GU. The contributions to each one of them, are described in this section. Furthermore, contributions to design science are also discussed.

6.2.2.1. Open Innovation

This research study considered *the university as the focal point of the Open Innovation paradigm*. Information was gathered using the framework for new research on Open Innovation by Bogers, et al., (2016), as a base. In this sense, the university took the place of the "focal firm", at two different levels of analysis: the organizational level (via the InnoSpace) and at the extra-organizational level (the E&I community around the InnoSpace).

Researching a prototyping and experimentation space, a topic that addresses the strategic value of *design and design-led innovation*, and that facilitates the emergence of ideas at the intersection of different disciplines, was the aim of this study. This report adds a source to the under-researched topic.

Until now, the open innovation literature has focused a lot more on dyadic relationships or alliances, while *networks, ecosystems and platforms* have been understudied (West, 2014). This research study contributes to this last area while studying the intersections of different analysis levels.

Finally, as research in open innovation is changing from a restrictive role, giving reviews of advantages and disadvantages to a more proactive one which provides with "how to" approaches, using a *design perspective* contributes to the open innovation literature. Following suggestions from

Vanhaverbeke, Chesbrough, and West (2014), to maintain alignment between research and practice and applying them to the university context, university's managers and practitioners can benefit from the academic insights, while academically the study offers research that is relevant to practice.

6.2.2.2. Academic entrepreneurship and technology commercialization

The *comparison of the main kinds of programs and institutions created to enhance and/or support spin-off and start-up creation, and technology commercialization at universities*, namely *1. University-based Incubators (UBIs), 2. University Technology Transfer Offices (UTTOs), and 3. Proof of Concept Centers (PoCCs)* contributes not only to characterize and better understand what is the purpose of each of them, but it also can be used as an artifact to identify the services a university offers to (student) entrepreneurs.

The analysis of information yielded the following results:

- *No use of external sources of ideas* - All programs and institutions related to universities use only the ideas generated within the university, paying little or no attention at all to possible inputs from industry, external entrepreneurs or society as a whole.
- *Lack of collaborative efforts/mindset* - Following the previous point, as universities are (still) not seen as the focal point of the open innovation paradigm, their role is limited to a fraction of what it could be if they open themselves to collaboration, and most of all, *lead these efforts.*
- *Few funding schemes* - Public funding is still seen as the major contributor to university breakthroughs. While owning shares from the newly developed ventures has been recently used, the practice of this revenue model is not widespread among universities. Other streams of funding could supplement these sources as universities position themselves to lead innovation.
- *No clear "graduation" policies and duration of PoCCs processes* - Although the young literature about PoCCs mentions the benefits of not investing in projects that are commercially weak, it still does not consider the ways in which universities could screen these projects in a better way.

On the other side, the comparison itself bridged important gaps not previously revised in literature:

- *The joint consideration of these spaces as part of a bigger academic entrepreneurship and technology commercialization ecosystem at universities*, which allows to find the complementarities and still existing gaps within the efforts and strategies universities follow to commercialize their technology.
    - *The characterization of these spaces across several dimensions or variables*, such as their

mission or the type of services they provide, could give practitioners, university boards, and investors a better understanding of their differences and similarities. This could help to shape a coherent, strong and focused technology commercialization strategy at universities. It could help investors clearly identify the kind of projects they are supporting and what type of outputs to expect from them.

This report also contributes to identifying and exemplify the *links between academic entrepreneurship and Open Innovation.*

Finally, this study was focused on the *context of a European public university*. Most of the literature reviewing academic entrepreneurship and technology commercialization investigates cases given within a US context. It is expected this study adds to this needed and nascent stream of research.

6.2.2.3. The third generation university

The *third generation university*, while still a descriptive and very general model of what the future top universities could be, presents an interesting vision and initial guidelines for universities to further explore. This study contributes to the *academic research* useful to generate knowledge about the new paradigm and how it can benefit universities the most. The "*technostarter", "technostarter factory"* and *"technostarter team"* were all concepts explored within this study.

6.2.2.4. Design Science

It was mentioned before, that there were *three main reasons to use a design science lens* for this research project as a whole.

First, there is recognized a *gap between theory and practice* in organizational studies, and a science-for-design perspective can bridge theoretical and practical significance, as this approach is pragmatic in nature (Romme, 2003; Jelinek, et al., 2008; Denyer, Tranfield, & van Aken, 2008). This research project not only aimed to derive design principles from literature, but in an effort to enhance its hands-on significance, it derived design principles from the context that is directly influencing the units of analysis.

The second reason, the fact that *designing gives components their meaning from the links and networks in which they are embedded* (Romme, 2003), reflects the *context-awareness* intended to be revealed by this project. The case that was analyzed, the Innovation Space at TU/e, is a "local" and not an external case. Therefore, the insights and opinions that were gathered by the researcher responsible for this research project, were directly linked to this university's context. Thus, the resulting design principles perform in a context-wise line. It was the intention of this research, to be responsive to the environment of the problem owners.

Finally, the *prescriptive* nature of design science, represented by the creation of an artifact, focused on solving a problem (Romme, 2003; Denyer, et al., 2008), helped to achieve the objective of using science in order to design a solution for the problem owners.

6.2.3. FUTURE RESEARCH DIRECTIONS

In regards to future research, gaps were identified both by means of the literature review, and by performing the case study.

Regarding the case study, it produced insights into topics that need further development. The *revenue generation models for the experimental university business lab* is a very interesting and also complex topic to study. Being this kind of centers quite new, academic literature still does not provide helpful advice about it.

Moreover, some of the "guiding principles" which resulted from the Mechanisms (M) of the design principles, are topics that could require a research study on their own. The most representative example of this is *"Community building".*

Additional to the guiding principles, the key activities described in the artifact also need further exploration. Interesting themes to research here are:

- *The generation of more flexible IP structures*
- *The development of new incentives schemes for cross collaboration, problem-based projects, and entrepreneurial activities*
- *The role "Business-schools" or similar could take in the development of an entrepreneurial university ecosystem*
- *The mechanisms working behind entrepreneurial experimentation, its challenges and best practices to apply.*

Concerning literature, it was found that the university is never the center of the Open Innovation model. More studies considering the university as the focal firm would be in synchronicity with the changes universities are experiencing worldwide.

The *comparison* between UBIs, UTTO's, and PoCCs represents one of the main contributions of this research. This comparison could be *expanded to consider other kinds of university-based programs or institutions.*

Linked to this last point, the *development of a university E&I ecosystem assessment framework* could be of great importance to all those universities experiencing rapid societal and budget changes that impulse them to get involved in knowledge valorization efforts.

7. REFERENCES

Andersson, T., Formica, P., & Curley, M. G. (2009). *Knowledge-driven entrepreneurship: the key to social and economic transformation.* Springer Science & Business Media.

Audretsch, D. B., & Hayter, C. S. (2015). *Concise guide to entrepreneurship, technology and innovation.* Cheltenham UK: Edward Elgar Publishing.

Barczak, G. (2012). The future of NPD/Innovation research. *Journal of Product Innovation Management, 29(3)*, 355-357. doi:10.1111/j.1540-5885.2012.00907.x

Bekkers, R. N. (2010). An evaluation of incentives and policies that affect research institutions' knowledge transfer activities at researcher and management level.

Bhattacherjee, A. (2012). *Social Science Research: Principles, Methods and Practices* (2nd ed.). Tampa, Florida: USF Tampa Bay Open Access Textbooks. Retrieved from http://scholarcommons.usf.edu/oa_textbooks/3

Bogers, M., Zobel, A. K., Afuah, A., Almirall, E., Brunswicker, S., Dahlander, L., . . . Hagedoorn, J. (2016). The Open Innovation Research Landscape: Established Perspectives and Emerging Themes across Different Levels of Analysis. *Industry and Innovation, Forthcoming*. doi:10.2139/ssrn.2817865

Bruns, H. C. (2013). Working alone together: Coordination in collaboration across domains of expertise. *Academy of Management journal, 56(1)*, 62-83. doi:10.5465/amj.2010.0756

Brunswicker, S., & van de Vrande, V. (2014). Exploring open innovation in small and medium-sized enterprises. In H. Chesbrough, W. Vanhaverbeke, & J. (. West, *New frontiers in open innovation* (pp. 135-156). Oxford UK: OUP.

Brunswicker, S., Wrigley, C., & Bucolo, S. (2013). Business model experimentation: What is the role of design-led prototyping in developing novel business models? In M. Curley, & P. Formica, *The experimental nature of new venture creation: Capitalizing on open innovation 2.0 (1;2013; ed.)* (pp. 139-151). Heidelberg, Germany: Springer International Publishing. doi:10.1007/978-3-319-00179-1

Buckminster Fuller, R. (1992). *Cosmography: A Posthumous Scenario for the Future of Humanity*. Hoboken, NJ: Hungry Minds (Wiley).

Chesbrough, H. (2003a). *Open innovation: The new imperative for creating and profiting from technology.* Boston: Harvard Business School Press.

Chesbrough, H. (2003b). The era of open innovation. *MIT Sloan Management Review, 44(3)*, 35.

Chesbrough, H., & Winter, C. (2014). Managing inside-out open innovation: The case of complex ventures. In H. Chesbrough, W. Vanhaverbeke, & J. (. West, *New frontiers in open innovation* (pp. 208-222). Oxford UK: OUP.

Chmielewicz, K. (1970). Forschungskonzeptionen der Wirtschaftswissenschaft: zur Problematik einer entscheidungstheoretischen und normativen Wirtschaftslehre. *CE Poeschel*.

Curley, M., & Formica, P. (2013a). Accelerating venture creation and building on mutual strengths in experimental business labs. In M. Curley, & P. Formica, *The experimental nature of new venture creation: Capitalizing on open innovation 2.0 (1;2013; ed.)* (pp. 51-58). Heidelberg, Germany: Springer International Publishing. doi:10.1007/978-3-319-00179-1

Curley, M., & Formica, P. (2013b). Laboratory experiments as a tool in the empirical economic analysis of high-expectation entrepreneurship. In M. Curley, & P. Formica, *The experimental nature of new venture creation: Capitalizing on open innovation 2.0 (1;2013; ed.)* (pp. 35-50). Heidelberg, Germany: Springer International Publishing. doi:10.1007/978-3-319-00179-1

Denyer, D., Tranfield, D., & van Aken, J. E. (2008). Developing design propositions through research synthesis. *Organization studies, 29(3)*, 393-413. doi:10.1177/0170840607088020

Designregio Kortrijk and Lancaster University. (2014, December). *A MODULAR BUSINESS PLAN FOR THE CREATION OF DESIGN INNOVATION HUBS.* Retrieved from PROUD: http://www.proudeurope.eu/proudeurope/site/assets/files/1016/business-plan_dih.pdf

Enkel, E., Gassmann, O., & Chesbrough, H. (2009). Open R&D and open innovation: Exploring the phenomenon. *R and D Management, 39(4)*, 311-316. doi:10.1111/j.1467-9310.2009.00570.x

Frow, P., Nenonen, S., Payne, A., & Storbacka, K. (2015). Managing co-creation design: A strategic approach to innovation. *British Journal of Management, 26(3)*, 463-483. doi:10.1111/1467-8551.12087

Gassmann, O., & Enkel, E. (2004). Towards a theory of open innovation: three core process archetypes. *R&D Management Conference (RADMA).* Lisbon, Portugal: ITEM - Institute of Technology Management with Transfer Center for Technology Management (TECTEM).

Gómez Puente, S. M., Jochems, W. M., & Eijck, v. M. (2014). Design-based learning : Exploring an educational approach for engineering education.

Graham, R. (2014, June). *Creating university-based entrepreneurial ecosystems: evidence from emerging world leaders.* Retrieved from MIT Skoltech Initiative: http://www.rhgraham.org/RHG/Recent_publications_files/MIT%3ASkoltech%20entrepreneurial%20ecosystems%20report%202014%20_1.pdf

Grimaldi, R., & Grandi, A. (2005). Business incubators and new venture creation: An assessment of incubating models. *Technovation, 25(2)*, 111-121. doi:10.1016/S0166-4972(03)00076-2

Grönroos, C. (2011). Value co-creation in service logic: A critical analysis. *Marketing Theory, 11(3)*, 279-301. doi:10.1177/1470593111408177

Gulbranson, C. A., & Audretsch, D. B. (2008). Proof of concept centers: Accelerating the commercialization of university innovation. *The Journal of Technology Transfer, 33(3)*, 249-258. doi:10.1007/s10961-008-9086-y

Han, K., Oh, W., Im, K. S., Chang, R. M., Oh, H., & Pinsonneault, A. (2012). Value cocreation and wealth spillover in open innovation alliances. *MIS Quarterly, 36(1)*, 291-325.

Holmström, J., Ketokivi, M., & Hameri, A. P. (2009). Bridging practice and theory: A design science approach. *Decision Sciences, 40(1)*, 65-87.

Holton, J. A. (2007). The coding process and its challenges. In A. Bryant, & K. (. Charmaz, *The SAGE handbook of grounded theory* (pp. 265-289). Thousand Oaks, CA: SAGE.

Hoyer, W. D., Chandy, R., Dorotic, M., Krafft, M., & Singh, S. S. (2010). Consumer cocreation in new product development. *Journal of Service Research, 13(3)*, 283-296. doi:10.1177/1094670510375604

Innovation Technology Entrepreneurship & Marketing Group. (2016). *About ITEM*. Retrieved from ITEM EIndhoven: http://www.item-eindhoven.nl/general/general.html

Innovation Technology Entrepreneurship & Marketing Group. (2016). *Technology entrepreneurship and new venturing*. Retrieved from ITEM Eindhoven: http://www.item-eindhoven.nl/research/technology-entrepreneurship-and-new-venturing.html

Isabelle, D. A. (2013). Key factors affecting a technology entrepreneur's choice of incubator or accelerator. *Technology Innovation Management Review, 3(2)*, 16.

Jelinek, M. M., Romme, A. G., & Boland, R. (2008). Introduction to the special issue: Organization studies as a science for design: Creating collaborative artefacts and research. *Organization Studies, 29(3)*, 317-329. doi:10.1177/0170840607

Kockelkoren, L. (2015). Automotive Studententeams van de Technische Universiteit Eindhoven: Een itgebreide profielschets. Eindhoven, The Netherlands: Eindhoven University of Technology.

Lee, S. M., Olson, D. L., & Trimi, S. (2012). Co-innovation: Convergenomics, collaboration, and co-creation for organizational values. *Management Decision, 50(5)*, 817-831. doi:10.1108/00251741211227528

Lockett, A., Siegel, D., Wright, M., & Ensley, M. D. (2005). The creation of spin-off firms at public research institutions: Managerial and policy implications. *Research Policy, 34(7)*, 981-993. doi:10.1016/j.respol.2005.05.010

Maia, C., & Claro, J. (2013). The role of a proof of concept center in a university ecosystem: An exploratory study. *The Journal of Technology Transfer, 38(5)*, 641-650. doi:10.1007/s10961-012-9246-

March, S. T., & Smith, G. F. (1995). Design and natural science research on information technology. *Decision Support Systems, 15(4)*, 251-266. doi:10.1016/0167-9236(94)00041-2

Marshall, C., & Rossman, G. B. (2011). *Designing qualitative research.* SAGE.

McAdam, M., & McAdam, R. (2008). High tech start-ups in university science park incubators: The relationship between the start-up's lifecycle progression and use of the incubator's resources. *Technovation, 28(5)*, 277-290. doi:10.1016/j.technovation.2007.0

O`Shea, R., Allen, T. J., O'Gorman, C., & Roche, F. (2004). Universities and technology transfer: A review of academic entrepreneurship literature. *Irish Journal of Management, 25(2)*, 11.

Osterwalder, A., Pigneur, Y., & Clark, T. (2010). *Business model generation: A handbook for visionaries, game changers, and challengers.* Amsterdam, NL: Alexander Osterwalder & Yves Pigneur.

Perks, H., Gruber, T., & Edvardsson, B. (2012). Co-creation in radical service innovation: a systematic analysis of microlevel processes. *Journal of Product Innovation Management, 29(6)*, 935-951. doi:10.1111/j.1540-5885.2012.00971.x

Piller, F., & West, J. (2014). Firms, users, and innovation: An interactive model of coupled open innovation. In H. Chesbrough, W. Vanhaverbeke, & J. (. West, *New frontiers in open innovation* (pp. 29-49). Oxford UK: OUP.

Prahalad, C. K., & Ramaswamy, V. (2004a). Co-creation experiences: The next practice in value creation. *Journal of Interactive Marketing, 18(3)*, 5-14. doi:10.1002/dir.20015

Prahalad, C. K., & Ramaswamy, V. (2004b). Co-creating unique value with customers. *Strategy & Leadership, 32(3)*, 4-9. doi:10.1108/10878570410699249

Price, J. H., & Murnan, J. (2004). Research Limitations and the Necessity of Reporting Them. *American Journal of Health Education*, 66-67.

Reymen, I. (2015). Envisioning Entrepreneurship (Education) @ TU/e. Eindhoven, The Netherlands.

Reymen, I. M., Beijer van Montfort, F., Bruns, M., de Lange, H. C., Greve, M. J., Monen, M., . . . van Ooijen, M. (2016). *Concept Business Case TU/e Fontys Innovation Space Unpuslished manuscript*. Eindhoven University of Technology, Eindhoven, The Netherlands.

Romero, D., & Molina, A. (2011). Collaborative networked organisations and customer communities: Value co-creation and co-innovation in the networking era. *Production Planning & Control, 22(5-6)*, 447-472. doi:10.1080/09537287.2010.536619

Romme, A. G. (2003). Making a difference: Organization as design. *Organization Science,14(5)*, 558-573. doi:10.1287/orsc.14.5.558.16769

Romme, A. G., & Damen, I. C. (2007). Toward Science-Based Design in Organization Development Codifying the Process. *Journal of Applied Behavioral Science, 43(1)*, 108-121. doi:10.1177/0021886306297011

Sieger, P., Fueglistaller, U., & Zellweger, T. (2014). *Student Entrepreneurship Across the Globe: A Look at Intentions and Activities.* St.Gallen : Swiss Research Institute of Small Business and Entrepreneurship at the University of St.Gallen (KMU-HSG).

Silberglitt, R., Antón, P., Howell, D., Wong, A., Gassman, N., Jackson, B., & . . . Wu, F. (2006). *The Global Technology Revolution 2020, In-Depth Analyses: Bio/Nano/Materials/Information Trends, Drivers, Barriers, and Social Implications.* RAND Corporation. Retrieved from http://www.jstor.org/stable/10.7249/tr303nic

Simon, H. A. (1996). *The sciences of the artificial.* MIT press.

TU/e. (2011, January). *TU/e 2020.* Retrieved November 1, 2016, from TU/e: https://static.tue.nl/fileadmin/content/universiteit/universiteit/strategie_2020/TUE_2020_Strategisch_Plan_EN.pdf

TU/e. (2016). *About Innovation Lab*. Retrieved from TU/e: https://www.tue.nl/en/innovation/about-innovation-lab/

TU/e. (2016). *Education: Intellectual property rights*. Retrieved from TU/e: https://www.tue.nl/en/education/studying-at-tue/admission-and-enrollment/undergraduate-programs/enrollment/intellectual-property-rights/

TU/e. (2016). *Innovation: Impuls instrument*. Retrieved from TU/e: https://www.tue.nl/en/innovation/about-innovation-lab/impuls-instrument/

TU/e. (2016). *Innovation: Partnerships*. Retrieved from TU/e: https://www.tue.nl/en/innovation/about-innovation-lab/partnerships/

TU/e. (2016). *Innovation: Students*. Retrieved from TU/e: https://www.tue.nl/en/innovation/students/

TU/e. (2016). *Innovation: Valorization Academy*. Retrieved from TU/e: https://www.tue.nl/en/innovation/about-innovation-lab/valorization-academy/

TU/e. (2016). *Profile TU/e*. Retrieved November 1, 2016, from TU/e: https://www.tue.nl/en/university/about-the-university/profile-tue/

TU/e. (2016). *Tu/e Science Park*. Retrieved from TU/e: https://www.tue.nl/en/university/about-the-university/tue-science-park/

TU/e Innovation Lab. (2014, January). *Manual of Knowledge Valorization.* Retrieved from TU/e: https://static.tue.nl/fileadmin/content/innoveren/TU_e_Innovation_Lab/Medewerkers/TUe_Manual_of_Knowledge_Valorization_concept_140124.pdf

University of Southern California. (2017, January 4). *USC Libraries*. Retrieved from Organizing Your Social Sciences Research Paper: Limitations of the Study: http://libguides.usc.edu/writingguide/limitations

van Aken, J. E. (2004). Management research based on the paradigm of the design sciences: The quest for field-tested and grounded technological rules: Paradigm of the design sciences. *Journal of Management Studies, 41(2)*, 219-246. doi:10.1111/j.1467-6486.2

van Aken, J., Berends, H., & van der Bij, H. (2012). *Problem solving in organizations: A methodological handbook for business and management students.* Cambridge, UK: Cambridge University Press.

van Burg, E., Romme, A. G., Gilsing, V. A., & Reymen, I. M. (2008). Creating University Spin-Offs: A Science-Based Design Perspective. *Journal of Product Innovation Management, 25(2)*, 114-128. doi:10.1111/j.1540-5885.2008.00291.x

Vanhaverbeke, W., Chesbrough, H., & West, J. (2014). Surfing the new wave of open innovation research. In H. V. Chesbrough, *New frontiers in open innovation* (pp. 281-294). Oxford UK: OUP.

Vargo, S. L., Maglio, P. P., & Akaka, M. A. (2008). On value and value co-creation: A service systems and service logic perspective. *European Management Journal, 26(3)*, 145-152. doi:10.1016/j.emj.2008.04.003

Velasco Montañez, M. (2016). *1ML05 - Preparation Master Thesis 1: Literature Study.* Eindhoven, The Netherlands.

Winter, R. (2014). Towards a Framework for Evidence-Based and Inductive Design in Information Systems Research. In M. Helfert, B. Donnellan, & J. (. Kenneally, *Design Science: Perspectives from Europe* (pp. 1-20). Springer.

Wissema, J. G. (2009). *Towards the third generation university: Managing the university in transition.* Cheltenham UK: Northampton MA: Edward Elgar.

Yin, R. K. (2014). *Case study research: Design and methods.* SAGE.

Zwass, V. (2010). Co-creation: Toward a taxonomy and an integrated research perspective. *International Journal of Electronic Commerce, 15(1)*, 11-48. doi:10.2753/JEC1086-4415150101

8. APPENDIXES

8.1. Appendix A – Business model canvas

8.1.2. BUILDING BLOCKS

1. *Customer segments:* An organization serves one or several customer segments.
2. *Value propositions*: It seeks to solve customer problems and satisfy customer needs with value propositions.
3. *Channels*: Value propositions are delivered to customers through communication, distribution, and sales channels.
4. *Customer relationships*: Customer relationships are established and maintained with each customer segment.
5. *Revenue streams*: Revenue streams result from value propositions successfully offered to customers.
6. *Key resources*: Key resources are the assets required to offer and deliver the previously described elements…
7. *Key activities*: … by performing a number of key activities.
8. *Key partnerships*: Some activities are outsourced and some resources are acquired outside the enterprise.
9. *Cost structure*: The business model elements result in the cost structure.

8.1.3. VISUALIZATION

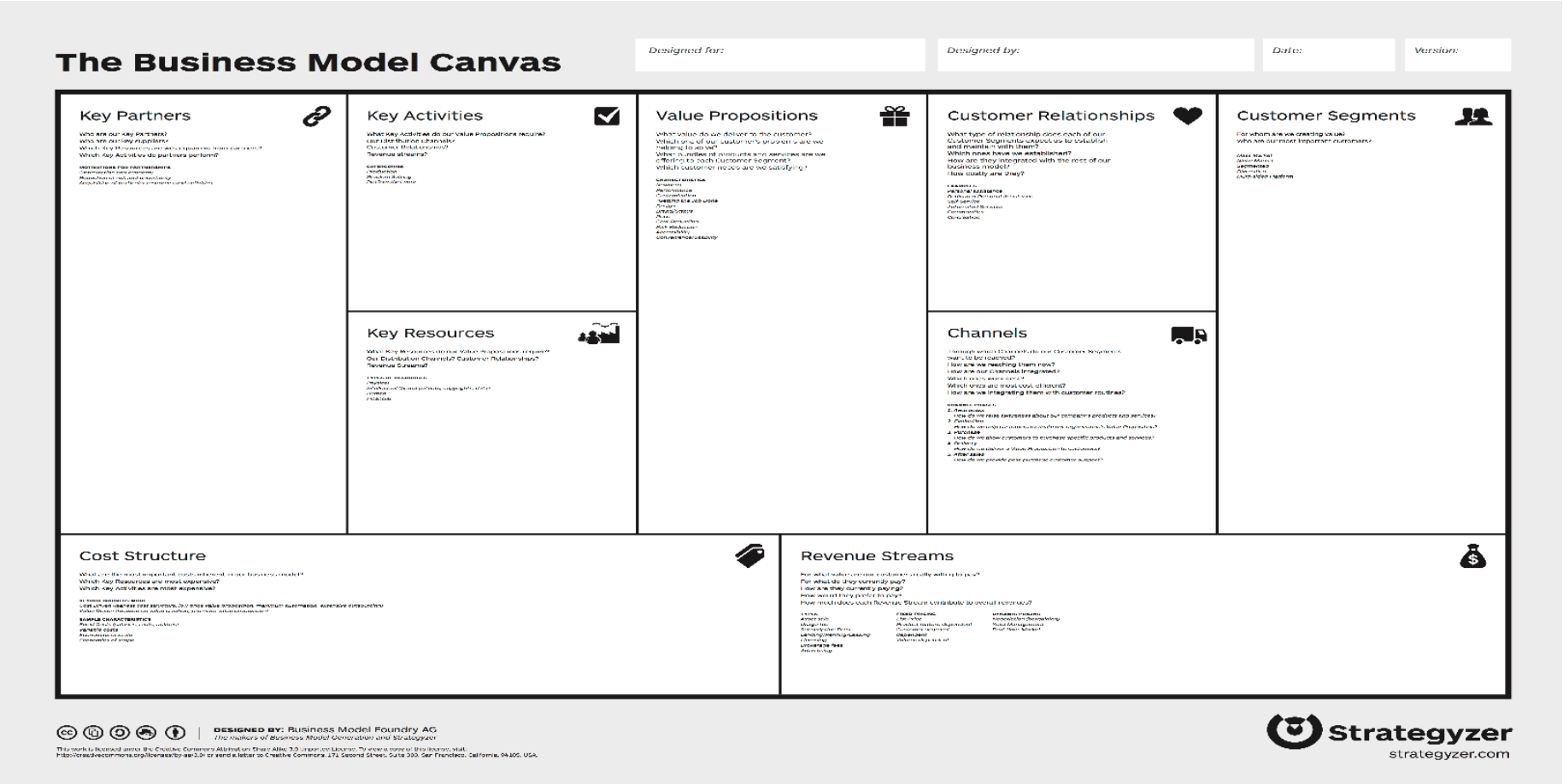

Figure 11 Business model canvas

8.2. Appendix B – "Innovation Space" Business model canvas

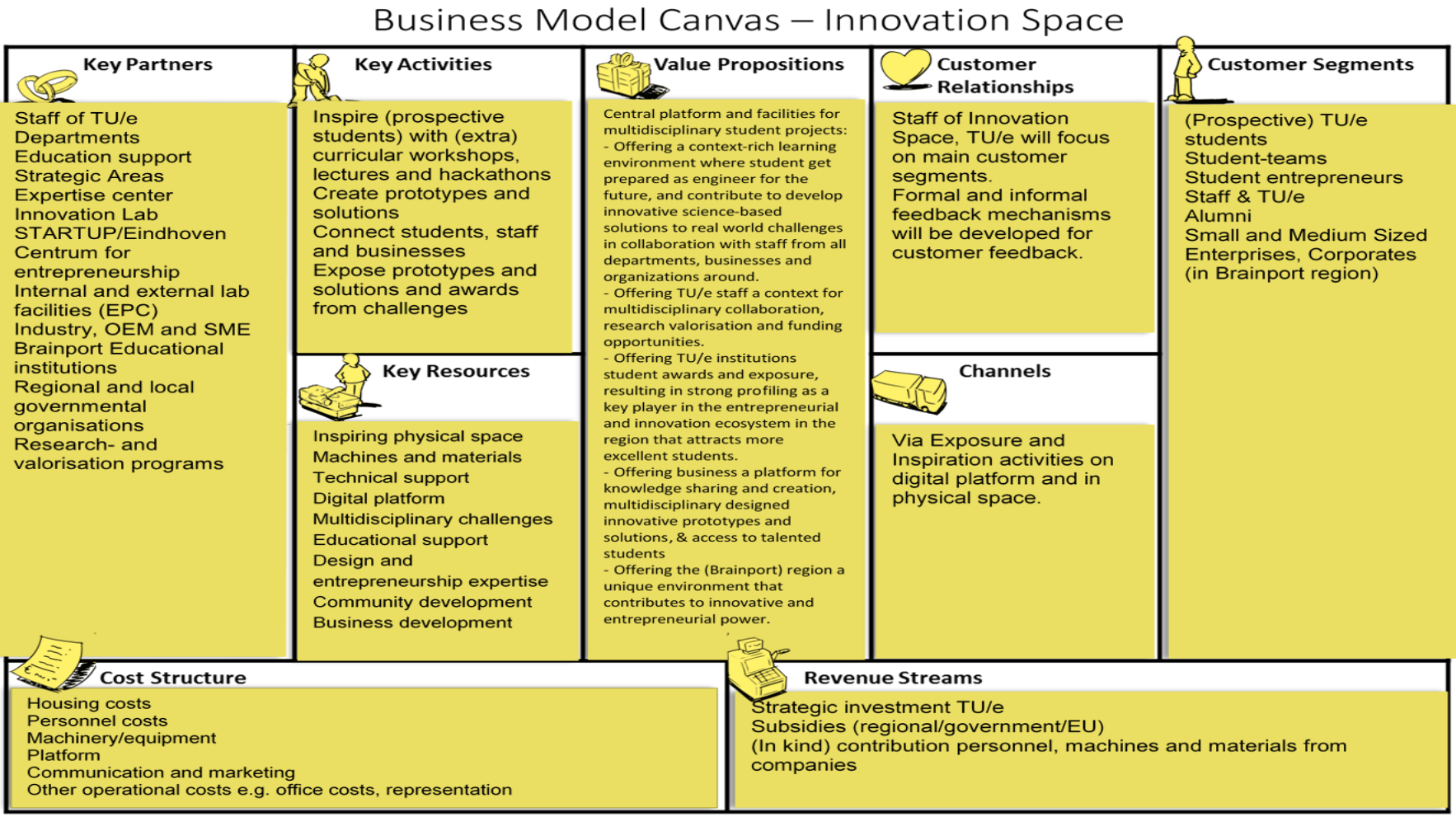

Figure 12 Business model canvas for the InnoSpace (Reymen, et al., 2016)

8.3. Appendix C – Innovation Space core work team

InnoSpace core work team

Function/Representation	Name
Coordinator	dr.ir. Isabelle Reymen
Research/Education	dr.ir. Miguel Bruns
StartUp Eindhoven/Innovation Lab	Drs. Marius Monen
Student teams	Rein Westerdijk
Student assistant	Robbert Alblas
Housing services	Jan Willem Schellekens
Communication Expertise Center	Femke Beijer & Ingrid van de Ven

Table 6 InnoSpace core work team

8.4. Appendix D – Framework for designing Open Innovation research

Very recently, a new *framework* proposed by Bogers, et al., (2016), *for designing Open Innovation future research* acknowledged that *"OI does not only take place at a single level of analysis but involves research categories that are nested in between or span different levels of analysis".* The study proposed that new research questions should span across the following levels of analysis:

- Intra-organizational
- Organizational
- Extra-organizational
- Inter-organizational
- Industry, regional innovation systems and society

The framework suggests key categories to be researched, such as *"OI strategy and design",* which includes entrepreneurship and business models as related concepts. While usually studied at the organizational level, this category expands into different levels of analysis (Bogers, et al., 2016).

8.5. Appendix E – Academic entrepreneurship initiatives comparison

8.5.2. SUMMARY

Table 4 Characteristics of the university-entrepreneurial initiatives

	Characteristics of the:		
	University based Incubator (UBI)	University Technology Transfer Office (UTTO)	Proof of Concept Center (PoCC)
Mission	Provide support and services to new knowledge-based ventures; placing emphasis on the transfer of scientific and technological knowledge from universities to companies (Grimaldi & Grandi, 2005)	Facilitate commercial knowledge transfers through the licensing to industry of inventions or other forms of intellectual property resulting from university research (Siegel, et al., 2003; Siegel, et al., 2004; Link & Siegel, 2005; Siegel, et al., 2007; Markman, et al., 2005; O'Shea, et al., 2004; Clarysse, et al., 2005)	Encourage and support the commercialization of new technology stemming from university research, focused on the maturation of new technology (Audretsch & Hayter, 2015) Provide funding, mentoring, and education, in a customizable support to Proof of Concept activities in Technology Commercialization (Maia & Claro, 2013)
Sector	University research area related (Grimaldi & Grandi, 2005)	University research area related (Siegel, et al., 2003; Siegel, et al., 2004; Link & Siegel, 2005; Siegel, et al., 2007; Markman, et al., 2005; O'Shea, et al., 2004; Clarysse, et al., 2005)	University research area related (Bradley, et al., 2013; Gulbranson & Audretsch, 2008; Maia & Claro, 2013; Sergey, et al., 2015; Pebalk, et al., 2015)
Location	Close to/inside university (Grimaldi & Grandi, 2005)	Close to/inside university (Siegel, et al., 2003; Siegel, et al., 2004; Link & Siegel, 2005; Siegel, et al., 2007; Markman, et al., 2005, O'Shea, et al., 2004; Clarysse, et al., 2005)	Inside university (Gulbranson & Audretsch, 2008) Close to various universities, as an Innovation Hub (Bradley, et al., 2013)
Market	Regional, National (Grimaldi & Grandi, 2005)	Regional, National, International (Clarysse, et al., 2005)	Regional – usually limited to university related inventions (Pebalk, et al., 2015)
Origin of ideas	University - internal (Grimaldi & Grandi, 2005)	University - internal (Siegel, et al., 2003; Siegel, et al., 2004; Link & Siegel, 2005; Siegel, et al., 2007; Markman, et al., 2005, O'Shea, et al., 2004; Clarysse, et al., 2005)	University – internal (Bradley, et al., 2013; Gulbranson & Audretsch, 2008; Maia & Claro, 2013; Sergey, et al., 2015; Pebalk, et al., 2015)
Phase of intervention	Pre-incubation, business concept definition, early growth (Grimaldi & Grandi, 2005) Invention disclosure, acceleration* (Isabelle, 2013)	Early stage, after invention disclosure (Siegel, et al., 2003; Siegel, et al., 2004; Link & Siegel, 2005; Siegel, et al., 2007)	Very early, before invention disclosure (Bradley, et al., 2013; Gulbranson & Audretsch, 2008; Maia & Claro, 2013; Sergey, et al., 2015; Pebalk, et al., 2015)

	Characteristics of the:		
	University based Incubator (UBI)	University Technology Transfer Office (UTTO)	Proof of Concept Center (PoCC)
Period or duration	Medium, long (Grimaldi & Grandi, 2005)	Medium, long – guided by technology transfer process (Siegel, et al., 2004)	Not available
Sources of revenue or business model	Public, private funding, fees (Grimaldi & Grandi, 2005)	Return on investments - revenue from licenses (Siegel, et al., 2003; Siegel, et al., 2004; Link & Siegel, 2005; Siegel, et al., 2007)	Public, private funding – donations (Pebalk, et al., 2015) Shares from resulting ventures (Sergey, et al., 2015)
Services	Logistic services, access to technical and scientific knowledge and academic facilities, networking, consulting (Grimaldi & Grandi, 2005) Shared offices, administrative staff, university research, grant support (McAdam & McAdam, 2008)	Legal - Intellectual Property related (Siegel, et al., 2003; Siegel, et al., 2004; Macho-Stadler, et al., 2007) Revenue stream management (Siegel, et al., 2003; Siegel, et al., 2004) Partner search, business development (Macho-Stadler, et al., 2007)	Seed funding, advice/consulting/mentoring, educational programs (Bradley, et al., 2013; Gulbranson & Audretsch, 2008; Maia & Claro, 2013; Sergey, et al., 2015; Pebalk, et al., 2015) Networking (Maia & Claro, 2013) Marketing research and incubation space (Bradley, et al., 2013)
Characterization of concept	Institution (Grimaldi & Grandi, 2005; Mian, 1994; 1996). Hybrid* (Isabelle, 2013)	Institution (Siegel, et al., 2003; Siegel, et al., 2004; Link & Siegel, 2005; Siegel, et al., 2007; Markman, et al., 2005; O'Shea, et al., 2004; Clarysse, et al., 2005; Macho-Stadler, et al., 2007)	Institution (Bradley, et al., 2013; Pebalk, et al., 2015) Program within an institution (Pebalk, et al., 2015) Hybrid (Gulbranson & Audretsch, 2008)
Selection policies	Non-Selective* (Isabelle, 2013)	From non-selective accepting all disclosures, to selective by choosing the best inventions to commercialize (Siegel, et al., 2003; Siegel, et al., 2004)	Selective (Bradley, et al., 2013; Gulbranson & Audretsch, 2008; Sergey, et al., 2015)
Graduation policies	Time, milestones (Mian, 1994; 1996)	Not available	Not available

* From the general business incubators literature

Table 7 Characteristics of the university-entrepreneurial initiatives

8.5.3. CHARACTERIZING VARIABLES

*Adapted from Grimaldi and Grandi (2005).

1. Mission: On the basis of the institutional mission, it is possible to distinguish between non-profit and profit-oriented incubators. BICs and UBIs are non-profit institutions: they are set up by governmental authorities with the objective of promoting regional development (Grimaldi & Grandi, 2005). I extended it to include a brief definition of each reviewed concept.

2. Sector: Incubators might focus on a specific industry and develop a capacity to attract start-ups in the same industrial sector or in different but related industries. Sectors are based on competencies, which in turn may be technical (e.g. focus on a particular technology), industry-related (e.g. focus on a particular competitive environment), etc.

3. Location: The physical location of the reviewed space tells us something about their objectives and mission. As far as location is concerned, possibilities are: areas in the process of revitalization, industrialized areas and areas close to a university.

4. Market: Depending on their strategy, different initiatives might target companies/entrepreneurs operating locally (and therefore physically available in its proximity), or companies operating nationally or internationally (not necessarily established in close proximity to the incubator).

5. Origin of ideas: According to Grimaldi and Grandi (2005) it is possible to distinguish between ideas coming from an already existing organization to which the incubator/initiative is affiliated (internal) and those coming from all other individuals/organizations (external).

6. Phase of intervention: Depending on the requirements of the hosted companies/entrepreneurs, the initiatives might provide assistance from the first phase of business concept definition through to the independence of its ventures. Some might develop specific skills at a given phase of the business development life cycle (concept definition, early growth, acceleration, etc.).

7. Period or duration: This refers to the average period of time that companies/entrepreneurs are hosts of the institution. This factor depends on several other variables, which in turn depend on the business models of different ventures.

8. Sources of revenue or business model: Public incubators are non-profit, hence they cover their expenses through regional/national/ international funding, and partly through the fees paid by companies for the services they get. Some services are based on a pay-per-use model (likewise rents and telephone lines). Private initiatives do not benefit from public funding. In addition to fees for the services they offer, they buy equity in their companies, which may go up to the total control of the company. The mixed model (fees and equity) is the most common and used by private incubators.

9. Services offered: Companies are provided different ranges of services. Services could be tangible ones, or/and intangible ones. Examples of services are logistic services, training,

information, advertisement for local visibility, access to technical and scientific knowledge and academic facilities, networking, day-by-day management support, consulting, networking, funding, logistical services, technical knowledge, etc.

In order to enhance usefulness of the dimensions for the specific comparison exercise in this review, the following variables were added:

10. Characterization of concept: It is the way the concept is perceived by the ventures/entrepreneurs and the general public. It could be an institution, program within an institution, or a hybrid between those two.

11. Selection policies: These are tenant selection (or entry) policies (Mian, 1994). As the purpose of this description is merely comparative, I limited to a choice between selective and non-selective policies.

12. Graduation policies: These refer to tenant graduation (or exit) policies. A predetermined incubation period is common (Mian, 1994). Milestones were added as these mechanisms were also implied within the reviewed literature.

8.6. Appendix F – Emergent and deliberate design

Emergent design or practice pushes the creation of design solutions and principles. It is likely to prevail when design principles are non-existent, underdeveloped, or unknown to practitioners. When a discipline is more mature, design is as much emergent as it is deliberate because the emergent dimension accounts for the unambiguous characteristics of specific cases, and deliberate dimension helps to develop the knowledge that can be generalized (van Burg, et al., 2008). Figure 15 depicts the *research–design–development cycle* from a science-based design perspective, where the de-contextualization of the emergent design which produces research findings interacts with the contextualization of a deliberate design effort to apply those findings into practice.

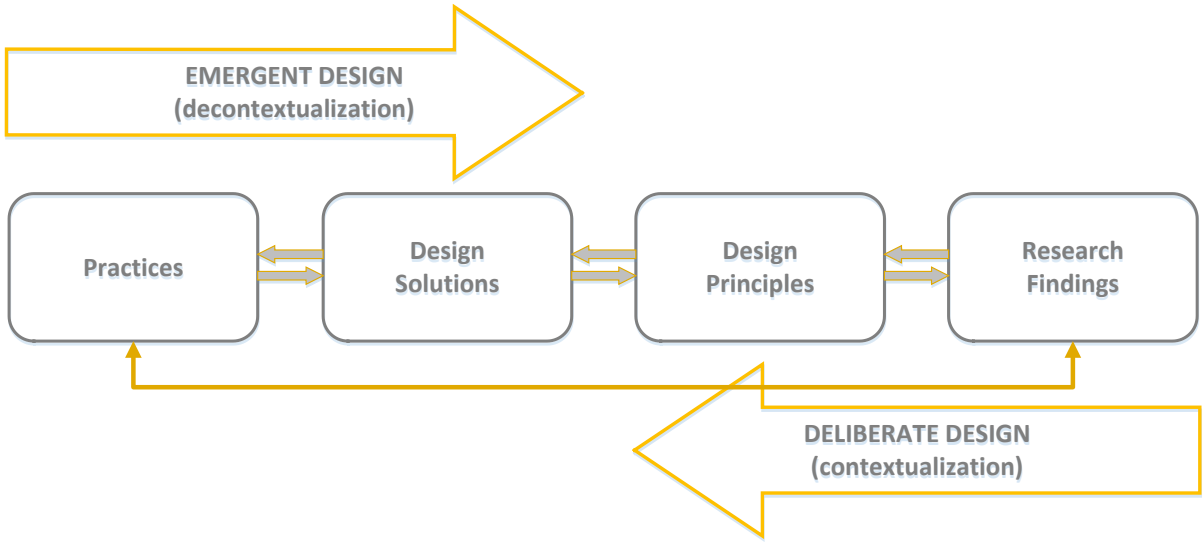

Figure 13 Research-Design-Development cycle from a Science-Based Design perspective (van Burg, et al., 2008)

Drawing on the mentioned authors' model, this project relies on deliberate design efforts to derive design principles from research, and then design solutions to the given problem.

8.7. Appendix G – Regulative cycle

The research will be conducted following the *problem solving cycle* as described by van Aken, et al., (2012), which is depicted in Figure 14. The cycle steps are:

(1) Problem definition.

(2) Analysis and diagnosis.

(3) Solution design.

(4) Intervention.

(5) Evaluation and learning.

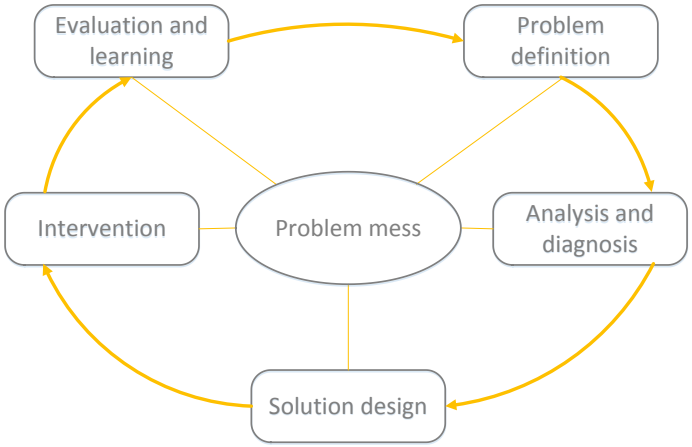

Figure 14 The problem solving cycle

This master thesis project encompasses the first three steps of the cycle. Intervention and evaluation steps are out of the scope of the project, and hopefully will be carried on leading to the continuity of the design process.

According to van Aken, et al., (2012) the problem definition step determines the whole project. It is followed by the analysis and diagnosis step which is the analytical part of the project. For this project, the final step from the cycle will be the Solution design step, for which the most powerful support can be given by design principles.

8.8. Appendix H – Interviewee list

Interviewee list

Function/Representation	Name
InnoSpace	dr.ir. H.C. (Rick) de Lange
Research/Education InnoSpace	dr.ir. Miguel Bruns
Innovation Lab	Drs. Marius Monen
StartUp Eindhoven/Innovation Lab	Steven van Huiden
Student assistant InnoSpace	Robbert Alblas
Open Innovation expert	Anonymous

Table 8 Case study interviewee list

8.9. Appendix I – Interview protocol

Date:

Time:

Place:

Interviewee:

INTERVIEW PROTOCOL

This interview protocol intends to identify and collect data related to the state of connectedness between the formal work structures and the student-led entrepreneurial activity at TU/e. It is targeted to individuals involved in the "Innovation Space" project. The protocol considers questions related to aspects affecting the "Innovation Space" at both the organizational and extra-organizational levels.

Introduction

SELF-INTRODUCTION

I am Marisol Velasco. I am a student of the Innovation Management Master Program at this University.

As part of my Master Thesis, I am currently doing research for the "Innovation Space".

AIM OF THIS STUDY

The aim of this study is to analyse the current state of connectedness between the formal work structures at TU/e and the Student-led entrepreneurial activity, and the barriers affecting this connectedness. My research focuses on the University's approach to this issue.

Outputs of this interview will be used to supplement the information found by means of secondary data analysis, derive research principles, and finally design an artifact that would be complementary for the Business Model (Canvas) of the "Innovation Space".

Confidentiality: Detailed information on confidentiality is available in the *Consent Form* for the Audiotaped Interview. (Sign Consent).

Time: The interview should last about an hour.

Questions and probes

PART 1. BACKGROUND

1. *What is entrepreneurship for you?*

Probes

- In your opinion, is there an entrepreneurial community at TU/e?

2. *What instances of student-led entrepreneurship happening at TU/e can you mention?*

Probes

- Student-teams. Something more?
- Entrepreneurial graduation projects?
- Techno-starters?

3. *What is knowledge valorization for you?*

Probes

- How broad is it for you?
- Does it include entrepreneurship? Or does it consider only licencing?
- Any other types?

4. *Could you mention some examples of Knowledge valorization at this University?*

Probes

- Valorization academy

5. *What is hands-on education for you? Is it the same as "hands-on projects"?*
6. *Could you mention some examples of hands-on education at this University? (and hands-on projects").*

Probes

- Bachelor's Design course
- Other?

PART 2. E&I SUPPORT RESOURCES AT TU/E

7. *Can you tell me about the current types of resources available at TU/e for student-entrepreneurship?*

Probes

- For classification of kind of resources only
- IT
- Human resources
- Spaces
- Machinery/Tools
- What do you consider is the main barrier to get access to this resources as a student?
- Services/networking
- Do you consider these resources foster the development/growth of an entrepreneurial community at TU/e?
    - If so, in which ways?
    - If not, why do you think so?
- Do you consider these resources somehow help to connect student activity with the work the University is doing (Regarding entrepreneurship and innovation)?
    - If so, in which ways?
    - If not, why do you think so?

8. *What examples of support personnel for Innovation and Entrepreneurship (E&I) do you know (at this university)?*

Probes

- Professors
- Coaches
- General support staff
- Administrative
- Others

9. *Do you know of the different services/programs offered at TU/e to foster entrepreneurship?*

Probes

- What can you tell me about them?
- For every mentioned service:
    - how do people access to that service?
    - *Identify in funnel*

10. *Do you know about available experimentation spaces at the university? What examples can you give?*

Probes

- Labs per department
- ID Atelier space

11. *Do you know about Open spaces/meeting space at the university where students could work on multidisciplinary projects and meet fellow students from other departments?*

    What is in there? What do they include?

Probes

- Describe the space briefly

12. *What do you think are the needs for these kind of spaces?*

Probes

- What does it imply? Can you tell me more about this vision?

13. *Do you know of any kind of communication platforms currently in use that allow students to connect to each other?*

Probes

- Describe example.
- Is there somewhere a student could find information of the project currently available or currently developing at TU/e?

PART 3. E&I ACADEMIC ACTIVITIES AT TU/E

14. *Can you tell me about the current types of academic activities, related to entrepreneurship, that are available at TU/e for students?*

- Courses
- Participation in research projects

- What do you consider is the main barrier students face when trying to get access to this activities?
- Do you consider these activities foster the development/growth of an entrepreneurial community at TU/e?
    - If so, in which ways?
    - If not, why do you think so?
- Do you consider these academic undertakings somehow help to connect student activity with the work the University is doing (Regarding entrepreneurship and innovation)?
    - If so, in which ways?
    - If not, why do you think so?

15. *Do you know of any courses that connect students from different departments?*

Probes

- Are they entrepreneurship oriented in content?
- Are they entrepreneurship oriented regarding what students experience during the course?
- In your opinion, what is the main benefit or these courses?
- And back draws, or difficulties?
- Could also ask about Entrepreneurship courses, and if they are multidisciplinary.
- For every mentioned one:
    - *Identify in funnel*

16. *Do you know of any education tracks that connect students from different departments?*

Probes

- At what level, Bachelor? Master?
- Are they entrepreneurship oriented in content?
- Are they entrepreneurship oriented regarding what students experience while following it?

17. *Do you know how does it work if a student wants to conduct research, or work in his/her thesis project by funding his own company, or participating in one of the university's entrepreneurial activities?*

Probes

- Please describe.

PART 4. E&I STRATEGIC ACTIONS AT TU/E

18. *Can you tell me about the current strategy of the University regarding Entrepreneurship and Innovation?*

Probes

- TU/e 2020.
- Vision
- What do you think are the main barriers to achieve this vision? (to develop and follow an Entrepreneurial strategy otherwise)
- Recommendations

- Do you consider the current strategy fosters the development/growth of an entrepreneurial community at TU/e?
    - If so, in which ways?
    - If not, why do you think so?
- Do you consider these actions somehow help to connect student activity with the work the University is doing (Regarding entrepreneurship and innovation)?
    - If so, in which ways?
    - If not, why do you think so?

19. *Do you know about current vision, mission and objectives of the University?*

Probes

- Are they related to E&I?
- Good points
- Difficulties that you observe?
- Recommendations

20. *Do you know about any kind of metrics, KPIs or assessment regarding E&I activity at TU/e?*

Probes

- Resources
- Education
- Overall staff involvement levels
- partnerships with industry
- Start-ups/spin-offs
- Number of Student Teams
- Support to student teams
- Others

21. *What about incentives, are they aligned with this vision, or with E&I?*

Probes

- How do they work, for personnel, professors and staff?
- What do you recommend regarding incentives?

PART 4. RECAP

22. *Do you have any comments, or recommendations?*

Probes

- Recommendations regarding support resources
- Recommendations regarding academic activities
- Recommendations regarding strategic actions

Thank you and next steps

I intend to have one interview per person. However, if I need to clarify some information, I would contact you via e-mail.

Thank you very much!

8.10. Appendix J – Diagnosis visualization, reframing the problem

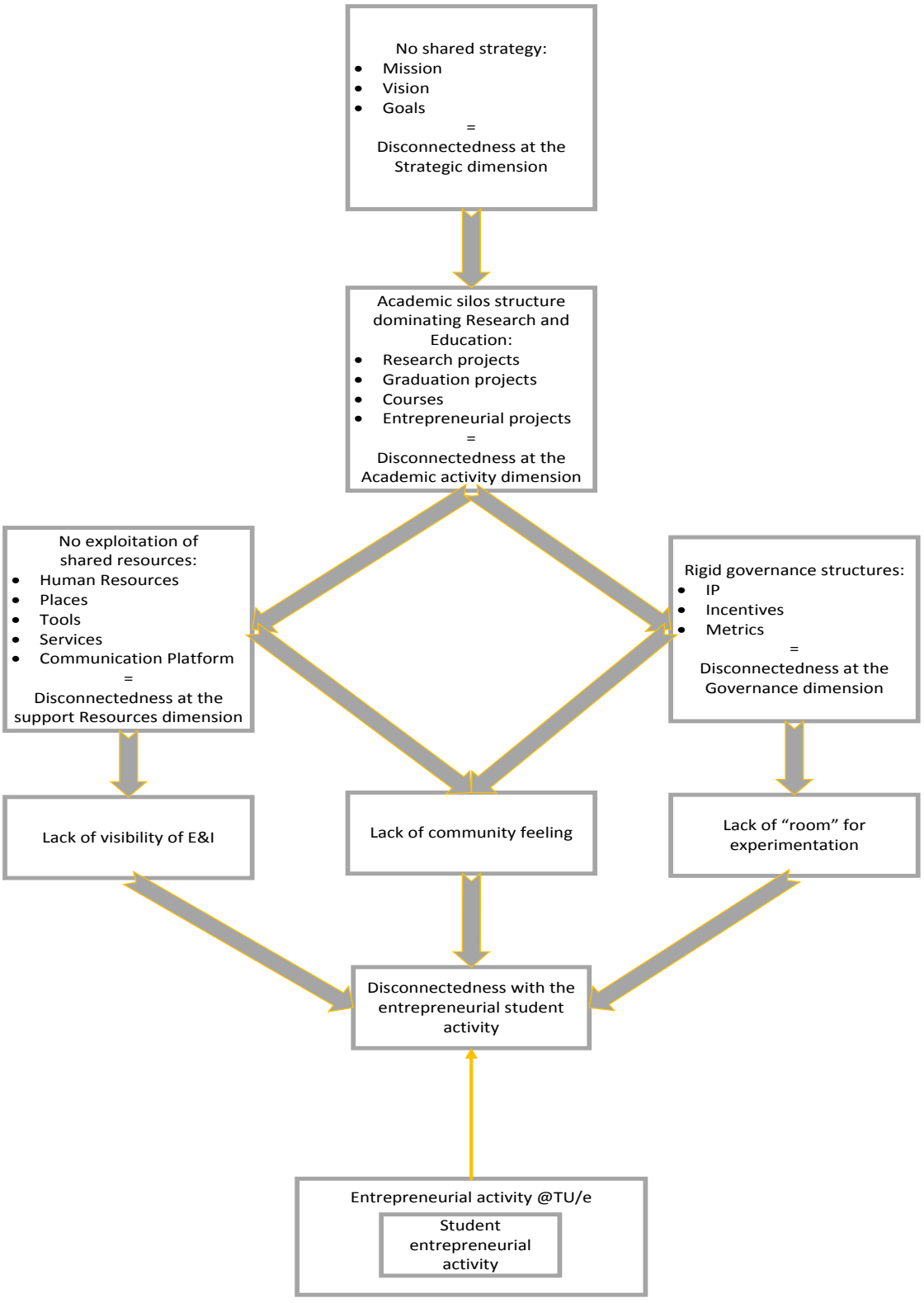

Figure 15 Reframing the problem

8.11. Appendix K – Preliminary artifact

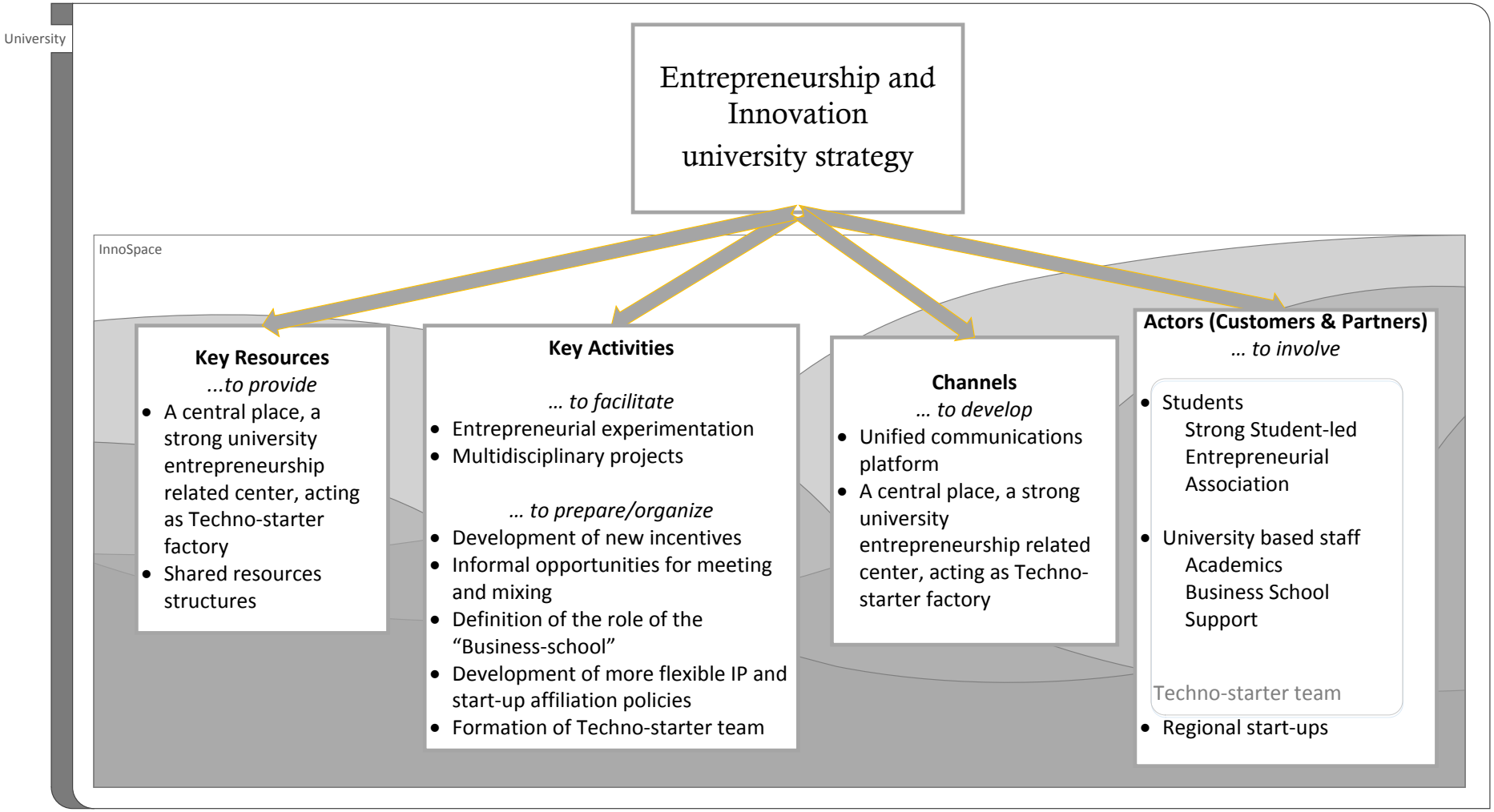

Figure 16 Preliminary artifact

8.12. Appendix L – Assessment lists

Support resources assessment

In literature	Present at TU/e	Observations
Shared spaces (Piller & West, 2014)	✓	Only among techno-starters
Shared support staff (Piller & West, 2014)	✓	For techno-starters and university technology commercialization
Prototyping and experimentation spaces (Curley & Formica, Accelerating venture creation and building on mutual strengths in experimental business labs, 2013a)		
Center for marketing and know-how commercialization (Wissema, 2009; Graham, 2014)	✓	Innovation Lab (UTTO+)
Facilities for techno-starters (Wissema, 2009)	✓	Flexroom for techno-starters only
Center specialized in venturing (Graham, 2014)	✓	StartUp Eindhoven/Innovation Lab
Stream of investment from university-affiliated start-ups (Graham, 2014)		

Table 9 Support resources assessment

Academic activities assessment

In literature	Present at TU/e	Observations
Cross-disciplinary research (Bruns, 2013)		Not documented
Entrepreneurship embedded into schools (departments) (Graham, 2014)	✓	By means of an entrepreneurship certificate, and a bachelor's college learning line.
Business school (or similar) as entrepreneurship research center		Role of business school (equivalent) within the ecosystem not defined
Problem-based learning / Project-based learning (Graham, 2014)	✓	University-wide

Table 10 Academic activities assessment

Strategic actions assessment

In literature	Present at TU/e	Observations
Open Innovation view of the E&I ecosystem, with the university as "focal firm"		Not explicitly
Top-down strategy to develop the E&I ecosystem (Graham, 2014)	✓	Not currently connected to bottom-up strategy
Bottom-up strategy towards developing the E&I ecosystem (Graham, 2014)	✓	Not currently connected to top-down strategy
Polices designed to encourage cross-disciplinary collaboration and entrepreneurship (Graham, 2014)		
De-emphasizing university IP and start-up affiliation (Graham, 2014)		
Procedures tailored to encourage cross-disciplinary collaboration and entrepreneurship (Graham, 2014)		
Incentives developed to encourage cross-disciplinary collaboration and entrepreneurship (Graham, 2014)		
Formalization of technology transfer and commercialization activities (Graham, 2014)	✓	Mainly by means of the 2020 vision for TU/e and the Innovation Lab
Mechanisms to adapt strategy to needs of dynamic ecosystem (Graham, 2014)		Not explicitly
Development of an entrepreneurial community as part of the strategy (Piller & West, 2014)		
Strategic partnerships with university affiliated startups (Graham, 2014)		Vision focuses a lot more on strategic partnerships with big companies

Table 11 Strategic actions assessment

8.13. Appendix M – Artifact visualization tool

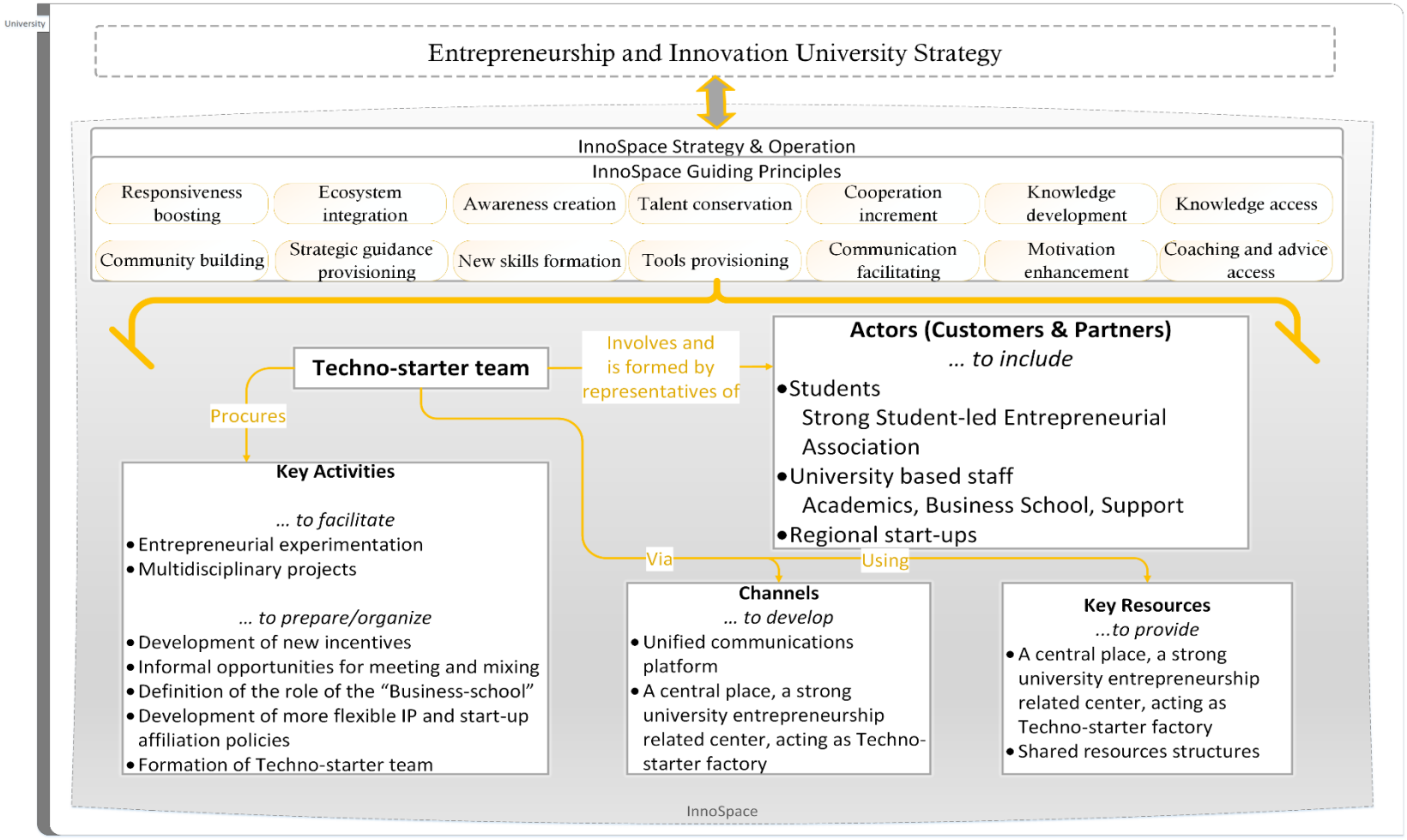

Figure 17 Artifact visualization tool

9. LISTS

9.1. List of Figures

9.2. List of Tables