Fostering student entrepreneurship

improving the available support programs at the Eindhoven University of Technology

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Fostering student entrepreneurship: improving the available support programs at the Eindhoven University of Technology

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Acknowledgments

When I started my studies at lower general secondary education (VMBO), I never would have dreamt of one day graduating from a university and obtaining my master's degree. Several years later, this is exactly what I am doing. This thesis report represents the finalization of my educational journey, to great relief from my parents.

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Elwin Dozeman, January 2020

Management summary

Universities have an active role in supporting socio-economic development in the region, and the transfer of knowledge from university to industry has become an important third mission of most universities (Baglieri, Baldi, & Tucci, 2018; Maas & Jones, 2017). The role of universities has become much broader than only generating and transferring knowledge, as the university also serves as a stimulator for entrepreneurial activities for their students, academics, and staff. To create an adequate entrepreneurial environment, programs are created that can support these entrepreneurship activities (Baglieri et al., 2018). Prior work on university programs that stimulate entrepreneurship mainly focused on strategic objectives, competitive focus, and service offerings, but largely neglect the business model (Baglieri et al., 2018; Pauwels, Clarysse, Wright, & Van Hove, 2016). The concept of business models is well suited to gain more insights into the inner workings of these programs, as it is often used to conceptualize organizations' internal operations, interactions with stakeholders, and revenue models (Isabelle & Westerlund, 2016). This thesis report presents the results of the research project conducted at the Eindhoven University of Technology (TU/e). This thesis aims to shed more light on how the TU/e can create entrepreneurship support measures for its students, to better meet their needs. For this thesis, the business model will be used as a conceptual model because it offers a shared language and a concrete tool that fosters dialogue and can promote common understanding. The activity system, in the form of a business model, enables the TU/e to create value for the students and the choices in this system and influence the performance and thus the value offered to students (Zott & Amit, 2010). This thesis explores how the TU/e can improve the available support for student start-ups. This is done by researching student opinions on the current entrepreneurial climate, and their preferences on entrepreneurship support. This is subsequently compared with the current support for student start-ups available at the TU/e. For the final solution, a business model lens is used to look at the support for start-ups as an activity system. This leads to the following research question:

"What support do students desire for their start-up activities, and how can the Eindhoven University of Technology create and deliver this support?"

Methodology

This thesis follows the methodology presented by van Aken en van der Bij (2016) and uses the design science paradigm. The design science paradigm aims to produce solutions for field problems and follows the problem-solving cycle (also called the regulative cycle). This cycle is driven by the needs that arise when a company has a business problem (van Aken, Berends, & van der Bij, 2016). This thesis has two aims; to solve the organization's business problem, and contribute to the academic literature. Because the problem-solving cycle's use is to solve business problems, the steps of this cycle are used as basic structure for this thesis. With the problem-solving cycle, a pragmatic solution can be developed within the context of the TU/e. To discover a potential new theory, and contribute to the existing literature, the problem-solving cycle is extended to a reflective redesign process. This study researches the case for the TU/e. In order to do this, interviews are conducted to gain insights into the current support for entrepreneurial students the TU/e offers. Furthermore, a student questionnaire is created to be able to research which support measure is the most desirable according to entrepreneurial students. The gap between the existing support and the support that is the most desirable is subsequently analyzed and used as input for the design.

Empirical analysis

First, to research which support measures for student entrepreneurs are currently available at the TU/e, interviews are conducted. This is subsequently compared to the support that is questioned in the questionnaire. The results of this are visualized in Table A.

Table A: Available support at the TU/e

Support	**TU/e Innovation Space**	**STARTUPeindhoven**
Based on research by Selten (2018) & literature review	Available yes/no	
Access to financing	Yes	Yes
Access to high-tech facilities	Yes	No
Entrepreneurship events	Yes	Yes
Investments from the TU/e	Sporadically	Sporadically
Legal support	No	No
Entrepreneurship mentoring/coaching program	Yes	Yes
Network facilitator	Yes	Yes
Providing Staff	No	No
Idea testing	Yes	No
Entrepreneurship workshops	Yes	No
Brand building	No	Yes
Discussed during interviews		
Office Space	No	
Development of soft skills	Insufficient	

The student questionnaire is created to research the opinions of entrepreneurial students on what entrepreneurship support measures are the most popular. The student questionnaire is based on previous research by Selten (2018) supplemented with research from the systematic literature review for this thesis. The finished questionnaire is shared with entrepreneurial students from the TU/e. To analyze the gap between the available support at the TU/e and the support that is the most desirable according to the opinion of entrepreneurial students, Table B is created. This table visualizes the support with the highest ranking (top 3) by students compared to the availability of support measures.

Table B. Gap in support

	Stage 1: Definition stage	Stage 2: Validation stage	Stage 3: Efficiency stage	Stage 4: Growth stage
Non-entrepreneur	Mentoring/coaching	Idea testing	Network facilitator	Access to financing & brand building
	Network facilitator	Access to high tech facilities	Access to financing	Network facilitator
	Idea testing	Network facilitator	Legal support	Legal support & providing staff
Entrepreneur	Idea testing	Idea testing	Brand building	Legal support
	Entrepreneurship events & Entrepreneurship workshops	Network facilitator	Network facilitator	Access to financing
	Mentoring/coaching	Entrepreneurship events	Investments from TU/e	Providing staff

The student questionnaire also questioned the popularity of certain policy-related statements. The statements *'Entrepreneurs should have a special administrative status at the TU/e, comparable to top-class sport'* and *'At the TU/e, it should be possible to graduate with your start-up'* both got positive reactions from students. Currently, these practices are not a standard policy of the TU/e, but the opinions from students indicate that there is a desire from these students to make this standard policy.

Design

The support chosen for the design is *investments from the TU/e*. There is some academic literature that indicates the relevance of universities providing financing to start-ups. Usually, start-ups are characterized by a high level of uncertainty and information asymmetry (Widding, Mathisen, & Madsen, 2009). This usually leads to private investors waiting to invest until the start-up reaches the later stages of development, creating a funding gap for start-ups (Wright, Lockett, Clarysse, & Binks, 2006). Universities can take an active role in bridging this funding gap, by creating innovative financial and incubating instruments. These instruments can provide the capital necessary for start-ups to work on their prove of concept and convert the levels of uncertainty into risk, making them more interesting for investments from the private sector (Munari, Pasquini, & Toschi, 2015; Widding, Mathisen, & Madsen, 2009).

The elements of the Business Model Canvas (BMC) are used to describe the activity system for this support. The completion of these elements is based on the literature review and empirical analysis for this thesis, specific literature, and a guest lecture and interview with venture capitalists. The BMC can be seen in Figure A. Furthermore, a process flow is created to illustrate the structure of the activity system. This can be seen in Figure B. The governance of the business model is clarified by describing who performs which activities.

Conclusion and contribution

According to the empirical analysis that is carried out for this thesis, the support measures entrepreneurial students most desire are *network facilitation*, *access to financing*, and *legal support*. Support measures that students desire that are not available at the TU/e, and therefore provide room for improvement, are *legal support*, *providing staff*, and *investments from the TU/e*. Furthermore, some forms of entrepreneurship support that are related to TU/e policy are also researched. Entrepreneurial students indicated their desire for a *special administrative status* at the TU/e comparable to top-class sport, and the ability to *graduate with a start-up*. Currently, this is not an option that is offered at the TU/e. Second, a design is proposed that focused on how the TU/e can create and deliver one of the desired support measures. The support that the TU/e can offer is the provision of seed investments to promising start-ups in order to provide financial room to further develop the business and technology, bridging the financing gap until private investors become interested. The TU/e can create and deliver this support by using the proposed BMC, the process flow that shows how the coherency of the business model, and the proposed governance linked to the business model.

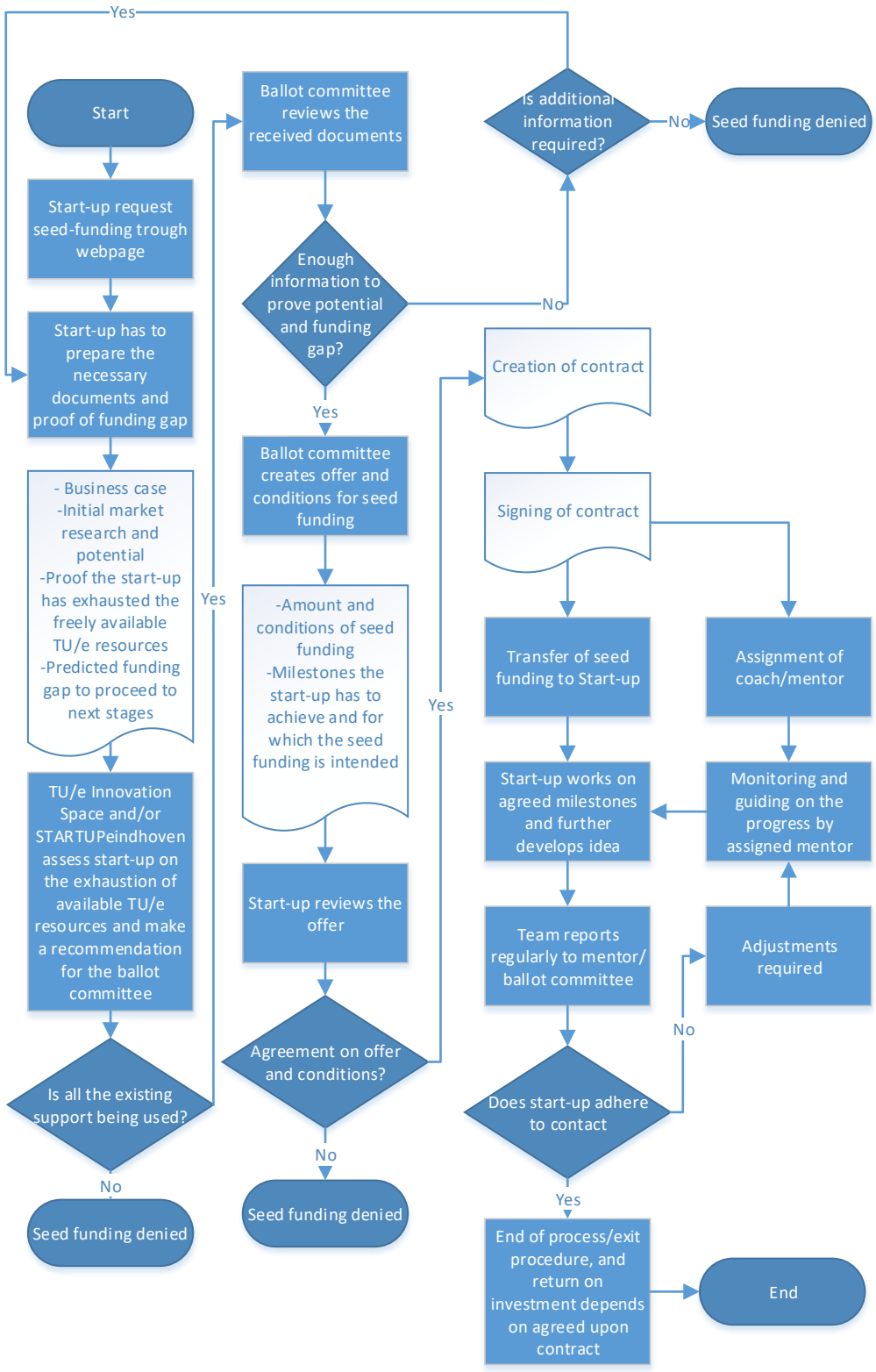
The contributions of this thesis are as follows. Fist, prior research on university programs aimed at stimulating entrepreneurship mainly focuses on strategic objectives, competitive focus, and service offerings, but has largely neglected the business model (Baglieri et al., 2018; Pauwels et al., 2016). This study attempts to shed some light on these business models and bundles the findings from several literature streams into a description of this business model making clear how certain support measures can be realized. Second, prior work on university entrepreneurship programs largely neglects the financial side of these programs, as they focused more on what types of programs should be created with what strategic objectives (Baglieri et al., 2018). This study identified and bundled various (alternative) forms of revenue generation possibilities for entrepreneurship support programs, and included some of them in the final design. Third, using a business model perspective ensures the customer is placed central and a new business model is created around their wishes and preferences, in

contrast to existing research that pushes their findings on the customers (Osterwalder & Pigneur, 2010). Understanding the value creation and capturing process of these programs through their business models enhances the understanding and can improve these programs for universities and the students participating in these programs, possibly making the execution and maintenance more efficient and sustainable. Lastly, the business model, corresponding process flow, and governance of a university entrepreneurship support measure have been described. Although this a preliminary exploration and it is done for a specific context, there is no prior research describing an activity system in its entirety for this purpose.

Figure A. The design Business Model Canvas

<table>
<tr><th>Key partners</th><th>Key activities</th><th>Value proposition</th><th>Customer relationships</th><th>Customer segments</th></tr>
<tr><td rowspan="3">Co-financiers
- Angel investors
- Government funds
- Venture capital firms</td><td>- Screening of business ideas, approval/disproval
- deciding on milestones
- mentoring activities and progress tracking</td><td rowspan="3">- Seed financing for promising start-ups
- mentoring/coaching (on idea testing/proof-of-concept, development of business model, and market analysis)
- focus on quality of research and increase in experience to enhance the entrepreneurial climate</td><td>- On demand (start-up has to request)
- Ballot committee (approve investment & determine milestones
- Personal relation with coach/mentor
-Contractual</td><td rowspan="3">Start-ups that have
- A business case
- (Almost) finished the first stage of the start-up entrepreneurial process
- Need financing to develop idea in the following stages</td></tr>
<tr><th>Key resources</th><th>Channels</th></tr>
<tr><td>- Seed capital
- Knowledge on entrepreneurship process and activities</td><td>- Traditional communication (webpage/mail)
- Face-to-face</td></tr>
<tr><th colspan="3">Cost structure</th><th colspan="2">Revenue</th></tr>
<tr><td colspan="3">- Uncertainty (lost investments, letting non-viable candidates die)
- Personnel (time spend on screening ideas/mentoring progress)</td><td colspan="2">- Equity in company
- Loan
- IP licensing, royalties (only if IP is applicable)
- Student placement in companies
- Sponsored research
- Grant (intangible benefits)</td></tr>
</table>

Figure B. The design process flow



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List of Abbreviations

BMC	Business Model Canvas
IP	Intellectual property
TTO	Technology transfer office
TU/e	Eindhoven University of Technology

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1. Introduction

Universities have an active role in supporting socio-economic development in the region, and the transfer of knowledge from university to industry has become an important third mission of most universities (Baglieri, Baldi, & Tucci, 2018; Maas & Jones, 2017). The role of universities has become much broader than only generating and transferring knowledge, as the university also serves as a stimulator for entrepreneurial activities for their students, academics, and staff. To create an adequate entrepreneurial environment, programs are created that can support these entrepreneurship activities (Baglieri et al., 2018). A lot of these programs that support entrepreneurship activities are operated for non-profit, and they often depend on some form of support from a parent organization or government. To make these programs more sustainable, the value creation and capturing process of these projects needs to be understood. Prior work on university programs that stimulate entrepreneurship mainly focused on strategic objectives, competitive focus, and service offerings but largely neglect the business model (Baglieri et al., 2018; Pauwels, Clarysse, Wright, & Van Hove, 2016). The concept of business models is well suited to gain more insights into the inner workings of these programs, as it is often used to conceptualize organizations' internal operations, interactions with stakeholders, and revenue models (Isabelle & Westerlund, 2016).

This thesis report presents the results of the research project conducted at the Eindhoven University of Technology (TU/e). This thesis aims to shed more light on how the TU/e can create entrepreneurship support measures for its students, to better meet their needs. The report is structured as follows, first, this chapter describes the context of the research, elaborating on the problem statement that forms the base of this thesis. Second, the current literature on the business models for programs that stimulate (student) entrepreneurship is reviewed in a systematic literature review in chapter two. The research design and methodologies that are used in this thesis are explained in chapter three. This is followed by the empirical analysis that is conducted for this thesis in chapter four. For one support measure, a design is created that focused on how the TU/e can create and deliver this support. This is done in chapter five. Lastly, the results of this thesis are concluded and discussed in chapter six.

1.1 Eindhoven University of Technology

This thesis is carried out in the context of the TU/e. The TU/e is one of four technical oriented universities in the Netherlands. Formed closely with industry (DAF, Philips) in 1956, today it is one of the top-ranking Dutch universities. The TU/e combines research with education, in close collaboration with partners in the public and private sectors. In 2018, the university hosts more than 10.000 students with almost 3.000 researchers and additional staff members (Eindhoven University of Technology, 2018). The mission of the TU/e consists of three parts. First, the TU/e wants to provide excellent education, by training engineers with a sound scientific basis and depth, who can excel in social sectors and functions. Second, contributing to scientific progress and the development of innovations by advancing quality research. Third, the valorization of knowledge. This is done by translating research into innovations and stimulating entrepreneurship (About the University, 2019).

The TU/e has the ambition to become one of the world-leading universities in science and technology. As a reaction to a changing society and industry, the TU/e is revising its education and research strategy in the TU/expedition 2030 plan. This is necessary in order to educate a new generation of engineers that are able to contribute to future challenges in meaningful ways. To achieve this goal, the TU/e wants to invest in individual research talent, strengthen the collaboration with industry and society, and extend the support for student entrepreneurship and the development of new businesses (TU/e Strategy 2030, 2018). This leads to entrepreneurship becoming a more formal part of the curriculum, and valorization of research becoming more integrated with entrepreneurship. Furthermore, the TU/e wants to actively stimulate and facilitate the creation of student start-ups. This is done by investing in the further development of technological concepts with strong market potential. Also, the TU/e wants to support an entrepreneurial climate by facilitating the community of students, academics, and staff in

experimenting, sharing ideas and supporting each other (den Ouden, Valkenburg, Blok, & Mengelers, 2017). These changes in strategy mean the TU/e is becoming an entrepreneurial university. The role of an entrepreneurial university is much broader than only generating and transferring knowledge, as the university also serves as a stimulator for entrepreneurial activities for their students, academics, and staff. To create an adequate entrepreneurial environment, programs are created and/or expanded that can support these entrepreneurship activities (Baglieri et al., 2018).

One of the challenges the TU/e is facing now is increasing the number of student start-ups at the campus in alignment with the goals of the TU/expedition strategy. This can, among other things, be achieved by increasing the support the TU/e offers for the students working towards or in their start-up company (Bobelyn, 2019). Intensifying this support is also part of the TU/e strategy to create an entrepreneurial climate at the campus. The TU/e already has some programs that stimulate (student) entrepreneurship, these are briefly discussed below.

STARTUP/eindhoven (part of innovation lab)

STARTUP/eindhoven is the business incubator at the TU/e. They provide basic facilities to guide start-ups tot the market. Furthermore, they have a large network consisting of business partners, coaches, and the extensive knowledge base of the TU/e. STARTUP/eindhoven helps start-ups to explore their options in an informal and relaxed way. The services offered at STARTUP/eindhoven are free of charge (STARTUP/eindhoven, 2019). STARTUPeindhoven is part of TU/e Innovation Lab, the technology transfer office (TTO) from the TU/e. The aim of TU/e Innovation Lab is to translate academic and technological findings into solutions that are market-ready (TU/e Innovation Lab, 2019).

TU/e Innovation Space

TU/e Innovation Space is a community that supports entrepreneurship together with interdisciplinary hands-on education and engineering design. The focus of TU/e Innovation Space is the development of prototypes and developing innovations. Also, TU/e Innovation Space support lectures that develop hands-on courses and contribute to innovation in education (TU/e Innovation Space, 2019).

1.2 Problem identification

The problem has been identified based on the proposed changes in the TU/e's strategy and the ambition to increase support for student start-ups. First, the available policy documents from the TU/e considering the strategy 2030 plan and valorization strategy have been analyzed. Subsequently to this initial analysis, the possible problems and thesis possibilities were discussed with this thesis' main client Dr. A.S.A Bobelyn in a series of unstructured and explorative interviews. From these interviews, it can be concluded that the TU/e does not reach its full potential regarding the number of start-ups created on campus. In particular, it has been observed that most entrepreneurial projects developed by students during the course and project work are abandoned at an early stage. Moreover, students struggle to combine their entrepreneurial endeavors with studying (Bobelyn, 2019; Students at Springplank , 2019). Therefore, this thesis sets out to explore how the TU/e can improve the support to students with an entrepreneurial intent and facilitate the creation of start-ups. This thesis studies the problem from a student perspective and investigates the needs student entrepreneurs experience during their efforts to start their own venture. To further illustrate the problem, a (simplified) problem tree is given in Figure 1.

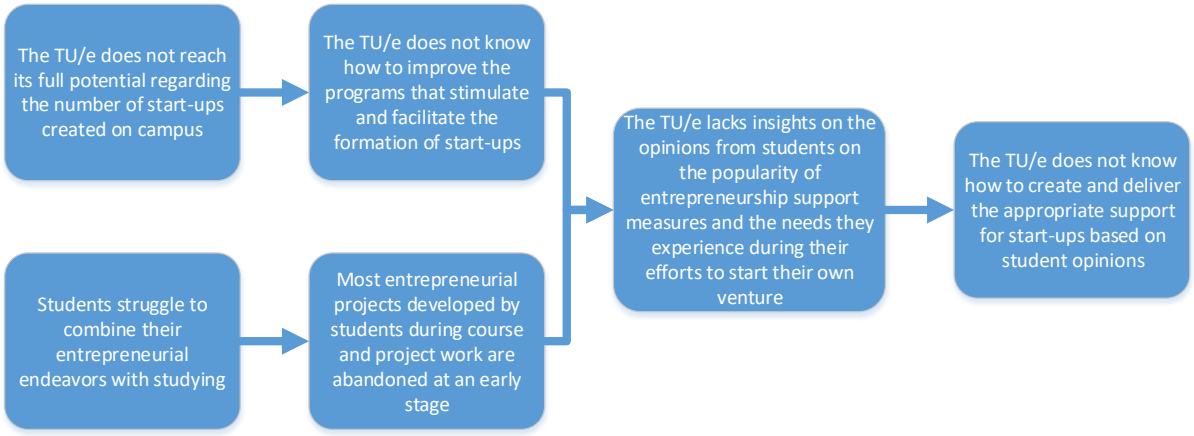

Figure 1: The (simplified) problem tree

As can be seen in the problem tree in the Figure above, the decision has been made to focus on the problem towards improving the creation and delivery of support for student start-ups at the TU/e. An important decision is that this thesis will only research support measures that influence students already in the process of creating a start-up, and does not include measures that stimulate entrepreneurial intent among students. This leads to the following problem statement:

"The Eindhoven University of Technology does not reach its full potential regarding the number of start-ups created, and lacks insights on how to better support students with an entrepreneurial intent"

This problem statement is supported with findings from informal meetings with students and organizers from the Springplank project at TU/e Innovation space. This is an experimental program within TU/e Innovation Space where entrepreneurial students can pitch their business ideas and get feedback from other students and experts. During Springplank project meetings, students and organizers commented on forms of support for entrepreneurship that is still missing at the TU/e and the opportunities of including student opinions as a basis to analyses this subject.

1.3 Business model perspective

New measures or programs that support the creation of student start-ups cannot just be 'created'. They need an underlying interconnected and interdependent bundle of activities, an activity system, to work properly (Foss & Saebi, 2018). This activity system enables the firm to create (and appropriate) value (Zott & Amit, 2010). For the TU/e, this means that potential new measures supporting entrepreneurship need to be linked to an underlying activity system to work on the TU/e campus. A business model is a bundle of these interconnected and interdependent activities. Consequently, this thesis will adopt a business model perspective towards researching the solution to the client's problem. Since the mid-nineties, the business model concept gained a lot of attention in the academic literature. The concept of business models is mostly used to address the following three issues: 1) strategic management issues (value creation, competitive advantage, performance); 2) in e-business; 3) technology and innovation management (Zott, Amit, & Massa, 2011). There is no single definition of a business model in the existing literature. The following definitions have been identified from important research, see Table 1.

Table 1: Business model definitions

Author	Definition
(Amit & Zott, 2001)	*"The business model depicts the design of transaction content, structure, and governance to create value through the exploitation of business opportunities"* (p.2)
(Chesbrough & Rosenbloom, 2002)	*"The business model creates a heuristic logic that connects technical potential with the realization of economic value"* (p.529) *"The business model provides a coherent framework that takes technological characteristics and potentials as inputs, and converts them through customers and markets into economic outputs"* (p.532)
(Magretta, 2002)	*"Business models are stories that explain how enterprises work. A good business model answers the questions: Who is the customer? And what does the customer value? It also answers the fundamental question every manager must ask: How do we make money in this business? What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost?"* (p.4)
(Teece, 2010)	*"A business model articulates the logic, the data, and the other evidence that support a value proposition for the customer, and a viable structure of revenues and costs for the enterprise delivering that value"* (p.179)
(Osterwalder & Pigneur, 2010)	*"A business model describes the rationale of how an organization creates, delivers and captures value"* (p.14)

Based on the above Table, the business model has several functions: 1) Specify a value proposition; 2) The identification of a market segment; 3) Defining the structure of the value chain; 4) Create an estimation of the cost structure and profit potential (Chesbrough & Rosenbloom, 2002). This thesis adopts the definition presented by Osterwalder and Pigneur (2010). For this thesis, the business model will be used as a conceptual model because it offers a shared language and a concrete tool that fosters dialogue and can promote common understanding. The activity system, in the form of a business model, enables the TU/e to create value for the students and the choices in this system influence the performance and thus the value offered to students (Zott & Amit, 2010). Furthermore, as became apparent after an extensive literature review, the topic of business models combined with university programs that stimulate and facilitate the creation of student start-ups is not elaborately described and discussed in academic literature (Baglieri et al., 2018; Pauwels et al., 2016). A downside of using a business model perspective is that this thesis does not focus so much on the effectiveness of the start-up support on the entrepreneurial process, but more on the creation and delivery. Because of this, this thesis uses prior work on entrepreneurship support that also focussed on how the support affected the entrepreneurial process as the basis for further analysis. This is further explained in chapter 3.

A conceptual project design for this master thesis is created based on the theory of J. van Aken, and can be seen in Figure 2. On the right-hand side of the model, the subject of analysis in this thesis is shown.

On the left-hand side of the model, the theoretical fields that are used to solve the problem are shown. Finally, the bottom of the model shows the deliverables, which will function as a reverence for the deliverables of this thesis (van Aken, Berends, & van der Bij, 2016).

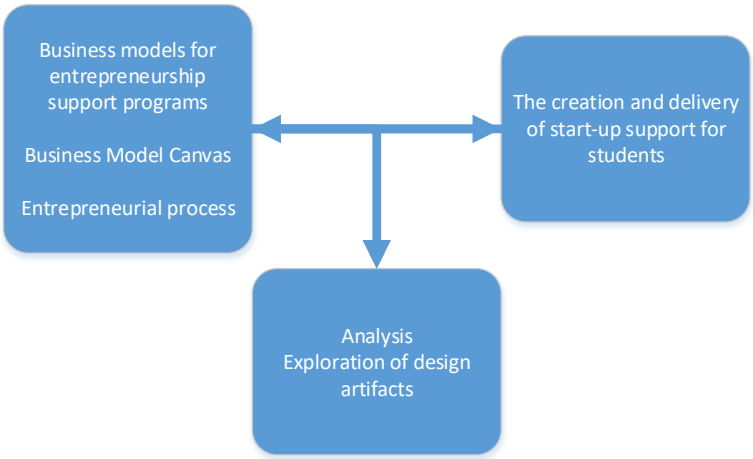

Figure 2: Conceptual project design

1.4 Research objective & questions

This thesis explores how the TU/e can improve the available support for student start-ups. This is done by researching student opinions on the current entrepreneurial climate, and their preferences on entrepreneurship support. This is subsequently compared with the current support for student start-ups available at the TU/e. For the final solution, a business model lens is used to look at the support for start-ups as an activity system. This leads to the following research question and sub-research questions.

Main research question

"What support do students desire for their start-up activities, and how can the Eindhoven University of Technology create and deliver this support?"

Sub-questions

1. Which support does the TU/e currently offer to start-ups?
2. What are the opinions from students on identified support measures for start-ups?
3. What is the gap between the student opinions and preferences and the existing support at the TU/e?
4. What are possible design solutions to fill the identified gap in start-up support?

2. Theoretical analysis

This chapter describes the theoretical analysis for this thesis. The aim of this chapter is to discuss the core concepts on which this thesis builds, identify business model practices as input for the empirical analysis, solution design, and to identify research gaps to which this thesis can contribute. The theoretical analysis is based on a systematic literature review, that followed the protocols based on the works of (Bereton, Kitchenham, Budgen, Turner, & Khalil, 2007; Kitchenham, 2004; Randolph, 2009). First, the important concepts on which this thesis builds are elaborated upon. Second, business model practices for programs that stimulate student entrepreneurship identified in the available literature are discussed. Finally, the identified gaps in the literature, and the possible ways this thesis contributes to these gaps, is discussed.

2.1 Important concepts

This paragraph gives some background on the important concepts that are used in this study. Furthermore, working definitions for this thesis are decided upon.

2.1.1 Entrepreneurship

This thesis looks at business models for programs that stimulate (student) entrepreneurship. Entrepreneurship is an important driver of economic change and sustainable growth for economies. An entrepreneur can be defined as someone who seizes opportunities to create or produce something new, driven by the pursuit of successful accomplishments. An entrepreneur needs to innovate and cluster resources in order to attain business goals (Hernández & González, 2016). Entrepreneurship is building on identified opportunities, by applying enterprise skills to create and grow an organization (Maas & Jones, 2017). Starting a new company is part of the entrepreneurship process. Hernández and González (2016) divide this process into four non-sequential stages: identifying and appraising the opportunity, business planning, defining the resources required, and start-up management. Start-ups are developing businesses, supported by a (new) technology and ideas that innovate the market (Hernández & González, 2016). The process for start-ups is different from the general entrepreneurial process because start-ups are at the early stages of venture creation. How the start-up evolves is very dependent on external and internal influences, possible commercial applications are relatively opaque, and entrepreneurial competencies have to be developed to make the transition from technology or academic research to the recognition and exploitation of economic opportunities (Rasmussen, Mosey, & Wright, 2015). Because of this, the stages in the start-up entrepreneurial process are defined as follows, see Figure 3.

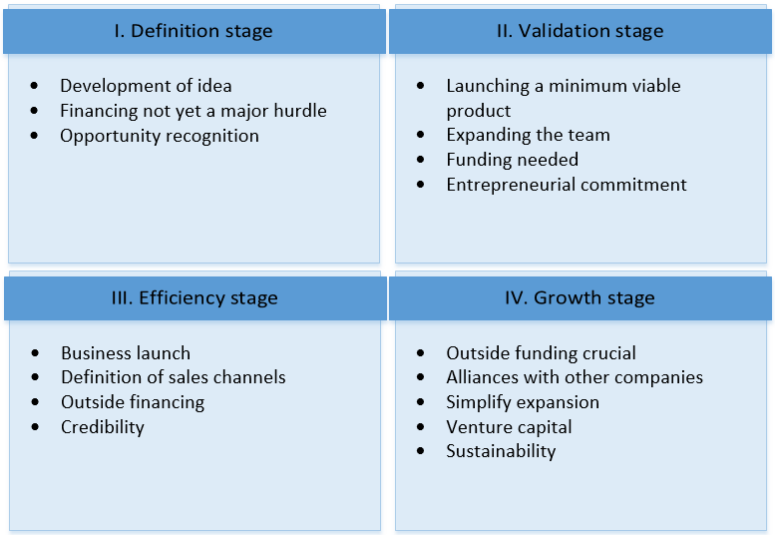

Figure 3: The start-up entrepreneurial process (Hernández & González, 2016) (Verbano, Wasser, Lincoln, & Venturini, 2016)

Figure 4 visualizes the start-up entrepreneurial process as proposed by Hérnandez & González (2016), complemented with research from Verbano et al. (2016). This process is chosen because it represents a very generic process of the start-up phases, suitable for use in the empirical analysis. For the theoretical analysis, business models of organizations and programs, linked to universities, that facilitate the start-

up entrepreneurial process as shown in Figure 3 are researched. In order to do this, literature streams on different topics that are related to this process are reviewed.

2.1.2 Entrepreneurship support

Universities have taken an active role in enabling the entrepreneur and facilitating the start-up process, while promoting an active transfer of academic research (Bercovitz & Feldmann, 2006). The first mission of universities focused on teaching and the preservation and expansion of knowledge. The second mission followed, focusing more on research. Nowadays, a more entrepreneurial mission has become the third mission of universities; economic and social development through the diffusion and commercialization of knowledge, (Baglieri et al., 2018; Etzkowitz, 2003). Entrepreneurial universities have the ability to formulate academic goals and translating knowledge produced in the university into use for society, creating a focused strategic direction (Etzkowitz, 2003). They have a role in providing adequate entrepreneurial environments for students, academics, and staff to explore and exploit entrepreneurial opportunities (Baglieri et al., 2018). Part of this strategic direction is supplying staff, access to skills, funds and other material and immaterial resources, enabling the entrepreneurial process (Venturini & Verbano, 2017). Also, entrepreneurship education programs at universities have increased rapidly (Paço, Ferreira, & Raposo, 2016).

A lot of these programs that support entrepreneurship activities are operated for non-profit, and they often depend on some form of support from a parent organization or government. In order to make these programs more sustainable and less dependent on funding, the value creation and capturing process of these projects needs to be understood. The concept of business models is well suited to describe this process, as it is often used to conceptualize organizations' internal operations, interactions with stakeholders, and revenue models (Isabelle & Westerlund, 2016). Furthermore, an overview of the different components of business models can potentially lead to new revenue possibilities, by configuring the business model in a different way (Osterwalder & Pigneur, 2010). This can help make the business models of entrepreneurship stimulating programs more sustainable.

2.1.3 The Business Model Canvas

Based on their definition of business models (see section 1.3), Osterwalder & Pigneur (2010) created the Business Model Canvas (BMC). The BMC is a model that facilitates the description and discussion of a business model so that it can be used as a shared language. The authors believe that a business model can be described in the best way through nine building blocks, these building blocks are visualized in Figure 4. The building blocks are: **Value proposition**, the value that the organization creates for its customers in the form of products and services; **Customer segments**, the groups of (different) customers the organization serves with its value proposition; **Channels**, how the value proposition is delivered to the customers, and how information is communicated; **Customer relationships**, the type of relationship the organization has with its customers; **Revenue streams**, how a cash flow is generated from the customer segments; **Key resources**, assets that are important to be able to deliver the value proposition; **Key activities**, important activities that have to be carried out; **key partnerships**, suppliers and/or partners that enable the organization to deliver value to the customers; **Cost structure**, the costs that are made in executing the business model (Osterwalder & Pigneur, 2010). The BMC articulates the value creation and capturing process that is typical of any business model while answering important questions about the customers, customer value, governance, and underlying economic logic. Because of the BMC' ability to describe

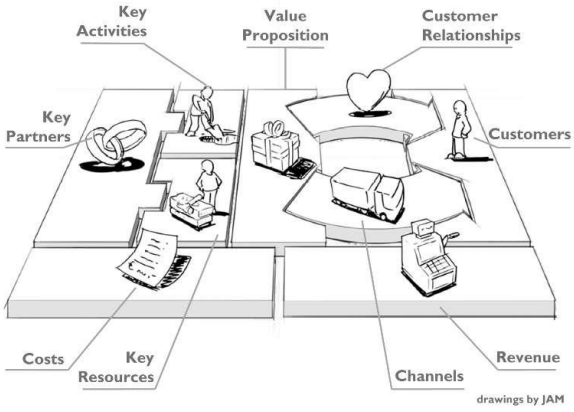

Figure 4: The Business Model Canvas (Osterwalder & Pigneur, 2010)

business models of organizations and institutions clearly and understandingly, it is used in this literature review to identify the different aspects of the business models under review

2.2 Identified business model practices

To identify suitable business model practices for this thesis, business models of organizations and programs that facilitate the start-up entrepreneurial process, as shown in Figure 3, are researched. The literature streams included in this study are those concerning incubators, accelerators, and university programs in general. Incubators and accelerators are closely linked to the start-up entrepreneurial process, as they support start-up firms during the turbulent early stages of venture development (Galiyeva & Fuschi, 2018). They are often sponsored by governments or universities and are linked to universities (Hirte, Münch, & Drost, 2017). For this thesis, incubators are defined using the definition from Galiyeva & Fuschi (2018): *"Unique and highly flexible combination of business development processes, infrastructure, and people designed to nurture new and small businesses by helping them to survive and grow through the difficult and vulnerable early stage of development"* (Galiyeva & Fuschi, 2018, p. 35). Accelerators are similar to incubators, but there are distinct differences. The main difference to an incubator is in the standardized program and the duration of the program. Accelerators usually offer a short program that is more rapid and intensive than an incubator does (sometimes just a few months) (Pauwels et al., 2016). Because the accelerator is so closely linked to the incubator, their business model practices are combined with those of an incubator. University programs that stimulate entrepreneurship are included because these programs are linked to the start-up entrepreneurial process as they provide essential services and support that enable this process (Venturini & Verbano, 2017). Universities have different programs that stimulate and facilitate entrepreneurship. Usually, these programs are tied in networks between universities, industry, and government (Ferreira & Steenkamp, 2015). Included in this theoretical analysis are programs that stimulate and facilitate the creation of start-ups within a university context. This means for this study to be included, the entrepreneurship programs should have an impact on the activities in the start-up entrepreneurial process, see Figure 3. It does not take programs that stimulate students to adopt a more entrepreneurial mindset into account.

It was necessary to derive business model practices from these literature streams, as prior work on programs that stimulate student entrepreneurship mainly focus on strategic objectives, competitive focus, and service offerings but largely neglect the business model (Baglieri et al., 2018; Pauwels et al., 2016). Understanding these programs' business models may help improve the programs (Baglieri et al., 2018). For the remaining part of this chapter, each of the elements of the BMC is discussed. From the focus of the literature concerning incubators and accelerators and literature concerning university programs that stimulate entrepreneurship.

2.2.1 Value propositions

Incubators/accelerators

An incubator provides value in various ways. Because not every incubator is the same, an incubator can have different value propositions. This section aims to identify and generalize the most common value propositions identified in the literature. The first concepts of incubators date back to 1959, at this time the incubator mainly provided office space for businesses who could not afford to lease elsewhere (Hirte et al., 2017; Isabelle & Westerlund, 2016). Because of the increased role of networking, an incubator nowadays contains co-working spaces, networked office spaces, virtual incubation networks, or combinations of these that can facilitate co-creation. Often, these office spaces come with certain office services. These services range from general business matters such as secretarial or administrative services to specialist services, typical for the type of industry of the incubator, such as laboratories (Hirte et al., 2017; Niar & Blomquist, 2019; Peters, Rice, & Sundararajan, 2004).

The main value proposition of an incubator is to enable the entrepreneurial process for its tenants. This is done by providing education services and business support in various ways. Coaching is often used

as an educational service to help entrepreneurial teams build a scalable business model. In this process, value is co-produced between the teams and the incubator and its network (Niar & Blomquist, 2019). Through coaching, the projects can be developed faster. The coaches can figure as mentors of entrepreneurial teams, provide counseling, or help to create workshops (Baraldi & Havenvid, 2016; Hirte et al., 2017). Furthermore, entrepreneurs can test business ideas in a trial and error approach (Niar & Blomquist, 2019). Regular ”office hours” provided by the management team provide further educational and counseling services (Pauwels et al., 2016). Mediation happens when the incubator connects the entrepreneurial teams with each other and the external environment. This network mediation aims to leverage entrepreneurial talent and resources, by enabling the provision of expertise and knowledge (Hirte et al., 2017). IP protection is an important issue, as this is one of the main concerns for investors (Niar & Blomquist, 2019). Products or process secrets can be protected by patents, security, secrecy, and other means. The incubator facilitates this process (Galiyeva & Fuschi, 2018; Gil-Pechuán, Palacios-Marqués, Peris-Ortiz, Vendrell, & Ferri-Ramirez, 2014). Business support also happens in the form of matchmaking between entrepreneurs and early stakeholders in order to procure funding. Also, the incubator assists in acquiring government loans and grants and general financial management (Niar & Blomquist, 2019; Wang, Lin, Hong, Lu, & Cheng, 2008). Together, these business support tasks form validation services by integrating deferent voices of stakeholders, reducing the uncertainty of the new business concept (Dellermann, Lipusch, & Ebel, 2017).

The network of the incubator is used to leverage knowledge to the benefit of the entrepreneurs. Through the network, entrepreneurs are connected with experts and customers. Also, this network supports the business support activities an incubator conducts (Hackett & Dilts, 2004; Hirte, Münch, & Drost, 2017). Social networks bring value to start-ups in the form of intellectual and material resources (Niar & Blomquist, 2019). Lastly, being associated with a certain incubator can help to build the brand of start-up companies. The name of the associated university and scientific credibility can provide symbolic capital that helps start-ups with their reputation and relationships (Kitagawa & Robertson, 2015; Wang et al., 2008).

University programs that stimulate entrepreneurship

Universities can play a large role in the development of start-ups, by providing managerial staff, the development of skills, and access to material and immaterial resources. Each university organizes these activities in a different way and to a varying degree (Venturini & Verbano, 2017). Technology transfer offices are used to commercialize technologies outside the university. Initially developed to handle licensing and other forms of IP agreements resulting from university research, nowadays they often also provide services for start-up formations. Usually, the university’s TTO has a large network from (previous) collaborations with industry that can provide entrepreneurial opportunities for faculty members and staff. The business network is enlarged by organizing entrepreneurship education, business plan competitions, and the nurturing of and entrepreneurial culture in the university. The TTOcan also promote entrepreneurship through (sponsored) research (Baglieri et al., 2018). Sometimes, entrepreneurship centers are linked to a university. These centers play a direct and indirect role in promoting start-up- and entrepreneurship activities. Sometimes entrepreneurship centers have their own programs and activities to facilitate start-up creation, or they create joint programs with other faculties. These programs include facilitating new venture creation, aiding in the market research process, the development of entrepreneurial skills, stimulating entrepreneurial behavior, and the creation of knowledge. Usually, these activities are linked to the strategic goals of the university (Maas & Jones, 2017). Lastly, a lot of universities provide (free) office space for entrepreneurial teams to work on their projects (Bervegal-Mirabent, Ribeiro-Soriano, & Sánchez García, 2015).

Projects that facilitate entrepreneurship vary greatly between universities, this means the value that is offered to the beneficiaries of these projects varies between the different types of projects. Because of this variation and absence of a holistic framework, it is difficult to describe a generalized value

proposition for these programs (Ferreira & Steenkamp, 2015). An overview of the identified revenue streams is visualized in Table 2.

Table 2: Identified value propositions

Literature	Value propositions
Incubators/ Accelerators	Office space + office services
	Educating services (coaching, workshops, training and education)
	Business support (idea testing, mediation, protection of IP, procurement of funding)
	Networking possibilities
	Brand building (name of associated university/company)
University programs for student entrepreneurship	Facilitating the start-up process
	Providing staff, access to material & immaterial resources
	Development of (entrepreneurial) skills
	Licensing opportunities
	Access to university network
	Creation entrepreneurship programs (sponsored research, joint programs)
	Providing office space

2.2.2 Customer segments

Incubators/accelerators

The customers for an incubator are the entrepreneurs participating in the program. These start-up companies are in the early stage of business development when they join the incubator (Amelia, Irianto, Thoyib, & Rofiq, 2018). The business ideas are innovative and novel business concepts that potentially come with a high (financial) risk (Galiyeva & Fuschi, 2018). The main focus of the incubator is to validate these new business concepts and business models in order to reduce uncertainty. So, enabling the entrepreneur to continuously adapt the business model (Dellermann, Lipusch, & Ebel, 2017). Sometimes, incubators can have a selection preference; university incubators usually favor faculty and student entrepreneurs from the host university, and corporate (internal) incubators favor internal employees over external entrepreneurs (Carayannis & von Zedtwitz, 2005). Lastly, incubators can add value by cooperating with existing industries and universities. By transferring technologies and knowledge the economic development in the region can be impacted (Lyra & Almeida, 2018).

University programs that stimulate entrepreneurship

Entrepreneurial universities have taken an active role in enabling the entrepreneur and facilitating the start-up process, while promoting an active transfer of academic research (Bercovitz & Feldmann, 2006). The first mission of universities focused on teaching and the preservation and expansion of knowledge. The second mission followed, focusing more on research. Nowadays, a more entrepreneurial mission has become the third mission of universities; economic and social development through the diffusion and commercialization of knowledge, (Baglieri et al., 2018; Etzkowitz, 2003). Entrepreneurial universities have the ability to formulate academic goals and translating knowledge produced in the university into use for society, creating a focused strategic direction (Etzkowitz, 2003). They have a role in providing adequate entrepreneurial environments for students, academics, and staff to explore and exploit entrepreneurial opportunities (Baglieri et al., 2018). Frequently, this is done through academic knowledge valorization. Knowledge valorization is the process of making a new technology market-ready, by adding value in order to transform it into a new and improved product (van Greenhuizen, 2010). In an academic context, technology transfer offices (TTO) are created to bridge between academic knowledge and ‘customers’ namely entrepreneurs, capitalists, and existing firms (Huyghe, Wright, & Piva, 2014). Although some TTO’s preform activities that stimulate entrepreneurship, their main objective is knowledge valorization (Huyghe at al., 2014). This means a

TTO is not a program that specifically stimulates entrepreneurship, and the customers are not included in the BMC. In the academic literature, a lot of research is done in the field of TTO's, while less focus is placed on entrepreneurship programs in general.

The direct customers for the university programs that specifically stimulate entrepreneurship are mostly students of the university. Also academic- and faculty staff may participate in these programs (Baglieri et al., 2018). As mentioned before, these customers are in the entrepreneurial process of creating a start-up company. Sometimes, these programs collaborate with industry. Sponsored research is an example of this. Because the sponsor firm pays to get benefits out of this collaboration, it is also a customer of these entrepreneurial projects (Baglieri et al., 2018; Bercovitz & Feldmann, 2006). An overview of the identified customer segments is visualized in Table 3.

Table 3: Identified customer segments

Literature	Customer segments
Incubators/ Accelerators	Entrepreneurs/entrepreneurial teams/start-ups
	Early-stage of business development
	Novel (high risk) business ideas
	Industry/university (Knowledge transfer)
University programs for student entrepreneurship	Students, academic- & faculty staff
	Companies (collaboration)

2.2.3. Customer relationships

Incubators/accelerators

Entrepreneurial teams that want to participate in the incubator have to go through a selection process. The selection of promising teams ensures a more effective allocation of the incubator's available resources. Also, this selection relates to the kind of start-ups the incubator wants to attract. There are two main selection approaches; focusing on the idea, or focusing on the team or individual. In order to select the most promising teams, the incubator manager needs to have knowledge of the business development requirements and should be able to judge the team members' personalities (Hirte et al., 2017). Studies have indicated that the selection procedure is closely related to incubator success (Niar & Blomquist, 2019). The business support that is offered in the incubator is based on personal contact. This contract is between the teams' participants and the incubator founders, financers, important customers and/or development partners. To track the process of the teams, assessments take place. During these assessments, the teams are monitored on their progress (milestones) (Baraldi & Havenvid, 2016). When the time comes for a start-up to leave the incubator, an exit procedure needs to be in place. Common scenarios are: the sale of a start-up to other companies; the start-up has a positive return on investment; or a public offering of the company (or a complete takeover) (Kreusel, Roth, & Brem, 2018).

University programs that stimulate entrepreneurship

Sometimes, start-up companies try to commercialize technology that is developed in the university. The (patented) technology can then be licensed to the start-up company for exploitation. This means a contractual relationship arises between the start-up and the university with agreements about ownership and payments (Baglieri et al., 2018; Venturini & Verbano, 2017). The type of customer relationship varies between de different programs. In general, the relationships are personal, with a lot of contact between the programs' organizers, coaches, and key partners. This personal relationship is also required to be able to give proper support to the different entrepreneurial teams (Sousa, Magalhães, Lopes,

Fernandes, & Costa-Lobo, 2017). An overview of the identified customer relationships is visualized in Table 4.

Table 4: Identified customer relationships

Literature	Customer relationships
Incubators/ Accelerators	Selection-/exit procedure
	Personal relationships
	Assessment (milestones, evaluations)
University programs for student entrepreneurship	Contractual (licensing IP)
	Personal
	Mentoring/coaching

2.2.4 Channels

Incubator/accelerator

The channel through which the incubator offers its value to the entrepreneurs is the shared environment space of the incubator; the brick and mortar building (Kreusel, Roth, & Brem, 2018). This incubator location also includes the co-location that enables networking with other start-ups. Furthermore, this location can provide access to office services such as laboratories (Baraldi & Havenvid, 2016). Virtual infrastructures are also used as a way to enter the incubator network. Though a virtual infrastructure, incubators can include start-ups based on their business model rather than location. Knowledge-based assets can be allocated more effectively with virtual communication (Carayannis & von Zedtwitz, 2005).

University programs that stimulate entrepreneurship

The entrepreneurial teams get most of the business support on the university campus. Here, the university has the (technological) infrastructure and the network of interconnected actors in place to govern the start-up process. Sometimes, the university has specific entrepreneurship centers. These centers have brick-and-mortar buildings that can be on the university campus or another location outside the campus (Maas & Jones, 2017). Technology transfer offices are also used to facilitate the start-up process. In these offices, various activities that facilitate and promote entrepreneurship can be organized (Baglieri et al., 2018). An overview of the identified channels is visualized in Table 5.

Table 5: Identified channels

Literature	Channels
Incubators/ Accelerators	Mortar and brick building
	Virtual infrastructure
University programs for student entrepreneurship	University campus
	Entrepreneurship center
	Technology transfer office

2.2.5 Revenue streams

Incubators/accelerators

The business model for the first generation of incubators was mainly focused on leasing office space to tenants. These office spaces were provided below-market prices, so start-up firms could have easy access (Hirte et al., 2017). As the incubator started to provide more services, so did the revenue streams expand. This started by providing and selling extra office services such as faxing or photocopying

possibilities (Grimaldi & Grandi, 2003; Isabelle & Westerlund, 2016). Also, if available at the incubator, specialist spaces such as laboratories or cleanrooms can be made available for a fee. The value-adding services (educating- and/or business services, etc.) are sometimes provided to the start-ups for a fee (Hirte et al., 2017; Isabelle & Westerlund, 2016). Revenues for an incubator can also be created through a successful exit. Sometimes, technologies and IPs can be licensed or sold to other companies. This process requires IP protection to be in place and agreements on ownership of this IP (Baraldi & Havenvid, 2016; Galiyeva & Fuschi, 2018). A mechanism often used in for-profit incubators is the conversion of the debt incurred during the incubation process into shares of the company by successful exit. Furthermore, successful companies can be integrated into the parent company of the incubator (Hirte et al., 2017). Non-profit incubators are the most common type of incubator, this means they very often lack self-sustainability. Funding from external (parent) organizations can therefore play a major role in the sustainability of an incubator (Isabelle & Westerlund, 2016).

University programs that stimulate entrepreneurship

For universities, there are ways to generate revenues while still providing services and support to students that want to create new ventures. A logical way is earning revenues from the commercialization of research. There are different types of transactions possible between a company and industry to do this. Research can be commercialized through: licenses, sponsored research, and spin-off firms. If IP is licensed, the legal rights to use this IP are converted to another firm. The knowledge and IP rights are transacted for funding for university projects. This type of research commercialization can be difficult, as there are various forms of agreements possible. Sponsored research is a contract between a university and a firm, it supports research that is commissioned by the firm or government. The university receives funding for the research projects and usually provides the infrastructure, (graduate) students, and support from faculty staff. Sometimes, consultancy agreements between universities and companies exist. The university-industry collaboration can provide a significant source of income, as well as entrepreneurial opportunities for students (Baglieri et al., 2018; Bercovitz & Feldmann, 2006; Broome, Bowersox, & Relf, 2018) University spin-offs can also be a source of income for the university. They are dependent on mentoring and attention. Not every university has the possibility to implement this because it depends on the workload of professors and the possibilities for academic staff to work outside the university. A spin-off consumes time, which a professor could otherwise devote to teaching, research, and other administrative activities (Bervegal-Mirabent et al., 2015). Spin-offs do, however, create ways to capture potential benefits that come from being close to the research from a university. University spin-offs can be formed by a university and its faculty and staff, through the licensing of IP, with joint research projects at a university, and firms that are started by students based on university research. Universities do not have simple profit objectives but have to balance the educational and societal objectives together with the interest of their faculty members. Furthermore, contracts for research commercialization are sometimes formulated before the research is completed, making it difficult to estimate the commercial value of the result (Baglieri et al., 2018; Bercovitz & Feldmann, 2006; Venturini & Verbano, 2017). Some programs place students in companies as a form of internships. Revenues can be generated from the payments these companies make to the university for the work of the students. These companies can be entrepreneurial firms, in which the student can develop entrepreneurial skills. Furthermore, these internships are an addition to the students' academic development. For the companies, these internships provide enthusiastic students who sometimes can come up with surprising solutions to business problems. Often, the companies also support the students during the technological analysis of their technology start-up (Soundarajan, Camp, Lee, Ramnath, & Weide, 2016; Wijnker, van Kasteren, & Romijn, 2015). An overview of the identified revenue streams is visualized in Table 6.

Table 6: Identified revenue streams

Literature	Revenue streams
Incubators/ Accelerators	Rent from office space
	Fee from office services (fax, photocopying, etc.)
	Selling value-added services (educating- and business services)
	Licensing
	Shares of a successful company
	Integration in the parent company
University programs for student entrepreneurship	IP licensing, royalties
	Sponsored research
	Spin-off firms
	Fee from student placement in companies

2.2.6 Key activities

Incubators/accelerators

Activities that are necessary for the execution of the business model are the key activities. The main activities for an incubator come from managing the investment risks and entrepreneurial risks. Office services are provided by handling simple tasks like secretarial and reception services, to ensure that the basic organizational resources are in place. The entrepreneurial risk is managed by providing educational- and business support services. These are the services that are necessary to successfully incubate the entrepreneurial teams. In order to do this, the incubator needs to organize and manage the tasks that come from providing these specific services (Carayannis & von Zedtwitz, 2005). Furthermore, incubators facilitate access to financial resources. For sectors that normally have high entrance barriers, in terms of capital, this is especially important (Gil-Pechuán et al., 2014). Sometimes, incubators organize demo-/investor days. During these events, potential investors and customers are both together for start-up companies (Pauwels et al., 2016). Lastly, the selection and exit process is an important activity (see customer relationships). These activities ensure an inflow of companies that fit with the incubator's strategy and an exit when the start-up does not longer needs the incubator's services (Kreusel, Roth, & Brem, 2018; Niar & Blomquist, 2019).

University programs that stimulate entrepreneurship

Depending on the type of support, there are various key activities needed to facilitate the start-up process. Universities develop entrepreneurial skills and an entrepreneurial mindset by the students through lectures and practical cases. These cases engage students in a business context and help develop entrepreneurial skills in a multidisciplinary setting (Paço, Ferreira, & Raposo, 2016; Sousa, Magalhães, Lopes, Fernandes, & Costa-Lobo, 2017). The university might provide a mentor or coach to the entrepreneurial team to guide them through the start-up process (Sousa et al., 2017). Usually, mentoring and coaching take place in an entrepreneurship ecosystem at the university. The university organizes events in order to build and grow the ecosystem. Start-ups can benefit from the available expertise in the university's network (Hernández & González, 2016). Being able to get financing for a start-up company is a determining factor. The university can provide an entrepreneurship community, in which it connects businesses to possible investors in the network of the university. Also, the university can assist in getting government subsidies to fund the start-up. Sometimes, universities use their own funds to provide financing for start-ups, this is usually the case by research-based university spin-offs (Guerrero & Urbano, 2017; Hernández & González, 2016; Venturini & Verbano, 2017). Because research is often commercialized through licenses, the university's IP needs to be managed. New patents need to be filed and license agreements need to be negotiated. This is often done by the university's

TTO (Baglieri et al., 2018; ONeill, Kimberly, & Teng, 2017). The identified key activities are in Table 7.

Table 7: Identified key activities

Literature	Key activities
Incubators/ Accelerators	Delivering and managing office services
	Organizing education- and business services
	Facilitating access to financial resources (demo-/investor days)
	Selection of entrants/exit procedure
University programs for student entrepreneurship	Developing entrepreneurial skills & mind-set
	Mentoring & coaching
	Assisting with financing
	Managing IP & licensing

2.2.7 Key resources

Incubators/accelerators

Incubators are property-based organizations, in order to operate they need access to an office building or office space. Furthermore, depending on the type of incubator, specialist service buildings (such as laboratories) are needed for the incubator clients (Hirte et al., 2017; Niar & Blomquist, 2019; Wang et al., 2008). Knowledge is an intellectual resource of the incubator. In order to operate, access to research and development personnel that is qualified in the interest areas of the incubator is needed (Galiyeva & Fuschi, 2018). Some incubators match a successful founder from an earlier start-up with a new start-up for support and coaching (Hirte et al., 2017). Funding is an important resource for the incubator. Because funding comes from external organizations and not from customers, it is a resource and not a revenue stream (Osterwalder & Pigneur, 2010). Usually, funding agencies provide a stable economic backing of the incubator to ensure continuation (Galiyeva & Fuschi, 2018). For most non-profit incubators, these funding agencies use public resources and come from government subsidies, universities, research institutions, or a combination. For-profit incubators are often sponsored by corporations or investment groups and focus on maximizing the profit-related objectives (Gil-Pechuán et al., 2014; Hirte et al., 2017). Incubators can also get financial resources from private funds, these come from venture capitalists or business angels (Carayannis & von Zedtwitz, 2005). A combination of the different types of funding is possible.

University programs that stimulate entrepreneurship

Usually, the university supports the entrepreneurial teams by allowing them to access to already existing facilities at the university. This means the start-up can get easier access to for example office space, laboratory facilities, and access to research equipment. These facilities in close proximity create a suitable environment to create, exploit, and share knowledge. Furthermore, start-ups can benefit from the already existing brand name of the university. Lastly, the university employs supporting research and development personnel, as well as academic- and faculty staff. These play a large role in facilitating and stimulating entrepreneurship in the university, and sometimes take part in the entrepreneurship programs (Bervegal-Mirabent et al., 2015; Venturini & Verbano, 2017). Funding for entrepreneurship programs often comes from governments (Bervegal-Mirabent et al., 2015; Guerrero & Urbano, 2017). As they make the financial resources available for the university to provide these programs, they are an important key resource. The identified key resources are visualized in Table 8.

Table 8: Identified key resources

Literature	Key resources
Incubators/ Accelerators	Office + specialized service buildings
	Knowledge in specialization field
	Qualified research and development personnel
	Funding (government, university, corporations, investment groups, private funds)
University programs for student entrepreneurship	Facilities (for example office space, laboratory facility, access to research equipment)
	Good (brand) name of university
	R&D personnel, academic- and faculty staff
	Government funding

2.2.8 Key partners

Incubators/accelerators

An incubator usually has an extensive network that sometimes takes years to create. They can leverage key individuals from this network for the success of start-ups. The network may consist of potential customers, complementors, development partners, suppliers, people with specialist knowledge and skills, or funding providers such as venture capitalists, institutional investors, or business angels (Kreusel, Roth, & Brem, 2018). Helping start-ups with access to financial capital is an important aspect of the value proposition of an incubator. Sometimes incubators have partnerships with service firms, such as consultancy- or technical control firms, that can help provide services for the start-up companies in the incubator program (Dellermann, Lipusch, & Ebel, 2017; Galiyeva & Fuschi, 2018). Because an incubator usually gets (funding) support from a backing organization (see key resources), these organizations are also key partners for the incubator (Kitagawa & Robertson, 2015). Usually, incubators are associated with an organization, such as a university or company. These companies are key partners of the incubator since they provide a resource base and environment the incubator can use for the commercialization of technologies. Also, the brand of the associated organization can help the incubator and its start-ups with brand building (Hackett & Dilts, 2004; Wang et al., 2008). Furthermore, in for-profit incubators (corporate incubators), the associated company may provide a financial investment at the beginning of the incubation process. This investment is paid back during the incubation program or converted into shares of the company at the end (Hirte et al., 2017). Lastly, incubators might maintain relationships with alumni, sometimes organizing events on a regular basis to invite them back to the program. This way the alumni can share their experiences with the current teams in the incubator. Also, they can be involved in the mentoring activities of the incubator (Pauwels et al., 2016).

University programs that stimulate entrepreneurship

The partners in the university's network can be leveraged to the benefit of the entrepreneurial teams and start-up firms. Networks can facilitate the start-up process by supporting the activities in the different phases, using important stakeholders. Also, the university can cut costs, using experts from the network on a voluntary basis in the entrepreneurship programs (Yu, 2018). The network of a university might consist of government/industry partners that can become potential customers or development partners for the start-up firm. Specialists in the form of (serial) entrepreneurs or consultants can provide the start-up with the right immaterial resources and knowledge to increase the likelihood of becoming successful (Sousa et al., 2017; Venturini & Verbano, 2017). Financing can be a major hurdle for start-up firms. The university network can facilitate this is matching start-ups with potential investors. There can be different types of investors in the network Angel investors use their

own money to develop a start-up, venture investors use third-party funds (Guerrero & Urbano, 2017). Government and industry are also key partners for university entrepreneurship programs. They often provide some form of financing, for the university as well as sometimes for start-ups (Hernández & González, 2016). Furthermore, they are partners of the university for the commercialization of research, as they are the organizations that license the IP or give the assignments for sponsored research (Bercovitz & Feldmann, 2006). Also, they create internship opportunities for students in entrepreneurial programs (Yu, 2018). An overview of the identified key partners is given in Table 9.

Table 9: Identified key partners

Literature	Key Partners
Incubators/ Accelerators	Potential customers, complementors, development partners, suppliers, specialists
	Service firms (consultancy, technical control, laboratories)
	Funding providers (venture capital, institutional investors, business angels)
	Alumni
University programs for student entrepreneurship	Potential customers, complementors, development partners, suppliers
	Specialists (entrepreneurs, consultants)
	Investors (angel-, venture investors)
	Government & industry (financing, sponsored research, student placement)

2.3.9 Cost structure

Incubator/accelerator

Due to a lack of transparency, not a lot is written about the cost structure for incubators (Galiyeva & Fuschi, 2018). Costs for incubators come from executing the business model, therefore the cost structure is derived from the other building blocks of the BMC. Since incubators provide office space and services for their tenants, this contributes to the incubators' cost structure. Usually, office space and services are offered below market price (Hirte et al., 2017). Furthermore, some incubators have specialized service buildings, depending on the type of start-up company the incubator wants to attract (Niar & Blomquist, 2019). Operating and maintaining these buildings is also a cost for the incubator. Operating a virtual infrastructure for the use of the incubator tenants and the staff also provides costs for the incubator (Carayannis & von Zedtwitz, 2005). Lastly, the incubator employs multiple staff members, from receptionists to research and development personnel (Galiyeva & Fuschi, 2018). Costs come from paying the salaries and secondary benefits in order to maintain the staff.

University programs that stimulate entrepreneurship

Not a lot is written about the cost structures of entrepreneurial programs at universities, they are also very dependent on the type of program. By using the BMC, a general cost structure can be derived from the other building-blocks. First, the buildings, workspaces, and special facilities that are made available for entrepreneurial programs need to be maintained and operated. This naturally leads to costs for the university. Furthermore, costs come from the salaries of R&D personnel and academic- and faculty staff employed by the university and also work in the university's entrepreneurial programs or organize network events. As it is often university research that is commercialized, through a university spin-off or start-up, the research expenditures are also costs in the entrepreneurship programs business model (ONeill, Kimberly, & Teng, 2017). An overview of the identified cost stricter is visualized in Table 10.

Table 10: Identified cost structure

Literature	Cost structure
Incubators/ Accelerators	Office space + services
	Specialized service buildings (laboratory, cleanroom etc.)
	Virtual infrastructure
	Staff
University programs for student entrepreneurship	Maintaining & operating brick-and-mortar buildings and facilities
	Staff
	Research expenditures

2.3 Gap identification

Based on the theoretical analysis, gaps in the available literature have been identified. First, prior work on university programs that stimulate entrepreneurship mainly focused on strategic objectives, competitive focus, and service offerings but largely neglect the business model (Baglieri et al., 2018; Pauwels et al., 2016). Understanding the value creation and capturing process of these programs through their business models enhances the understanding and can improve these programs for the universities and the participating students, possibly making the executing and maintaining these programs more sustainable. Furthermore, by taking a business model perspective, the emphasis shifts from what actions programs that stimulate entrepreneurship should take to how they can realize this. Also, the business model perspective ensures the customer is placed central and a new business model is created around their wishes and preferences, in contrast to existing research that pushes their findings on the customers (Osterwalder & Pigneur, 2010). Second, no prior research specifically links business model practices to certain types of start-up support measures. Some choices in the business model might not be suitable with the strategic goals of certain support measures, or would be impossible to maintain during the execution of the support measures' business model. Finally, this theoretical analysis aimed to create an overview of the different possibilities and options that are used in business models that stimulate entrepreneurship. It does not take into account that some options might not work together, or might exclude each other when the business model is executed. Furthermore, this analysis also does not describe the coherency and dependency of the separate elements of the business models.

Further research is needed to determine how, certain, entrepreneurship support measures can be constructed and executed, using a business model lens and placing the customers/users central. Furthermore, further research is needed to determine the effects of different business model configurations and combinations of available options on the attainment of the organization's strategic goals and value creation, delivery, and capturing process. This thesis aims to contribute to the fist described gap, by researching business model practices for programs that stimulate student entrepreneurship and placing the customer/user central in deciding what support should be offered. For the selected support, the business model lens will be used to research how the support measure can be created and the value delivered to students.

2.4. Prior research for the TU/e

For his thesis, Selten identified interventions that the TU/e could implement to initiate and stimulate student entrepreneurship and innovation activities, with a focus on the process of academic knowledge valorization. Interventions are actions or artifacts that can be used to influence or lead to a desired outcome (Holmström, Tuunanen, & Kauremaa, 2014). The main research question of his thesis is: "*Which university-related support interventions on student-led entrepreneurship and innovation activities could the TU/e use to enhance academic knowledge valorization?*" (Selten, 2018, p. iii). Based on an extensive literature review and interviews with relevant stakeholders by Selten, he created a taxonomy of support interventions for student entrepreneurship and innovation. To indicate how the identified support interventions impact student entrepreneurship and innovation, Selten created a

theoretical framework. This framework can be seen in Figure 5, and shows how the university-related support mechanisms influence students' intention and action to perform in entrepreneurship and/or innovation activities.

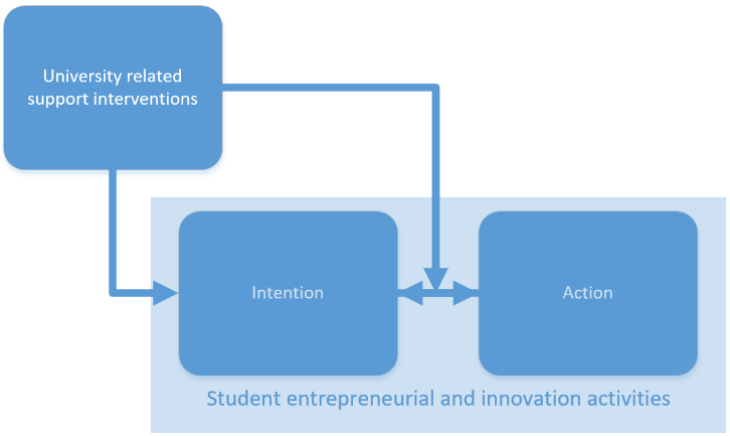

Figure 5: Theoretical framework used by T.G.J. Selten (Selten, 2018)

The final taxonomy of university-related support interventions is created by combining interventions identified in practice with interventions identified in relevant literature. This has led to a set of 40 unique interventions. These interventions are classified by Selten on the cultural, social, and material attributes of these interventions (Selten, 2018). This taxonomy can be seen in Appendix 1. With his thesis Selten has created an overview of the various entrepreneurship support measures, that stimulate and facilitate student entrepreneurship and innovation, the TU/e could implement. Although some entrepreneurial student teams were included in the analysis to generate the taxonomy of university-related support mechanisms, they were not directly asked to the usefulness of each measure according to them. Furthermore, the perceived effect of these measures, when taking the stages of advancement in entrepreneurship into account, has also not been a part of his study. Lastly, the thesis of Selten did not take the implications for the business models at the TU/e into account, when the measures are enacted. For this thesis, the taxonomy of university-related support interventions by Selten will be used, with modifications, as input for researching students' opinions on the entrepreneurial climate and support for the creation of start-ups. As addition to the thesis from Selten, the support measures will be ranked on popularity according to student opinion.

3. Research methodology

This chapter describes the approach used to answer the research questions for this thesis. The research methodology is rooted in design science, based on the methodologies presented by van Aken, Berends, and van der Bij (2016). The first section describes the research paradigm in which this thesis builds. Subsequently, the process followed to answer the main research question, together with the methodologies that are used, is described. Lastly, the measures taken to improve the quality of this research and the thesis' deliverables are discussed.

3.1 Research paradigms

In their work, van Aken, Berends, and van der Bij (2016) propose two main research paradigms; the explanatory paradigm and the design science paradigm. The explanatory paradigm aims at producing explanatory and descriptive knowledge and follows the empirical cycle. The second research paradigm is the design science paradigm. The aim of the design science paradigm is to produce solutions for field problems and follows the problem-solving cycle (also called the regulative cycle). This cycle is driven by the needs that arise when a company has a business problem (van Aken, Berends, & van der Bij, 2016). This thesis has two aims; solve the organization's business problem, and contribute to the academic literature. Because the problem-solving cycle's use is to solve business problems, the steps of this cycle are used as basic structure for this thesis. With the problem-solving cycle, a pragmatic solution can be developed within the context of the TU/e. The problem-solving cycle is visualized in Figure 6.

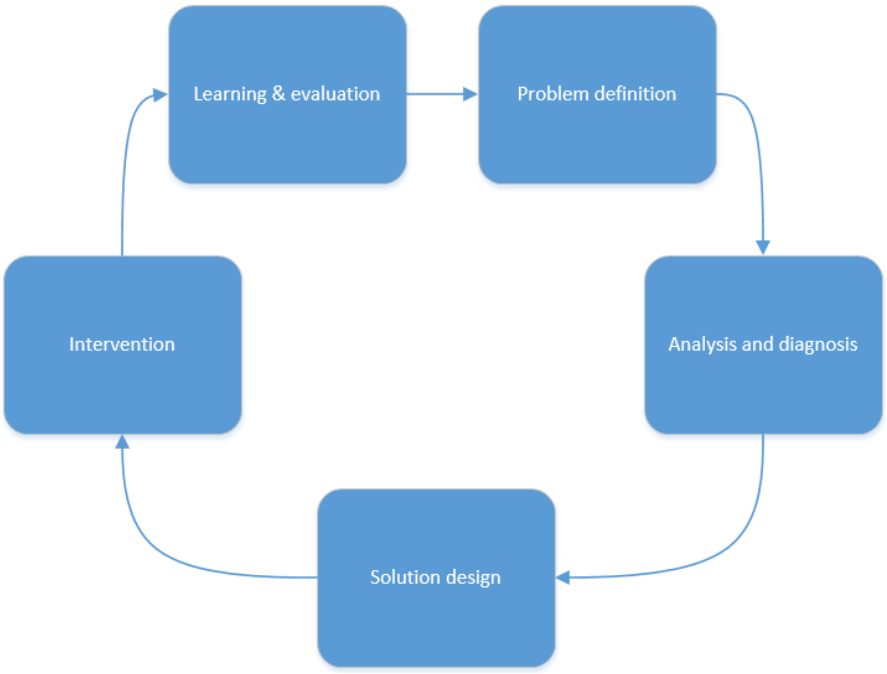

Figure 6: The problem-solving cycle (van Aken, Berends, & van der Bij, 2016)

The input for the problem-solving cycle is a business problem. Based on an analysis of this problem, a problem definition is formulated in the first step of this cycle. During the analysis and diagnosis step, the causes of this problem and possible solution directions are analyzed. Both have to be identified and validated. In the solution design step, a solution is created that tackles the most important issues of the identified business problem. The designed solution is implemented at the company during the intervention step. Finally, the effects of the designed solution are assessed in the evaluation step (van Aken et al., 2016).

3.2 Reflective redesign process

As mentioned before, this thesis has two aims; solve the organization's business problem, and contribute to the academic literature. The first aim has been addressed in the first paragraph of this chapter. In order to discover a potential new theory, and contribute to the existing literature, the problem-solving cycle is extended to a reflective redesign process. This process is visualized in Figure 7.

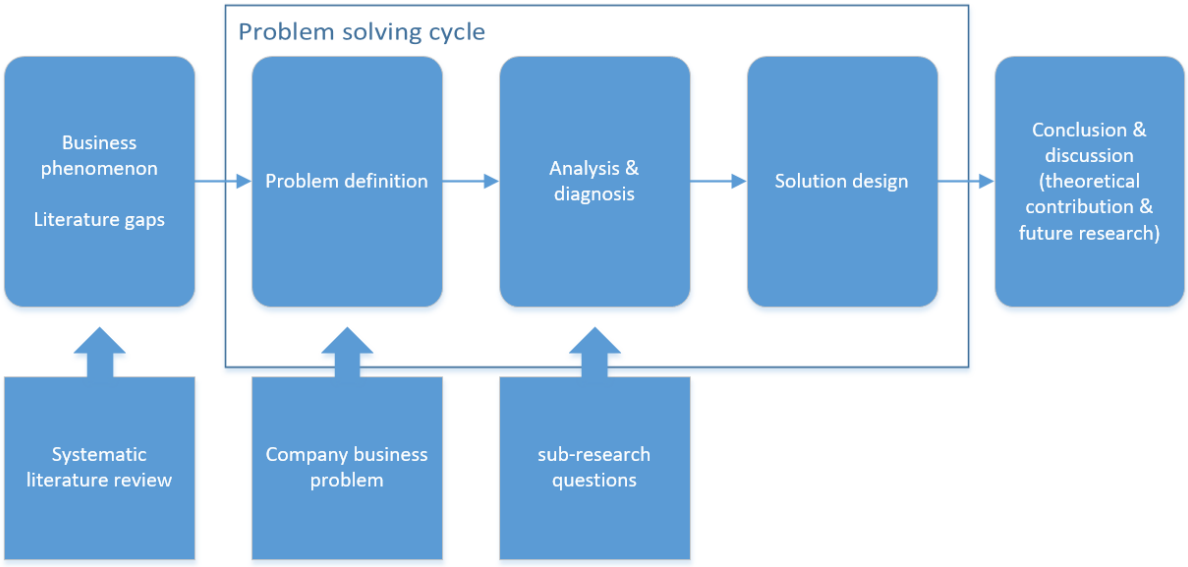

Figure 7: The Reflective redesign process (van Aken, Berends, & van der Bij, 2016)

The outcome of the reflective redesign process is a context-specific solution to a business problem, together with generic design propositions for solving this type of problem. A general research question, which is not yet thoroughly addressed in the existing literature, forms the basis of the reflective redesign process. The question 'how' to deal with this type of problem constitutes the gap in the literature. The problem-solving cycle can be used after the selection of the business problem. In the problem definition step, the problem is further analyzed in the context of the company. This results in a problem definition. Further analysis of the problem and possible solution directions are analyzed in the analysis & diagnosis step. In the solution design step, a solution is created that tackles the most important issues of the identified business problem. In the last step of the reflective redesign process, the context-specific solution to the company's problem is examined on a more aggregate level. This leads to generic guidelines for this type of business problem (van Aken et al. , 2016).

3.2.1 Business phenomenon & literature gaps

The start of the reflective redesign process is the detection of a phenomenon within a specific context. For this thesis, the phenomenon is business models for university programs that stimulate and facilitate students in the start-up entrepreneurial process as mentioned in Figure 3. This phenomenon is derived from the research objectives of this thesis. To create a knowledge base for further analysis and to assess whether this topic has been adequately researched before, a systematic literature review on this topic is conducted. This systematic literature review followed the protocols based on the works of (Bereton, Kitchenham, Budgen, Turner, & Khalil, 2007; Kitchenham, 2004; Randolph, 2009). Because prior work on these programs largely neglects the business model lens, it was necessary to include business model practices of incubators and accelerators as well as university programs that stimulate entrepreneurship. Works on these topics were included based on the following criteria:

1. Studies with a focus on or a strong emphasis on the business model side of these programs;
2. Only studies after 2008 were included to ensure the relevance;
3. Only studies in English and studies available online as download or online texts were included.

In total, 46 studies have been identified for the systematic review based on the title and the abstract. These studies have been assessed based on the whole text. Furthermore, a snowballing procedure was used to identify other potentially relevant studies. This led to the inclusion of 34 articles as base for the systematic literature review.

The exploration of the core concepts, on which this thesis builds, resulted in a list of business model practices. The systematic literature review created an overview of business model practices for incubators, accelerators, and university programs that stimulate entrepreneurship, using the BMC. For each of the topics, the entire BMC has been described. Also, gaps in the literature on this phenomenon have been identified. Part of the systematic literature review has been described in chapter 2. This chapter also elaborates on the literature gaps. During the duration of this project, the literature will be continually assessed based on insights gained in the subsequent steps.

3.2.2 Problem definition

The next step of the reflective redesign process is the selection of the company's business problem and the problem definition. The design science paradigm, used for this thesis, requires a context-specific problem (a field problem). This means the problem is not a pure knowledge problem but oriented towards a solution. The reflective redesign process can be used to develop a generic theory, based on gained understanding from the solution-oriented theory (van Aken et al., 2016).

The problem definition phase was exploratory in nature. The problem has been identified based on the information from various stakeholders and related documents considering the TU/e's strategy plan. In accordance with the main client of this thesis, the context-specific problem has been defined. The problem definition and related research questions for this thesis are described in chapter 1.

3.2.3 Analysis & diagnosis

After the context is defined, and the case is selected at the TU/e, the problem in analyzed further in the analysis and diagnosis step. This section describes the methods used for the empirical analysis for each sub-research question.

1. **Which support does the TU/e currently offer to start-ups?**

Objective: The objective of this sub-research question is to find out what support for start-ups the TU/e currently offers to its students, and serves as the diagnosis part of this thesis. For this question, the programs at STARTUP/eindhoven and TU/e innovation space will be researched, since these organizations focus on stimulating student entrepreneurship. This information is valuable for this thesis, as is serves as the basis for possible improvements and recommendations for the solution design. Since this thesis takes a business model perspective, the business models of the before mentioned organizations are also globally mapped using the BMC.

Data collection: The first step of the data collection for the first sub-question is to globally map the BMC of STARTUPeindhoven and TU/e Innovation Space. This is done to get an initial overview of each organizations' available support and how they realize this. The BMC is selected as a tool to visualize this since this model offers a shared language for describing and visualizing a business model (Osterwalder & Pigneur, 2010). The information is gathered from the websites of each organization and the main website of the TU/e. From the available information, a BMC is created for each organization. Subsequently, the interview questions are created. Because this sub-research question is interested in the qualities of things and not the quantities, a qualitative method is selected (van Aken et al., 2016). Interviews are selected as the technique to uncover these qualities, as they are a suitable tool to gather descriptions of the life-world of the interviewee and there is room to explain questions that the respondent did not initially understand (Kitto, Chesters, & Grbich, 2008; Phellas, Bloch, & Seale, 2017). The aim of the interviews is to get an overview of the available entrepreneurship support at STARTUPeindhoven and TU/e Innovation Space, and how these organizations realize this support.

Therefore, the BMC is used as a format for these questions. This makes the results of the interview easily comparable with the initial online search and ensures sufficient focus on how these organizations realize the available support. Semi-structured interviews are created were the elements of the BMC provide the structured part and are used as a list of topics that need to be covered with each respondent, but the order and the exact wording of these questions is not that important. To get extra information or depth, there was also enough room to include unstructured questions. The interview questions are included in Appendix 2.

The organizations under study for the first sub-question are STARTUPeindhoven and TU/e Innovation pace. From each organization, one person is selected for the interviews. STARTUPeindhoven consists of only one employee, so there are no other candidates. Because some time has been spent working at TU/e Innovation Space, several observations and informal meetings with employees and students resulted in some prior knowledge of the organization and its workings. Therefore, only one formal interview is conducted at TU/e Innovation Space. For this interview, the person with the most expected knowledge of the organization in its entirety and specific knowledge about the entrepreneurship support is selected. An overview of the interviewees is visualized in Table 11.

Table 11: Interviewees

Organization	Name	Function
STARTUPeindhoven	S.I. (Steven) van Huiden	Director
TU/e Innovation Space	C. (Christiaan) Teeuwen	Coach

Selecting only one interviewee from each organization has some implications. First, it is not possible to triangulate results with other respondents to compare answers and assess their correctness. Second, it becomes harder to assess if the information is complete (Kitto, Chesters, & Grbich, 2008). For the interviews, a deductive approach has been used. This means an expected pattern is tested against observations. The available support and the business model is mapped based on prion knowledge and available information form the organizations' websites. Triangulation is used, in the form of comparing the answers with the initially created business model, to both assess the correctness and completeness of the information. The information from the interview did not result in changes to the initially created business models, only additions. As this thesis adopts a more practical oriented approach, and the main aim is to develop a solution for the organization's business problem, a practical form of analysis is sufficient.

The interviews are executed face-to-face. The benefits of this method are that there is more room for explanation from the interviewee, if necessary, and there is more room to ask open questions based on the (non-verbal) clues on what is relevant to the interviewee (Phellas et al., 2017). A problem with this approach is that the interviewer can introduce bias, by revealing their own opinions, which might affect the reliability of the responses. To minimize this bias, the questions are reviewed by the thesis client and the results of the interviews are triangulated with the initial BMC created from the online information.

Data analysis: To combat reporting bias, one interviewee permitted recording the interview, this interview was subsequently transcribed. During the second interview, notes were taken during the interview process. In order to ensure all the relevant information is extracted from these interviews, and to allow for extra control on this process the interviews have been coded. For the coding of the interviews, the template approach is used. This means the coding is based on existing concepts and theories (van Aken et al., 2016). In the case of this thesis, the coding is based on the elements of the BMC (see Figure 4). To get a clear overview of the elements of the BMC, the work of Osterwalder & Pigneur (2010) is used as reference work. To further develop the coding template, the steps presented in the work of M.B. Miles, A.M. Huberman & J. Saldaña (1994) are followed. This lead to the

development of two more code templates based on a quick-scan of the interviews. The final coding template is divided into three sub-categories; personal information, with four sub-codes, organizational information, with four sub-codes, and business model information, with 11 sub-codes. The coding template is visualized in Appendix 3. All interviews are coded using the same template. The business model information codes include the different elements of the BMC. Since the aim of this analysis is to research what support for start-ups is available at the TU/e, the support of STARTUPeindhoven and TU/e Innovation Space is included in the code for the value proposition of these organizations. The coding is reviewed by an independent researcher, which led to an agreement about the applied coding.

For the final analysis of the data, the information from the interviews is compared with the initial BMC created from the web search to triangulate the results. This resulted only in additions to the business models and no changes. Furthermore, in order to compare the available support with the results of the questionnaire, the available support is grouped in the same format as questioned in the questionnaire. The final business model and the description of the available support has been sent to each interviewee to check for correctness and completeness. This resulted in some minor changes to the description of the available support. Even with the limited amount of interviews, the results are useful for this thesis, as they provide an overview of the available support at the TU/e and how this support is realized. This information can be used as input for further analysis.

2. What are the opinions from students on identified support measures for start-ups?

Objective: The objective of this sub-research question is to poll the opinions of students on the desirability of measures that support the formation of student start-ups. This information provides valuable input for the gap analysis, as it creates more insights into what type of entrepreneurship support is important according to students.

Data collection: To gather the data for this research question, a questionnaire is created. A benefit of this method is that questionnaires are cheap to administer and that they can potentially reach a higher coverage than interviews. Furthermore, the questionnaire is created as a web-based survey. This is done because these types of questionnaires can be administered fast, and the data collected needs minimal processing for further analysis (Phellas et al., 2017). The aim of the questionnaire is to uncover the preferences of TU/e students on certain support measures. This means the unit of analysis for this sub-question are the current students at the TU/e. Because not all the students at the TU/e might have the knowledge that is necessary to assess the desirability of entrepreneurship support, the decision has been made to focus on entrepreneurial students currently at the TU/e. Entrepreneurial students are students at the TU/e that participate in entrepreneurship courses, participate in one of the entrepreneurship support programs offered at the TU/e, or have their own start-up. This means that the population from which the sample for this research is drawn are entrepreneurial students currently studying at the TU/e. Because of constraints in this thesis (time/resources), it is not feasible to use a probability sampling method to select the students that are going to participate in the questionnaire. Therefore, the sample is selected using non-probability methods. Students are selected based on the before mentioned criteria, this means judgment sampling is the basis of creating the sample for this analysis (Blumberg, Cooper, & Schindler, 2011). This method is used because it is assumed that these entrepreneurial students have more knowledge about entrepreneurship and desirable support measures than non-entrepreneurial students. To increase the response for the questionnaire further, convenience sampling is used to select the students within the population of entrepreneurial students. Entrepreneurial students that can potentially participate in the questionnaire are reached through multiple channels. First, with the help of Dr. A.S.A. Bobelyn, students participating in the Technology entrepreneurship course are reached. This is done by sharing a link to the questionnaire with these students. Second, a link to the questionnaire is posted on the internal communications platform of TU/e. Innovation Space in order to reach students who participate in one or more of their programs. Third, entrepreneurial students are reached in person by email, inviting them to participate in the questionnaire.

The responses for the questionnaire are divided into two groups. One group consists of entrepreneurial students who have participated in entrepreneurship courses, and the other group consists of entrepreneurial students who currently have their own start-up. This is done to be able to assess if there are differences in preference between these groups. From the students that participated in the questionnaire, 24 students are included for further analysis. This is because not every participant completed the questionnaire. From these 24 entrepreneurial students, 15 belong to the non-entrepreneurs group, and 9 to the entrepreneurs. Although efforts have been taken to increase the number of respondents, the final group remains rather small. This means the results have the be interpreted with some caution, as they might not be representative of the entire population of entrepreneurial students at the TU/e. They do, however, provide a preliminary indication of the support preferences from this population.

The creation of the questions for the questionnaire will be discussed in this section. The questions are created based on prior research by Stelten. For his theses, T.G.J. Selten created a taxonomy of university-related support mechanisms for entrepreneurship. The taxonomy not only focused on student entrepreneurship but also on student innovation see literature review section 2.3 and appendix 1. To make the taxonomy suitable for this thesis, only measures that focus on student entrepreneurship are taken into account and measures that exclusively focus on student innovation are left out of the student questionnaire's scope. Subsequently, the measures that remained from the original taxonomy were compared with findings from the systematic literature review, conducted prior to this thesis, in order to validate the support measures and increase their validity. This leads to the following list of student entrepreneurship support mechanisms, see Table 12.

Table 12: Taxonomy of entrepreneurship support, validated by literature review

Name from taxonomy	Description	Validated by literature review
Accelerator	Accelerator for entrepreneurship activity	Yes
Acceptance of entrepreneurial career	Acceptance of advancing on the entrepreneurial ladder instead of academic	No
Access to grants	The TU/e facilitates access to grants for entrepreneurship activities	Yes
Access to funding	Accessibility of local capital and pre-seed funds	Yes
Accessibility of high-tech facilities	High-tech facilities open for entrepreneurship activities	Yes
Affordable office space	Office space available below market price	Yes
Alumni relationships	Involvement of alumni in support activities	Yes
Business contest	Business plan contest	Yes
Challenge based courses	Courses designed on challenges	No
Collaboration projects with industry	Collaboration projects with industry during study, for experience	Yes
Entrepreneurship in curricula	Entrepreneurship courses in standard curricula	No
Entrepreneurial competence education	Availability of appropriate entrepreneurial courses	No
Entrepreneurship in mission	Entrepreneurship in TU/e mission	No
Events	Appropriate entrepreneurship events (networking, contests, etc.)	Yes
Experimental education center	Availability of experimental education center for entrepreneurship activities	No

Financial incentives	Financial incentives for staff to participate in entrepreneurship	Yes
Financial investing	(Small) financial investments from the TU/e	Yes
graduate with spin-off	Graduation with a spin-off as student	No
incubator	Incubator for entrepreneurship activity	Yes
Integration of valorization	Integrate valorization within research and education on a university-board level	No
IP policy	Clear TU/e IP policy	Yes
Legal support	Availability of appropriate legal support	Yes
Life-long learning	Opportunities at the TU/e for life-long learning	No
Matchmaking between students	Availability of students from other disciplines to start entrepreneurship	No
Mentoring/coaching program	Availability of mentoring program for entrepreneurship activity on campus	Yes
Negotiation process	Clear negotiation process for quid pro quo from students	Yes
Network facilitator	Accessibility of TU/e network for entrepreneurship activities	Yes
Pre-defined entrepreneurship mindset	Adaption of a predefined entrepreneurship mindset on campus	No
Recruitment campaign	University-wide campaigns on entrepreneurship	No
Revenue model	Clear revenue model of how TU/e can benefit from entrepreneurship	Yes
Role models	Availability of role models in entrepreneurship in TU/e staff	No
Selection of first-year students	Entrepreneurship driven selection procedure on first-year students	No
Study-related pressure	Perceived study related pressure by students	No
Success story telling	Story telling on successful entrepreneurship activity on campus	No
University staff competence	Availability of staff experienced in entrepreneurship	Yes
Visibility of entrepreneurship activities	Entrepreneurship activity in a visible setting at the campus	No

Because the systematic literature review conducted for this thesis focused on business model practices of incubators, accelerators, and university support programs, not all of the support measures have been validated. As can be seen from the above table, most of the support measures that are not validated focus on education or the educational process, which was outside the scope of the systematic literature review for this thesis. Furthermore, the systematic literature review yielded four measures that were not included in the original taxonomy by T.G.J. Selten namely, idea testing, entrepreneurship workshops, brand building (linking start-up to university name), and providing temporary staff. After consultation with the thesis client, these support measures were added to the above set of support mechanisms. To create the final list of entrepreneurship support measures for the student questionnaire, the individual measures were assessed on their influence on the start-up entrepreneurial process (see section 2.1.1., Figure 3) and if a business model is necessary to execute the support measures. If a support measure has no (expected) influence on the start-up entrepreneurial process, it is excluded from the student questionnaire. Also, if a support measure does not need a business model to be executed on the TU/e, it is also excluded from the student questionnaire. This means that, for a support measure to be included,

the support measure needs to have an influence on the start-up entrepreneurial process, and be suitable for execution on a business model. Furthermore, to ensure that the questionnaire is not too lengthy and comprehensible for students, some support measures are grouped. All of the above steps were executed in accordance with the thesis client to ensure the relevance of the support measures. Finally, further advancement of a start-up in the entrepreneurial process might lead to different support measures to become more useful. In order to include this in the student questionnaire, the phases of the start-up entrepreneurial process are used in the questionnaire to indicate the growth of the start-up. Also, some support measures that did not meet the before-mentioned criteria of influence on the start-up entrepreneurial process and the suitability for a business model, are still relevant for this study. These measures are included as policy guideline questions for improvement of the entrepreneurial campus climate at the TU/e. The complete list of entrepreneurship support measures that are included in the student questionnaire, and the policy statements based on the original taxonomy, are presented in Table 12 and 14.

Table 13: List of support measures for start-ups, as included in the student questionnaire

Support measure	Description
Access to financing	The TU/e and its partners help you come into contact with possible financiers and facilitate access to grants and funding.
Access to high-tech facilities	Start-ups have the opportunity to use the high-tech facilities at the TU/e.
Entrepreneurship events	The TU/e organizes events such as business contests and matchmaking between entrepreneurial students.
Investments from the TU/e	The TU/e provides (small) financial investments to promising start-ups.
Legal support	The TU/e offers support to start-ups considering legal questions.
Entrepreneurship mentoring/coaching program	Experienced mentors and coaches guide the start-up through the difficult first phases of the start-up process.
Network facilitator	Start-ups have access to the extensive network of the TU/e.
Providing staff	The TU/e provides temporary staff for administrative functions to work for your start-up company.
Idea testing	The TU/e provides you with opportunities to test your business idea, by creating a minimum viable product or lab testing.
Entrepreneurship workshops	E.g. workshops focused on developing entrepreneurial competencies such as leadership, decision making, etc.
Brand building	Start-up companies formed at the TU/e can use the existing brand name of the TU/e to promote their company.

Table 14: Policy statements included in the student questionnaire derived from the taxonomy by Selten

TU/e policy statements
Entrepreneurs should have a special administrative status at the TU/e, comparable to top-class sport.
At the TU/e, it should be possible to graduate with your start-up.
The TU/e should organize a campus-wide recruitment campaign to attract more students to the entrepreneurial path.
Entrepreneurship should be a standard part of every curriculum at the TU/e.

Subsequently to the creation of the questions, the format on how to ask the support measures and policy questions is decided upon. For the support measures, visualized in Table 13, it is important to be able to uncover some form of rank as to what support is deemed more important by participants. This is achieved by presenting all the forms of entrepreneurship support (as seen in Table 13), and allowing students to rank each measure from most important (1) to least important. This way of ranking includes some notion of rank between each measure, but the distance between each point cannot be determined (Phellas et al., 2017). As mentioned earlier, the preferred support may change upon further advancement in the start-up entrepreneurial process. To be able to measure this change in preference over the different stages, the question to rank the support preferences is asked for the four stages of this process. This means that, essentially, the same type of question is asked four times. As one of the risks of a questionnaire is participants quitting because it is too lengthy (Phellas et al. 2017), the participants are asked to rank up to five support measures for each stage. This means losing the ability to measure all the support preferences for each respondent for each stage, but hopefully reducing the number of participants who quit halfway through the questionnaire. Furthermore, the order in which the support measures are presented for each stage is randomized. For the policy statements, see Table 14) the aim is to measure how much each respondent agrees/disagrees with each statement. To be able to do this, multiple-choice Likert-scale questions are created where respondents can select how they feel towards each question. This is done because these types of fixed choice questions can be easily compared to each other as they provide quantitative data (Phellas et al., 2017). These Likert-scale questions are single-item measures since they are not intended to measure the same variable (van Aken et al., 2016). This means they might have a lower representation of the concept they are supposed to measure, compared to a multi-item scale and a higher random measurement error. This makes these measures less reliable (Gliem & Gliem, 2003; Olaniyi, 2019). They do, however, provide a preliminary indication for this thesis regarding the preferences of students for the policy statements.

Validity is for the questionnaire ensured by basing the entrepreneurship support questions and policy statements on prior research on these topics and validating them with the literature review carried out for this thesis. To increase the reliability of the questionnaire, the questions are checked by the thesis' client, and the questionnaire has been tested and reviewed by student researchers (van Aken, Berends, & van der Bij, 2016). This resulted in the correction of spelling and grammar mistakes and some minor changes in the final wording of the questions. Since the questionnaire is created in a web-based format, there is no control over who participates in the questionnaire. Therefore, questions are added at the beginning of the questionnaire to assess some general information about each participant. The online questionnaire is created with the software from Qualtrics. Qualtrics is a software tool used for quantitative data collection and analysis. The complete list of questions (with answers from the respondents) can be seen in appendix 5.

Data analysis: The questionnaire analysis is done by first gathering all the data from the respondents. Not all respondents finished the questionnaire in its entirety and some responses were empty. This meant that not all responses could be included in the analysis. Only respondents who finished the whole questionnaire are included in the analysis, this is because the respondents who did not complete the entire questionnaire all skipped the questions regarding entrepreneurship support. Second, the respondents are divided into two groups. The first group are non-entrepreneurs, these are students who

participated in entrepreneurial courses or teams related to TU/e courses, but do not participate in their own start-up. The second group are entrepreneurs, these are students who participate in their own start-up. This distinction is made because it is assumed that the answers from the non-entrepreneur group are based on their expectations of participating in the start-up entrepreneurial process since they are not currently working in their own start-up. The entrepreneur group answers are more based on experience with the start-up entrepreneurial process since they are currently participating in this process. Separating these groups means it is possible to research if these groups have different options and preferences regarding entrepreneurship support. An overview of all the questionnaire questions with answers and calculations can be seen in Appendix 5.

The final analysis of the questionnaire is done with Microsoft Excel and SPSS. The questions considering the desirability of entrepreneurship support are analyzed in Microsoft Excel. For each stage of the start-up entrepreneurship process, participants could rank up to five support measures on their desirability, with position 1 meaning most desirable for that stage. To analyze the score for each support measure, the ranking is inversed so the first position got the highest score. These inversed results are subsequently summed to get the total score for each measure. The results can be interpreted as the support measure with the highest score can be seen as the most desirable for each stage. The policy statements are asked on a seven-point Likert-scale. Descriptive statistics are used to measure what the respondents think about the policy statements. Using a Likert-scale leads to ordinal data, which means that the mean is meaningless. Therefore, the median and interquartile range are calculated for each statement with the help of SPSS. For these questions, the median is used as an indication of the attitude towards each policy statement. For each support measure, the trend over the different stages of the start-up entrepreneurial process is also visualized, these can be seen in Appendix 6.

It is difficult to assess how the 24 entrepreneurial students who participated in the questionnaire relate to the size of the entire population, as the size of this population is not known and it is difficult to assess. Furthermore, the respondents are a product of convenience sampling which in general leads to results that are less generalizable for the entire population (Kitto, Chesters, & Grbich, 2008). Given the various constraints for this thesis that limit the possibilities to research this topic, this thesis aimed to ensure the questionnaire is based on conceptual clarity and proper documentation of the research process. This is aided by creating the questions based on prior research, which is triangulated with findings from an extensive literature review. Also, the final format of the questions has been discussed and reviewed by the thesis client. Furthermore, the final questionnaire has been tested and evaluated by two independent student researchers and subsequently improved. This improves the quality of the questionnaire and makes the results of this analysis useful for this thesis, as the results can be used to design a practice-oriented solution towards the selected company problem.

3. What is the gap between the student opinions and preferences and the existing support at the TU/e?

Objective: The objective of this sub-research question is to find what the gap is between the support for start-ups the TU/e offers right now and the most popular support according to student opinions. This will become the input for the solution design.

Input: The input for this sub-research question are the results of the first and second sub-research questions. From the first research question, this is a list of the support for student start-ups the TU/e currently offers and the corresponding business models (in the form of a BMC) that show how this support is realized. From the second research question, these are the results of the student questionnaire, the preferences of the entrepreneurial students on the support measures for start-up and the policy statements.

Data analysis: Based on the input from the previous questions, the gap between the existing offer and the preferences from entrepreneurial students is analyzed. This is done by researching the top three most

desirable support measures for each stage for both the non-entrepreneur group and the entrepreneur group. This is subsequently compared with the available support, researched during the interviews. The support that has a high ranking (in the top three) and is currently not available at the TU/e. becomes a possible candidate for further analysis in the solution design step.

3.2.4 Solution design

The final sub-research question (*"what are possible design solutions to fill the identified gap in start-up support, when synthesizing theoretical and practical findings?"*) will be answered during the solution design step. The design is based on an abductive approach, guided by the design inputs. These are the problem contexts, the systematic literature review, and the results of the empirical analysis. For the solution design, design requirements are defined. These requirements set the demands that the designed solution has to meet and guide the abductive design process. The design requirements can be divided into four categories:

1. *Functional requirements*, these are the core requirements in the form performance demands the designed solution has to meet;
2. *User requirements*, these are specific requirements created from the viewpoint of the user;
3. *Boundary conditions*, these set the borders of the design space for the solution, and have to be met unconditionally;
4. *Design restrictions*, these comprise the preferred solution space by the projects' principal. (van Aken et al., 2016)

As the design is judged on pragmatic validity, the design will be created in accordance with this thesis's main client and will be aligned to fit within the strategy of the TU/e. furthermore, the design step will also take into account what projects that stimulate student entrepreneurship are already present at the TU/e.

Intervention and learning & evaluation

The last two steps of the problem-solving cycle are intervention and learning & evaluation. Due to time constraints, these steps are not part of this thesis. The aim of this thesis is to create a solution for the clients' business problem. However, some suggestions and guidelines for the implementation of the solution design discussed in the design.

3.2.5 Conclusion & discussion

The last step of the reflective redesign process is the conclusion & discussion. Here, the main research question of this thesis is answered and discussed. Also, as part of the reflective redesign process, a reflection of the theoretical implications of this thesis is presented. Specific guidelines for improvements at the TU/e will also be presented. As with all studies, this study is not without limitations. These will be discussed together with possible future research directions.

3.3 Quality of research

During the research design and the execution, multiple steps were taken to ensure the quality of this research. This section describes the measures in this study that were taken to enhance the quality of the empirical analysis and the solution design. Controllability, reliability, and validity are taken into account, together with the main client recognizing the results.

To ensure controllability the research steps and execution are documented in this thesis. This methodology describes the steps that are taken to execute this study. Also, questions used in the interviews and the student questionnaire are included in this thesis. Furthermore, the methods used to select the respondents are described. This detailed description helps to judge the reliability and validity of this thesis (van Aken et al., 2016).To increase the level of reliability for this thesis, multiple strategies are used. First, the interview questions, the code-schemes for the interviews and applied coding, and the student questionnaire were reviewed by another independent researcher. This increases the level of

integrity for both instruments. Furthermore, part of the interviews were standardized (semi-structured interviews) for all respondents, allowing for comparison of the answers. Second, triangulation is used, as multiple sources of data (online sources, interviews, and questionnaire) are combined in the empirical analysis. One of the limitations of this study the limited amount of people interviewed for the analysis which might affect the correctness and completeness of the information. Third, several measures were taken to increase the validity of this study. Measuring instruments and interview questions were evaluated by an independent researcher (the TU/e supervisor of this thesis and student researchers). Furthermore, this thesis uses a systematic approach as the basis of the research steps and the analysis. The systematic approach is grounded in existing theory for problem-solving projects. Because this research is carried out within a context-specific environment, in a single case study, this research is limited in its external validity. Convenience sampling is used to select the respondents for the questionnaire. This can lead to lower generalizability (Kitto et al., 2008). Furthermore, the sample of students who participated in the questionnaire is rather small which can lead to sample bias. Efforts have been taken to limit this bias by including some personal questions at the beginning of the questionnaire and to increase the response to the questionnaire. Finally, this research is carried out while keeping the main client and the project's principal continuously informed. This ensures that the results of this thesis are recognized by the client organization. The final judgment of the quality for this thesis is the practical solution for the company's problem.

3.3 Deliverables

The final goal of this thesis is to help the TU/e in creating and delivering support for start-ups based on feedback from entrepreneurial students. Since this thesis uses a business model perspective, the business models of highly relevant support will be created using the concept of BMC. The deliverables of this theses are summarized below:

1. An overview of the support for start-ups the TU/e currently offered, based on the value offering from STARTUP/eindhoven and TU/e Innovation Space. This is combined with a qualitative analysis of the business model practices used to deliver this support;
2. A quantitative analysis of the opinions from entrepreneurial students on support for the creation of start-ups and TU/e policies;
3. An analysis of the gaps that can be identified based on the support the TU/e currently offers and the desired support based on student opinions;
4. A solution design that uses a business model perspective and focuses on how the TU/e can create and deliver highly relevant support based on the gap in the previous analysis.

4. Empirical analysis

This chapter describes the empirical analysis of data collected for this study. First, the analysis of the interviews conducted to research what kind of support is available for students at the TU/e alongside the business models used to deliver this support is described. Second, the results of the student questionnaire on what support is the most desirable according to entrepreneurial students are described and elaborated upon. Lastly, this section researches the gaps between the available support at the TU/e and the desired support according to students.

4.1. Interviews

This section describes the available support at the TU/e, combining the findings from the interviews and research of available policy documents from the TU/e. First, the main goals and focus of STARTUPeindhoven and TU/e Innovation Space are elaborated upon, together with a visualization of the business model that is used in these organizations. Second, the support that is questioned in the student questionnaire (see Table 13 in methodology) is described supplemented with support that is available at the TU/e but not questioned in the student questionnaire.

4.1.1. Business models

The business models of STARTUPeindhoven and TU/e Innovation Space are elaborated upon, together with the main goas and focus of each organization. This is done to gain more insights into the workings of each organization and how the available support for start-ups is delivered. Also, the business models serve as a framework in which potential design solutions can be inserted. Furthermore, this gives the available support some context connecting to the perspective of each organization. First, STARTUPeindhoven is elaborated upon, followed by TU/e Innovation Space.

STARTUPeindhoven

STARTUPeindhoven can be seen as the business incubator at the TU/e. It is a vehicle and a community that supports students with their entrepreneurial activities (STARTUP/eindhoven, 2019). The main aim is business development and to support students in such a way they can get a soft landing in the market. This is done by providing basic facilities, coaching, and a large network that can help to start and grow a business (STARTUP/eindhoven, 2019).

"We start at point zero, and I support the start-ups with the difficult first steps by holding up a mirror" (van Huiden S. , 2019)

STARTUPeindhoven accepts students with a business idea, they not necessarily need a business registration. There is no linear process in the business development and it greatly depends on the time and effort the start-ups are willing to put in. The support focusses on breaking through typical entrepreneurship barriers and the creation of a business plan. Furthermore, STARTUPeindhoven functions as the mediator between its network and the startups, to leverage this to the benefit of the startups (STARTUP/eindhoven, 2019). The business model of STARTUP eindhoven is visualized using the BMC and can be seen in Appendix 3. Currently, as can be seen from the business model, STARTUPeindhoven does not generate any revenue and the services of STARTUPeindhoven are free of charge. STARTUPeindhoven has indicated that would be positive to identify and/or incorporate forms of revenue that can be generated from the start-ups, especially if the support from STARTUPeindhoven is very significant.

"I think that, if we offer a significant amount of support, it is logical the start-ups offer something in return so we can cover some of the costs" (van Huiden S. , 2019)

TU/e Innovation Space

The focus of TU/e Innovation Space is on innovating education. Student teams work out societal and company issues, in co-operation with companies. This is done to promote interdisciplinary hands-on

education, engineering design and entrepreneurship (TU/e Innovation Space , 2019). TU/e Innovation Space supports these teams in this process.

"In essence, we are an institute that innovates education, we let teams work on societal questions in partnership with private companies and coach the iterative process of developing a solution" (Teeuwen, 2019)

Students enter with their own business idea or by joining an existing team. Through a thorough analysis of the company's problem or their own business case, the teams develop possible solutions and a prototype. TU/e Innovation Space has the facilities to design and develop a prototype. Various duties and challenges exist as milestones to guide the teams through this process. The end-stage for a team is the commercialization phase when the team develops a recurring revenue stream. The main focus of TU/e Innovation Space is on education and interdisciplinary learning (TU/e Innovation Space , 2019). The business model of TU/e Innovation Space is visualized using the BMC and can be seen in Appendix 3. Just as STARTUPeindhoven, TU/e Innovation Space currently generates no revenue from the student teams/start-ups and would be open to explore possibilities to start doing this. One condition is that it cannot put off teams from joining. Furthermore, because TU/e Innovation Space is already focusing on education, they have indicated an interest in exploring the options of generating revenue from educating businesses. This would mean providing small courses or certificate courses to company employees who need to refresh or catch up on their knowledge. Currently, TU/e innovation space is not offering this option.

4.1.2. Available support at TU/e

As can be seen in the previous section, STARTUPeindhoven focusses more on business development and the creation of a business plan, while TU/e Innovation Space focusses more on education and interdisciplinary learning. Both organizations do provide various types of support beneficial for start-ups on the TU/e campus. The support that is available at the TU/e, from each of the organizations or otherwise, is discussed here. First, all the individual support measures that are questioned in the questionnaire are discussed, followed by support measures that are not questioned in the questionnaire. For an overview of the questionnaire questions see Table 13 in the previous chapter.

1. Access to financing ~ available at TU/e

Access to financing is available on the TU/e in the form of facilitating the contact between the start-ups and potential financiers and supporting with the requests for subsidies. Both STARTUPeindhoven and TU/e Innovation Space offer this support. STARTUPeindhoven has various contacts that can provide financing for start-ups in their network, both private companies, and government institutions. Both organizations help start-ups with the application process for various subsidies. Usually, STARTUPeindhoven and TU/e Innovation Space are included as partners in these requests.

"STARTUPeindhoven is included in the requests for subsidies for the start-ups as one of the partners" (Interviews TU/e, 2019)

2. Access to high-tech facilities ~ available at TU/e

Start-ups have access to the high-tech facilities at the TU/e. TU/e Innovation space has its own facilities that can be used to develop a prototype. Experienced technical personnel is also available to help design and develop prototypes and to operate the machinery. The prototypes' IP developed within TU/e Innovation Space is owned by the team/start-up.

"We have everything you need to develop a prototype, including technical staff that really thinks along with you" (Interviews TU/e, 2019)

3. Entrepreneurship events ~ available at TU/e

The TU/e, STARTUPeindhoven, and TU/e Innovation space organize and/or participate in various entrepreneurial events. TU/e Innovation Space various events such as networking events, workshops, matchmaking between students, drinks. STARTUPeindhoven organizes guest lectures in the Technology Entrepreneurship course and judges in entrepreneurship events, pitches and awards. Furthermore, STARTUPeindhoven organizes the EU venture program for the TU/e. This is a summer boot camp for startups in which multiple start-ups from different universities participate.

"The EU venture program is kind of a boot camp for start-ups in which twenty start-ups participate and learn from each other" (Interviews TU/e, 2019)

4. Investments from the TU/e ~ sporadically available at TU/e

Investments from the TU/e into start-ups do happen sporadically. Both STARTUPeindhoven and TU/e Innovation Space indicate that this has happened before. There is, however, no formal process to realize this and it happens ad hoc.

"There have been constructions were the TU/e made some investments in exchange for stocks, but this does not happen often" (Interviews TU/e, 2019)

According to STARTUPeindhoven, it could be beneficial to formalize this process in order to be able to provide start-ups with different forms of financing provided that certain criteria are met.

5. Legal support ~ not available at TU/e

On the TU/e campus, legal support is currently lacking. Both STARTUPeindhoven and TU/e Innovation Space have knowledge and experience that is available from the coaches, but no in-house expert for legal advice. TU/e Innovation Space organizes general workshops around this topic and may sometimes use partners for legal advice but indicated this support is insufficient.

"We offer some lectures on legal topics, but those are insufficient, ideally we would have external experts to help us with that" (Interviews TU/e, 2019)

6. Entrepreneurship mentoring/coaching program ~ available at TU/e

Both STARTUPeindhoven and TU/e Innovation Space offer a mentoring/coaching program, as both organizations assign a coach to each start-up. The main aim for the coach at STARTUPeindhoven is to support the start-up with breaking through typical entrepreneurship barriers and the creation of a business plan. For TU/e Innovation Space the aim is to guide the start-ups through difficult first steps of the entrepreneurial process and typical pitfalls. Also, the teams and start-ups might help each other.

"We have several experienced coaches, and the advice they can give to the teams is very valuable" (Interviews TU/e, 2019)

7. Network facilitator ~ available at TU/e

Both STARTUPeindhoven and TU/e Innovation Space act as a network facilitator for start-ups. Start-ups may use the network of the TU/e, STARTUPeindhoven and/or TU/e Innovation Space, and sometimes the personal network of the coaches. Both organizations mediate in the contact between the start-up and the different actors in the network. TU/e Innovation Space indicated they are also able to make quick connections within the TU/e because of their prominent presence.

"There is a lot of knowledge available at befriended organizations, we mediate in the contact between the start-up and the external partners" (Interviews TU/e, 2019)

8. Providing Staff ~ not available at the TU/e

Both STARTUPeindhoven and TU/e Innovation Space gave no mention of providing (temporary) staff for start-ups.

9. Idea testing ~ available at TU/e

TU/e Innovation space has the facilities and technical staff to create a minimum viable product/prototype and test this, the developed applications are owned by the student teams. Furthermore, TU/e Innovation Space organizes events to discuss business ideas with like-minded students.

10. Entrepreneurship workshops ~ available at TU/e

TU/e Innovating Space organizes its own workshop on various entrepreneurial topics, workshops can also be tailored to the needs of the teams. Sometimes field experts are invited to organize/host the workshops.

11. Brand building~ available at TU/e

STARTUPeindhoven stimulates the use of the TU/e and the STARTUPeindhoven name for the start-ups. This is also used as free advertisement for STARTUPeindhoven and the TU/e.

"Doing something in return can also include start-ups referring to us in the media" (Interviews TU/e, 2019)

According to STARTUPeindhoven, there is still support missing at the TU/e, as there is no office space and/or dedicated space provided for start-ups on the TU/e campus. Student teams may work in the various working spaces that are provided throughout the campus, but there is no space that is specifically dedicated to and has the facilities for start-ups. Also, there is no formal process to obtain financing from the TU/e. Such a process should be in place according to STARTUPeindhoven. According to TU/e Innovation Space, the opportunities for the development of 'soft skills' (for example leadership or personal development) is still insufficient at the TU/e. The support for start-ups that is discussed is visualized in Table 15.

Table 15: Available support at TU/e

Support	**TU/e Innovation Space**	**STARTUPeindhoven**
Based on research by Selten (2018) & literature review	Available yes/no	
Access to financing	Yes	Yes
Access to high-tech facilities	Yes	No
Entrepreneurship events	Yes	Yes
Investments from the TU/e	Sporadically	Sporadically
Legal support	No	No
Entrepreneurship mentoring/coaching program	Yes	Yes
Network facilitator	Yes	Yes
Providing Staff	No	No
Idea testing	Yes	No
Entrepreneurship workshops	Yes	No
Brand building	No	Yes
Discussed during interviews		
Office Space	No	
Development of soft skills	Insufficient	

4.2. Questionnaire

The student questionnaire is created to research the opinions of entrepreneurial students on what entrepreneurship support measures are the most popular. As mentioned in section 3.2.3, the student questionnaire is based on previous research by Selten (2018) supplemented with research from the systematic literature review for this thesis. Subsequently, the questionnaire is created using survey software from Qualtrics. The finished questionnaire is shared with entrepreneurial students from the TU/e. This section describes the analysis and the results of the student questionnaire.

4.2.1. Questionnaire results

In total, 24 students participated in the questionnaire. The questionnaire distinguishes between entrepreneurial students, students who have followed one or more entrepreneurship courses, and entrepreneurs, students who have their own startup or are working in a student team not related to any TU/e course. From the 24 students who participated in the questionnaire, 15 belong to the non-entrepreneurs group, and 9 to the entrepreneurs. Although efforts have been taken to increase the number of respondents, the final group remains rather small. This means the results have the be interpreted with some caution, as they might not be representative of the entire group of entrepreneurial students at the TU/e. They do, however, provide a preliminary indication of the support preferences from this group.

Non-entrepreneur group

The non-entrepreneur group consists of 15 students. All students in this group are male, and the average age is 23. 60% of students in this group are bachelor students, and 40% are master students. All of the master students in this group come from the Innovation Management program, which is also the program that is the most represented in this group. A large portion of this group, around 90% of the cases, participated in one or more entrepreneurial courses at the TU/e, with the USE Technology Entrepreneurship course being the most popular. An overview of the group characteristics is visualized in Table 16.

Entrepreneur group

The entrepreneur group consists of 9 students. In this group, 30% of students is female and the average age is 24. 56% of the students is a bachelor student, followed by 30% master students and 14% indicating they followed another type of education. For this group, the TU/e program that is the most represented is also the Innovation Management program. Only 75% of students in this group participated in one or more entrepreneurial courses at the TU/e, with the USE Technology entrepreneurship course being the most popular. An overview of the group characteristics is visualized in Table 16.

Table 16: Overview of group characteristics

	Non-entrepreneur	Entrepreneur
Number of respondents	15	9
% Female	0%	30%
Average age	23	24
Bachelor/Master/Other student	40%/60%/0%	56%/30%/14%
Top 3 most represented education programs	Innovation Management Industrial Engineering Psychology & Technology	Innovation Management Other education programs equally represented
% of students who participated in one or more entrepreneurial courses	90%	75%
% of students who have family members that are entrepreneurs	56%	60%

Entrepreneurship support

In the questionnaire, entrepreneurial students ranked up to five support measures, with the first position meaning the most desirable one for that stage. To get an overview of the entrepreneurship support, as ranked on the desirability by students, the total score is given for each support measure in Table 17. To calculate the rank of each support measure, the total score for each measure has been calculated. In order to be able to compare the larger non-entrepreneur group with the smaller entrepreneur group, each total score is subsequently divided by the maximum score possible for a support measure for each group.

Table 17: Total scores of each support measure

Support	Non-entrepreneurs		Entrepreneurs		Both groups	
	Percentage of max score	Group rank	Percentage of max score	Group rank	Average	Rank
Access to financing	0.41	2	0.26	6	0.35	2
Access to high-tech facilities	0.20	8	0.12	11	0.17	9
Entrepreneurship events	0.25	6	0.33	3	0.28	7
Investments from the TU/e	0.19	9	0.19	9	0.19	8
Legal support	0.31	3	0.31	5	0.31	3
Entrepreneurship mentoring/coaching program	0.31	4	0.26	6	0.29	5
Network facilitator	0.50	1	0.41	1	0.47	1
Providing staff	0.12	10	0.17	10	0.14	10
Idea testing	0.23	7	0.37	2	0.28	6
Entrepreneurship workshops	0.07	11	0.20	8	0.12	11
Brand building	0.29	5	0.32	4	0.30	4

As can be seen from the above Table, the non-entrepreneur students gave the highest score to network facilitator, followed by access to financing and legal support. The entrepreneur group gave the highest score to the same support measure as the non-entrepreneurs, namely network facilitator. The numbers two and three differ from the non-entrepreneurs, as the entrepreneur group ranked idea testing and entrepreneurship events second and third. It is important to notice that for both groups network facilitator has the highest overall score. This indicates that, according to the opinions in both groups, this support measure has the highest impact on the steps of the start-up entrepreneurial process. The

lowest scores are given by non-entrepreneurs to entrepreneurship workshops, providing staff, and investments from the TU/e. The entrepreneurs gave the lowest scores to access to high-tech facilities, providing staff, and investments from the TU/e. Providing staff and investments from the TU/e get a consistent low overall score from both groups.

Because both groups are small, especially the entrepreneur group, it is not feasible to say something about the variations in scores between the two groups. The average score of both groups can be used as an indicator for the TU/e on what support measures are ranked as overall important based on student opinions and which are ranked as least important. It is, however, important to realize that there might be differences in preferences between the two groups that are statistically significant. As mentioned before, the entrepreneur group has experience with the start-up entrepreneurial process. It is therefore expected that they rank the support based on experience instead of expectation. This could mean that this group is a better indicator of which support is important. As can be seen from Table 17. the highest scores, averaging the two groups, are given to network facilitator, access to financing, and legal support. The high score of these three support measures indicates that it is important for the TU/e to commit time and resources to these support measures, as they have a beneficial impact on the steps and activities in the start-up entrepreneurial process according to students. The lowest scores, averaging the two groups, are given to entrepreneurship workshops, providing staff, and access to high-tech facilities. This means that, according to students, they have the smallest positive contribution to the steps in the start-up entrepreneurial process. This does not necessarily mean the TU/e should no longer commit to these measures, as the low score does not mean these measures are not important, but that other measures are more important.

Although Table 17 provides a clear overview of the total scores of each support measure given by students, it has a few shortcomings. First, it does not take into account the different phases of the start-up entrepreneurial process. This means the table does not indicate in which phase each support measure is the most desirable according to the opinions from students. Second, some support measures score high in certain phases and low in other phases. This means they might have a lower score and rank in the table because these are the total scores over all the phases of the start-up entrepreneurial process. Some measures could therefore seem less important overall, while they might have a large impact according to students in certain phases. To combat these issues, the support per phase of the start-up entrepreneurial process is visualized in the next section.

Entrepreneurship support per stage of the start-up entrepreneurial process

This section describes the results of the entrepreneurship support ranked by TU/e students per stage of the start-up entrepreneurial process (see Figure 3). The results of the first stage of this process, the definition stage, are visualized in Figure 8.

As can be seen from Figure 8, the support with the highest rank for the non-entrepreneur group is mentoring/coaching followed by network facilitator and idea testing. For the entrepreneur group, idea testing got the highest score followed by entrepreneurship events and entrepreneurship workshops on a shared second place and mentoring/coaching in third place. Idea testing and mentoring/coaching are in the top 3 of both groups, meaning they have

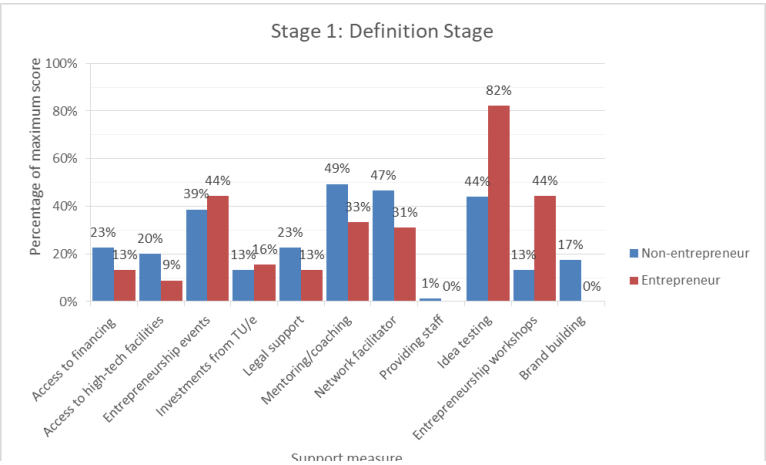

Figure 8: the support in the definition stage

a high positive contribution to the definition stage of the start-up entrepreneurial process, according to students. The second stage, the validation stage, is visualized in Figure 9.

As can be seen from Figure 9. The non-entrepreneurs ranked idea testing as most important in this stage, followed by access to high tech facilities and network facilitator. The entrepreneur group ranked idea testing as highest, followed by network facilitator and entrepreneurship events. Idea testing and network facilitator and ranked high by both groups, indicating they might have a high contribution to this stage.

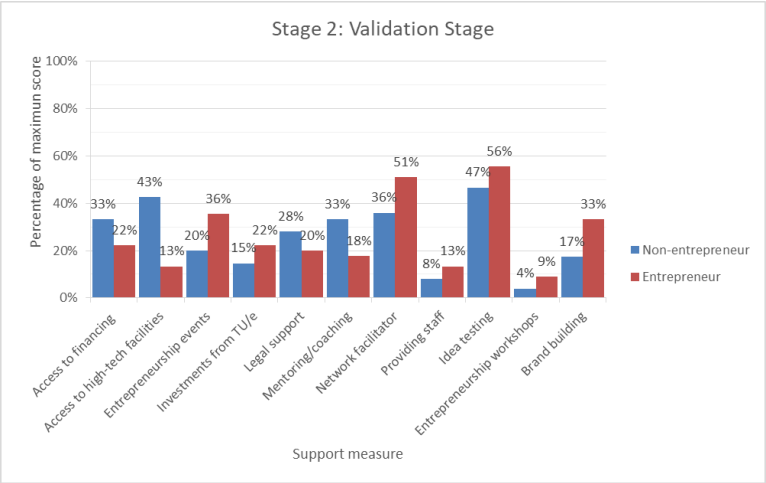

Figure 9: The support in the validation stage

Network facilitator and idea testing are high in both groups and both stages. Furthermore, the non-entrepreneur group scored entrepreneurship events high in both stages. These support measures can be seen as having an important positive impact on the beginning stages of the start-up entrepreneurial process according to students. The third stage of the start-up entrepreneurial process is visualized in Figure 10.

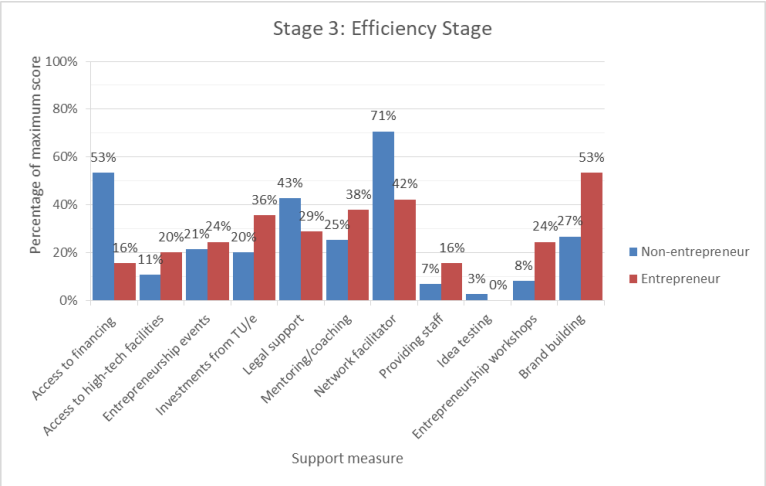

Figure 10: The support in the efficiency stage

From Figure 10. it can be seen that the non-entrepreneur group ranked network facilitator as highest. This is followed by access to financing and legal support. For the entrepreneur group, the top three are brand building, network facilitator, and mentoring/coaching respectively. In this stage, only network facilitator is ranked high by both groups. The last stage of the start-up entrepreneurial process is visualized in Figure 11.

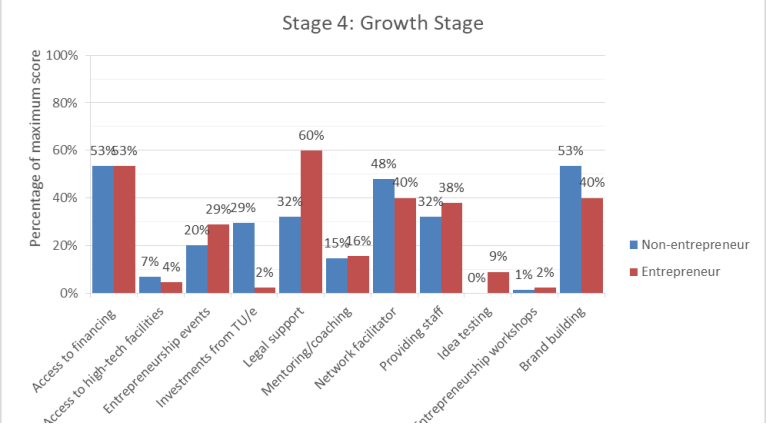

Figure 11: The support in the growth stage

From this Figure, it can be seen that the non-entrepreneur group ranked brand building and access to financing highest, followed by network facilitator and legal support and providing staff on a shared third place. For the entrepreneur group, legal support is ranked highest, followed by access to financing and network facilitator and brand building on a shared third place. Both groups ranked access to financing, legal support, brand

building, and network facilitator as important contributors to the steps in the start-up entrepreneurial process.

Just as in the first stages, network facilitator is ranked high by both groups over the last two stages. Overall this support measure can be considered as having the most important positive contribution to the whole start-up entrepreneurial process. Otherwise important support measures for the last two stages are legal support, access to financing brand building, as they are all ranked highly in the last two stages.

From the figures visualizing the popularity of the support per phase (Figure 8,9,10, and 11), some other things stand out. First, non-entrepreneurs consistently rank entrepreneurship workshops lower than the entrepreneur group, this is visualized Figure 12. Especially in the first stage, the difference is high. Because both groups are small, it is not possible to test if this difference is statistically significant. Second, non-entrepreneurs rank access to financing higher than the entrepreneur group, see Figure 13. It is, again, not possible to test if this difference is statistically significant. Third, if the scores of the overall Table (Table 17) are compared to the popularity of support per stage, it can be noticed that providing staff gradually becomes more important as the stages of the start-up entrepreneurial process progress, see Figure 14. This support measure scored second to last when looking at the overall scores. Also, idea testing scored in the middle of the overall table (Table 17) but, as can be seen in Figure 15 idea testing is ranked among one of the most important support measures in the first two stages. A visualization of the trend over the stages of the start-up entrepreneurial process for each support measure is visualized in Appendix 6.

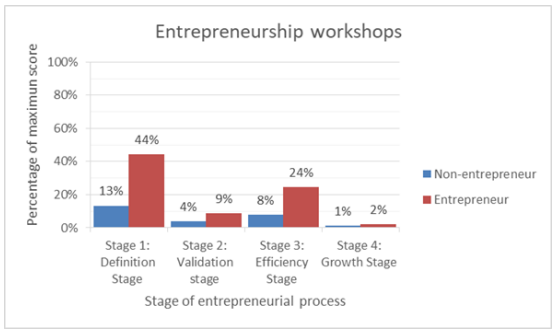

Figure 12: Entrepreneurship workshops trend over the stages

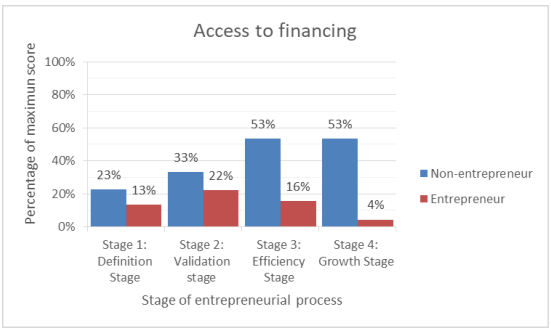

Figure 13:Access to financing trend over the stages

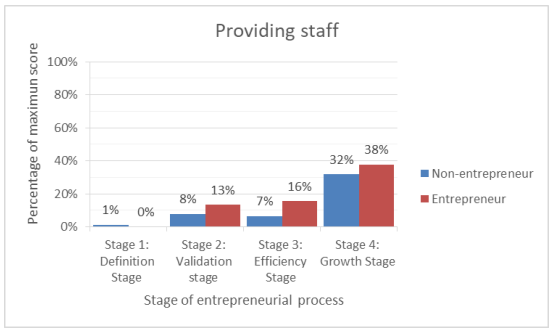

Figure 14: Providing staff trend over the stages

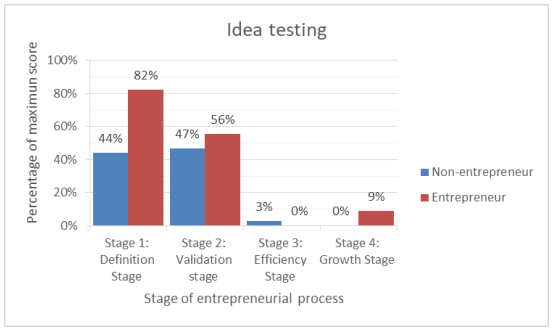

Figure 15: Idea testing trend over the stages

Lastly, the student questionnaire asked students some questions about policies that consider entrepreneurship at the TU/e, see methodology Table 14. The answers are given on a seven-point Likert scale, and the results can be seen in Table 18.

Table 18: Answers to the policy statements

Question	Non-entrepreneur (N=15)	Entrepreneur (N=9)
1) Entrepreneurs should have a special administrative status at the TU/e, comparable to top-class sport	Median=3 (somewhat agree) IQR=2	Median=2 (agree) IQR=4
2) At the TU/e, it should be possible to graduate with your start-up	Median=2 (agree) IQR=2	Median=1 (strongly agree) IQR=4
3) The TU/e should organize a campus-wide recruitment campaign to attract more students to the entrepreneurial path	Median=3 (somewhat agree) IQR=2	Median=3 (somewhat agree) IQR=2
4) Entrepreneurship should be a standard part of every curriculum at the TU/e	Median=4 (neither agree/disagree) IQR=3	Median=5 (somewhat disagree) IQR=2

1) Strongly agree 2) Agree 3) Somewhat agree 4) Neither agree/disagree) 5) Somewhat disagree 6) Disagree 7) Strongly disagree
IQR= interquartile range

As can be seen from the above Table, the median and interquartile range for each statement is visualized. The first statement, *'entrepreneurs should have a special administrative status at the TU/e, comparable to top-class sport'* got generally positive responses from both groups. The entrepreneur group has a large interquartile range (of 4) meaning the answers are more diverse compared to the answers of the non-entrepreneur group (with an interquartile range of 2). The second statement *'at the TU/e, it should be possible to graduate with your start-up'* got the strongest positive results of all the policy questions. For this statement, the interquartile range of the entrepreneur group is again larger than for the non-entrepreneurs. The median response for the statement *'the TU/e should organize a campus-wide recruitment campaign to attract more students to the entrepreneurial path'* is lightly positive. The last statement *'entrepreneurship should be a standard part of every curriculum at the TU/e'* got a neutral to negative response from students. Based on student opinions this would be de least desirable policy measure for the TU/e to implement. Currently, none of the questioned policy statements are a standard policy of the TU/e.

The results of the questionnaire have to be interpreted with some caution since convenience sampling is used to gather the respondents. Furthermore, although it is not known how the number of 24 respondents relates to the size of the entire population, it is assumed it this is just a small section of the population. Therefore, the results of the questionnaire might have a lower generalizability to the entire population. Also, the decision has been made to focus on entrepreneurial students. The results, therefore, might not be representative of the opinions of the general students at the TU/e. For this thesis, however, they provide enough practice-based evidence to provide some preliminary results on what support measures are important according to entrepreneurial students and can be used to develop a practical solution for the company's business problem.

4.3. The gap in available entrepreneurship support at the TU/e

To analyze the gap between the available support at the TU/e and the support that is the most desirable according to the opinion of entrepreneurial students, Table 19 is created. This table visualizes the support with the highest ranking (top 3) by students compared to the availability of support measures.

Table 19: Gap in available support based on top 3 highest rank from the questionnaire for each group

	Stage 1: Definition stage	Stage 2: Validation stage	Stage 3: Efficiency stage	Stage 4: Growth stage
Non-entrepreneur	Mentoring/coaching	Idea testing	Network facilitator	Access to financing & brand building
	Network facilitator	Access to high tech facilities	Access to financing	Network facilitator
	Idea testing	Network facilitator	Legal support	Legal support & providing staff
Entrepreneur	Idea testing	Idea testing	Brand building	Legal support
	Entrepreneurship events & Entrepreneurship workshops	Network facilitator	Network facilitator	Access to financing
	Mentoring/coaching	Entrepreneurship events	Investments from TU/e	Providing staff

Red indicates support measures is not available at the TU/e
Orange indicates support measure is sometimes available, but no formal process

As can be seen from Table 19, the TU/e already offers a lot of support that is important according to students. For the first two stages of the start-up entrepreneurial process, there are no gaps. The gaps in support occur for the last two stages of this process, namely legal support, providing staff, and investments from the TU/e. Although STARTUPeindhoven and TU/e Innovation Space both have some knowledge on legal matters from the coaches, and TU/e Innovation Space arranges workshops on this topic, there is no expert available at the TU/e for legal issues. From the analysis of the overall scores, visualized in section 4.1.2 Table 17, legal support obtained high overall support, indicating entrepreneurial students think this is an important contributor to the start-up entrepreneurial process. Providing (temporary) staff is not available at the TU/e, as there is currently no organization that offers this to start-ups. This is in line with the comment from STARTUPeindhoven that there is also no official office space available on the TU/e, although the importance of this is not questioned in the student questionnaire. Investments from the TU/e do sometimes occur but this happens sporadically and there is no formalized process. According to STARTUPeindhoven, such a process should be in place to make it possible for start-ups to obtain financing form the TU/e in certain situations.

The student questionnaire also questioned the popularity of certain policy-related statements, see section 4.2.2. Table 18. The statements *'Entrepreneurs should have a special administrative status at the TU/e, comparable to top-class sport'* and *'At the TU/e, it should be possible to graduate with your start-up'* both got positive reactions from students. Currently, these practices are not a standard policy of the TU/e, but the opinions from students indicate that there is a desire from these students to make this standard policy. Lastly, TU/e Innovation Space remarked that the development of 'soft skills' (for example leadership or personal development) is insufficient, and could negatively impact the ability of students to create and manage a start-up. Because this statement is subjective and not further researched in this thesis, it is left out of the support that is missing at the TU/e. An overview of the gaps in the available support for start-ups is visualized in Table 20. An 'X' indicates that this support measure is discussed in that type of analysis.

Table 20: Missing support at the TU/e

Missing support	Based on		
	Interviews	Student questionnaire	Gap analysis
Legal support	X		X
Providing staff			X
Investments from TU/e	X		X
Special administrative status for entrepreneurs comparable to top-class sport		X	X
Graduation with start-up		X	X
Office space	X		X

As became apparent after the interviews TU/e Innovation Space focuses more on the first two stages of the start-up entrepreneurial process (focus more on education), and STARTUPeindhoven focusses more on the last two stages (focus more on entrepreneurship and growth). Furthermore, STARTUPeindhoven indicated that, in an ideal flow of students and start-ups, these groups would exit after finishing the first stages at TU/e Innovation space and continue their process with STARTUPeindhoven. As can be seen from the visualization of available support, see Table 15, STARTUPeindhoven and TU/e Innovation Space offer some of the same support. It is not in the scope of this thesis to research if the support measures that are offered in both organizations are beneficial to the start-up entrepreneurial process, and should be offered by both TU/e Innovation Space and STARTUPeindhoven. However, the student questionnaire indicates that some support is more valuable according to students in begin stages and some in the end stages (see the trends of the support over the stages of the start-up entrepreneurial process in Appendix 6.). From a recourse based perspective, it could therefore be worthwhile to further investigate if the support that is offered by both organizations should be offered by both organizations. Furthermore, the trends in support over the stages of the start-up entrepreneurial process could also help as an indicator for policymakers to which organization newly created support measures could best go.

4.4. Conclusions empirical analysis

In general, most of the support measures questioned in the student questionnaire are available at the TU/e. The overall most important support measure, according to students, is network facilitator. Currently, both STARTUPeindhoven and TU/e Innovation Space offer this support. It is important to notice that the desirability of each support measure varies greatly over the different stages of the start-up entrepreneurial process, and it is therefore beneficial to research each stage separately. Furthermore, the results from the student questionnaire serve as a preliminary indication that non-entrepreneurs and entrepreneurs may think differently about what support is the most desirable in which stage of the start-up process.

Based on the empirical analysis for this thesis, it can be concluded that the TU/e is better equipped to handle the first half of the start-up entrepreneurial process, compared to the last steps of this process as there is some support considered important according to students that is missing in the last two stages. Support with a high desirability according to students that is currently missing at the TU/e is legal support, providing staff, and investments from the TU/e. furthermore, based on the student questionnaire, students stand positive in creating a special administrative status for entrepreneurs at the TU/e and allowing students to graduate with their start-up. These results can form the basis of improving the support that is available for entrepreneurs at the TU/e and help indicate which support measure is most desirable, according to students, at each stage of the start-up process. Furthermore, the results of the interviews indicated that, currently, both STARTUPeindhoven and TU/e Innovation Space do not generate any recurring form of revenue, apart from granted subsidies. Both organizations indicated that it could be worthwhile to research revenue options to implement in the future.

5. Solution design

In this chapter, the solution for the organization's problem will be presented and elaborated upon. First, the design requirements are discussed and synthesized with the conclusions from the empirical analysis. In section 5.2 two alternative design directions are discussed. This is followed by a further elaboration of one of these design directions in section 5.3 Lastly, the design is tested and improved in section 5.4.

5.1 Design specifications and requirements

The main aim of this thesis is to solve the organization's business problem. The problem statement for this thesis is: *"The Eindhoven University of Technology does not reach its full potential regarding the number of start-ups created, and lacks insights on how to better support students with an entrepreneurial intent".* This design aims as a preliminary exploration of a new support measure and how it can be created at the TU/e, as an addition to the existing support that is available. This might increase the number of TU/e start-ups that become successful, increasing the start-up potential at the TU/e. In order to gain insights on how to better support students with an entrepreneurial intent, entrepreneurial students have been questioned on their support preferences in the empirical analysis. Subsequently, a gap analysis provided a list of support measures that are currently not existing at the TU/e, but are desirable according to entrepreneurial students. Throughout this thesis, and also for the design, a business model perceptive is adopted. This is done to offer a shared language and a concrete tool to foster dialogue and promote common understanding. Furthermore, this perspective places the customer, in this case the students, at the center of the proposed solution (Osterwalder & Pigneur, 2010), which is in line with the problem statement. Using a business model perspective also expands the focus to not only what should be done, but also including how it can be done.

To be able to design a solution, design requirements are created. The required performance demands of the design are indicated by the functional requirements. User requirements are requirements from the users of the design. Boundary conditions are conditions the solution design must meet unconditionally. Lastly, design restrictions sketch the design space of the solution (van Aken, Berends, & van der Bij, 2016). For this design, the requirements are established based on deductive reasoning based on knowledge from the organization, the problem statement, and the empirical analysis. The user of the design will be the TU/e, as the proposed design will clarify how the new support measure can be realized. The design requirements are presented in Table 21 and indicate the desired requirements for the solution design on the four different levels.

Table 21: Design requirements

Functional requirements	
1	The realization of the design should help the TU/e identify key elements of the business model that are important considerations for the implementation of the selected support measure
2	The design should focus on what resources are necessary and elaborate on important considerations to provide insights on 'how' the selected support measure can be realized
3	The design should include mechanisms to generate revenue
4	The design should be an activity system, specifying the content, structure, and governance of a Business Model Canvas
User requirements	
5	The design should be user-friendly (for TU/e employers and students)
6	The design should make use, where possible, of existing support measures and infrastructure available at the TU/e
Boundary conditions	
7	The system should comply with the legal requirements of a university
8	The system should fit with the present company culture
9	The design should also include revenue mechanisms that minimize the financial burden for start-ups
Design restrictions	
10	The solution should change as little as possible in the current system
11	Both start-ups from STARTUPeindhoven & Innovation space should be able to use the solution

5.2. Design directions and alternatives

In this paragraph, two alternative designs are briefly presented and compared with each other. First, the creation of the design alternatives and the problems they intend to solve are elaborated upon. Second, the design alternatives are briefly discussed. Third, a choice is made for one of these alternatives.

The empirical analysis revealed what type of entrepreneurship support is desired by entrepreneurial students but nonexistent or underrepresented at the TU/e. The support chosen for the design is *investments from the TU/e*. During the interviews, it was mentioned by both STARTUPeindhoven and TU/e Innovation Space that investments to start-ups from the TU/e did happen in the past. There is, however no formal process on how this is done, and it happens in an ad hoc manner. Both organizations indicated that it would be worthwhile to research this topic and to formalize the process. Also, the entrepreneurial students in the questionnaire indicated that investments from the TU/e could be an important support measure to the start-up process. However, investments from the TU/e is not the support that is missing with the highest-ranked desirability from students. Besides the endorsement of this support measure mentioned in the interviews, the choice for this support measure is motivated by a pragmatic one. First, there is literature on this topic available to research best practices on how this is realized at other universities, aiding in the creation of the design. Second, the creation of this design coincided with the availability of venture capitalists, who were able to provide their expert opinion on the matter and give insights on how start-ups should leave the TU/e in order to be attractive for private capital.

There is some academic literature that indicates the relevance of universities providing financing to start-ups. Usually, start-ups are characterized by a high level of uncertainty and information asymmetry (Widding, Mathisen, & Madsen, 2009). Uncertainty comes from start-ups that are operating in untried markets with new technologies, with the number of possible outcomes and the probability for each outcome unknown (Widding et al. 2009). Information asymmetry creates further challenges. First, the start-up usually does not what to give too much information about the concept, as this is the base for their competitive advantage (Widding et al., 2009). There is also no historical information available for the investor to base a decision on (Oforegbunam Thaddeus, 2011). Furthermore, the start-up has

information the possible investors lack, this could lead to opportunistic behavior from the start-up and could limit the ability to monitor the start-up from an investor's perspective (Widding et al., 2009). This usually leads to private investors waiting to invest until the start-up reaches the later stages of development, creating a funding gap for start-ups (Wright, Lockett, Clarysse, & Binks, 2006). Furthermore, this information asymmetry might also diminish the possibilities for debt financing (bank loans) (Davila, Foster, & Gupta, 2003). Universities can take an active role in bridging this funding gap, by creating innovative financial and incubating instruments. These instruments can provide the capital necessary for a start-up to work on their prove of concept and convert the levels of uncertainty into risk, making them more interesting for investments from the private sector (Munari, Pasquini, & Toschi, 2015; Widding et al., 2009). These types of funding might also provide a credible signal to potential investors about the quality of the start-up, enabling the start-up to differentiate itself from their counterparts (Davila et al., 2003).

Universities providing financial investments to start-ups and the financial instruments that can be leveraged to do this is a relatively under-researched topic in the academic literature (Munari, Pasquini, & Toschi, 2015). There are, however, some best practices available at other universities. In order to research how this is done, and to be able to create two design alternatives, the current literature and best practices at universities in Europe and the United Stated are researched.

To bridge the funding gap, university seed funds can be created. These funds can be seen as early-stage capital, specifically provided for university start-ups. The aim of these funds is to promote technology transfer and aid the commercialization of university knowledge and research (Munari et al., 2015). One of the first examples of such a fund in Europe is the University Challenge Fund program in the United Kingdom. The fund specifically aimed to foster an entrepreneurial spirit and to provide universities, the fund is not owned by a specific university, with the funding to take the results of research projects into the commercial world. Initial findings on the impact of this fund are positive compared with a matched control sample (Munari et al., 2015). Another example is Chalmers University in Sweden which established Innovationskapitaal in 1999, this fund is partly owned by the university (Munari et al., 2015). Munari et al. (2005) researched the impact and characteristics of university-oriented seed funds in Europe. Their analysis shows that these funds are highly heterogeneous and highlights several important dimensions. Fist, a distinction can be made between funds that are internally managed by the university and funds that are externally managed by national or regional agencies. Funds that are internally managed typically provide the capital injections for the fund, these can be complemented by other types of funding most frequently from public sources. Usually, internally managed funds are associated with a single university. Externally managed funds may include the university as financially involved limited partner. The research shows that Internally managed funds usually invest with a co-investor while this is less likely to be the case for externally managed funds. Furthermore, externally managed funds are statistically larger in fund size (Munari et al., 2015). Second, the size of the fund and the type of funding. In Europe, university seed funds can be, on average, characterized by a small initial size. Internally managed funds usually have an even smaller scale. In most cases, equity investments are used to invest in start-ups. Sometimes hybrid forms of investments such as a mix of grants, loans, and equity investments are used (Munari et al., 2015). Lastly, an important dimension for the distinction between seed investment funds is the investment strategy. University seed funds can choose to invest only in start-ups that use technology generated by the university and/or start-ups that are generated by the university. Or they can expand this by also investing in other types of new ventures. Their research shows that start-ups backed by seed funding from the seed capital fund are less likely to experience a plosive exit through public offering or trade sale. However, they do better in involving external investors and attracting follow-up investments. This shows that a university seed fund can act as a catalyst in encouraging follow-up investments (Munari et al., 2015). In a study done by Widding et al. (2009), the researchers propose that a university-affiliated venture capital fund can overcome the before mentioned funding gap. According to the researchers, these funds should be considered as an alternative to effectuate start-up performance and the frequency (Widding, Mathisen, & Madsen, 2009).

Although the name venture capital is used in the research, the funds are specifically aimed to provide the capital necessary to prepare a prototype and conduct a thorough market research in order to reduce the risk and uncertainty, and thus bridge the funding gap. In their research, they developed recommendations based on an analysis of best practices. First, the establishment of these funds should address and correct specific market value, in this case the funding gap. Second, there should not be a focus on short-term profit maximization. Third, the initiative should establish and maintain a close link to private investors. Lastly, managing a capital fund can be costly, especially if high skilled management is necessary (Widding et al., 2009).

Based on the assessment of the literature, two design alternatives are created. To be able to do this, the available literature on this topic is considered, especially the dimensions researched by Munari et al. (2005) and best practices mentioned by Widding et al. (2009) and different considerations are made for each of the designs.

Design alternative 1. Venture capital fund

To overcome the risk and uncertainty typically associated with start-ups and to bridge the funding gap, the TU/e could create a venture capital investment fund. This fund would be managed by the TU/e as a separate organization with its own management. The aim of this fund is to provide start-ups with the necessary capital injection to develop prototypes, proof-of-concept, and conduct a thorough market analysis (Munari et al., 2015; Widding et al., 2009). The fund is intended not only for TU/e students, but may also invest in other types of new ventures (Munari et al., 2015). This design would mostly use traditional types of financing, such as equity investments (Munari et al., 2015). The management of this fund should maintain close links to private investors. This fund is intended to have a larger size and be less dependent on co-financiers. This design alternative would research how a venture capital fund could be created and operated within the context of the TU/e.

Design alternative 2. Seed investments

Another option to overcome the before mentioned risk and uncertainty, and to be able to bridge the funding gap, is for the TU/e to provide start-ups with seed investments. This fund would be internally managed by the TU/e and makes use of the existing infrastructure and management that is already available. This fund is only intended for TU/e start-ups and aimed to aide these start-ups in developing prototypes, proof-of-concept, and conduct a thorough market analysis (Munari et al., 2015; Widding et al., 2009). The fund is intended to be smaller in size and to make use of co-investors where possible to promote the establishment of bridging structures (Munari et al., 2015). Furthermore, traditional types of financing (such as equity investment), as well as alternative forms of financing (grants, loans, labor) can be used in this design (Munari et al., 2015). The main focus of the seed investments is to act counter-cyclically and to help create start-ups that are more interesting for private investors in a later stage (Luukkonen, 2010). This design alternative would research how these seed investments could be created and operated within the context of the TU/e.

The alternative designs are assessed based on the match with the design requirements. Both design alternatives could be designed in such a way as to match the functional requirements. For the user requirements, there is no match with design alternative 1. Because the fund would be managed by the TU/e as a separate organization with separate management, it is not possible to include existing support measures and infrastructure into this design. For the boundary conditions, there is also no match with design alternative 1. This design would only include the more traditional forms of financing, and therefore revenue-generating mechanisms, so it would place a financial burden on start-ups. Furthermore, the design restrictions can also not be matched to design alternative 1. Creating a venture capital fund would change a lot in the current systems in place at the TU/e. Taking into account the design requirements, design alternative 2 is preferred over design alternative 1. This design alternative can comply with all the requirements. Furthermore, design alternative 2 could be the first step in order

to create a separate internal venture capital fund, as the smaller seed investments could potentially grow to larger venture capital investments once proven successful.

5.3 Design artifact

At the TU/e there are already possibilities to develop a business idea, conduct a preliminary market research, and to develop a prototype. These are all free of charge for students. This means, for most cases, the definition stage of the start-up entrepreneurial process can be completed at the TU/e without any investments. Funding typically becomes a hurdle in the second stage, the validation stage, of the start-up entrepreneurial process. During this stage, the start-ups must develop a minimum viable product/proof-of-concept, conduct a thorough market research and test this market, and create entrepreneurial commitment from its team. The aim of seed investments is to provide the financial room necessary to perform these activities as they are usually more expensive and cannot always be performed within the TU/e context. The steps taken in this stage typically decrease the initial levels of uncertainty and information asymmetry, as the start-up gathers more evidence of the feasibility of the business case. If a start-up successfully finalizes this stage, they become more attractive for private investors (Widding et al., 2009). Ofcourse the stages of the start-up entrepreneurial process do not have well-defined boundaries. This means the seed investments could also help the start-up to perform tasks typically mentioned in the latter stages of this process. This design focuses on how the TU/e can make seed investments available for start-ups, by defining an activity system in which this can be performed. First, the content of the activity system is defined, using the elements of the BMC. Second, the structure of this business model is explained by linking the various elements. Lastly, the governance of the business model is elaborated upon.

5.3.1 Business model

This section elaborates on the proposed business model for the solution design. The elements of the BMC are used to describe the activity system. The completion of these elements is based on the literature review and empirical analysis for this thesis, specific literature, and a guest lecture and interview with venture capitalists.

Value proposition

The value proposition is making seed investments available for start-ups at the TU/e. Seed investments are usually characterized as relatively small investments with a high risk (Businessideaslab, 2019). The aim of this investment is to decrease the start-up's uncertainty and information asymmetry so the start-up might become more interesting for private and institutional investors in a later stage (Widding et al., 2009). Also, the investment can be used to further develop university technologies and promote their commercialization potential (Munar et al., 2015). Although primarily intended as investments, the TU/e could also use other forms to make this money available for start-ups, see the description in the revenue streams. This is because the main aim for the TU/e should not be maximizing financial returns, but to enhance the entrepreneurial climate at the university, stimulating knowledge transfer, and being able to contribute to local development (Munari et al., 2015). There are several things to consider when making these seed investments available for start-ups. First, milestones the start-up wants/has to reach should be determined. The provided capital would be intended for these predetermined milestones. These milestones could be, among others, successful idea test/proof-of-concept, the development of a business model with tested assumptions, conducting a thorough market analysis, or developing the value chain (Luukkonen, 2010; Widding et al., 2009). Second, the TU/e should offer coaching to the start-ups who receive the investment (Whitehead, 2003). For the TU/e this coaching could come from the existing network and coaches available at STARTUPeindhoven and TU/e Innovation Space. The primary aim of the coaches is to guide the start-ups through further development of the business, reaching the predetermined milestones. The coaching could include, for example, meetings every other week with the members of the start-up and the coach. During these meetings, the progress can be discussed. Also, the coach could use the network available from the TU/e, or his personal network, to bring the start-up

in contact with various experts who could contribute to the start-up. Finally, although seed investments are characterized by a relatively small invested amount, the maximum amount that may be invested is to be determined and outside the scope of this thesis.

Customer segments

The customer segment of the seed investments are start-ups from students at the TU/e. It is advisable that the seed investments go to a variation of start-ups, instead of targeting a specific sector or technology. Although coaching might become more difficult because there is no room for specialization, this variation increases the deal flow, by providing a broader selection of possible start-ups for further development (Luukkonen, 2010). The potential start-ups should already have a preliminary business case since they can participate in the steps of the first stage of the start-up entrepreneurial process with the existing support that is available for students at the TU/e free of charge. An important criterion should be that the start-up experiences a funding gap to go further develop their business idea and that all the support options and resources the TU/e has available for free are exploited (Widding et al., 2009). Further considerations could be the exploitation of IP that stems from prior research at the university or other types of TU/e knowledge valorization. Also, the quality of the research that is already conducted should be an important parameter in the selection process (Munari et al., 2015). Furthermore, private investors usually assess the start-up on problem-product-market fit, the development of the value chain that is necessary to deliver the product/value, proposed business model and financial model, and the team composition (Williams, 2019). Although the start-up might not have worked out all the details of these concepts, the preliminary research that is carried out on these concepts should be considered in selecting the most promising start-up. In their research, Gartner, Frid & Alexander (2010) propose that start-ups who have a business registration are also more likely to attract funding (Gartner, Frid, & Alexander, 2010). Some specific selection criteria and considerations might be dependent on the type of start-up and its team and are outside the scope of this thesis.

Channels

The channels that can be used to reach the stat-ups are the traditional communication channels. A webpage could be created to initiate the first contact between the start-up and the committee that is responsible for allocating the seed investments. Further contact could happen through emails or personal meetings. When an investment has been granted, the contact becomes more personal, as the start-up receives coaching and monitoring to help them obtain certain (pre-determined) milestones.

Customer relationships

The initial contact has to be requested by the start-up. A problem within the TU/e is that students and employees often do not know what kind of support is available (Hulscher, 2019). This could lead to start-ups missing out on this support measure. In order to combat this issue, the informal atmosphere and short communication lines specific to the TU/e can be used. A lot of start-ups are concentrated within the network of STARTUPeindhoven and TU/e Innovation Space. If these organizations are sufficiently informed, and possibly even included in this process, the chances of a start-up missing out on this support measure might decline (Hulscher, 2019). The start-up has to pitch their existing concept/business idea and exchange the research that has already been undertaken to further this idea. A ballot committee can then assess the situation and determine if and how much funding the start-up receives. Together with the start-up, the ballot committee can also agree on which milestones should be reached with the received investment and agree on the conditions on which the money is invested in the start-up. This will lead to a contract specifying the amount of financing and the milestones that the start-up is indented to use the financing for. Subsequently, the TU/e should maintain direct contact with the start-up and its business operations and provide a mentor/coach. This is done in order to strengthen the business idea and the business plan. A key investment criterion should be that significant milestones have to be reached by the start-up when spending the seed investment, in order to make follow-up

investments easier to obtain (Whitehead, 2003). The personal coaching of these start-ups can be seen as value-added services and may provide start-ups with advice and capabilities to enhance their competitive advantage (Luukkonen, 2010).

Revenue streams

As mentioned earlier, it is recommended not to focus on profit maximization (Widding et al., 2009). There are, however, ways to generate revenue since the seed capital is a form of investment. Firstly, the most common mechanism used to invest in start-ups by universities is equity investment (Munari et al., 2015). This means the TU/e receives shares of the start-up based on the amount that is invested. Hybrid forms are also possible, in which case there is a mix of seed grants and investments (Munari et al., 2015). The downside of these types of investments is that the start-up gives up parts of his autonomy to manage the start-up to the university in exchange for the investment. Founders of the start-up might not want this, and it might be the case the university does not have the proper knowledge to manage this responsibility or uses this management involvement for the wrong objectives. For example, extracting value for the university instead of growing the start-up (Williams, 2019). Furthermore, private investors might see these forms of investments as a dilution of ownership. This might diminish the desirability of the start-up for these investors as they have to share the management responsibility with more organizations (Williams, 2019). In order to overcome this issue, the seed investment could be provided in the form of a loan to the start-up (Munari et al., 2015). This way, the TU/e can still provide the stat-up with the capital to further develop without diluting the ownership of the company. A convertible loan would also be an option (Hulscher, 2019). In this case, the loan gets converted into equity, usually during later investment rounds. Second, if the start-up uses IP from the TU/e, licensing could also be an option to generate revenues (Luukkonen, 2010). Although licensing on its own does not provide the start-up with seed capital, the TU/e could provide this to ensure further development. The licensing agreement could be created in such a way that (parts of the) investment are recouped during the licensing period. A downside of this option is that this might also make the start-up less attractive for private investors, as the IP is still owned by the university and can therefore not be sold to recoup their investment (Williams, 2019). In order to combat this issue, the IP could be sold to the start-up or licensed in such a way the start-up gains ownership over the IP after several years. Third, alternatively students working in the start-up could also be placed in companies in the form of internships. Revenues can be generated from the payments these companies make to the TU/e for the work of the students. These companies can be entrepreneurial firms, in which the student can develop entrepreneurial skills and gain insights that could help them with their start-up. For the companies, these internships provide enthusiastic students who sometimes can come up with surprising solutions to business problems. These companies could also support students with the development of their business case up (Soundarajan, Camp, Lee, Ramnath, & Weide, 2016; Wijnker, van Kasteren, & Romijn, 2015). TU/e Innovation Space already has connections with several companies, and their network could be used to source these places and to match the students with the company (Teeuwen, 2019). Lastly, the students could participate in sponsored research. Sponsored research is a contract between a university and a firm, it supports research that is commissioned by the firm or government. The university receives funding for the research projects and usually provides the infrastructure, (graduate) students, and support from faculty staff. Sometimes, consultancy agreements between universities and companies exist. The university-industry collaboration can provide a significant source of income, as well as entrepreneurial opportunities for faculty members and staff (Baglieri, Baldi, & Tucci, 2018; Bercovitz & Feldmann, 2006; Broome, Bowersox, & Relf, 2018). For the TU/e placing students to gain experience and work in companies and/or engaging in sponsored research could be specifically interesting. These options do not place a heavy financial burden on the start-ups one of the design requirements, and the TU/e could still recoup, parts of, the investment. This is also a way to alleviate the risks for the TU/e associated with these investments, as many start-ups might not reach a stage of profitability and/or are able to pay the seed investment back (Munari et al., 2015). Lastly, the seed capital provided by the TU/e could be in the form of a grand. In terms of revenue, this is the least desirable option, as there is no way to recoup

the capital for the TU/e. However, this might comply with other goals of the TU/e such as the valorization of knowledge or enhance the entrepreneurial climate (Munari et al., 2015). Also, the students of these start-ups might be deployed for presentations or events at the TU/e possible inspiring new start-ups and promote the university as a prerequisite for the grant (Hulscher, 2019). Intangible revenues for the TU/e can also come from investing in start-ups. Successful start-ups could benefit the TU/e in potential assignments for new research and reinforced cooperation, or invest time for presentations at the university or coaching of potential new start-ups (Hulscher, 2019). For all the revenue-generating mechanisms, the exact conditions and requirements have to be determined for each case and are outside the scope of this thesis.

Key activities

The key activities follow form the first half of the business model. An important activity is the screening of the start-up's business idea and deciding if and how much funding is allocated to the start-up. Furthermore, the milestones for which the money is indented have to be agreed upon. The coach/mentor assigned to the start-up has the track the process of the start-up considering these milestones while performing mentoring activities.

Key resources

A key resource for the design is capital that is available for seed investments. On average, the funds available in Europe are characterized by a small initial size (Munari et al., 2015). How the TU/e makes the financial resources available for these investments is outside the scope of this thesis. Furthermore, in order to determine the milestones and to guide the start-up through this process, knowledge of start-up activities and the steps of the start-up entrepreneurial process is necessary.

Key partnerships

Some universities only invest in start-ups if they are able to find a co-financier. This is a successful strategy if a strong entrepreneurial infrastructure in present and universities have the ability to use well-developed social networks to select the best entrepreneurial projects and possible financiers (Widding et al., 2009). Possible co-financiers could be government funds, angel investors, and sometimes, nut not usually, venture capital firms (Munari et al., 2015; Whitehead, 2003; Widding et al., 2009). Because seed investments are characterized as relatively small investments, finding a co-financier would not be necessary for all the projects. For some projects, the TU/e already guides start-up with subsidy requests, with the university as one of the applicants. It is advisable the TU/e uses the networks and knowledge of the existing partners in the region as much as possible (Williams, 2019). One way to achieve this is through co-financing. Possible partners for the TU/e in the region are Brightmove that helps start-ups by providing financing and knowledge, Brainport Eindhoven that has experience in obtaining finance for start-ups, Brabant Startup Fonds who specifically aim to bridge the mentioned funding gap and has experience in attracting other financiers, and the Business Angels Netwerken Nederland, that represents over 5000 business angels in the Netherlands. STARTUPeindhoven already has connections with Brightmove, Brainport Eindhoven and the Brabant Startup Fonds. Also, the alumni network of the TU/e could be used to attract possible co-investors (Hulscher, 2019). The best match for the TU/e and the start-up depends on the type of start-up and technology (Williams, 2019). By partnering with these organizations for the investments, the TU/e can promote the creation of bridging structures, create a higher diversity in the start-ups, and come into contact with professionals who can also be of value to the various start-ups (Munari, Pasquini, & Toschi, 2015). A last option could be that the TU/e decides not to invest, but directs the start-up to suitable financiers in the network in order to obtain financing there (Hulscher, 2019).

Costs

There are various costs that come from operating the business model. Some of the start-ups and innovations they are developing might fail during the start-up process. This means the investment in (partially) lost. Luukkonen (2010) stresses the importance of letting non-viable candidates die, as keeping them alive can be seen as failing to support other start-ups with success potential. He argues that the selection of promising start-ups is just as important as the creation of diversity and variation between them (Luukkonen, 2010). It requires long-term commitment until tangible effects of providing seed capital are realized, and programs should not be abandoned too quickly (Luukkonen, 2010). Based on initial failures and successes the program should be fine-tuned and improved. Apart from the uncertainty which might cause lost investments, other costs come from the salaries of the personnel operating in the system.

The proposed business model for seed investments from the TU/e is visualized in Figure 16.

<table>
<tr><th>Key partners</th><th>Key activities</th><th>Value proposition</th><th>Customer relationships</th><th>Customer segments</th></tr>
<tr><td rowspan="2">Co-financiers
- Angel investors
- Government funds
- Venture capital firms</td><td>- Screening of business ideas, approval/disproval
- deciding on milestones
- mentoring activities and progress tracking</td><td rowspan="2">- Seed financing for promising start-ups
- mentoring/coaching (on idea testing/proof-of-concept, development of business model, and market analysis)
- focus on quality of research and increase in experience to enhance the entrepreneurial climate</td><td>- On demand (start-up has to request)
- Ballot committee (approve investment & determine milestones
- Personal relation with coach/mentor
-Contractual</td><td rowspan="2">Start-ups that have
- A business case
- (Almost) finished the first stage of the start-up entrepreneurial process
- Need financing to develop idea in the following stages</td></tr>
<tr><td>Key resources
- Seed capital
- Knowledge on entrepreneurship process and activities</td><td>Channels
- Traditional communication (webpage/mail)
- Face-to-face</td></tr>
<tr><th colspan="3">Cost structure</th><th colspan="2">Revenue</th></tr>
<tr><td colspan="3">- Uncertainty (lost investments, letting non-viable candidates die)
- Personnel (time spend on screening ideas/mentoring progress)</td><td colspan="2">- Equity in company
- Loan
- IP licensing, royalties (only if IP is applicable)
- Student placement in companies
- Sponsored research
- Grant (intangible benefits)</td></tr>
</table>

Figure 16: Business model seed investments

5.3.2 Business model structure

This section describes the structure of the activity system, by describing how the aspects of the developed BMC are linked and the sequencing between them (Zott & Amit, 2010). In order to do this, a process flow has been created. To reduce the complexity of the process flow, the option to include possible include co-financiers has been left of the scheme. The process flow is visualized in Figure 17. The actors mentioned in the process flow are elaborated upon in the next paragraph (section 5.3.3).

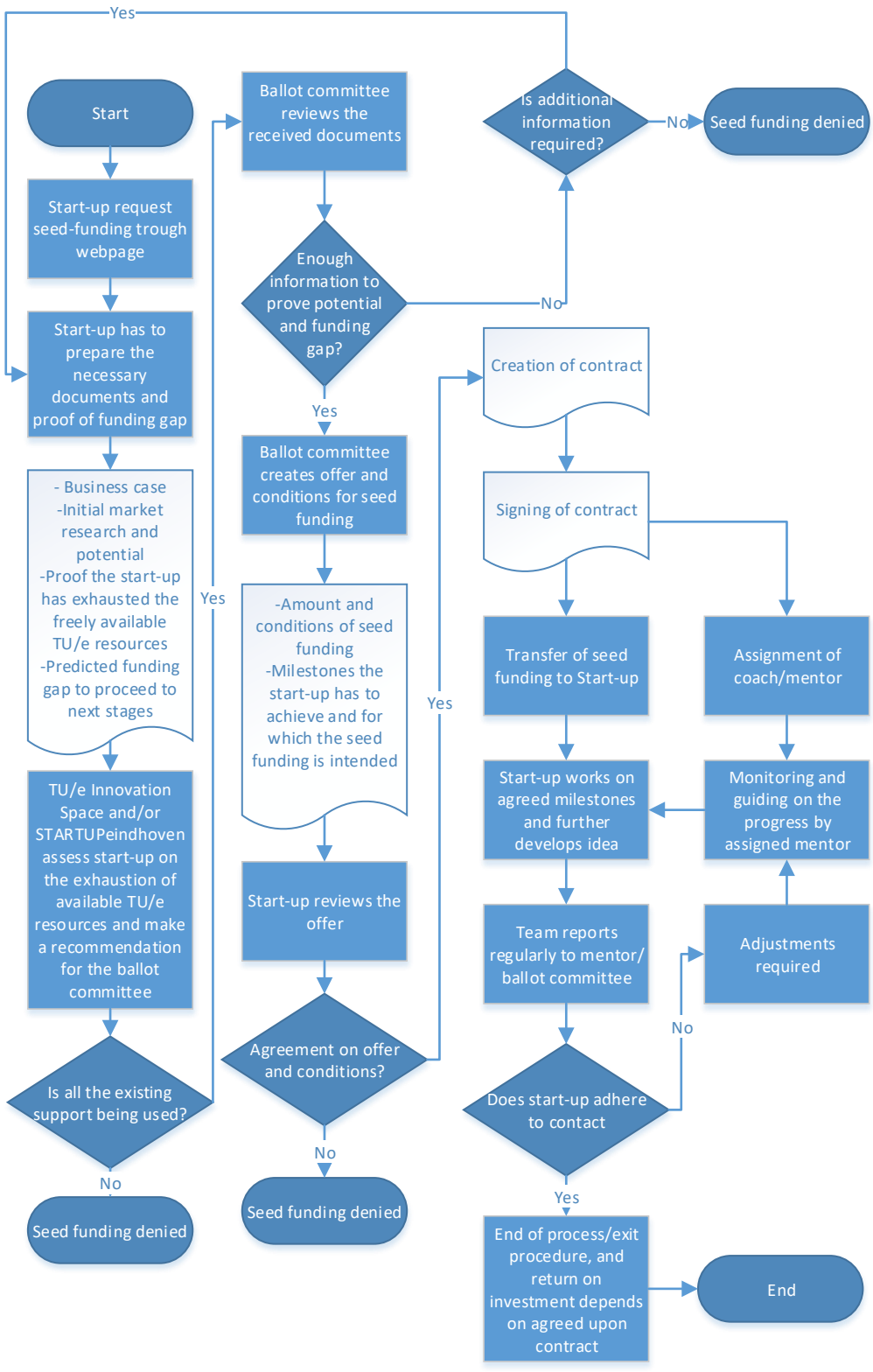

Figure 17: The design process flow

The process begins with a request from the start-up. This can be done through a specific webpage on the TU/e website. Subsequently, the start-up has to prepare and send in the documents that show the potential of the business idea, and demonstrate that the start-up needs capital in order to further develop the idea. TU/e Innovation Space and/or STARTUPeindhoven assess the start-up by comparing the development needs of the start-up with the available support on the TU/e. If the start-up has exhausted

all the support that is available for free, the start-up can progress in the application process and a recommendation is written for the ballot committee Both TU/e Innovation Space and STARTUPeindhoven are suited for this, based on their knowledge of the existing support at the TU/e and their close connection to the start-ups (van Huiden S. I., 2020). The ballot committee receives the information form the start-up and the assessment from TU/e Innovation Space and STARTUPeindhoven and may request additional information necessary to form a decision on the potential of the start-up. Based on the information, the ballot committee decides if the TU/e wants to invest, the amount of seed capital the TU/e wants to invest, and the conditions for investment. An important aspect of this is that the ballot committee decides on what progress they would like to see in the start-up, and for which milestones the investment is intended. It is advisable to keep negotiations to a minimum and to use predetermined conditions for each start-up. This way the university prevents students/start-ups from feeling they have been treated unfairly (van Huiden S. I., 2020). In the end, the start-up can decide to sign the contract, and receive the seed funding, or not to sign.

If the contract is signed, the start-up gets a coach/mentor assigned. The aim of this coach is to guide the start-up through the stages of the start-up process and the agreed milestones and to check on the progress. The coach/mentor can demand adjustments if the start-up does not fulfill their end of the signed contract. When and how this process ends depends on the terms and conditions in the contract. How and when the start-ups pays back the seed investment or other measures that are taken to create revenues from this investment are also dependent on the contract. This thesis included various options for this, but the selection of the revenue mechanisms is outside the scope of this thesis.

5.3.3 Business model governance

The governance of the business model is clarified by describing who performs which activities (Zott & Amit, 2010). In order to change as little as possible to the current systems at the TU/e, the governance of the model makes use of existing sub-organizations within the university. These are suggestions based on the existing literature and a creative leap for this design, the final selection of who performs which activity is outside the scope of this thesis.

Overall responsibility for seed investments

In order to oversee the investments made by the TU/e and to monitor the process in which this is done, the overall responsibility of this system needs to be allocated. The role of this responsibility would include the final say in the contracts, and the decision to include experts to the ballot committee. Also, this authority should focus on maintaining the long-term goals of the program, which are bridging the funding gap between idea and private investors, and the, intangible, benefits from this system for the TU/e. Currently, there are a lot of changes happening at the TU/e considering the role and responsibilities of organizations (Hulscher, 2019). It is therefore, at the moment of writing, difficult to assign this role to a specific part of the organization. Future developments have to indicate which organization of the TU/e would be best suited for this responsibility. Currently, (financial) contracts between start-ups and the TU/e are processed and managed by the TU/e holding (Hulscher, 2019). Parts of the responsibility for this system could potentially be attributed to this holding. Furthermore, the technology transfer office of the TU/e, TU/e Innovation Lab, could potentially take (parts of) the responsibility for this process. TU/e innovation lab has previous experience with contracts and the commercialization of TU/e technologies to the market (van Huiden S. I., 2020; TU/e Innovation Lab, 2019).

Ballot committee

The ballot committee has to make the decision to allocate seed capital to a start-up and under which conditions. The available literature reveals little about this selection process and the exact workings. Two main selection approaches are: focusing on the idea/technology or focusing on the strength of the team (Hirte et al., 2017). Important tasks for the ballot committee for the TU/e would be to assess the

potential of the start-up, to determine which milestones and key steps are required for the start-up to reach the next stage, and to decide on the amount and form of investment. This has to be formalized in the form of a contract.

In order to assess the potential of a start-up, experienced entrepreneurs and/or investors are required to make the correct decision. Furthermore, this committee should include legal and financial counsel to create the contract and determine the right terms and conditions. Also, the entrepreneurial expertise and knowledge on the existing support at the TU/e, available from STARTUPeindhoven and TU/e Innovation Space could be used to assess if a start-up as made use of all the freely available resources at the university. They could also potentially help, together with TU/e Innovation Lab, to find co-financiers from their extensive network (van Huiden S., 2019; Hulscher, 2019; Teeuwen, 2019). It is important to notice that, although STARTUPeindhoven and TU/e Innovation Space might participate in the assessment of the start-up in regards to the available support, they are not included in the ballot committee and/or the creation of the contract (van Huiden S. I., 2020; Hulscher, 2019). This is because they are often also personally involved in the coaching of the start-up.

Coach/mentor

The coach/mentor has the responsibility to guide the start-up through the stages of the start-up entrepreneurial process while monitoring the progress on the predetermined milestones the start-up has to achieve. Another important aspect of the coach is to check if the start-up adheres to the agreed-upon terms and conditions of the seed funding, and to steer the start-up in this direction when this is not the case. The coaches for this system could come from STARTUPeindhoven and TU/e Innovation Space, since both already have qualified coaches/mentors in their organization. This would mean that the system can use the already existing coaching network available at the TU/e and does not have to hire new personnel. It is important to notice that the coach/mentor should not be involved in contractual assignments. This to prevent the, appearance, of conflict of interests (van Huiden S. I., 2020; Hulscher, 2019).

5.4 Design test – user evaluation

To test the design, a user evaluation is proposed. The aim of this evaluation is to discuss if the design meets the design requirements and if fits within the specific culture and structure of the TU/e. Also, additions or changes to the design could be incorporated. Ideally, the user evaluation would include all the proposed actors in the design. These are TU/e Innovation Lab, STARTUPeindhoven, TU/e Innovation Space, and entrepreneurial students preferably already working on their start-up. Within the available time for this thesis, however, there was room for two evaluations. For the proposed evaluation with all the actors in the system, the steps that would have been executed are described and questions and considerations are included. Subsequently, the user evaluation that is executed will be discussed.

To be able to evaluate the design, the BMC, process flow, and governance can be discussed. First, the described reason for selecting the specific support measure and the corresponding problems should be assessed. Improvements are needed if there are parts unclear or missing. Second, the designed solution has to comply or ‘fit’ with the design requirements. These should also be assessed from the viewpoint of the users. At this point, other concerns or considerations can also be included to improve the design overall. Third, all the separate elements of the design can be presented and discussed. Each element has to be clear and implementation ready as much as possible. The expectation is that the proposed users of the system are able to make significant contributions to this, based on their expert opinion and their knowledge of the TU/e. From the viewpoint of students, that are potentially at the receiving end of the system, it is important to validate if the design solves a real problem they encounter with their own start-up. For both users from the TU/e and TU/e students, and evaluation form with questions is created. This can be seen in Appendix 7.

The proposed design has been tested in the form of an evaluation with J.H. (Jolan) Hulscher and S.I. (Steven) van Huiden. Hulscher currently works as an external consultant for the TU/e, and is a former TU/e student, van Huiden is the director of STARTUPeindhoven. Both the motivation for the design, the problems the design aims to solve, and the BMC with process flow and governance are discussed. This has led to several changes in the design, based on the knowledge of the participants from the TU/e and the entrepreneurship support. These changes are already incorporated into the design as presented in this thesis.

6. Conclusion & discussion

This thesis undertook an exploratory study on entrepreneurship support at the TU/e, with the aim to improve the support that is currently available in order to support the TU/e to reach, parts of, the TU/expedition 2030 plan to actively stimulate and facilitate the creation of start-ups. To do this, entrepreneurship support currently available at the TU/e has been mapped, together with the business models of STARTUPeindhoven and TU/e Innovation Space as these organizations provide a large portion of the available support to students. Also, the opinions on entrepreneurship support measures of entrepreneurial TU/e students have been researched. This resulted in insights in the match between the support currently offered and the views from students on the importance of these measures. Furthermore, the analysis made clear that certain support measures are not available at the TU/e that are deemed important according to these students.

For one of these missing support measures, a design is proposed that focusses on how the TU/e could implement and execute this measure. This design is visualized in the form of BMC in order to make the inner workings of how this support measure can be realized clear. The design has been put together based on a literature review, feedback from professionals, and a creative leap while keeping the specific context and requirements of the TU/e in mind. Furthermore, the design has been evaluated by users and subsequently improved.

6.1 Answer to research question

The main aim of this thesis is to provide an answer to the main research question, which is discussed in this paragraph. The main research question for this thesis is:

"What support do students desire for their start-up activities, and how can the Eindhoven University of Technology create and deliver this support?"

To answer this question, several sub-questions were answered to obtain the necessary knowledge. From this knowledge, the answer to the main research question can be formulated in two parts. First, according to the empirical analysis that is carried out for this thesis, the support measures entrepreneurial students most desire are *network facilitation*, *access to financing*, and *legal support*. Support measures that students desire that are not available at the TU/e, and therefore provide room for improvement, are *legal support*, *providing staff*, and *investments from the TU/e*. Furthermore, some forms of entrepreneurship support that are related to TU/e policy are also researched. Entrepreneurial students indicated their desire for a *special administrative status* at the TU/e comparable to top-class sport, and the ability to *graduate with a start-up*. Currently, this is not an option that is offered at the TU/e. Second, a design is proposed that focused on how the TU/e can create and deliver one of the desired support measures. The support that the TU/e can offer is the provision of seed investments to promising start-ups in order to provide financial room to further develop the business and technology, bridging the financing gap until private investors become interested. The TU/e can create and deliver this support by using the proposed BMC, the process flow that shows how the coherency of the business model, and the proposed governance linked to the business model.

6.2 Theoretical contribution

The main aim of this thesis is to solve the organization's business problem. There are, however, some theoretical contributions, these are discussed in this paragraph. Fist, prior research on university programs aimed at stimulating entrepreneurship mainly focuses on strategic objectives, competitive focus, and service offerings, but has largely neglected the business model (Baglieri et al., 2018; Pauwels et al., 2016). This study attempts to shed some light on these business models and bundle the findings from several literature streams into a description of this business model making clear how certain support measures can be realized. By taking a business model perspective, the emphasis shifts from what action programs that stimulate entrepreneurship should take to how they can realize this. This is because the business model can be used as a conceptual model, a shared language, and a concrete tool

that fosters dialogue and common understanding (Osterwalder & Pigneur, 2010). Furthermore, the business model specifies the underlying interconnected and interdependent bundle of activities that are necessary for entrepreneurship support to work effectively (Zott & Amit, 2010). Understanding the value creation and capturing process of these programs through their business models might improve these programs for universities and the students participating in these programs, possibly making the execution and maintenance more efficient and sustainable.

Second, prior work on university entrepreneurship programs largely neglects the financial side of these programs, as they focused more on what types of programs should be created with what strategic objectives (Baglieri et al., 2018). This study identified and bundled various (alternative) forms of revenue generation possibilities for entrepreneurship support programs, and included some of them in the final design. This may help to make these programs less costly and possible making more support within these programs available as (parts of) the costs can be recouped and reused in the system. This study shows that there are multiple possibilities for universities to generate different forms of revenue from entrepreneurial programs while still providing essential services to entrepreneurial teams in the start-up process. The overview of various revenue options together with the described business model components can potentially lead to new revenue possibilities, by configuring existing business models in a different way or when creating new ones (Osterwalder & Pigneur, 2010).

Third, using a business model perspective ensures the customer is placed central and a new business model is created around their wishes and preferences, in contrast to existing research that pushes their findings on the customers (Osterwalder & Pigneur, 2010). This thesis aimed to do this by researching the desirability of various support measures from a student perspective. The results of this study provide a preliminary indication of the desirability of different support measures as perceived by students and how the preferences change over the different stages of the start-up entrepreneurial process.

Lastly, the business model, corresponding process flow, and governance of a university entrepreneurship support measure have been described. Although this a preliminary exploration and it is done for a specific context, there is no prior research describing an activity system in its entirety for this purpose. This activity system describes the interplay of the elements and actors in the system to show how a university can realize the proposed support including several considerations that are important when creating such a system. For other universities, it creates an overview of the possible options that can be implemented and important considerations that have to be made when configuring new business models for new entrepreneurship stimulating projects.

6.3 Practical implications

The results from this study have some practical implications, these will be summarized in this section. In the systematic literature review, a generic business model for programs that stimulate student entrepreneurship is described. For the TU/e the description of the various elements with the different options can be used for the configuration of new business models for new entrepreneurship stimulating projects. Also, it might enhance existing business models, by making clear what alternative options are possible and including them in existing practice.

The results from the empirical analysis provide a preliminary indication of the desirability of support measures over the different stages of the start-up entrepreneurial process. The trend for each support measure over the stages can potentially be used by the TU/e to determine which sub-organization of the TU/e is best suited to take responsibility for future support measures. As it became apparent after the interviews that TU/e Innovation Space focuses more on the first two stages of the start-up entrepreneurial process (focus more on education), and STARTUPeindhoven focusses more on the last two stages (focus more on entrepreneurship and growth). From a resource-based perspective, the TU/e can use the results of the trends in support over the different stages to assess if it is necessary that some of the currently available support is offered by both STARTUPeindhoven and TU/e Innovation Space simultaneously or if the responsibility for certain measure could be shifted to one of these organizations

in order to not overspend resources. Furthermore, the results indicate that there is support currently missing at the TU/e that is important according to students. The current support that is offered to start-ups could therefore be improved by making these support measures also available. This would be legal support, providing staff, and the proposed design for investments for the TU/e. Furthermore, the TU/e could research the possibility to give a special administrative status to entrepreneurs and to make it possible to graduate with a start-up.

The proposed design in this thesis can be used as a starting point in creating a system that makes seed investments from the TU/e possible. The created BMC, process flow, and governance can be used as a conversation tool in order to create a shared language and consider the various aspects that are necessary to make this support measure possible. The design describes various considerations that have to be taken into account when creating this measure and translates them to the specific TU/e context. Also, possible partners the TU/e can use to increase the chance of success for this support measure are described. By including, elements of the existing structure, knowledge, and currently existing support in this design it becomes easier to implement.

6.4 Limitations and future research

As with all studies, this study is not without limitations. This section will discuss how these limitations have affected the outcomes of this research together with the future research directions it opens up.

First, this explorative study focused on a single-case and therefore lacks external validity (van Aken et al., 2016). It is carried out in the context of the TU/e, and for this context, a case-specific solution has been designed. The results of this study should therefore not be generalized to other universities without some caution. A single-case analysis is chosen because the focus of this thesis is to solve a specific problem in the context of the organization (van Aken et al., 2016). Future research that extends the single-case to a multiple-case analysis, including other universities, might further refine and extend the preferences in entrepreneurship support as perceived by students. This analysis might support universities in creating an adequate entrepreneurial environment for their students.

Second, construct validity refers to the extent to which the measures in this study reflect the concepts that are studied (van Aken et al., 2016). In order to increase the construct validity, measuring instruments are based on prior research on these concepts, and validated, where possible, by the literature review that is carried out for this thesis. Triangulation is used, where possible, do draw conclusions based on multiple sources instead of one measurement. Also, experts and independent researchers are used to evaluate and test the measuring instruments, and these were subsequently improved. A limitation considering the construct validity is that only a few actors participated in the analysis, for both the interviews and the student questionnaire. Together with possible bias introduced by the researcher, this might result in opinions, judgments, and feelings that are not fully included in this study. Especially for the student questionnaire, future research with a larger group of respondents could validate if the results in this study on the student options are correct. Also, if this study is carried out on a larger scale, differences between de non-entrepreneurs and the entrepreneurs could be further assessed.

Third, the reliability of this thesis is enhanced, due to the description of the methodologies that are used and steps that are executed to obtain the results. Also, the interview protocols and questions for the student questionnaire are included. Furthermore, the research on which the measuring instruments are based and the modifications that are made to make this suitable for this study are described and reviewed by independent researchers. Future research could replicate the study to further assess the reliability and see if the results differ from each other.

A fourth limitation is that, by taking a business model perspective, the research did not access the impact of the entrepreneurship support measures that are researched in this study on the start-up entrepreneurial process. Although the results can be used to indicate preliminary insights in the opinions of

entrepreneurial students at the TU/e on the desirability of support measures, that does not conclusively mean these measures are also the most effective at supporting these students. Future research could combine the findings of this study on the preferences of students with research on the effectiveness of each measure. This way support measures that are desired by students and have a high impact on the start-up entrepreneurial process can be uncovered. This could potentially help universities to more effectively and efficiently select support measures to increase entrepreneurial performance.

Fifth, the design aimed to include all the important considerations regarding the business model, process flow, and in the description of the governance to make it as implementation ready as possible. The design can be used as the first step in improving the support at the TU/e by focusing on how this support can be realized in the specific TU/e context. Due to time and scoping restraints, there are still some considerations in the design that are not made explicit in this thesis. Also, the implementation of the design is not included in the scope of this thesis. Future research could use the design as a starting point to further develop the path to implementation while answering the remaining questions that are not in the scope of this thesis.

Lastly, this thesis uncovered several support measures that could be improved at the TU/e, but only one measure has been selected for the design. Future research could take the other missing support measures into account, and research how they could be created and managed at the TU/e.

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Appendices

Appendix 1. Taxonomy of university related support mechanisms by Selten (2018)

Table 22: Taxonomy of university related support mechanisms by (Selten, 2018, p. P.viii)

Name	Description
Accelerator	Accelerator for entrepreneurship activity
Acceptance of entrepreneurial career	Acceptance of advancing on the entrepreneurial ladder instead of academic
Access to grants	The TU/e facilitates access to grants for entrepreneurship activities
Access to funding	Accessibility of local capital and pre-seed funds
Accessibility of high-tech facilities	High-tech facilities open for entrepreneurship activities
Affordable office space	Office space available below market price
Alumni relationships	Involvement of alumni in support activities
Business contest	Business plan contest
Challenge based courses	Courses designed on challenges
Collaboration projects with industry	Collaboration projects with industry during study, for experience
Entrepreneurship in curricula	Entrepreneurship courses in standard curricula
Entrepreneurial competence education	Availability of appropriate entrepreneurial courses
Entrepreneurship in mission	Entrepreneurship in TU/e mission
Events	Appropriate entrepreneurship events (networking, contests, etc.)
Experimental education center	Availability of experimental education center for entrepreneurship activities
Extra-curricular teams	Availability (to start) university-supported extracurricular innovation teams
Financial incentives	Financial incentives for staff to participate in entrepreneurship
Financial investing	(Small) financial investments from the TU/e
graduate with spin-off	Graduation with a spin-off as student
incubator	Incubator for entrepreneurship activity
Integration of valorization	integrate valorization within research and education on a university-board level
IP policy	Clear TU/e IP policy
Legal support	Availability of appropriate legal support
Life-long learning	Opportunities at the TU/e for life-long learning
Matchmaking between students	Availability of students from other disciplines to start entrepreneurship
Mentoring/coaching program	Availability of mentoring program for entrepreneurship activity on campus
Multidisciplinary research themes	Multidisciplinary research teams to spur new ideas
Negotiation process	Clear negotiation process for quid pro quo from students
Network facilitator	Accessibility of TU/e network for entrepreneurship activities
Pre-defined entrepreneurship mindset	Adaption of a predefined entrepreneurship mindset on campus
Recruitment campaign	University-wide campaigns on entrepreneurship
Revenue model	Clear revenue model of how TU/e can benefit from entrepreneurship
Role models	Availability of role models in entrepreneurship in TU/e staff
Selection of first-year students	Entrepreneurship driven selection procedure on first-year students
Study-related pressure	Perceived study related pressure by students
Success story telling	Story telling on successful entrepreneurship activity on campus
University staff competence	Availability of staff experienced in entrepreneurship
Visibility of entrepreneurship activities	Entrepreneurship activity in a visible setting at the campus

Appendix 2. Interview questions

Name interviewee:

Company/organization:

Function:

Parts of the interview might be included in my master thesis project, but all quotations will be anonymous.

Do you give permission to allow the interview to be audio recorded in order to ensure proper processing of the information?

Questions

Could you tell me more about your organization and your role in it?
(History, mission, ambition/goals/function)

What type of support does your organization provide to start-ups?
(Skills development, coaching, office space, access to network, etc.)

> Why is this form of support important/effective, according to you?
>
> What type of start-ups/students are the target audience for the support you offer?

How many start-up companies are in your portfolio right now, and how many of the companies that enter become successful?

What are the entry requirements for a start-up/student(s) to enter your organization?

What type of relationships does your organization have with the start-ups receiving the support?
(Contractual, personal, on demand etc.)

To what extent is the program or support standardized/customized?

Through which channels do you reach your target audience?
(New and existing start-ups/students)

Does your organization generate any form of revenue, if yes what are the most important revenue streams for your organization?
(Licensing, sponsored research, student placement in companies, shares, rent, service fee, etc.)

> Are these revenues an important aspect of the overall financing of the organization?
> Do you think these revenue mechanisms have an effect on the accessibility of the support for the start-ups?
>
> If no, why has the choice been made not to generate any form of revenue?
> (Accessible support, missed opportunity?)

What are the most important activities for your organization relating to the realization if the before mentioned support?
(Realization of support)

> Why are these so important?
>
> What steps have been taken to execute these key activities in the most suitable manner (low cost/efficiency)?

What are the important resources your organization needs in order to deliver the support?
(Physical, intellectual, human, **financial**)

Why are these so important?
(Connection with organization goals)

Which steps has your organization taken to acquire these resources on a low cost/efficient manner?

What are the most important key partners for your organization?
(Optimization and economies of scale, reduction of risk and uncertainty, acquisition of resources and activities)

Why are these so important?
(Connection with organization goals)

What are the benefits and challenges of maintaining relationships with your key partners?

Do you see your organization's alumni entrepreneurs as a key partner, and how do you deploy them in your business model?

What are major cost for your organization that come from offering the support?
(Building/facilities, personnel, research, how are these financed?)

What unique combination of business model practices sets your business model apart from other organizations? (Or are they similar)

Is there, according to you, any support for start-ups that could be valuable but is currently not being offered at the TU/e?

Do you know any other people within your organization that could possibly help me gaining insights in the types of support available and how this support is realized?

Thank you for participating and helping me with my thesis

Appendix 3. Coding template

Table 23: personal information

Coding	Description	Indicators
Pers_company_role	Personal role of interviewee in the organization	Function, role
Pers_company_activities	Activities performed by interviewee in organization	Tasks, activities, responsibilities
Pers_tips_thesis	Tips on thesis project/process, research that is beneficial for interviewees organization	Various
Pers_more_interviews	Other people in organization that could be interviewed to create and overall picture of the organization	Names of people

Table 24: Organizational information

Coding	Description	Indicators
Org_goals	The common goals of the organization	Goals/targets, why and how
Org_future_plans	Future plans (not in current support offering) of organization	Expanding, future services, future BM changes
Org_ideal_situation	The ideal future scenario	Future, ideal
Org_ongoing_processes	Processes that are currently being improved or changed	(Re-)structuring, formalization, changing

Table 25: Business model & support information

Coding	Description	Indicators
BM_VP_1	The value propositions of the organization specifically aimed at supporting start-ups	Various
BM_VP_2	The value propositions of the organization **not** specifically aimed at supporting start-ups	Various
BM_CS	The customers of the organization	Students, teams, start-ups, academics, companies
BM_CH	The channels used to reach the customers	Traditional communication, online communication, personal communication, aftercare (alumni)
BM_CR	The type of relationships with the customers	Personal, on-demand, contractual, ad hoc, entry/exit requirements, acquisition, retention
BM_RV_1	The revenue streams generated from the start-up support offered by the organization	Pay for use, donations, licensing, stock options
BM_RV_2	Revenue streams generated from other means	Entrance fee, project fee, licensing

BM_KR	Key resources for the organization	Human capital, financial capital, building/working space, machinery
BM_KA	Key activities for the organization	Related to start-up support, related to running the organization
BM_KP	Key partners for the organization	Strategic alliances, alumni, professors at TU/e
BM_CO	Important that occur in the organization	Costs, costs items

Appendix 4. Business models STARTUPeindhoven & TU/e Innovation Space

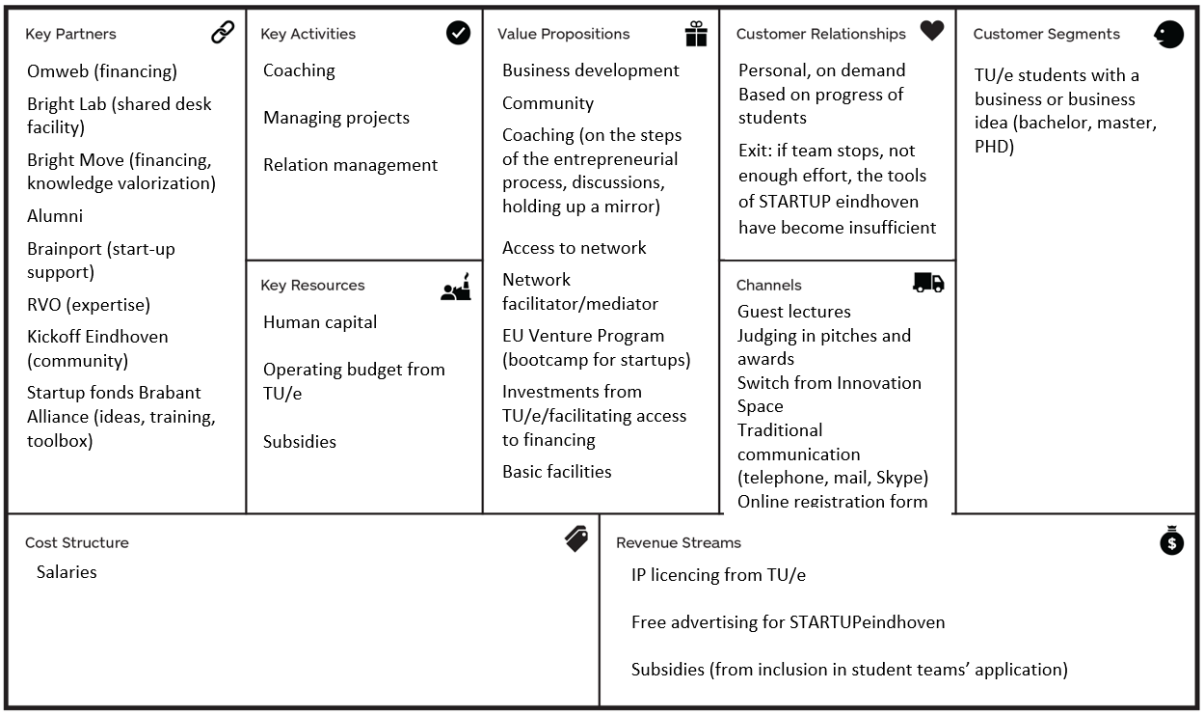

Figure 18: Business Model Canvas STARTUPeindhoven

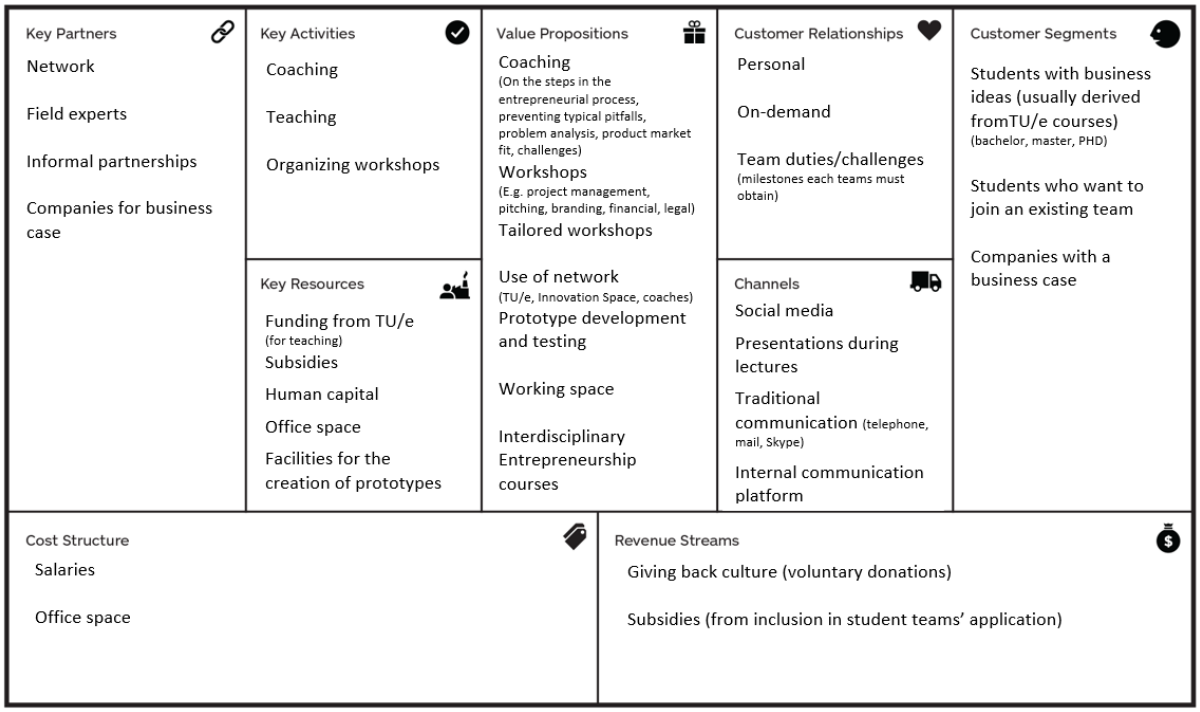

Figure 19: Business Model Canvas TU/e Innovation Space

Appendix 5. Questionnaire questions with answers

Group non-entrepreneur= 15 Group entrepreneur= 9

The numbering of the questions is in order of the creation of the questions, the format presented here is the format used in the final questionnaire.

PART I

Question 1. What is your gender?

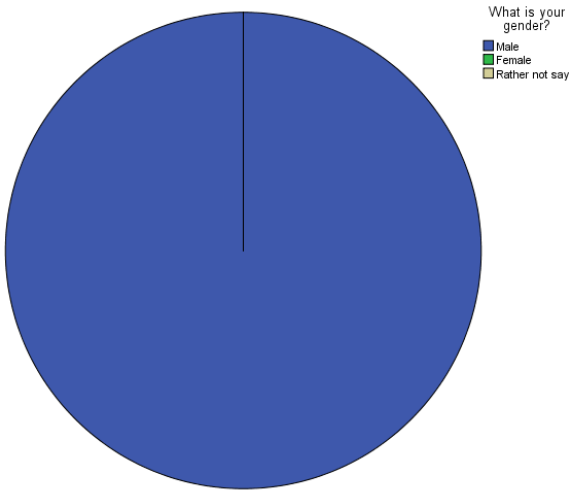

Figure 20: Question 1 non-entrepreneur

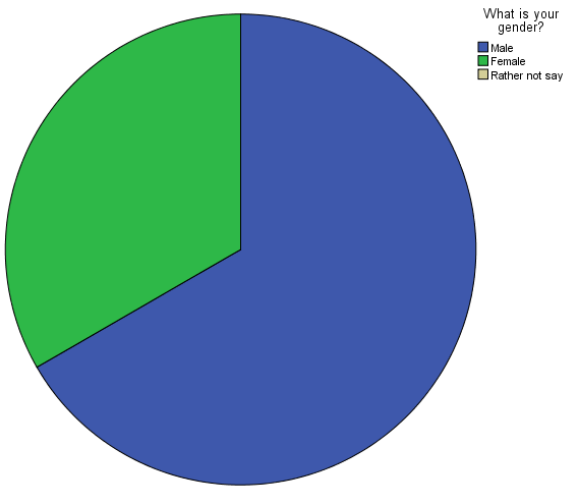

Figure 21: Question 1 entrepreneur

Question 2. What is your age?

Average non-entrepreneur = 23 Average age entrepreneur = 24

Question 3. Are you a Bachelor or Master student?

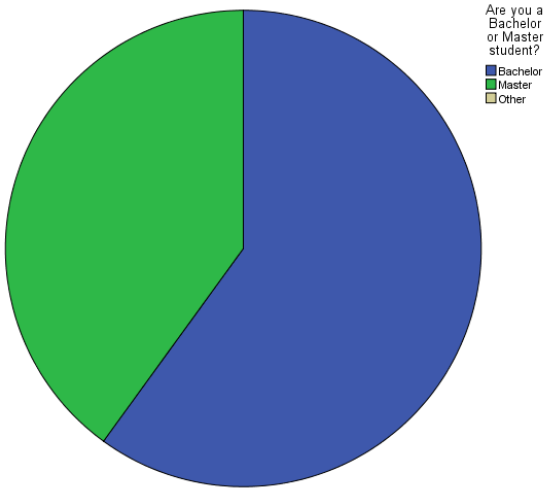

Figure 22: Question 3 non-entrepreneur

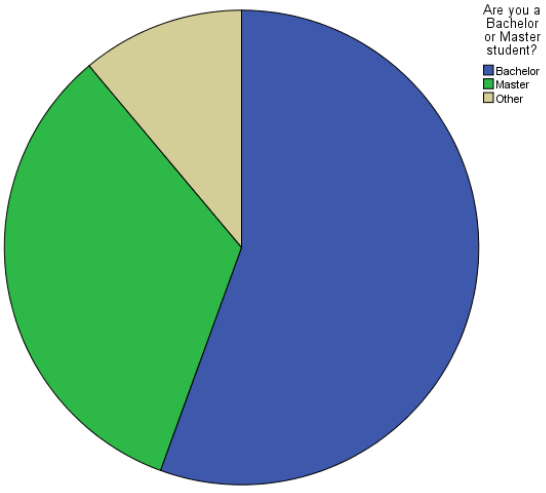

Figure 23: Question 3 entrepreneur

Question 4. What is the name of your education program at the TU/e?

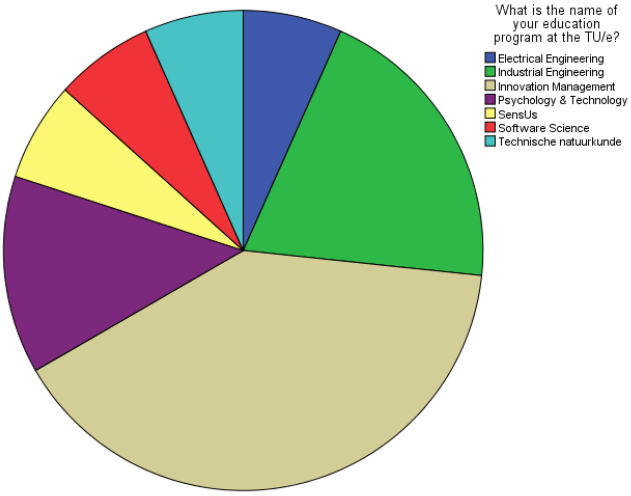

Figure 24: Question 4 non-entrepreneur

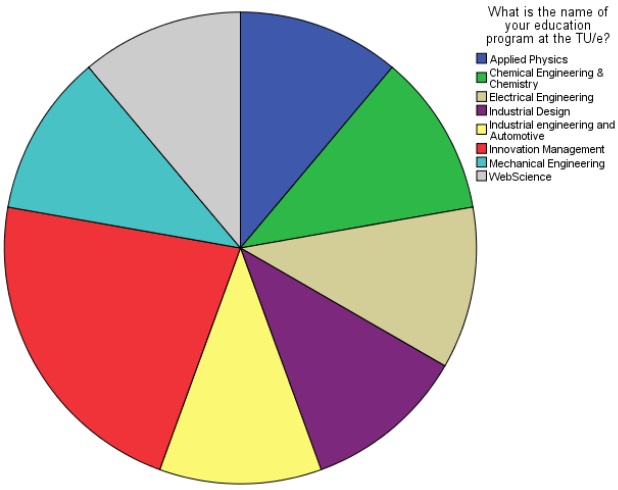

Figure 25: Question 4 entrepreneur

Question 28. Did you participate in any of the following entrepreneurship courses? (multiple options are possible)

Non-entrepreneur

Table 26: Question 28 frequency table non-entrepreneur

$Entrepreneurshipcourses Frequencies

		Responses		
		N	Percent	Percent of Cases
Entrepreneurshipcourses[a]	Did you participate in any of the following entrepreneurship courses? (Multiple options are possible) USE Technology Entrepreneurship	9	50,0%	60,0%
	Did you participate in any of the following entrepreneurship courses? (Multiple options are possible) Msc Course Technology Entrepreneurship	5	27,8%	33,3%
	Did you participate in any of the following entrepreneurship courses? (Multiple options are possible) Other entrepreneurship oriented course (e.g. green business models)	2	11,1%	13,3%
	Did you participate in any of the following entrepreneurship courses? (Multiple options are possible) No, I did not take any entrepreneurship related course	2	11,1%	13,3%
Total		18	100,0%	120,0%

a. Dichotomy group tabulated at value 1.

Entrepreneur

Table 27: Question 28 frequency table entrepreneur

Entrepreneurship courses Frequencies

		Responses		
		N	Percent	Percent of Cases
Entrepreneurship courses	Did you participate in any of the following entrepreneurship courses? (Multiple options are possible) USE Technology Entrepreneurship	3	25,0%	33,3%
	Did you participate in any of the following entrepreneurship courses? (Multiple options are possible) Msc Course Technology Entrepreneurship	1	8,3%	11,1%
	Did you participate in any of the following entrepreneurship courses? (Multiple options are possible) Certificate Technology Entrepreneurship	2	16,7%	22,2%
	Did you participate in any of the following entrepreneurship courses? (Multiple options are possible) Other entrepreneurship oriented course (e.g. green business models)	3	25,0%	33,3%
	Did you participate in any of the following entrepreneurship courses? (Multiple options are possible) No, I did not take any entrepreneurship related course	3	25,0%	33,3%
Total		12	100,0%	133,3%

a. Dichotomy group tabulated at value 1.

Question 5. Are any of your family members entrepreneurs?

Non-entrepreneur

Table 28: question 5 frequency table non-entrepreneur

$Familymembers Frequencies

		Responses		
		N	Percent	Percent of Cases
Familymembers[a]	Are any of your family members entrepreneurs? (multiple answers possible) Parent(s)	2	12,5%	13,3%
	Are any of your family members entrepreneurs? (multiple answers possible) Other family member(s)	7	43,8%	46,7%
	Are any of your family members entrepreneurs? (multiple answers possible) None	7	43,8%	46,7%

Total	16	100,0%	106,7%

a. Dichotomy group tabulated at value 1.

Entrepreneur

Table 29: Question 5 frequency table entrepreneur

$Familymembers Frequencies

		Responses		
		N	Percent	Percent of Cases
Familymembers[a]	Are any of your family members entrepreneurs? (multiple answers possible) Parent(s)	2	20,0%	22,2%
	Are any of your family members entrepreneurs? (multiple answers possible) Other family member(s)	4	40,0%	44,4%
	Are any of your family members entrepreneurs? (multiple answers possible) None	4	40,0%	44,4%
Total		10	100,0%	111,1%

a. Dichotomy group tabulated at value 1.

Question 8. Do you have your own company or are you participating in an entrepreneurial team/project not linked to a specific TU/e Course?

Group non-entrepreneur= 15 Group entrepreneur= 9

PART II

The following questions are about what support measures are the most valuable in each stage of the start-up entrepreneurial process, according to you. The start-up entrepreneurial process has 4 stages: 1) definition stage, 2) validation stage, 3) efficiency stage, 4) growth stage. More information about the stages is provided by each question.

Support:

1. **Access to financing** (the TU/e and its partners help you come into contact with possible financiers and facilitate the access to grants and funding);
2. **Affordable office space** (There is office space, provided at a reduced rate, available at the TU/e);
3. **Entrepreneurship events** (The TU/e organizes appropriate entrepreneurship events such as business contests, networking opportunities, and matchmaking between entrepreneurial students);
4. **Investments from the TU/e** (The TU/e provides (small) financial investments to promising start-up companies);
5. **Legal support** (The TU/e offers support to start-ups considering legal questions
6. **Entrepreneurship mentoring/coaching program** (experienced mentors and coaches guide the start-up through the difficult first phases of the start-up process);
7. **Network facilitator** (Start-ups have access to the extensive network of the TU/e);
8. **Providing staff** (The TU/e provides temporary staff for administrative functions, and has experienced staff that could temporarily work for your start-up company);
9. **Idea testing** (The TU/e provides you with opportunities to test your business ideas, by creating a minimum viable product or lab testing);
10. **Entrepreneurship workshops** (members of start-ups can participate in workshops focused on developing entrepreneurial competences such as leadership, decision making, team building, financing etc.);
11. **Brand building** (Start-up companies formed at the TU/e can use the existing brand name of the TU/e to promote their company).

For each stage of the start-up entrepreneurship process, participants could rank up to five support measures on their desirability, with position 1 meaning most desirable for that stage. To analyze the score for each support measure, the ranking is inversed so the first position got the highest score. These inversed results are subsequently summed to get the total score for each measure. In order to compare the larger group of non-entrepreneurs with the smaller group of entrepreneurs, the total score for each measure is expressed as a percentage from the maximum obtainable score for a support measure. The results can be interpreted as the support measure with the highest score can be seen as the most desirable for each stage.

Question 12/question 18. The definition stage (1) of the start-up entrepreneurial process concerns opportunity recognition and the development of the initial idea, leading to a preliminary product/market fit. Which of the following support measures do you value the most in this stage? Please rank up to 5 support measures that are valuable according to you in this stage. A minimum of 3 must be selected. 1 represents the most useful/valuable support measure in this stage.

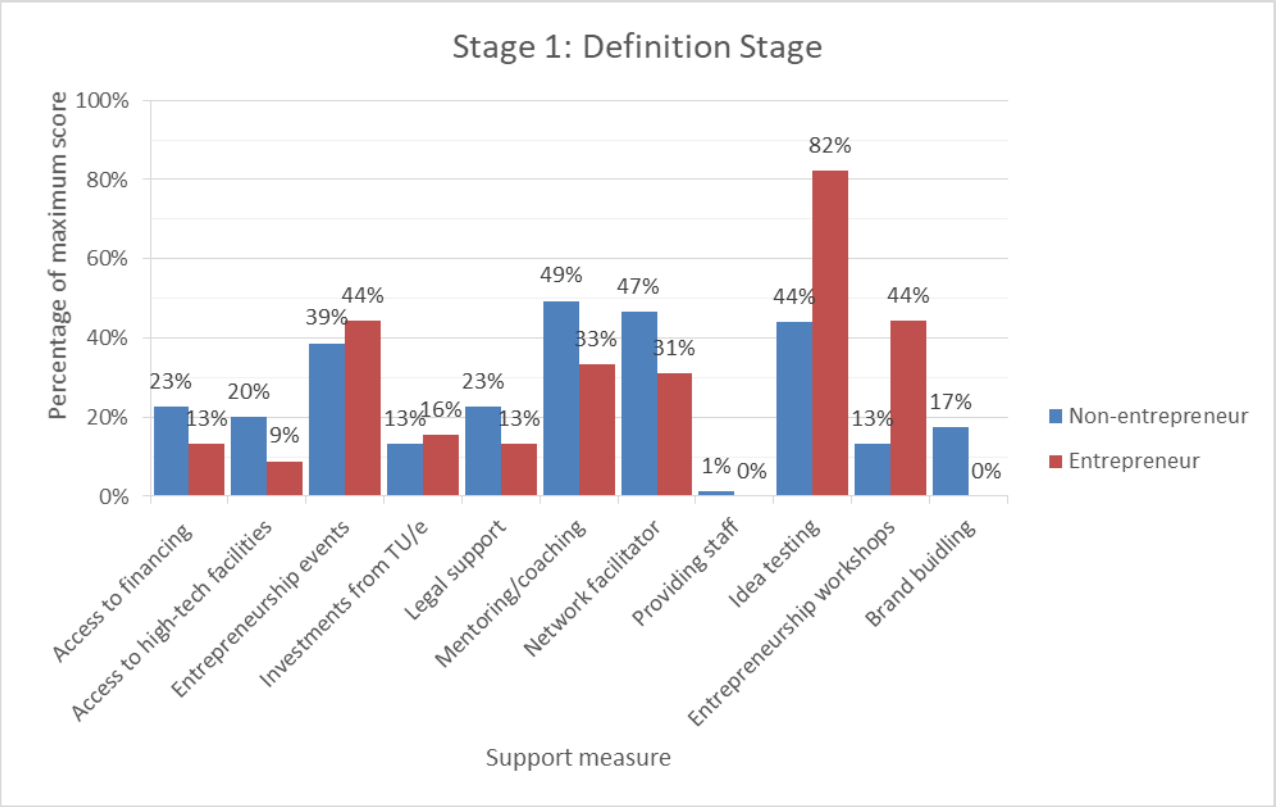

Figure 26: Support measure score stage 1

Question 13/question 19. The validation stage (2) of the start-up entrepreneurial process concerns launching a minimum viable product, expanding the team, and entrepreneurial commitment. Which of the following support measures do you value the most in this stage? Please rank up to 5 support measures that are valuable according to you in this stage. A minimum of 3 must be selected. 1 represents the most useful/valuable support measure in this stage.

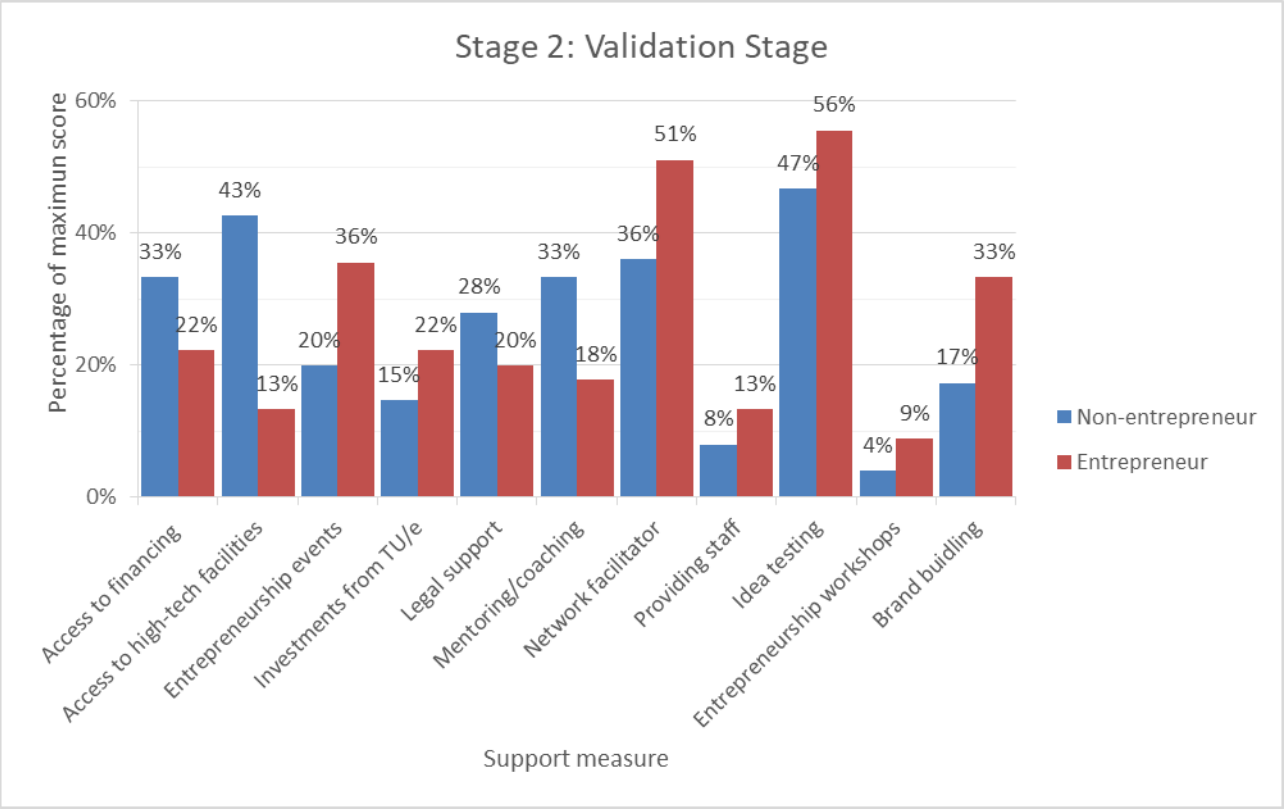

Figure 27: Support measure score stage 2

Question 14/question 20. The efficiency stage (3) of the start-up entrepreneurial process concerns the business launch, defining and developing the sales channels, and building credibility. Which of the following support measures do you value the most in this stage? Please rank up to 5 support measures that are valuable according to you in this stage. A minimum of 3 must be selected. 1 represents the most useful/valuable support measure in this stage.

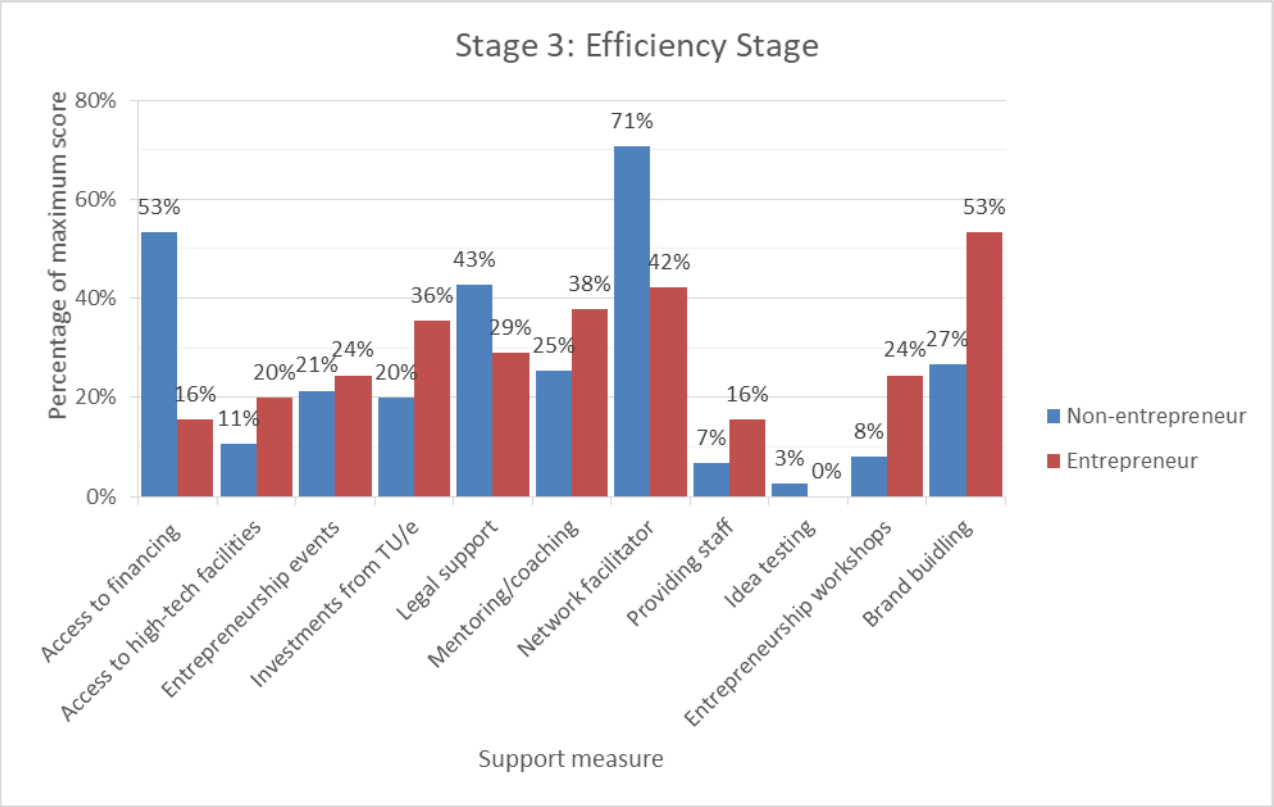

Figure 28: Support measure score stage 3

Question 16/question 21. The growth stage (4) of the start-up entrepreneurial process concerns expanding the company and sustainability of the company. Please rank each of the entrepreneurship support measures below on their value to the activities in this step according to you. (with position 1 meaning this support measure has the most value to the activities in the growth stage)

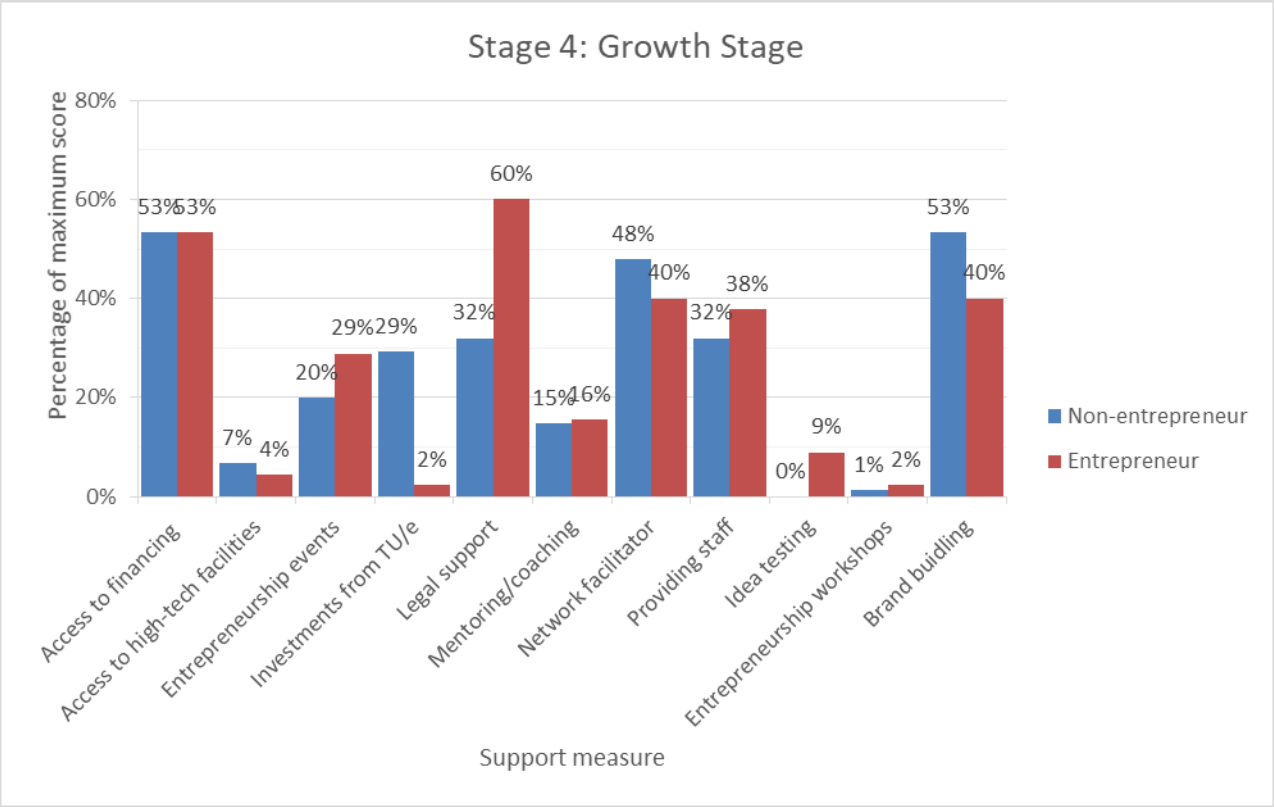

Figure 29: Support measure score stage 4

Question 23. In what stage of the start-up entrepreneurial process do you think you are with your own company/entrepreneurial team? (only group entrepreneurs)

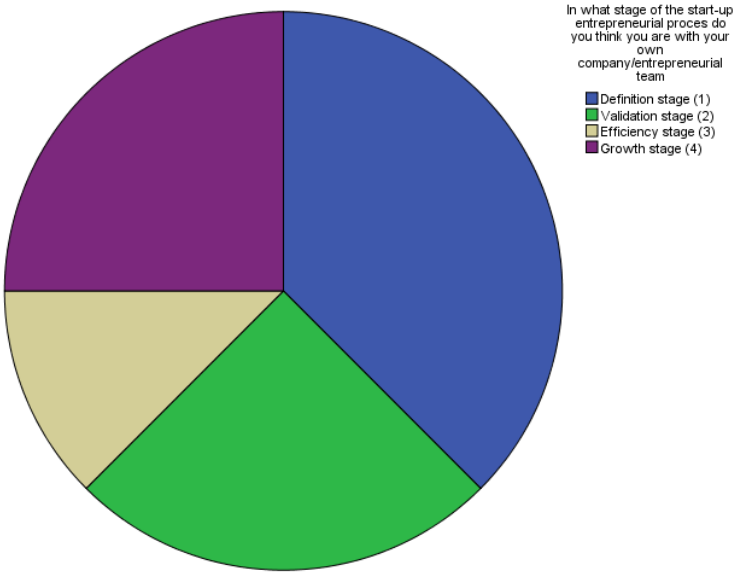

Figure 30: question 23 entrepreneurs

PART III

Question 24. The following questions refer to policies to support student entrepreneurs. To what extent do you agree or disagree with these statements?

1) Strongly agree 2) Agree 3) Somewhat agree 4) Neither agree/disagree) 5) Somewhat disagree 6) Disagree 7) Strongly disagree

Table 30: Question 24 answers

Question	Non-entrepreneur	Entrepreneur
1) Entrepreneurs should have a special administrative status at the TU/e, comparable to top-class sport?	Median=3 (somewhat agree) IQR=2	Median=2 (agree) IQR=4
2) At the TU/e, it should be possible to graduate with your start-up?	Median=2 (Agree) IQR=2	Median=1 (strongly agree) IQR=4
3) The TU/e should organize a campus wide recruitment campaign to attract more students to the entrepreneurial path?	Median=3 (somewhat agree) IQR=2	Median=3 (somewhat agree) IQR=2
4) Entrepreneurship should be a standard part of every curricula at the TU/e?	Median=4 (neither agree/disagree) IQR=3	Median=5 (somewhat disagree) IQR=2

Appendix 6. Tends in entrepreneurship support

Trends in support desirability over the phases of the start-up entrepreneurial process.

1. Access to financing (the TU/e and its partners help you come into contact with possible financiers and facilitate the access to grants and funding)

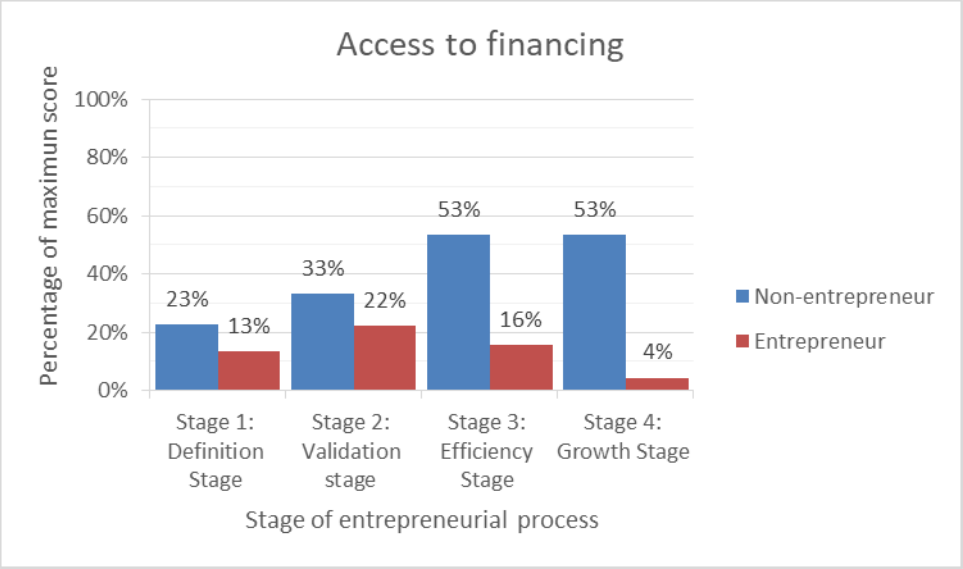

Figure 26: Trend access to financing

2. Access to high-tech facilities (Start-ups have the opportunity to use the high-tech facilities at the TU/e)

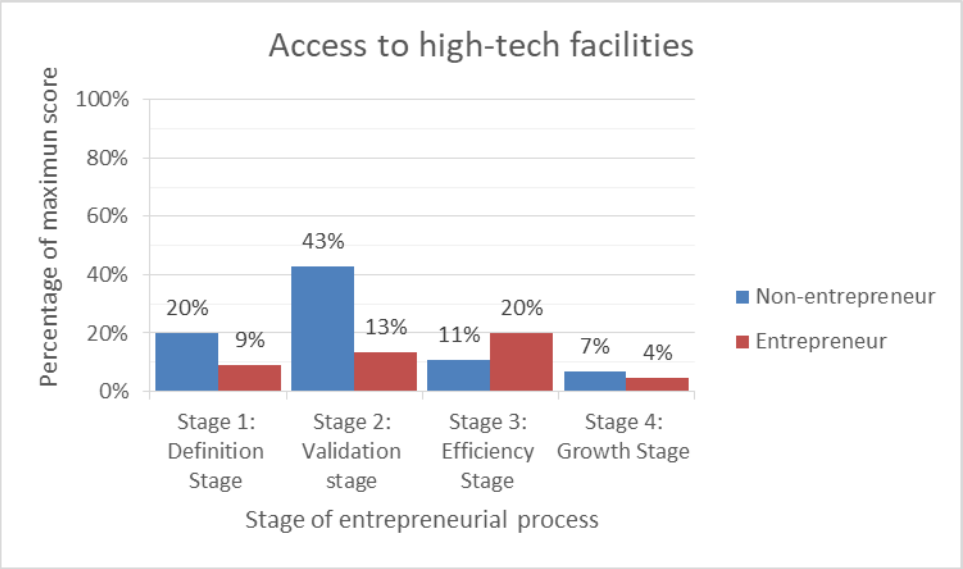

Figure 27: Trend access to high-tech facilities

3. Entrepreneurship events (The TU/e organizes appropriate entrepreneurship events such as business contests, networking opportunities, and matchmaking between entrepreneurial students)

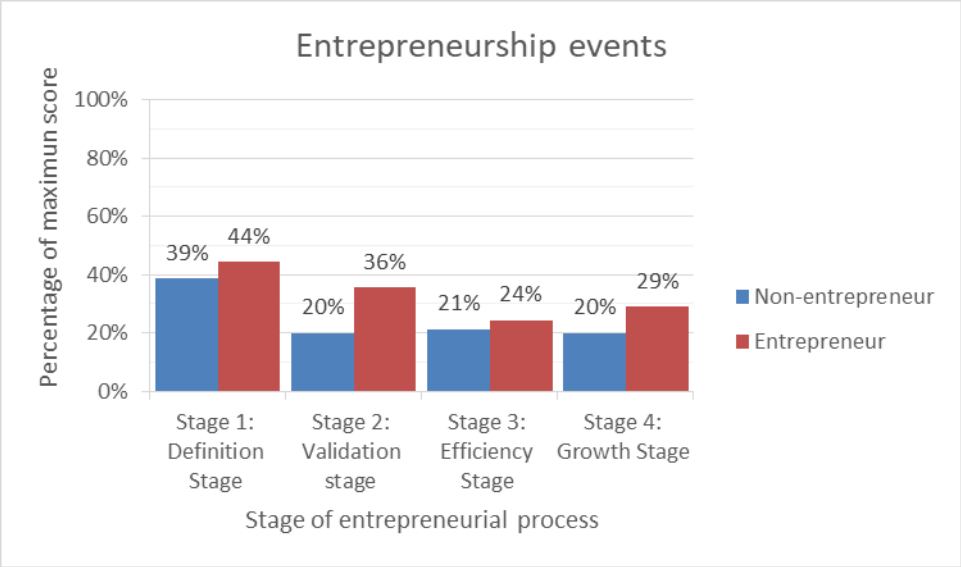

Figure 28: Trend entrepreneuship events

4. Investments from the TU/e (The TU/e provides (small) financial investments to promising start-up companies)

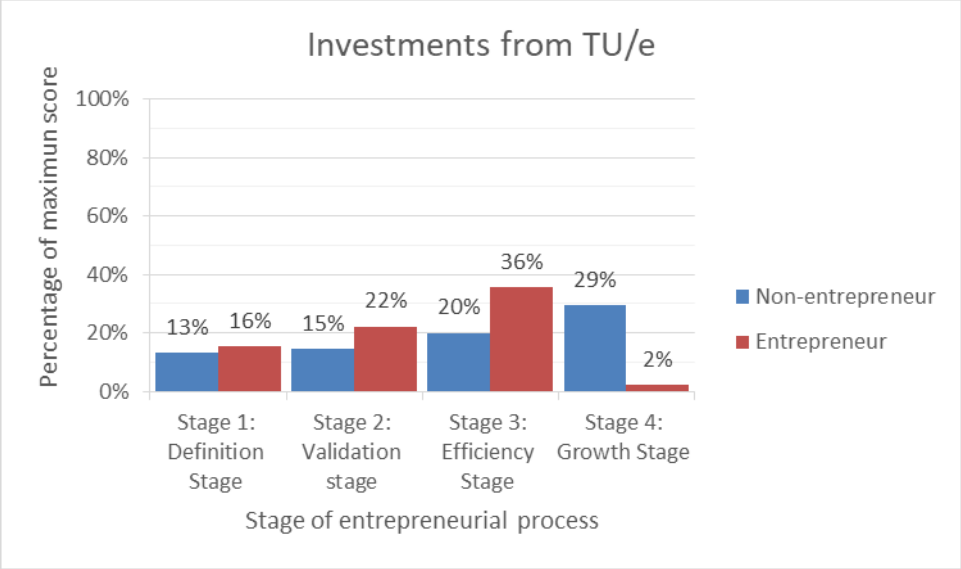

Figure 29: Trend investments from TU/e

5. Legal support (The TU/e offers support to start-ups considering legal questions)

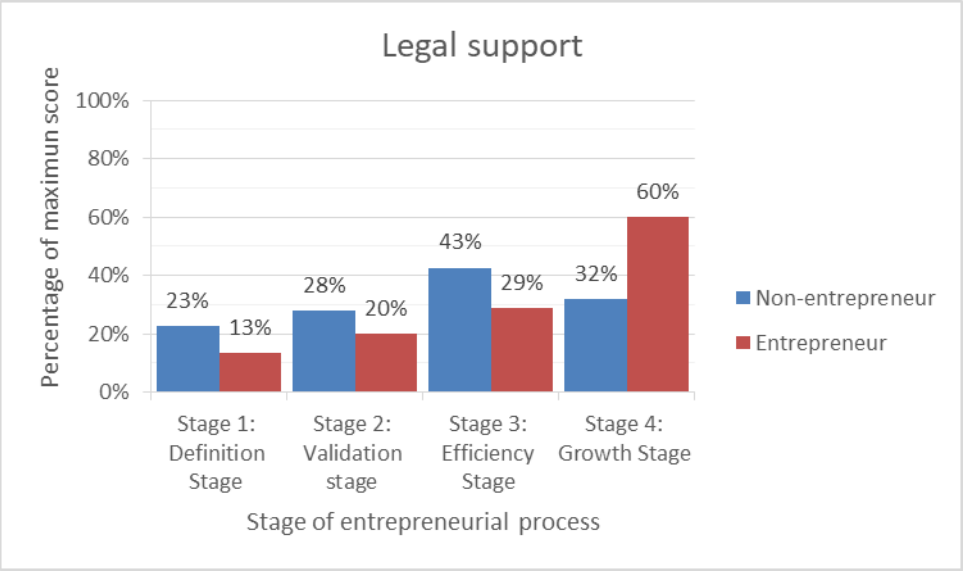

Figure 30: Trend legal support

6. Entrepreneurship mentoring/coaching program (experienced mentors and coaches guide the start-up through the difficult first phases of the start-up process)

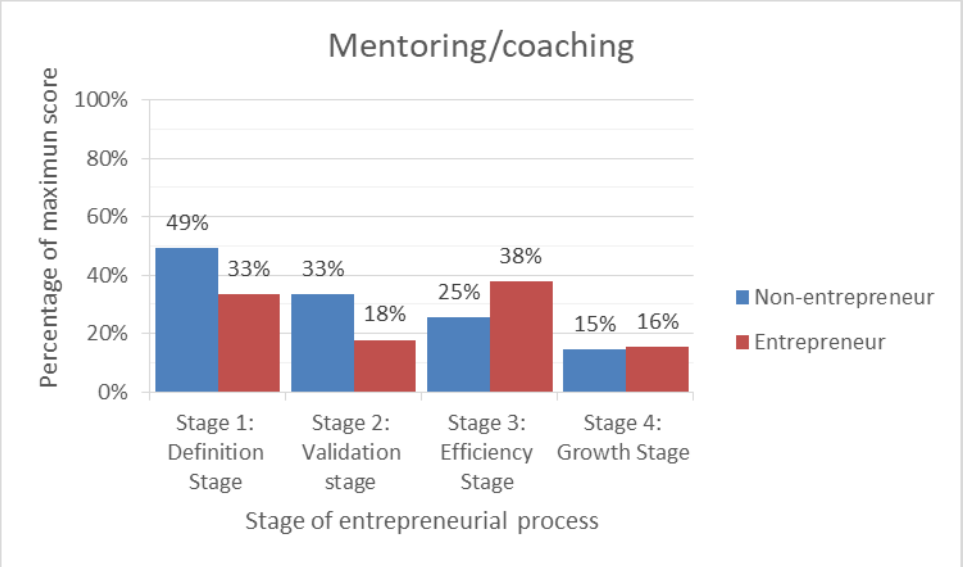

Figure 31: Trend mentroing/coaching

7. Network facilitator (Start-ups have access to the extensive network of the TU/e)

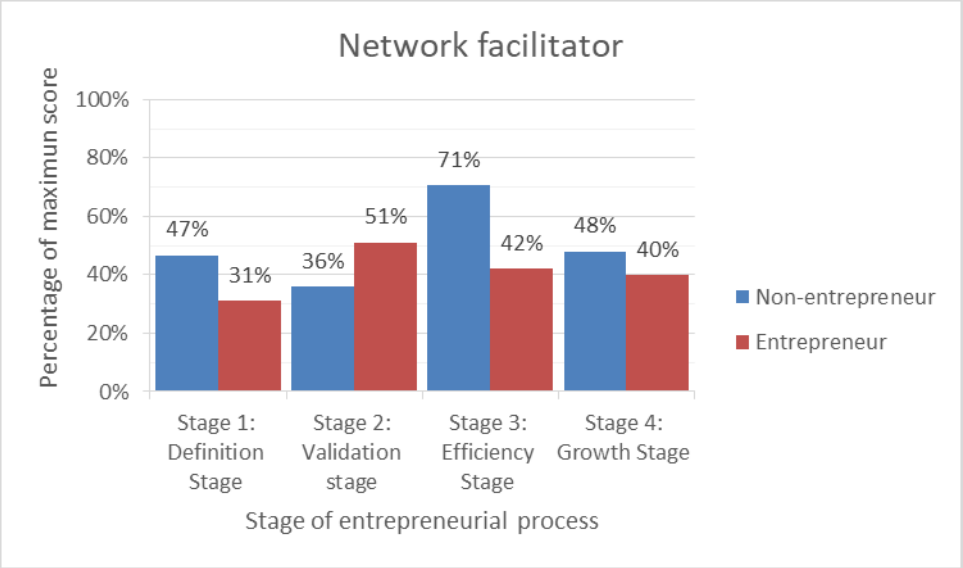

Figure 32: Trend netwrok facilitator

8. Providing staff (The TU/e provides temporary staff for administrative functions, and has experienced staff that could temporarily work for your start-up company)

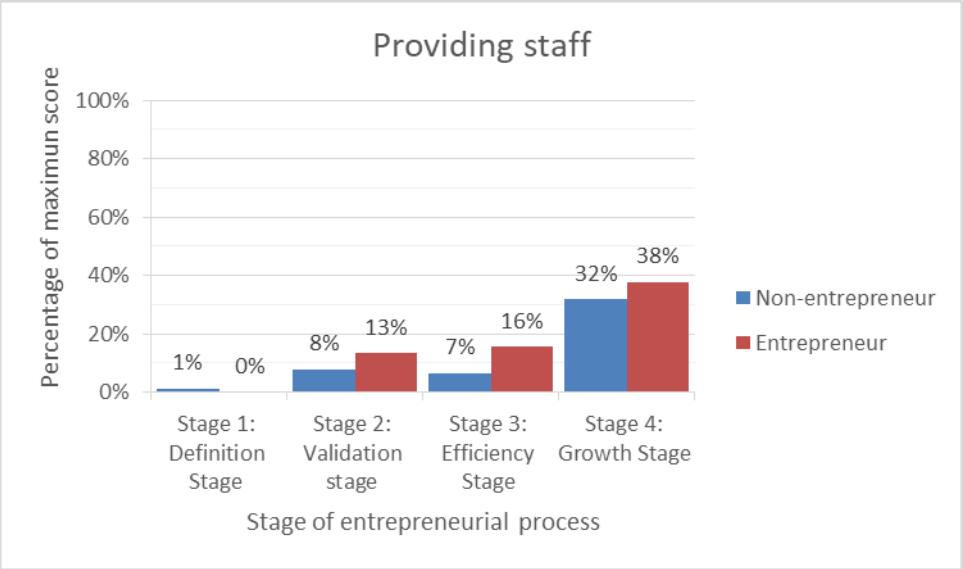

Figure 33: Trend providing staff

9. Idea testing (The TU/e provides you with opportunities to test your business ideas, by creating a minimum viable product or lab testing)

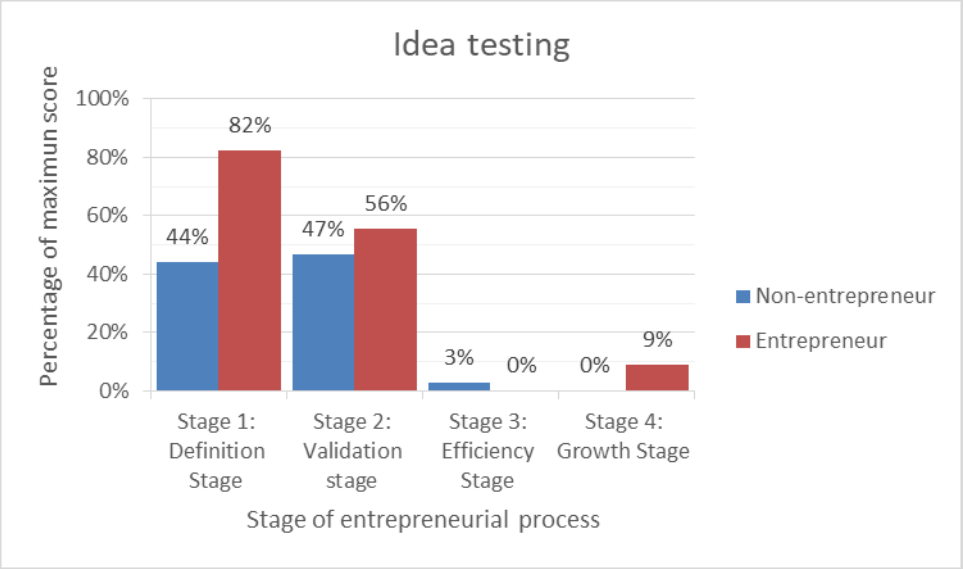

Figure 34: Trend idea testing

10. Entrepreneurship workshops (members of start-ups can participate in workshops focused on developing entrepreneurial competences such as leadership, decision making, team building, financing etc.)

(Overall least important according to students)

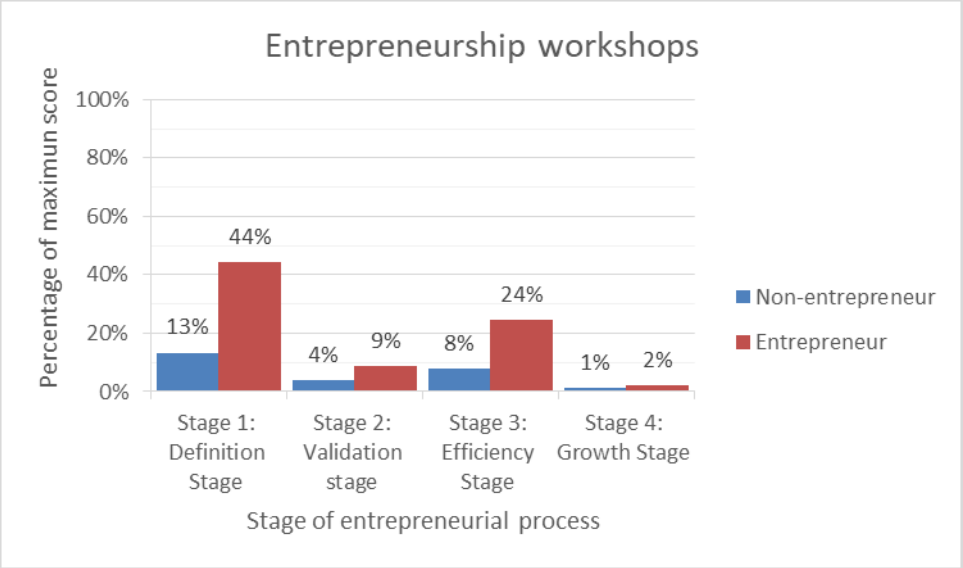

Figure 35: Trend entrepreneurship workshops

11. Brand building (Start-up companies formed at the TU/e can use the existing brand name of the TU/e to promote their company)

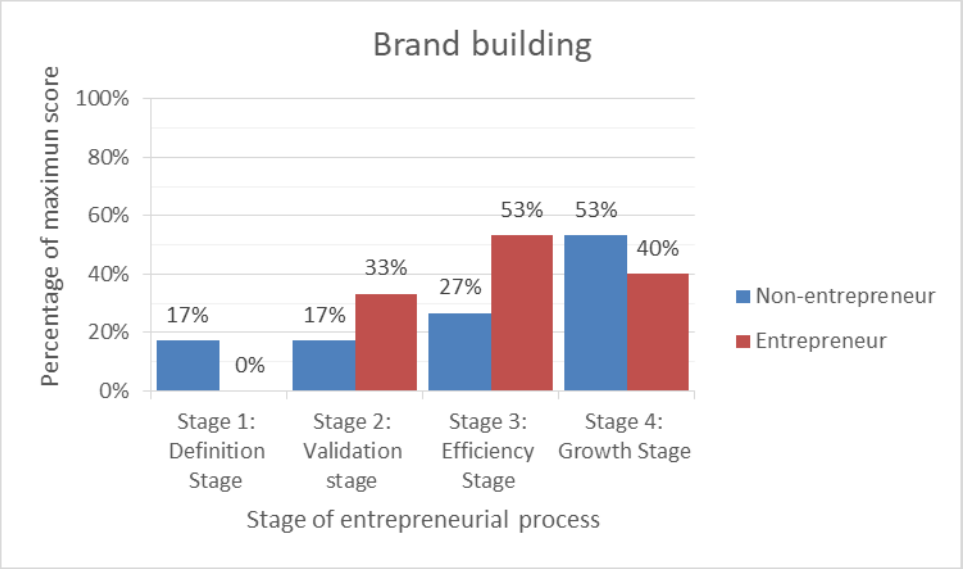

Figure 36: Trend brand building

Appendix 7. Design test evaluation forms

Table 31: Design evaluation form for TU/e

Design evaluation form for TU/e				
Overall design		Yes/no	Please motivate your answer	Other comments
1	Is the problem the design aims to solve for the TU/e and the start-ups clear?			
2	Is there a fit with the design requirements?			
R1	The realization of the design should help the TU/e identify key elements of the business model that are important considerations for the implementation of the selected support measure			
R2	The design should focus on what resources are necessary and elaborate on important considerations to provide insights on 'how' the selected support measure can be realized			
R3	The design should include mechanisms to generate revenue			
R4	The design should be an activity system, specifying the content, structure, and governance of a Business Model Canvas			
R4	The design should be user friendly (for TU/e employers and students)			
R6	The design should make use, where possible, of existing support measures and infrastructure available at the TU/e			
R7	The system should comply with the legal requirements of a university			
R8	The system should fit with the present company culture			
R9	The design should also include revenue mechanisms that minimize the financial burden for start-ups			
R10	The solution should change as little as possible in the current system			
R11	Both start-ups from STARTUPeindhoven & Innovation space should be able to use the solution			
3	Do you think the combination of business model, process flow, and governance is sufficient to form an initial advice on how to realize this support for the TU/e?			What else should/could be included?
Business Model Canvas		Yes/no	Please motivate your answer	Other comments
4	Is there, according to you, a logical coherency between the elements of the business model?			
5	Are there, according to you, aspects of the business model that are not clear?			

6	Are there any additions to the business model you can make based on your knowledge/network?			
Process flow		Yes/no	Please motivate your answer	Other comments
7	Do you think the process flow is clear?			
8	Do you think extra steps should be included, if so which steps?			
Governance		Yes/no	Please motivate your answer	Other comments
9	Do you think the proposed governance could be realistic?			
10	Do you know, based on your knowledge/network, any improvements and/or new elements that can be included in the proposed governance?			
Concluding remarks		Yes/no	Please motivate your answer	Other comments
11	Are there any other additions or considerations that could improve the design?			

Table 32: Design evaluation form for students (start-ups)

Design evaluation form for Students (start-ups)				
Overall design		Yes/no	Please motivate your answer	Other comments
1	Is the problem the design aims to solve for the TU/e and the start-ups clear?			
2	Do you think seed investments from the TU/e could help you to further develop your start-up?			
3	Are there any reservations you have that might prevent you from using this support measure?			
4	Do you think the coaching required for the investment is useful for your start-up?			
5	Is the current design missing elements that potentially be beneficial for your start-up?			
Business Model Canvas		Yes/no	Please motivate your answer	Other comments
4	Is there, according to you, a logical coherency between the elements of the business model?			
5	Are there, according to you, aspects of the business model that are not clear?			
6	Are there any additions to the business model you can make based on your knowledge/network?			
Process flow		Yes/no	Please motivate your answer	Other comments
7	Do you think the process flow is clear?			

8	Do you think extra steps should be included, if so which steps?			
Concluding remarks		Yes/no	Please motivate your answer	Other comments
11	Are there any other additions or considerations that could improve the design?			