Silje Uhlen Maurset

The influence of entrepreneurial role models on commercialization of research from universities

Master's thesis in NTNU School of Entrepreneurship
Supervisor: Lise Aaboen

March 2020

Master's thesis

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Faculty of Economics and Management
Dept. of Industrial Economics and Technology
Management

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Problem Description

Academic entrepreneurship and the commercialization of research from science and technology contribute to great social, economic and environmental development. However, the level of commercialization from universities is limited by the individual academic's own interests, intentions and capabilities to engage in such activities. Some researchers consider entrepreneurial role models to have an influence on the individual academic's entrepreneurial intentions and behaviour. Despite this, several researchers emphasize the lack of studies investigating how role models influence academics towards commercialization activities.

Abstract

In recent years, universities and policymakers have shown increased attention to academic entrepreneurship, with the aim of increasing commercialization from universities. Having entrepreneurial role models is one of the factors that is believed to have an influence. Despite this, research on entrepreneurial role models in the academic context is scarce, and with conflicting findings.

The purpose of this study is to investigate how entrepreneurial role models contribute to increased commercialization rate from universities. In particular, the effect of entrepreneurial role models on other academics' entrepreneurial intentions and behaviour will be investigated. Two research questions have been formulated for this purpose:

> *RQ1: How are academics' entrepreneurial intentions and behaviours influenced by academic entrepreneurial role models?*

> *RQ2: What are the direct and indirect functions of influence from the role model to the role aspirant?*

To answer the research questions and fulfill the purpose of the study, a single case study in a deep technology research community has been chosen as research design. Qualitative semi-structured interviews have been performed with 6 academics who have already shown entrepreneurial behaviour, where the interviewees have been asked about their perception of academic entrepreneurial role models.

The insights gained from this study have provided more in-depth understanding of how different role models influence academics in different ways. Role models seem to influence academics in their perceived probability of succeeding with commercialization, and on their desirability towards commercialization activities. Especially the similarities between the role model and the academic, and thus the academic's perception of the role model, has been pointed out to be an important factor for the type of influence from the role model. These findings provide a possible explanation to the conflicting findings in existing literature.

While most existing studies focus on the quantitative effect of role models on entrepreneurial *intentions*, the findings from this study contribute to existing literature by providing insights on how academics are influenced towards entrepreneurial *behaviour*. Furthermore, the study provides universities and research communities with actionable advice on how to best foster a culture for entrepreneurship, to increase their rate of commercialization. Lastly, the study addresses gaps in the literature with recommendations for further research.

Sammendrag

Det har de siste tiårene vært et økt fokus på akademisk entreprenørskap, med mål om økt kommersialisering fra universiteter. Entreprenørielle rollemodeller er ansett som én av mange faktorer som påvirker kommersialiseringsprosessen positivt. Til tross for dette finnes det begrenset forskning på entreprenørielle rollemodeller i akademia.

Formålet med denne studien er å utforske hvordan entreprenørielle rollemodeller bidrar til økt kommersialiseringsrate fra universiteter. Spesielt effekten av entreprenørielle rollemodeller på andre akademikeres entreprenørielle intensjoner og atferd vil bli undersøkt. To problemstillinger har blitt definert for dette formålet:

> ***Problemstilling 1:*** *Hvordan blir akademikeres entreprenørielle intensjoner og atferd påvirket av entreprenørielle rollemodeller?*

> ***Problemstilling 2:*** *Hva er de direkte og indirekte funksjonene av innflytelse fra rollemodell til akademiker?*

En enkel casestudie i et dypteknologisk forskningsmiljø har blitt utført for å svare på problemstillingene og oppfylle formålet med studien. Kvalitative semi-strukturerte intervjuer har blitt gjennomført med 6 akademikere i forskningsmiljøet, der alle akademikerne allerede har vist entreprenøriell atferd. Akademikerne har blitt spurt om deres oppfatning av akademisk entreprenørielle rollemodeller.

Funnene fra studien har gitt et bedre innblikk i hvordan ulike rollemodeller påvirker akademikere ulikt. Rollemodeller ser ut til å påvirke akademikere i deres oppfattede sannsynlighet for å lykkes med kommersialisering, samt på deres ønske om kommersialisering. Spesielt likheter og ulikheter mellom akademikerne og deres rollemodeller, og dermed akademikernes oppfatning av rollemodellene, ser ut til å være en viktig faktor for hvilken type påvirkning rollemodellene har. Disse funnene gir en mulig forklaring på de motstridende funnene i eksisterende litteratur.

Mens de fleste eksisterende studier fokuserer på kvantitative effekter av rollemodeller på entreprenørielle *intensjoner*, bidrar denne studien til eksisterende litteratur ved å belyse hvordan akademikere blir påvirket til entreprenøriell *atferd*. Videre gir studien konkrete råd til forskningsmiljøer angående hvordan de kan fremme en kultur for entreprenørskap, og dermed øke grad av kommersialisering fra universitetet. Studien belyser i tillegg mangler i litteraturen og kommer med anbefalinger for videre forskning.

Preface

I consider myself a research scientist. For as long as I can remember, I've sought to find explanations of observed phenomena, and change what should be changed for the better. From 2012 to 2017 I studied nanotechnology at the Norwegian University of Science and Technology (NTNU), specializing in bionanotechnology, medicine and neuroscience. An urge to utilize research from science and technology and the newest discoveries within exponential technologies led me to NTNU School of Entrepreneurship, in order to obtain the skills and mindsets necessary to be able to commercialize findings from research.

Over the past years, I've grown an interest and desire to understand how humans interact, perceive each other, and are influenced by the actions of others. In this master thesis, I aim to describe the phenomena of role modeling between entrepreneurial academics and research scientists. How can these role models influence their academic peers to commercialize research? How can universities increase their commercialization rate by facilitating for the influence of entrepreneurial role models? How can the individual mind, with its perception of abilities, intentions and desires, be influenced to be more entrepreneurial?

I would like to thank NTNU Technology Transfer AS and CERN Knowledge Transfer for their support and knowledge about research commercialization, and my supervisor Lise Aaboen for valuable support. Finally, I would like to thank all my role models who have influenced me towards commercialization of research.

Silje Uhlen Maurset, 08.03.2020

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List of Abbreviations

CoE	Center of Excellence
ESE	Entrepreneurial self-efficacy
HMN	The Central Norway Regional Health Authority
IP	Intellectual property
NRC	The Research Council of Norway
NTNU	Norwegian University of Science and Technology
NTNU TTO	NTNU Technology Transfer AS
TTO	Technology Transfer Office
USO	University spin-off

Chapter 1

Introduction

Academic entrepreneurship is an evolving research field with a rapid increase in publications and citations on academic entrepreneurship, entrepreneurial universities and university spin-offs for the past 10-15 years (Mascarenhas et al., 2017; Miranda et al., 2018). Generally, the establishment of new ventures contributes to economic growth and development, and includes more individuals in the labour market. Academic entrepreneurship is no exception. In fact, commercialization of science and technology is considered one of the main sources of economic and social development, both regionally and nationally (Aghion and Howitt, 1992).

1.1 Why do we need commercialization of research?

Traditionally, the mission of universities has been education and research (Rothaermel et al., 2007). However, work done at universities does not only benefit the learning outcomes for students or new fundamental knowledge. Just as important, research from universities contributes to many great innovations that benefit society. Especially within science and technology, research is shown to be the main source of innovations (Blanco, 2007). However, many research results are not fully exploited before the product or knowledge is disseminated outside of academia. Commercialization of science and technology is a way of exploiting the results from research within the field, making them available for the rest of society. Research in fields such as materials science, biotechnology and electrical engineering contribute to e.g. the development of better energy storage solutions, new antibiotics, and communication systems, respectively. Without the research done by universities, these developments would not have driven social, economical and environmental development. Thus, commercialization of research often has a high societal benefit.

Due to the possible high social, economic and environmental gain from research res-

ults, many have argued that universities have a "third mission", namely the responsibility for economic development, as well as knowledge dissemination and social development (Etzkowitz and Leydesdorff, 2000). Especially with the Bayh-Dole Act in USA in 1980, where the ownership of inventions went from the inventor to the university, the universities' commercialization responsibilities were put in focus. With the Act, commercialization of science and technology from universities was mainly done through university technology transfer offices (TTOs). When TTOs were first formed in the 1980s and 1990s, their main activities were patenting and licensing, followed by an increasing trend in commercialization through the formation of university spin-offs (USOs). Today, USOs have become one of the most useful mechanisms for transferring knowledge from universities to companies (Miranda et al., 2018).

1.1.1 Challenges of university commercialization

When working on commercializing research results, engaging the individual researcher and inventor in the commercialization activities could be of importance to fully disseminate the knowledge. This comes with a practical challenge; Many academics are more interested in publications in high ranked journals rather than commercialization (Meyers and Pruthi, 2011), and their involvement in venture creation is often driven by the motives of gaining new insight that would contribute to their own research (Berggren, 2017) or enhancing their own academic position (Fini et al., 2009), rather than by an entrepreneurial attitude. Magnusson et al. (2009) found that there might exist a conflicting interest between patenting and publishing their research. Other barriers for commercialization include the lack of time and skills needed to create a spin-off, and the decision to commercialize might be a result of prior knowledge, skills, and the perception of possible barriers. These individual barriers could lead to lack of university commercialization, even though most researchers are positive towards commercialization activities in general (Bienkowska and Klofsten, 2012; Magnusson et al., 2009). This makes it interesting to investigate which factors influence academics towards commercialization related activities, and how more researchers can be influenced to engage in such activities.

1.1.2 The role of the individual researcher

Despite the fact that there exist barriers for researchers to engage in commercialization activities, there are many examples of researchers who have commercialized their own research, either through the creation of spin-off companies, or patenting and licensing activities. Some studies have aimed to find the differences between researchers engaged in commercialization and researchers who don't believe they have the time

and skills necessary (even though they are positive to commercialization). Magnusson et al. (2009) found that among researchers who have already commercialized some of their research, the majority had already taken courses on entrepreneurship or topics related to commercialization, hence obtaining some of the skills necessary to create a spin-off. Other studies focus on the importance of entrepreneurial intentions, and specifically entrepreneurial self-efficacy, as important factors for academics to engage in commercialization (Prodan and Drnovsek, 2010). There are many factors that could influence individuals' entrepreneurial intentions, and Van Burg et al. (2008) suggest that one of these factors could be having role models who create norms and increase entrepreneurial behaviour among their peers.

1.2 Gaps in the literature

Prior to this thesis, a literature review on entrepreneurial role models in the academic context was conducted by the author during autumn 2018 (Maurset, 2018). Most studies related to the role of the individual researcher in academic entrepreneurship have investigated factors affecting academics toward entrepreneurial activities, such as research field, entrepreneurial skills and education, perceived barriers, number of years spent in academia, organizational context, and leaders and colleagues (Bercovitz and Feldman, 2008; Bienkowska and Klofsten, 2012; Guerrero et al., 2016; Huyghe and Knockaert, 2015; Johnson et al., 2017; Magnusson et al., 2009; Prodan and Drnovsek, 2010). In parallel, the influence of role models for entrepreneurship *in general* has been studied, where the influence on entrepreneurial intentions is the most common link being studied (Auken et al., 2006; Guerrero et al., 2016; Krueger et al., 2000; Smilor et al., 2007; Urbano et al., 2017). Different functions of role models have been studied, including someone who teaches entrepreneurial skills, acts as a motivator, increases self-efficacy, shows that an entrepreneurial career is possible, and as someone who decreases the barriers of entrepreneurship.

Despite the fact that role models seem to be of importance for an individual's entrepreneurial behaviour, there has been limited studies related to role models in the *academic* context. Studies covering this topic are mainly looking at role models as one of several factors influencing an academic towards entrepreneurial activities (Prodan and Drnovsek, 2010), and are not covering the in-depth understanding of the function or influence of the role model itself. Other studies are primarily focusing on students (Auken et al., 2006; Dohse and Walter, 2012; Feder and Niţu-Antonie, 2017; Guerrero et al., 2016; Levie, 2014; Urbano et al., 2017), which is another group of potential entrepreneurs than already established academics.

Among the few studies looking at academics, there seems to be a lack of studies related to how role models influence the skill set of the academics (Maurset, 2018), i.e. more precisely *what* academics learn from observing role models. Additionally, the process of how role models increase entrepreneurial intentions, behaviours, or both, deserves more analysis. For entrepreneurial role models in general, studies have investigated whether it is the role model itself, or the role model's influence on the role aspirant's increased self-efficacy, that increases the role aspirant's entrepreneurial intentions (Feder and Niţu-Antonie, 2017; Krueger et al., 2000). In the academic context, the number of studies on this topic is limited, with the lack of consistent findings. The findings from Huyghe and Knockaert (2015) show that role models increase self-efficacy, and they argue that it is the increased self-efficacy that increases entrepreneurial intentions among the academics. In contrast, Prodan and Drnovsek (2010) found no significant correlation between role models and increased self-efficacy, even though both role models and self-efficacy had significant positive correlations with entrepreneurial intentions.

1.3 Purpose of the study

Due to the gaps in the literature as mentioned above, the following purpose of the study has been outlined:

> *To investigate how academic entrepreneurial role models contribute to increased commercialization rate from universities.*

Through this investigation, the author aims to provide an in-depth understanding of how academics get influenced by their entrepreneurial peers and how the role model changes the academic's engagement in entrepreneurial activities leading to increased commercialization rate. Entrepreneurial role models could potentially lead to increased commercialization rate in other ways, however, this study focuses on their influence on other academics' engagement in entrepreneurial activities according to the above-mentioned gaps in the literature.

By "entrepreneurial activities", the author refers to the process of establishing a university spin-off, and not patenting and licensing to a third party. "Academic" refers to a research scientist with at least a master degree, preferably a PhD, in science and technology. "Academic entrepreneurial role model" refers to an academic who has already shown entrepreneurial behaviour by engaging in university spin-off creation, and whom other academics see as someone who has carried out tasks and roles related to commercialization of research.

1.3.1 Research questions

The thesis aims to investigate the influence of entrepreneurial role models for academic entrepreneurship, with the following research questions:

> **RQ1:** *How are academics' entrepreneurial intentions and behaviours influenced by academic entrepreneurial role models?*

The first research question seeks to explore to which extent entrepreneurial role models have changed the academic's entrepreneurial intention and/or behaviour, focusing on the outcome for the role aspirant. Both "intention" and "behaviour" are included, as the specific influence of the role model is a debated topic (Feder and Niţu-Antonie, 2017; Liñán et al., 2011; Prodan and Drnovsek, 2010). "Entrepreneurial intentions" refer to the intentions of establishing a USO, while "entrepreneurial behaviour" refers to the actions of establishing the USO. "Entrepreneurial motivation" refers to the individual's personal motivations for establishing a USO.

Intentions are "assumed to capture the motivational factors that influence a behaviour" (Ajzen, 1991). Motivation could be the triggering factor from intentions to behaviour, however, a direct connection between intention and behaviour is missing (Adam and Fayolle, 2015). Therefore it is of interest to investigate whether role models influence intentions, behaviour, or both. Could it be that role models only influence intentions or motivation, and that behaviour is a natural consequence of this? Or do the academics already possess entrepreneurial intentions and motivation, but they need role models to show how to carry out entrepreneurial tasks or to demonstrate the attainability of academic entrepreneurship? Research question 1 focuses on the changed intention, motivation and/or behaviour of the *role aspirant*. To better understand the variations of influence on the role aspirant, the different outcomes as a result of the role model itself will also be investigated. Hence, a second research question is formulated:

> **RQ2:** *What are the direct and indirect functions of influence from the role model to the role aspirant?*

Research question 2 seeks to understand the specific functions of the role models, i.e. how different actions or characteristics of them influence the role aspirant in different ways, and what specific functions they have on the role aspirant's intention, motivation and behaviour. The literature show inconsistent findings on this topic, suggesting either a direct or indirect influence of role models (Feder and Niţu-Antonie, 2017; Huyghe and Knockaert, 2015; Krueger et al., 2000), some suggesting that role models only have an effect if they change the role aspirant's mindset and self-efficacy.

The specific functions of the role models will therefore be studied. Some of these functions can be: "teaching skills or showing what behaviour is necessary", "showing the attainability of research commercialization", "increasing self-efficacy of the role aspirant", "changing the perceived desirability of research commercialization", or "changing the perceived barrier for commercialization". While Research question 1 seeks to understand whether the role model changes the role aspirant's intention, motivation and/or behaviour, Research question 2 seeks to understand the processes that drive these changes.

1.4   Contribution

With the collected data, the study aims to understand to which extent role models influence commercialization of research from universities, and more specifically how role models contribute to academics' entrepreneurial behaviour. Such understanding has so far been limited in previous studies, were role models as an indicative factor for entrepreneurial *intentions* has been studied, but not necessarily the effect on entrepreneurial *behaviour*.

Furthermore, the study aims to explore and understand the underlying factors in the role modeling process in academic entrepreneurship, and the interplay between academics in this context, to provide deeper understanding of *how* academics are influenced towards entrepreneurial behaviour. Such understanding in the academic context has so far been very limited, and consequently, this gap will be addressed. Additionally, the study aims to provide deeper insight into the direct or indirect effect of role models, and more specifically the role of self-efficacy in the role modeling process, a topic which lacks consistent findings in existing literature.

Ultimately, the study aims to provide tools for universities on how to increase entrepreneurial behaviour among their academics by using entrepreneurial role models as influencers, hence increasing their level of commercialization of research from science and technology and fulfilling their third mission; social, economic and environmental impact.

1.5   Structure of the thesis

The thesis is structured into 6 chapters. Table 1.1 gives an overview of the content of each of the chapters.

Chapter 1	The introductory chapter presents the reasons for investigating the influence of entrepreneurial role models in academic entrepreneurship, as well as gaps in the literature on this topic. The purpose of the thesis, as well as two research questions with explanation of key terms have been presented.
Chapter 2	Chapter 2 presents relevant theory related to academic entrepreneurship, social theory including the influence of role models, and entrepreneurial role models in the academic setting. Finally, a theoretical framework for the role modeling process is presented.
Chapter 3	Chapter 3 presents the methodology of the study, presenting the methods being used when planning and conducting the study as well as analysing the data. Additionally, reflections and limitations on the methods used are included. The chapter also includes information about the case and the interviewees participating in the study.
Chapter 4	In this chapter, the data from the study is analysed and linked to the theoretical foundation. The chapter also provides answers to the research questions.
Chapter 5	Chapter 5 discusses how the findings from the study contribute to existing literature on entrepreneurial role models in academia, and whether the findings are of interest for other research communities.
Chapter 6	The final chapter presents a summary of the findings, including implications for university managers, TTOs, research communities, and individual academics. Limitations and suggestions for further research are also presented.

Table 1.1: *Structure of the thesis, giving an overview of the topics covered in each chapter*

Chapter 2

Theoretical Foundation

This chapter presents theory relevant for understanding the influence of entrepreneurial role models in academia. Firstly, an introduction to academic entrepreneurship and factors influencing the individual academic towards entrepreneurial activities is presented, followed by social theory including self-efficacy, expectancy-value theory, and role models. Theory about entrepreneurial role models, including their characteristics and functions, constitutes the main part of the chapter. Finally, a theoretical framework for the role modeling process in academic entrepreneurship is presented.

2.1 Academic entrepreneurship

Academic entrepreneurship is by many understood as the "development and commercial exploitation of technologies pursued by academic inventors through a company the (partly) own" (Perkmann and Walsh, 2007), however, several definitions exist. A commercial exploitation can be patenting and licensing of technology to an external party, or through the formation of new firms known as university spin-offs (USOs). Other conceptions of academic entrepreneurship include "the attempt to increase individual or institutional profit, influence, or prestige through the development and marketing of research-based projects" (Louis et al., 1989), "all commercialization activities outside of the regular university duties of basic research and teaching" (Klofsten and Jones-Evans, 2000), or "any form of technology transfer which has some commercial benefit" (Jain et al., 2009). The focus on this thesis has been the commercial exploitation by the academic inventors through a university spin-off.

When looking at how universities can increase their levels of commercialization, factors such as organizational policies and structures, organizational culture, the external environment, and characteristics of individuals are considered important (O'Shea et al., 2007). Success factors seem to be an entrepreneurial ecosystem (Maroufkhani et al.,

2018; Stam, 2015), mechanisms from the university and the TTO to foster the formation of USOs (Berbegal-Mirabent et al., 2015), team composition (Ferretti et al., 2018), and the academic's motivation for firm formation (Rizzo, 2015). The focus on this thesis lies on the individual academic, and more specifically his/her own intentions and motivation for entrepreneurial behaviour.

2.1.1   Factors influencing academics towards commercialization

Looking further into the role of the individual academic in commercialization activities, the mechanisms for successful university commercialization seem even more complex. Firstly, there exist individual factors such as entrepreneurial skills (Magnusson et al., 2009), mindset (Johnson et al., 2017), desirability (Berggren, 2017; Bienkowska and Klofsten, 2012; Magnusson et al., 2009), and other personality traits more open to entrepreneurial activities. Secondly, there exist individual factors more specific to the academic context that determine the probability of an academic pursuing an entrepreneurial journey. The academic field is of importance for commercialization activities, as some fields focus more on theory or fundamental research, while other fields are more applied (Magnusson et al., 2009). In addition, number of years in academia, as well as position, could determine whether an academic pursue commercialization activities (Bercovitz and Feldman, 2008; Prodan and Drnovsek, 2010). With less years in academia, and without a permanent position, it is seen as easier to change career and learn other skills necessary for entrepreneurship. Magnusson et al. (2009) have also pointed out that engagement in entrepreneurial activities is higher among academics who have already taken courses on entrepreneurship, suggesting that the decision to commercialize is a result of skills rather than attitude.

There also exist several barriers for academics to engage in entrepreneurial activities. Magnusson et al. (2009) pointed out the lack of time, lack of skills, and the feeling of not having the necessary skills to start a spin-off as reasons preventing academics from taking part in entrepreneurial activities. In addition, academics were found to be less positive to patenting compared to commercialization, signalling that there could be a conflicting interest between patenting and publishing. If the academic's focus lies on getting publications in high-ranked journals, this needs to be done *after* a potential patent application.

Several studies have investigated both individual and external factors influencing academics towards commercialization activities. In 2010, Prodan and Drnovsek (2010) pointed out the knowledge gaps of the specific determinants and processes that lead to academics' entrepreneurial intentions and activities, thus investigating this topic.

In addition to type of research, patents, and number of years spent at the academic institution, their results showed that entrepreneurial self-efficacy and perceived role models were significantly related to the academics' entrepreneurial intentions.

Among external factors influencing the individual academic, the importance of organizational culture and context has been pointed out (Guerrero and Urbano, 2012; Huyghe and Knockaert, 2015; O'Shea et al., 2007). Successful entrepreneurial universities where the individual academics have a high degree of motivation for entrepreneurial activities seem to have a culture that encourages entrepreneurship, and where entrepreneurship is looked upon as favorable (O'Shea et al., 2007). An organizational culture where entrepreneurship is part of the university's mission seems to increase the academics' intentions to engage in USO creation (Huyghe and Knockaert, 2015). Both leaders and colleagues are part of this organizational culture, and may influence entrepreneurial intent differently (Johnson et al., 2017). Some of these leaders and colleagues can act as entrepreneurial role models, who positively impact the university community and entrepreneurial intent among the academics (Guerrero and Urbano, 2012; Johnson et al., 2017).

2.2 Social theory

The role modeling process is seen as a social phenomenon (Morgenroth et al., 2015; Zozimo et al., 2017). In order to better understand the influence of entrepreneurial role models on individual academics, social theory related to self-efficacy and expectancy-value will be presented. The theory of expectancy and value, including self-efficacy, offers a prerequisite for understanding the influence of role models on the role aspirant's goals and motivation.

2.2.1 Self-efficacy

Self-efficacy is a social cognitive model of motivation described by Bandura (1997). His definition of self-efficacy is the "individuals' confidence in their ability to organize and execute a given course of action to solve a problem or accomplish a task" (Eccles and Wigfield, 2002). The main concept in the theory of self-efficacy is the role of perceptions of efficacy, characterized by strength, generality, and difficulty, and focuses on the expectancy for success. Some people may have a strong sense of capability to perform a task (i.e. strong self-efficacy), while others believe they are not able to (lack of self-efficacy). Some may believe they are able to perform a task even when they are not, while others believe they are not able to perform even the easiest tasks. Self-efficacy is measured in the perceived ease or difficulty in performing a behaviour

(Ajzen, 2002), and is often associated with the perceived controllability of the situation, i.e. to what extent performing the behaviour is up to the actor.

Several studies have investigated the self-efficacy and controllability of individuals in certain situations, such as engaging in regular exercise, attaining a certain grade, or stick to a certain diet (Ajzen, 2002). In these studies, self-efficacy has been found to account for variance in both intentions and behaviour. Individuals with higher degree of self-efficacy are more capable of setting higher goals and remain persistent even in challenging situations to achieve these goals. They are also more capable of seeing mistakes as something to learn from, while people with lack of self-efficacy have a tendency to fear challenging situations and believe mistakes are results of their lack of capabilities to perform the task (Bandura, 1997).

Self-efficacy is a result of previous experiences and mastering of tasks, and has to be tailored to the domain of task being assessed (Bandura, 1982). Experience from mastering a challenging task will thus increase self-efficacy in similar tasks. Similarly, experience from not mastering a task could decrease the individual's self-efficacy. This could explain why people who see mistakes as positive have higher self-efficacy, as they have remained persistent and finally mastered the task, and they have mastered even more challenging tasks compared to a person with lower levels of self-efficacy. This will in turn further increase their self-efficacy.

2.2.2 Self-efficacy in entrepreneurship

When it comes to self-efficacy in entrepreneurship, the concept of entrepreneurial self-efficacy (ESE) explains how individuals believe they are capable of performing tasks and roles related to entrepreneurship (Chen et al., 1998; Scherer et al., 1989). When measuring entrepreneurial self-efficacy, one can refer to specific tasks involved in running one's own business. Five domains are included in the ESE theory: Marketing, innovation, management, risk-taking, and financial control (Chen et al., 1998).

Studies of ESE among students and small business owners show that ESE is positively related to entrepreneurial intentions. Entrepreneurship students were found to have higher self-efficacy in marketing, management and financial control compared to management and psychology students, and founders had higher ESE scores in innovation and risk taking compared to non-founders (Chen et al., 1998). Consistent with these findings, Prodan and Drnovsek (2010) suggest self-efficacy to be the greatest predictor for entrepreneurial intentions. When believing you master certain tasks, you perform them more often and easier. Similarly, when believing you are not able to perform

certain tasks, you may avoid them. These results may imply that some individuals avoid entrepreneurial activities because they *believe* they don't have the necessary skills to do so, and not because they *actually* lack the skills necessary.

2.2.3 From entrepreneurial intentions to behaviour

In general, intention is seen as "the most immediate and important predictor of a person's behavior" (Sheeran, 2002). When looking at how to increase the commercialization rate from universities, not only entrepreneurial intentions are of interest, but more importantly entrepreneurial *behaviour*. Entrepreneurial intention is a topic being studied in the literature of academic entrepreneurship. Even though entrepreneurial intentions is often seen as a precursor for entrepreneurial behaviour (Douglas and Fitzsimmons, 2013; Lee and Wong, 2004; Thompson, 2009), a direct link between entrepreneurial intention and behaviour hasn't been established (Adam and Fayolle, 2015). Only a limited number of studies have investigated the link between entrepreneurial intention and entrepreneurial behaviour, where the variance in entrepreneurial behaviour explained by entrepreneurial intentions only count for 37 % (Schlaegel and Koenig, 2014).

As a response to the missing link between entrepreneurial intention and behaviour outlined by Fayolle and Liñán (2014), Adam and Fayolle (2015) studied the role of commitment and implementation intention as an attempt to bridge the gap between intention and behaviour. Implementation intention implies how you would respond in a given situation, and involves an automated initiation of the specific behaviour. People with an implementation intention commit themselves to this plan of where and when they initiate this behaviour. It is shown that implementation intention increases the probability to act (Sheeran and Silverman, 2003), but only if the person is motivated to reach his or her goals (Adam and Fayolle, 2015).

Motivation could be the link between entrepreneurial intentions and behaviour (Carsrud and Brännback, 2011). According to Adam and Fayolle (2015), motivation can be the triggering factor from intentions to behaviour, while commitment to the task takes over when motivation drops, ensuring persistence in the entrepreneurial journey. Thus, motivation seem to be the initiator to entrepreneurial behaviour, while commitment seem to help individuals stick to their intentions over time.

2.2.4 Expectancy-value theory

Theories of expectancy-value are often included when looking at motivation to achieve a certain goal (Morgenroth et al., 2015), and is relevant as one piece of the puzzle when looking at the motivation for individuals to perform entrepreneurial tasks. Expectancy is defined as "the subjectively perceived probability of success", and value as "the subjective desirability of a goal and goal-related behaviours". Hence, an individual's motivation to reach a certain goal is a result of both his/her desirability of the goal, and his/her beliefs in being able to reach the goal. You wouldn't be motivated to perform a task if you didn't believe you would be capable of doing it or that the task would lead to the achievement of the goal, and you would neither be motivated to perform the task if the achievement didn't lead to a desirable outcome.

Bandura (1997) distinguishes between two different expectancies when it comes to individuals' beliefs: 1) Outcome expectations, believing that a certain behaviour will lead to a certain outcome, and 2) self-efficacy, meaning the individuals' belief that they are able to perform the behaviours necessary to produce the outcome. These two expectancies are different because an individual may believe a certain behaviour lead to a certain outcome, but may not believe he or she is able to perform such a behaviour. Bandura also proposes that the efficacy expectations of individuals are the major factors of goal setting, persistence and effort, which all are factors important in entrepreneurship.

Eccles and Wigfield (2002) state that the context in which the expectancy and motivational theories are applied should be taken into consideration, and that it is difficult to understand the individual's motivation without understanding the context they are experiencing. The presence of role models could be seen as such a context, which is why the expectancy-value theory is combined with the theory of role models in order to understand the influence role models have on the role aspirants' goals and motivation.

2.2.5 Role models in general

The literature of role models is fragmented and lacks clear definitions on what role models do and who they are (Morgenroth et al., 2015). Originally, Merton (1957) used the term referring to individuals in specific roles who served as behavioural examples of the role they possessed. In more recent literature, the term role model has been associated with different functions, including 1) a behavioural model, such as how to perform a task or skill; 2) representations of the possible, showing oth-

ers that a certain goal is attainable; and 3) inspirational sources where they make a goal desirable (Morgenroth et al., 2015). Role models can be described as "individuals who influence role aspirants' achievements, motivation, and goals" by acting as one of the functions mentioned above. Role models can be found in a variety of settings; upbringing, social relations, at the workplace, in our hobbies, or as media icons.

2.2.6 Role models as contributors to expectancy and value

According to Morgenroth et al. (2015), role models are seen "as a way of motivating individuals to set and achieve ambitious goals". They focus on three different perceptions of the role model leading to increased expectancy and value for the role aspirant.

1. Those who embody a relevant goal for the role aspirant, and represent how these goals are achieved, are seen as *behavioural models*. Goal embodiment, i.e. the degree to which the role model has reached the role aspirant's goal, is linked to the motivation the role model is capable of passing on to the role aspirant. High levels of goal embodiment increase the success of vicarious learning from the role model, which in turn increases the expectancy.

2. Role models can also be seen as someone who represents what is possible or achievable, where they demonstrate the *attainability* of a goal. This function of the role model changes the self-stereotyping and the perception of external barriers, hence increasing expectancy for the role aspirant. This is done when there exist a shared social identity, such as gender or academic background, between the role model and the role aspirant. Attainability is linked to a potential future similarity between the role model and the role aspirant, where the role aspirants can imagine themselves having the position or competences as the role model in the future. When they observe how a role model reaches a goal (goal embodiment), and combine it with the perception of themselves being like the role model, they are likely to believe they can reach the goal themselves.

3. The third function of a role model sees the role model as someone who influences what the role aspirant finds *desirable* (Morgenroth et al., 2015). The social identity approach proposed by Turner et al. (1994) suggests that people generally want to be like the people in our in-group, and both shared group membership and similarity is important factors influencing the desirability of the role model.

In the motivational theory of role modeling proposed by Morgenroth et al. (2015), the three functions of role models are combined into a theory of how role models

influence role aspirants. The role model and role aspirant attributes are combined with the perception of the three role modeling qualities; goal embodiment, attainability, and desirability, and these factors influence role modeling processes resulting in a changed perception of the goals and goal related behaviour in terms of expectancy and value. Increased expectancy and value lead to the acquisition of new skills, increased motivation, reinforcement of the goals, and adoption of new goals. These role modeling outcomes may in turn change the attributes of the role aspirant. Hence, the theory can be seen as a cyclical process.

2.3 Entrepreneurial role models

Several studies have shown correlation between the presence of entrepreneurial role models for the individuals' entrepreneurial intentions and activities (Auken et al., 2006; Bosma et al., 2012; Fellnhofer and Mueller, 2018; Oppedisano and Laird, 2006; Wyrwich et al., 2016; Zozimo et al., 2017). In the sociology of entrepreneurship, Thornton (1999) found that peers and role models are important drivers for entrepreneurship. Studies have highlighted the positive influence entrepreneurs have on their children in the choice of self-employment (Hoffmann et al., 2015; Mungai and Velamuri, 2011), as well as the role model influence when it comes to nascent entrepreneurs (Bosma et al., 2012). Bosma et al. (2012) found that 54 % of the entrepreneurs in their study had a role model - and that 1/3 of them would not have started up their venture if the role model had not been present.

2.3.1 Characteristics of the role models: Who are they?

There exist variations regarding the type of role models and their relation to the role aspirant that have been studied. Some authors have suggested that both leaders and peers can affect the academics in their interest and intentions for commercialization (Bercovitz and Feldman, 2008; Tartari et al., 2014; Van Burg et al., 2008). This has been investigated by Johnson et al. (2017), where they specifically distinguished between influence from leaders and colleagues. Their findings suggest that both leaders and colleagues are able to influence the academics, and that leaders can affect the commercialization intentions of the academics either directly by acting as a role model engaging in formal or informal commercialization activities, or indirectly by engaging the colleagues of the group. The latter supports the work of Huyghe and Knockaert (2015), who determine role models as a part of the university culture as a whole. The two studies have looked at influence from both leaders and colleagues, but with a different focus. Huyghe and Knockaert (2015) let the respondents determine who their role models were, and from here found both categories present, while Johnson et al.

(2017) specifically selected for both leaders and colleagues in their study. However, both studies suggest the same findings: that both colleagues and leaders can act as role models and influence their peers towards entrepreneurial activities.

In a qualitative study of how entrepreneurs in general learn from observing role models, Zozimo et al. (2017) investigated where and how entrepreneurs observed their role models. The participants identified their role models at home, as fellow students, or colleagues at work. This is supporting the work of Bosma et al. (2012), who demonstrates that the typical role model is not media icons, but rather someone at the workplace of the role aspirant. Huyghe and Knockaert (2015) argue that since individuals are affected by peers within their organization, and academics are exposed to a peer-oriented culture, they are likely to be influenced by their peers. Studies have also investigated role models influencing students in class, either as entrepreneurs in lectures (Feder and Niţu-Antonie, 2017; Levie, 2014), when linking students with alumni entrepreneurs (Trequattrini et al., 2018), or when using role models as external guest-lecturers for students (Zozimo et al., 2017), all showing increased motivation and entrepreneurial intentions among the students.

2.3.2 Functions of the role models

When the functions of role models in relation to their role aspirants have been studied, there exist recurring functions being mentioned, including the influence on entrepreneurial intentions, demonstrations of the possible, reduced barriers, and increased self-efficacy (Bosma et al., 2012; Prodan and Drnovsek, 2010). The function as someone who increases entrepreneurial intention is the most common link being studied (Auken et al., 2006; Dohse and Walter, 2012; Johnson et al., 2017), where a significant positive correlation has been found (Huyghe and Knockaert, 2015; Prodan and Drnovsek, 2010).

Role models can also indirectly affect entrepreneurial intentions. One way of doing so is by affecting behavioural characteristics, which in turn affect entrepreneurial intentions (Feder and Niţu-Antonie, 2017). Another indirect effect on entrepreneurial intentions was found by Krueger et al. (2000), stating that role models only affect entrepreneurial intentions if the change attitudes and beliefs of the role aspirant.

Role models can have a positive effect on the individual's attitudes and mindset towards entrepreneurship (Fellnhofer and Puumalainen, 2017), such as having a positive impact on students' perceived desirability and feasibility to start a business, or by reducing the fear of failure for the role aspirant (Wyrwich et al., 2016). Guerrero and

Urbano (2012) argue that these attitudes are all results of several unique factors at each university, such as education, reward systems and role models. Role models can signal that success is achievable, and that commercialization of research is possible.

As mentioned in Section 2.2.6, Morgenroth et al. (2015) suggest that generic role models are in the possession of especially three functions; 1) behavioural models from whom we learn particular skills and behaviours, 2) representations of the possible, showing that a certain goal is attainable, and 3) as inspirational sources. Other studies have shown similar functions: "learning by example", "learning by support", "increasing entrepreneurial self-efficacy" and "inspiration/motivation" (Bosma et al., 2012). Venkataraman (2004) studied the function of entrepreneurial role models as "possibility proof", and argues that there is no better way to make a challenging venture creation process seem feasible than knowing somebody who has already done it, suggesting the functions of role models to be a representation of the possible.

Several studies have investigated how role models contribute to entrepreneurial self-efficacy (Bosma et al., 2012; Huyghe and Knockaert, 2015; Krueger et al., 2000; Prodan and Drnovsek, 2010; Scherer et al., 1989). The studies related to self-efficacy have varying findings, and will be presented in the following section.

2.3.3 Role models as contributors to entrepreneurial self-efficacy

Even though several researchers have found positive correlation between the presence of entrepreneurial role models and an individual's own entrepreneurial intention, activities or skills, chances are that these outcomes are not direct effects of the role model, as Krueger et al. (2000) suggest. In 2011, Liñán et al. (2011) concluded that the direct role model effect on entrepreneurial intentions needed further research. Later on, Feder and Niţu-Antonie (2017) argued that environment-specific entrepreneurial role models are only indirect precursors for entrepreneurial intentions, i.e. that there is no direct link between role models and entrepreneurial intentions; however, that the influence is mediated via the behavioural characteristics (personal attitude, perceived behavioural control and subjective norms) of the role model. This suggests that role models are of no benefit themselves, but that the behaviours, skills and learning they bring with them are indeed beneficial for inspiring students and peers towards entrepreneurship. Similarly, Feder and Niţu-Antonie (2017) suggest that the exposure to role models changes the behavioural characteristics of the role aspirant, and that it is the changes in behavioural characteristics that influence the individual's entrepreneurial intentions.

When studying how role models affect entrepreneurial intentions, Krueger et al. (2000) argue, based on the work of e.g. Scherer et al. (1989), that role models only affect entrepreneurial intentions if they affect the entrepreneurial attitudes such as self-efficacy. Using social learning theory, Scherer et al. (1989) found that individuals with entrepreneurial parents also had increased task self-efficacy and aspirations for training and education. This theory is supported by Huyghe and Knockaert (2015). In their quantitative study on the influence of organizational culture on entrepreneurial intentions among scientists, they found that role models increase the self-efficacy of the academic role aspirant, and that it is the increased self-efficacy that causes the increased entrepreneurial intentions. They argue that the increased entrepreneurial self-efficacy makes the academics feel more confident that they are able to engage in entrepreneurial activities, which is the reason why they choose to do so. All these studies suggest that there is an indirect effect of role models on entrepreneurial intentions and activities, where the increased entrepreneurial self-efficacy is the direct cause of entrepreneurial intentions.

Prodan and Drnovsek (2010) also investigated the role of self-efficacy related to the role modeling process. In their quantitative study of academics' entrepreneurial intentions, they found that both role models and entrepreneurial self-efficacy have a significant and positive correlation with entrepreneurial intentions. They hypothesize that there is a link between perceived role models and entrepreneurial self-efficacy, such as the findings presented by Scherer et al. (1989), Krueger et al. (2000) and Huyghe and Knockaert (2015). However, no significant correlation was found between perceived role models and entrepreneurial self-efficacy. Even though the positive correlation between role models and self-efficacy was not significant, they found that self-efficacy had the highest path coefficient among all their suggested precursors for entrepreneurial intentions, suggesting the same findings regarding the importance of self-efficacy for entrepreneurial intentions. The findings from Prodan and Drnovsek (2010) suggest that there could be other factors that influence the entrepreneurial self-efficacy, instead of or in addition to role models.

As mentioned in Section 2.2.2, Chen et al. (1998) found that entrepreneurial self-efficacy was positively related to the intention of setting up a firm, and that business owners had higher self-efficacy in innovation and risk taking than non-founders. This can either be due to the fact that people with higher self-efficacy are more likely to set up a new firm, or that the process of setting up a new firm increases the individual's self-efficacy. In either way, an increased self-efficacy could be positively related to entrepreneurial intentions and activities. Wood and Bandura (1989) suggest that role models build self-efficacy through comparison with people in the same social setting,

and that people judge their own abilities to be engaged in commercialization activities based on how they compare themselves to others. If people similar to the role aspirants have proven that they successfully can engage in entrepreneurial activities, chances are that the aspirants are able to do it as well, and that they will increase their entrepreneurial self-efficacy by observing entrepreneurial role models. If entrepreneurial academic role models manage to increase the entrepreneurial self-efficacy among their academic peers, this could be influential for their entrepreneurial intentions, desires and actions toward commercializing their own research.

2.3.4   The role aspirant's perception of the role model

As Wood and Bandura (1989) suggest, role models build self-efficacy through comparison with people in the same social setting. Both Morgenroth et al. (2015) and Bosma et al. (2012) mention the importance of being in the same social group or being similar in other ways. According to the motivational theory of role modeling proposed by Morgenroth et al. (2015), the role modeling process involves the role aspirant to take action towards becoming more similar to the role model. This suggests that similarities between the role model and the role aspirant are important in the role modeling process. Bosma et al. (2012) argue that without this similarity, it will be difficult for the role aspirant to perceive the behaviours of the role model as something he or she can accomplish by themselves.

Chen et al. (1998) suggest that the lack of perceived capabilities of engaging in commercialization activities is especially related to women and minority groups, who experience a lack of entrepreneurial role models they can relate to, suggesting that their role models would need to have other characteristics matching the role aspirant's self-perception. Contín-Pilart and Larraza-Kintana (2015) studied whether sociocultural fit for minority groups affect the influence by entrepreneurial role models. More specifically, they studied if the presence of regional entrepreneurial role models had a positive effect on people's decision to become a nascent entrepreneur, if the likelihood of becoming an entrepreneur was smaller for immigrants than natives, and if the influence from the role models increased by decreased cultural distance. Their findings support the theory of Chen et al. (1998), Bosma et al. (2012), and Morgenroth et al. (2015), that the dissimilarities between the role model and the role aspirant are moderators for the role modeling process.

Regarding women, Feder and Niţu-Antonie (2017) take gender into account as an individual variable in the role modeling process towards entrepreneurial intentions,

hypothesizing that gender is a moderator from the behaviour characteristics towards entrepreneurial intentions. Boissin et al. (2011) investigated the students' gender as a moderator for the influence from role models on professional values, vision of entrepreneurship and tension between professional values and vision of entrepreneurship, finding that female students seemed to be more influenced by entrepreneurial role models than male students were. In other words, role models can be perceived differently depending on the characteristics of the role aspirant.

When discussing the functions of entrepreneurial role models, and how role models build self-efficacy, the individual's perception of such role models is clearly of interest. Johnson et al. (2017) studied how the mindset of the academics affected their influence from promotion focused[1] or prevention focused[2] leaders. When studying their influence from leaders and colleagues, they found that academics with different mindset reacted differently when exposed to leaders and colleagues. These findings suggest that the mindset of the academic role aspirant is important when understanding the process and influence from entrepreneurial role models.

2.4 A framework for role modeling

When studying the influence of entrepreneurial role models in the academic context, the author has used the framework proposed by Morgenroth et al. (2015) to highlight relevant variables and develop a conceptual framework for role modeling in academia. In the motivational theory of role modeling described in Section 2.2.6, Morgenroth et al. (2015) presents that role models can act as three different functions: 1) a behavioural model, 2) representing the possible, and 3) being inspirational. The perception of role models is leading to changed expectancy and value for the role aspirant, and in turn motivation, goal adoption, goal reinforcement and the acquisition of new skills, all of which are of relevance when an individual is deciding to change his or her motivation and goals from academic activities towards entrepreneurial activities. The perception of the role model and the role modeling process leading to increased expectancy and/or value will be investigated in the primary research of entrepreneurial academic role models.

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[1]Focus on the perceived benefits and cost of not achieving success (i.e. positive towards commercialization)

[2]Focus on the perceived benefits and costs of avoiding failure
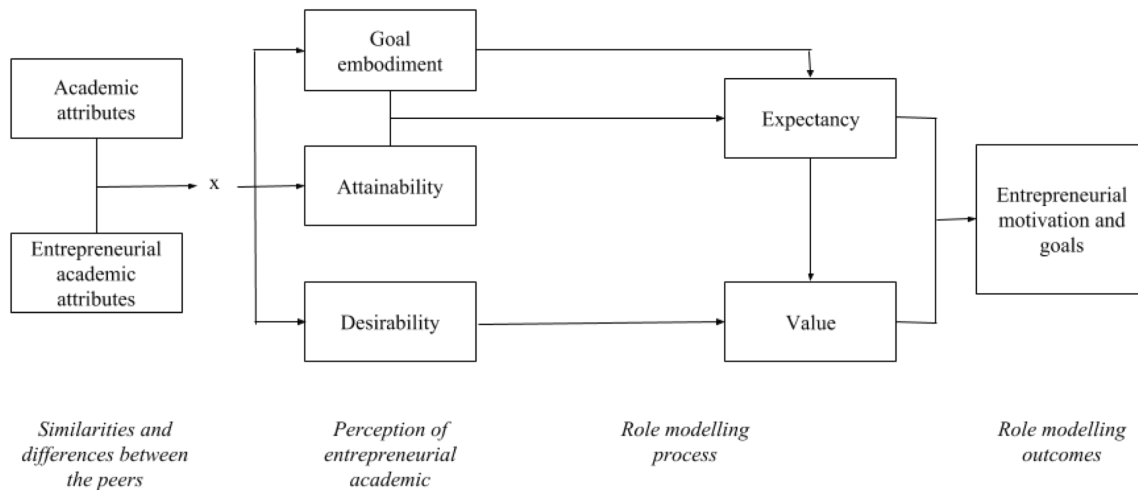
Figure 2.1: *A theoretical framework for the role modeling process between academics (role aspirants) and their respective entrepreneurial academics (role models). The perceptions of the role model, in relation to the three different role model functions, could lead to changed expectancy and value, and in turn changed entrepreneurial motivation and goals. Adapted from Morgenroth et al. (2015)*

2.4.1 The role modeling process in academic entrepreneurship

The study of entrepreneurial academic role models aims to investigate to which extent the presented variables affect the role modeling outcomes in the academic context. Firstly, the similar and different attributes and characteristics of the role model and the role aspirant will be compared and linked to the perception the academic peer has of the role model in terms of goal embodiment, attainability and desirability. Secondly, the process of which these perceptions change the expectancy and value will be investigated. Finally, the author will investigate to which extent potential changed expectancies and values affect the motivation and goal adoption of entrepreneurial activities for the academic.

Figure 2.1 shows a schematic of the different variables that will be investigated in the study. It should be noted that these variables have not been investigated in the academic context, and that the variables only proposes a framework that the author can relate findings to.

Chapter 3

Methodology

In this chapter, the research methods that have been used to explore the research questions for the master thesis will be explained. The research conducted in this thesis consist of two main parts; A literature review and a qualitative multiple case study to add empirical insights from entrepreneurial academics and their role modeling processes. This chapter explains the choice of the qualitative research design, criteria for selection of case and interview objects, how the interviews were conducted, and how the data was analyzed. Figure 3.1 gives an overview of the methodology for the thesis. Finally, the chapter presents the case being studied as well as the background information about the interviewees.

3.1 Research design

For the purpose of the thesis, which has been to investigate how academic entrepreneurial role models contribute to increased commercialization rate from universities by influencing their peers, the personal experiences of the academics being influenced are of high interest. Hence, a qualitative research method has been chosen. A qualitative research design has been used to get a deeper understanding of *how* academics are influenced towards entrepreneurship. The choice of a qualitative research design was made in order to understand and answer the research questions starting with "how" rather than "how many" (Zozimo et al., 2017), and for understanding subjective experiences, social processes and individual experiences of the academics involved (Flick, 2015; Hennink, 2011). The aim has been to find the underlying causes for and processes of influence between academics, in a more detailed way than what is possible from quantitative surveys.

When selecting for a qualitative study methodology, a method that offers analysis of complex social phenomena should be favoured. Understanding complex social
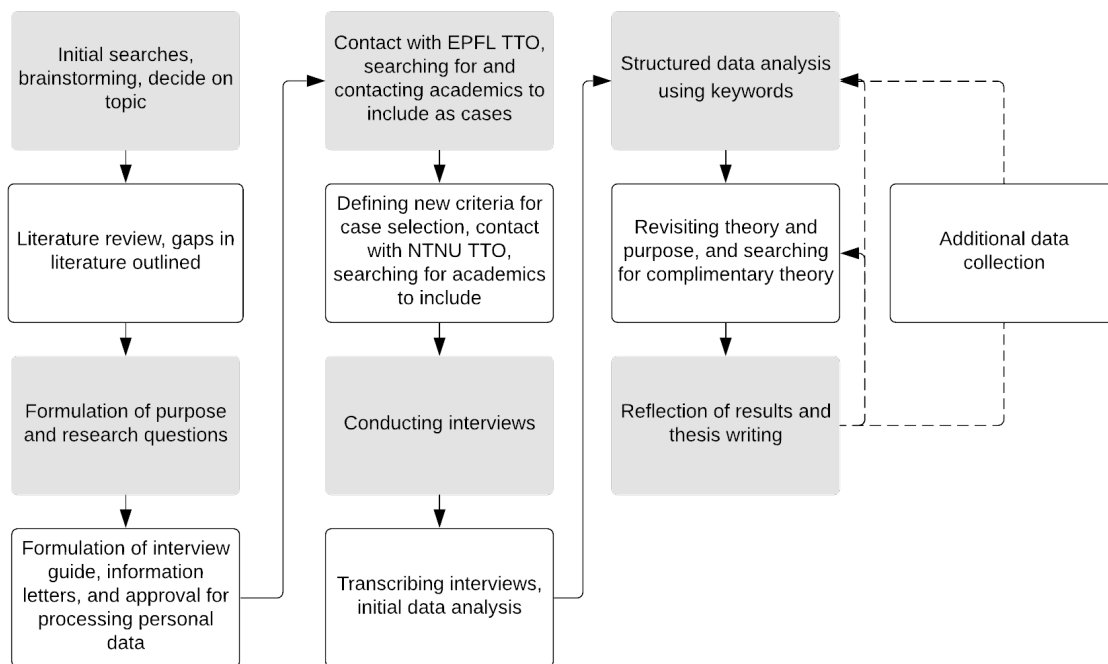
Figure 3.1: *Overview of the methodology of the thesis*

phenomena such as organizational processes, small group behaviour, neighbourhood change and individual life cycles is often done through case studies (Yin, 2009). The author has performed a single case study in order to observe the interplay between peers in a research community. The level of analysis has mainly been on the individual level, focusing on how the entrepreneurial academics perceive entrepreneurial role models around them, and how the entrepreneurial academics have been influenced by other entrepreneurial academics. This analysis has been put in context with the research community, as the culture and social phenomena in a group could be an important factor for the individual role modeling process.

3.2 Empirical data acquisition

The main source of empirical data acquisition has been from semi-structured interviews with academics who have already engaged in entrepreneurial activities. The author has performed interviews with 6 academics who have already engaged in such activities. Additional information has been collected from people who have worked together with the entrepreneurial academics or observed them in the work setting. This has been combined with secondary data from company websites and media articles to provide the data needed to structure the findings according to the theoretical

framework.

3.2.1 Planning of data acquisition

To answer the research questions, the author aimed at performing interviews with academics in a highly entrepreneurial university. An entrepreneurial university would provide many entrepreneurial research milieus as well as plenty of entrepreneurial role models, increasing the chances of an academic to be influenced by entrepreneurial peers. In this way, it would be possible for the author to get a deeper understanding of *how* these role models have influenced the entrepreneurial academics. As the author has been based in Geneva, Switzerland during the time when the data acquisition took place, a natural choice of university would be École Polytechnique Fédérale de Lausanne (EPFL) in Lausanne, Switzerland. EPFL is known for having plenty of university spin-offs in the fields of biotechnology, medical technologies, robotics, nanotechnology, sensors and energy (EPFL, 2017).

However, due to difficulties of getting in contact with relevant research milieus and potential interviewees, as well as with the EPFL technology transfer office, the author decided to continue the case selection and data acquisition from the Norwegian University of Science and Technology (NTNU) in Trondheim, Norway. The author already has knowledge about the research milieus at NTNU, including entrepreneurial academics and the work of the technology transfer office at the university.

3.2.2 Criteria for case selection

The main objective of this thesis has been to investigate how academics are influenced by entrepreneurial role models towards engaging in entrepreneurial activities, consequently increasing commercialization rate. As mentioned in Section 3.1, a single case study has been chosen in order to observe the interplay between peers in a research community. As mentioned in Section 2.1.1, the field of research plays an important role in academics' motivation for and engagement in entrepreneurial activities. Therefore, to avoid the field of research to be an uncontrolled factor in the study, the case being studied should be a research community composed of academics with common or closely related fields of research. As the number of entrepreneurial academics within a single research group is limited, the author has included related research groups in the single case.

As mentioned in Chapter 1, commercialization of science and technology is considered one of the main sources of economic and social development. Hence, a case within

science and technology has been preferred. The author has chosen the research community within deep technology at NTNU as the case being studied. Deep technologies are based on scientific discoveries, engineering innovation, chemistry, materials science, physics, mathematics, and/or medicine (Gaddy et al., 2017). Computer science has been excluded, as software solutions usually have a different commercialization process than hardware. Scientific discoveries including a physical product based on laboratory work usually involves comparable processes for commercialization. These processes are usually more complex, and this could be a relevant factor to the individual academic's own intentions of engaging in such activities.

3.2.3 Criteria for selection of interviewees

To acquire relevant information that would contribute to explaining the process of entrepreneurial role model influence on academics, where the individual academics are in focus, several individual academics have been selected as interviewees withing the case. The interviewees were selected based on a number of criteria. Firstly, the interviewee should be an academic in affiliation with NTNU, either previously or currently. This ensures that all interviewees are part of the community and culture at the same university. Secondly, the interviewee should have conducted research within science and technology, focusing on deep technologies such as nanotechnology, materials science, cybernetics, biotechnology or medical technologies (not software/ICT), during his/her period of association with NTNU. This increases the chance of the interviewees being influenced by similar factors for commercialization, such as research field and external barriers. Finally, the interviewee should be, or previously have been, involved in the processes of research commercialization within his/her fields of expertise, specifically the process of creating a university spin-off.

The first two criteria ensures the interviewee matches the criteria for the case. The final criteria selects for academics who are or have already been entrepreneurial. These academics have already shown entrepreneurial behaviour, and not only entrepreneurial intention. As this thesis investigates how role models influence commercialization rate, it is of interest to study the process towards entrepreneurial behaviour rather than entrepreneurial intentions only. When selecting for interviewees who have shown entrepreneurial behaviour, the author is able to investigate whether role models influence entrepreneurial intentions or behaviour, or both. This wouldn't have been possible if the interviewees had shown entrepreneurial intentions only.

Most of the related studies in the field have investigated the influence of role models on entrepreneurial intentions or behaviour, using a quantitative method. Many of these

have included academics without prior entrepreneurial behaviour as participants (Bercovitz and Feldman, 2008; Huyghe and Knockaert, 2015; Johnson et al., 2017; Krueger et al., 2000; Prodan and Drnovsek, 2010). Only a few qualitative studies on entrepreneurial behaviour exist, where e.g. the more general study by Zozimo et al. (2017) have interviewed entrepreneurs already showing entrepreneurial behaviour. Other studies focusing on academic entrepreneurship have included both academic entrepreneurs as well as people in the entrepreneurial community at the university (O'Shea et al., 2007). It seems to be a pattern that quantitative studies investigating entrepreneurial intentions include all academics, regardless of the participants' entrepreneurial behaviour, while qualitative studies on entrepreneurial behaviour select for interviewees who have already shown such behaviour. This study is an addition to the very limited qualitative studies on role model influence on entrepreneurial behaviour.

The interviewees being selected in the case have been selected to highlight different aspects of the entrepreneurial role modeling process. Some of the interviewees have previously been employed by NTNU, and are now working in a university spin-off based on their field of research. These academics have clearly showed entrepreneurial behaviour, and it is interesting to investigate how the influence of entrepreneurial role models affected their choice of behaviour. Other interviewees have previously worked in a university spin-off and are now back in academia. These academics could also have been influenced by role models, but they may also have been role models themselves and influenced current academic entrepreneurs. The final perspective covered by the interviewees is the one from aspiring entrepreneurs; academics who are interested in pursuing an entrepreneurial path and are involved in the early stages of a USO creation, but haven't yet spun out a company from the university. These academics may see the process differently, as they are currently in the middle of the process and haven't experienced any success of USO creation yet.

Before selecting cases and interview objects, the author was in contact with NTNU Technology Transfer (NTNU TTO). NTNU TTO works on creating value out of research results from NTNU and the Central Norway Regional Health Authority (HMN), and its goal is to secure, manage, develop, market and sell rights of use of knowledge, ideas and inventions from the respective research institutes (NTNU Technology Transfer AS, 2020). NTNU TTO has a good overall knowledge about commercialization of research from NTNU, and has the knowledge and network to suggest appropriate candidates among entrepreneurial academics at NTNU based on the above-mentioned criteria for the thesis.

Regarding the current entrepreneurs, NTNU TTO recommended interviewing previ-

ous researchers in a research project with funding from FORNY or NTNU Discovery (see Section 3.6.3), where the researchers had contributed in the commercialization process and started working for the spin-off company. One of the interviewees was a direct recommendation from NTNU TTO. The two other interviewees in this category were selected based on the author's prior knowledge of entrepreneurial academics who would fit the criteria, as well as by recommendations from early career researchers on who they see as entrepreneurial role models.

When selecting for aspiring entrepreneurs, the author has aimed at not selecting academics with less than 50 % of their work consisting of research, such as professors occupied with lecturing and supervising, because these academics might possess other reasons for not commercializing own research. According to Prodan and Drnovsek (2010), years spent in an academic institution has a negative correlation with entrepreneurial intentions, and unlike PhD students and postdocs, established professors already have a secured job in academia. PhD students and postdocs are often more formable than professors, and this group of academics could be a more successful group to target when it comes to impact of their future career choices. Master students and undergraduate students have not been selected as interviewees due to a number of reasons. Firstly, they often don't work in an equally close working environment with the role models like the PhD students or postdocs. Secondly, they haven't achieved an equally in-depth knowledge of their research field like the PhDs or postdocs. Finally, students often possess greater variety in career plans compared to PhD students or postdocs who have already chosen a more academic career pathway.

When selecting for interviewees who have already engaged in entrepreneurial activities and are now back in academia, professors with less than 50 % of their work consisting of research has been accepted, as it is their previous behaviour that is of interest for the study. The two interviewees in this category were selected based on recommendations from other interviewees, the author's prior knowledge, as well as from discussions with younger researchers about their entrepreneurial role models.

3.3 Executing data acquisition

The empirical data has been collected through semi-structured interviews with the selected interviewees. As the topic of entrepreneurial role modeling in academia is complex and lacks thorough prior research, a semi-structured interview process was chosen in order to capture the subjective interpretations of each of the interviewees' experiences. The semi-structured interviews followed predefined topics, but were not

structured, allowing the interviewees to elaborate on topics important for their entrepreneurial journey.

All interviews were based on the same interview guide. The interview guide contained overall topics with underlying follow-up questions, focusing on how the interviewee had been influenced by entrepreneurial role models. The guide contained two main topics related to the research questions, in addition to information, introduction and summary of the interview. The two main topics were:

1. The entrepreneurial activities in the interviewee's job

2. Entrepreneurial role models of the interviewee

The first topic dealt with how the interviewee had already engaged in entrepreneurial activities, how he/she perceived these activities, and his/her perception of own abilities in entrepreneurship. This topic aimed at providing information about the interviewees existing desirability towards entrepreneurship, his/her entrepreneurial self-efficacy, entrepreneurial motivation and goals. The second topic dealt with people (role models) influencing the interviewee towards entrepreneurial activities, their perception of these people, characteristics of the role models and their respective start-up companies, and similarities between the interviewee and the role model. From this topic, the author aimed at gaining information about how the role model had influenced the academic's desirability, self-efficacy, motivation and goals, and whether these changes were results of the role model's presence. The complete interview guide is found in Appendix A.

Although all interviews were based on the same interview guide, the order of the questions differed from interview to interview, and they were asked as natural follow-up questions to preserve the flow and connection throughout the interview. The interview guide was partly customized based on the situation of the interviewee (aspiring entrepreneur, current entrepreneur, or former entrepreneur), allowing more emphasis on topics relevant for their situation. The interview guide was mainly used by the author to prepare for the interviews and to ensure all topics being covered during the interviews. For most of the interviews, the interviewee elaborated easily on the topics, and the interview guide was mostly used as a back-up for follow-up questions.

Three of the interviews were held face to face in Trondheim, either at NTNU or at the interviewee's company office space. The three remaining interviews were held over Skype. The author aimed at conducting the interviews face to face when she was travelling to Trondheim, however, this was not possible for all the interviews as they

were not scheduled at the same time. The interviews on Skype were held when the author was located in Geneva, Switzerland. The author conducted all the interviews herself, ensuring consistency in conducting the interviews and analyzing the results. Each interview lasted for approximately 45 to 60 minutes.

Prior to the interviews, the author sent out a description of the project and purpose of the interview, including information about anonymity and confidentiality as well as handling of personal data. The interviewees were informed that the interviews would be audio recorded given their consent, and that they at any time could withdraw their consent to participate without any reason. The interviews were audio recorded when consent was given from the interviewees in the beginning of the interview. This allowed the author to be more free to engage in the interview and to ask the relevant follow-up questions. Basic field notes were taken in order to capture the non-audible observations, and to be able to start developing theory immediately during the data acquisition. In this way, the author could build an overlap between data acquisition and analysis (Eisenhardt, 1989).

3.3.1   Secondary data

In addition to primary data from interviews with entrepreneurial academics, secondary data has been collected to construct a better understanding of the context of the entrepreneurial academics and their journey. Information about the interviewees' earlier careers and backgrounds was obtained from LinkedIn and NTNU's employee websites, providing better understanding of the career choices that could have affected the interviewees. Relevant information about the interviewees' current or former start-up companies was gathered from the companies' websites, as well as from media articles. These sources presented factual information about the companies, as well as any stories about success or failure that could be of relevance for each of the interviewee's perception of his/her entrepreneurial journey. Additional data about the companies was gathered from the websites of NTNU and NTNU TTO, giving the author an understanding of the interviewees' companies seen from several point of views. The secondary data also provided information about how the interviewee, their colleagues and their companies had been presented in media, which could be relevant when investigating how they have influenced other people around them. The secondary data was mostly gathered prior to the interviews, providing the author with background information to better understand the journey of the interviewee during the interviews.

3.4 Data analysis

After the interviews were finished, the audio recording was stored and the interviews transcribed using oTranscribe. The interviews were transcribed word for word, and the underlying tone or excitement in the interviewee's voice was noted with the transcribed text. Following transcription, the author read through the transcribed text, highlighting important concepts, findings or statements from the interviewees. The texts were structured and categorized based on topics related to the theoretical framework and the research questions. The author used NVivo to structure and categorize the different parts of the interviews. In NVivo, each topic, as well as underlying topic, was highlighted, making it possible for the author to sort and gather all information related to a certain topic for comparison between the interviewees.

Throughout the interviews, the interviewees mentioned several aspects of their entrepreneurial journey. These aspects were categorised by keywords and grouped into categories, as shown in Table 3.1. These keywords show the overview of the aspects mentioned by the interviewees. Some of the topics are not directly related to the role modeling process, such as "funding mechanisms", "entrepreneurship education/courses", etc. In further analysis, the author focused on the topics related to the role modeling process mainly.

The different topics related to the role modeling process were further analyzed with the theoretical framework and theory about role modeling in mind. During the interviews as well as during the analysis of the interviews, aspects related to certain parts of the theoretical framework were identified. Likewise, aspects not related to the theoretical framework were also identified. Both aspects related to the theory, as well as aspects not directly related to the theory, were included in the analysis to improve credibility and confirmability, as described in Section 3.5.

After getting an initial overview of the topics related to the role modeling process described by the interviewees, the author looked further into each of the factors and processes mentioned in the theoretical framework (See Section 2.4). For each factor in the framework, the author compared the data from each interviewee with each other, looking for similar or different perceptions of the topic. These findings were combined with the background information about the interviewee in order to analyse the reasons for the similar or different perceptions.

Relation to role models	Who are the role models?
	Influence from leaders
	Influence from fellow students/PhDs
	Similarities between role model and role aspirant
Functions of role models	Role model showing what is possible
	Role model showing what is desirable
	Role model showing how to reach a goal
	Role model teaching skills
	Lessons learned from role model
Own mindset	Is it possible?
	Is it desirable?
	Expectations to start-up work
	Inspiration and motivation
	Self-efficacy
Ecosystem	Industry
	TTO
	Culture for entrepreneurship
	University
Barriers	Publish vs. patent
	Bound to one place
	Time pressure
	Available funding
Means	Funding mechanisms
	Focus on commercialization
	Entrepreneurship education and courses

Table 3.1: *Structuring of keywords from data analysis. The data from the analysis was categorized by 25 keywords/topics, which could be grouped into 6 main categories*

3.5   Limitations and challenges of the method

Several potential limitations with the case study research approach exist. The quality of the empirical social research can be discussed according to different logical tests (Yin, 2009). Trustworthiness is also an important factor when it comes to the value of qualitative research methods. Trustworthiness refers to the degree to which the results are credible, transferable, dependent and able to be confirmed (Halldórsson and Aastrup, 2003). In the following subsections, limitations to the single case study will be addressed.

3.5.1   Credibility

Credibility refers to the match between the interviewees' construction and the researcher's representation of the topic (Halldórsson and Aastrup, 2003). The author may misunderstand the meaning of the topic presented by the interviewee, or the author and the interviewee may have different understanding of terms or topics. Leading questions may cause the interviewee to answer in a different way than what she or he would have done otherwise. The author aimed to clarify misunderstandings by asking follow-up questions and ask whether her perception of what the interviewee told was correct or not, however, such misunderstandings may still exist.

Credibility should also be obtained by choosing the appropriate method and measures for the study. A qualitative study is selected to be able to dig into the individual perceptions of role models and their influence. The semi-structured interviews allow the interviewees to talk freely about their perceptions, and opens up for a dialogue about their personal opinions. This semi-structured and personal approach may lead to customized questions or topics related to the specific interviewee. To limit too much customization, the author used an interview guide to steer the interview in a less customized direction. The relevant variables from the theoretical framework enables the author to focus on defined concepts rather than a broad concept that could be varying between the interviewees. However, as all of the interviewees have different backgrounds, experiences, and opinions, the topics of the interview could still have floated slightly away from the main topics.

3.5.2   Transferability

Transferability is about to what extent the findings can be generalized beyond the case study itself. Halldórsson and Aastrup (2003) claim that no true generalization is possible, and that the similarities between the different contexts of the studies de-

termines the transferability. The author has aimed at making general findings about the entrepreneurial role modeling process that can be applicable to other academics in the deep technology research community at NTNU, and ultimately to other academic contexts outside NTNU. To tackle this challenge, the author has looked for similarities and repeating patterns between the different interviewees, to look for transferable concepts. Because the interviewees represent their individual perceptions and experiences, there is always the chance that the findings are not transferable to other academics nor research communities. The results will, however, contribute to further research in the field, and may be relevant to similar contexts. The context of which the study has been performed will be provided through description of the case as well as background information of the interviewees. This is done to enable other researchers to make decisions regarding similarities with further studies.

3.5.3 Dependability

Dependability refers to the consistency of the results, and to which degree other researchers can repeat and reproduce the study with the same results (Halldórsson and Aastrup, 2003). Especially in a qualitative study where the subjective perceptions of the academics are being studied, there are always chances that other researchers will not obtain the same results, even though they were to interview the same academics, as different authors may draw different conclusions based on the data. To tackle this challenge, the author has aimed at documenting all procedures, the logic behind the data analysis, and the assumptions being made, in order to allow other researchers to repeat the study with similar results.

3.5.4 Confirmability

Finally, confirmability addresses the objectivity of the study, where the findings should represent the results of the study, unaffected by the author's biases (Halldórsson and Aastrup, 2003). There is a chance that the results from the study are affected by the researcher's biases. The author has her background from natural sciences at NTNU, and has been involved in research projects and courses within the research milieu being studied in the case. This relationship might have affected the interviews and the findings from the study, both in selecting for candidates, in the initial perception of the interviewees, throughout the interviews, as well as during the analysis. When contacting NTNU TTO, the author removed parts of her own biases for selecting candidates she already knew of from before. However, due to the relatively small research community within deep technologies at NTNU, the author knew the background of some of the interviewees before contacting them for the study, opening up for sub-

jective interpretations of their responses.

The author has aimed at drawing all conclusions based on the case study data, and not subjective interpretations, where data and findings should be possible to track back to the original source from the interviewees. There will, however, always be chances that the researcher's subjectivity affect the results, as the methodology cannot be completely separated from the researcher.

3.5.5 Ethical considerations

The author has, to the best of her ability, followed the Guidelines for Research Ethics in the Social Sciences, Humanities, Law and Theology proposed by the Norwegian National Research Ethics Committees (Norwegian National Research Ethics Committees, 2016). The guidelines include the respect for individuals, groups and institutions, including the processing of personal data. Prior to the data acquisition, the author notified the Norwegian Centre for Research Data (NSD, 2019) about the project. The notification included information about the type of personal data being processed in the project, how to inform the participants in the study about the personal data processing, and procedures for gaining consent from the participants about their participation in the project. As mentioned in Section 3.3, the author sent out an information letter to the participants, describing the project, their rights to withdraw the consent at any time, and their rights related to the processing of their personal data. In this way, the participants have been able to make informed choices on whether they wanted to participate in the project or not.

Although the information given by the interviewees is not considered to be of sensitive character, the author has aimed to ensure confidentiality and anonymity of the participants. This has been done by not mentioning names or clearly recognisable background history of the participants. The information presented about the interviewees has been kept to the minimum, however, with enough information and context to be able to present a trustworthy research analysis.

3.5.6 Limitations

Even though the author has aimed at reducing challenges and limitations in the study, some limitations do exists. The author recommends that these suggestions are taken into account when designing new studies on the same topic.

Firstly, three of the interviews were held face to face, while the remaining three were

held over Skype or phone due to practical reasons. This inconsistency might have affected the interviews themselves, and further the results from the study. When conducting some of the interviews over Skype or phone, the author lacks the communication through body language with the interviewees. The interviewees being interviewed over Skype or phone may have perceived the situation and questions differently than the interviewees participating in a face to face interview, and the author may have perceived their answers differently due to the lack of non-verbal communication. To remove potential errors of the study, all interviews should have been performed in the same or similar settings, which is recommended for another study on this topic.

Most of the interviews covered topics not directly relevant for the study, due to the fact that the interviewees were free to elaborate on their own experiences in the semistructured interviews. For another study on the same topic, the author could have briefed the interviewees more in advance, to ensure the main topic of the interviews was on entrepreneurial *role models*. Alternatively, the interviews could have lasted for a longer time, allowing the author and the interviewee to focus more on the role modeling experiences in the added part of the interview. More interviewees should preferably have been selected to get an even better understanding of the role modeling processes through additional interviews. These interviews could have been conducted with colleagues of the interviewee, institutional or departmental managers, or with younger researchers observing the interviewee. These people could have provided more information about the interplay between the academics, and how they influence each other.

3.6 Case presentation

This chapter presents the case study and the context for each of the interviewees. Information about NTNU, its ecosystem, the university spin-off procedures and funding opportunities is included to give the reader the necessary context of the case. The main characteristics of each of the interviewees are also presented, allowing the reader to get a deeper understanding of each of the entrepreneurial academics and their journey, and to better understand the subjective perceptions of each if the interviewees.

3.6.1 Presentation of NTNU and its ecosystem

The Norwegian University of Science and Technology (NTNU) is a national university with headquarters in Trondheim, Norway, and campuses in the Norwegian cities Gjøvik and Ålesund. The university's main field of research and education is within

science and technology, but NTNU also offers studies within social sciences, economics, medicine, educational sciences, arts, humanities and entrepreneurship, among others. About half of the students at NTNU are within science and technology. There are currently about 42 000 students enrolled at NTNU, and about 7400 man-years and 400 PhD defences yearly. NTNU has the main responsibility for higher education in technology in Norway, with about 75 % of master candidates nationally. The strength of research at NTNU lies in the strong competence in science and technology combined with academic interdisciplinarity (NTNU, 2020a). NTNU collaborates with industry and with SINTEF, Scandinavia's largest independent research institution (NTNU, 2020b). The collaborations focus on innovation and entrepreneurship, and enables NTNU to conduct research that potentially solves today's (and tomorrow's) industry challenges.

The students at NTNU are known for engaging in a range of organizational and volunteer work. Two of these student organizations focus on entrepreneurship: Start NTNU and Spark NTNU. Start NTNU is a student organization inspiring and engaging students to explore the opportunities for innovation and entrepreneurship, by hosting events where all students at NTNU are invited (Start NTNU, 2020). Spark NTNU is a mentoring service for students with a business idea, where they can get support from students who have previously founded a start-up company themselves, as well as financial support for the initial market validation of their idea (Spark NTNU, 2020).

Intellectual property (IP) generated from use of resources at NTNU are owned by NTNU. This applies to work done by staff, contractors and students collaborating with external parties. Students own the IP they create themselves, unless other terms are agreed (NTNU, 2010). In practice, this means that IP created by employees at NTNU are owned by NTNU, while IP created by students are owned by the students. IP owned by NTNU is managed by the commercialization unit NTNU Technology Transfer AS.

3.6.2   NTNU Technology Transfer AS

As mentioned in Section 3.2.3, NTNU Technology Transfer AS (NTNU TTO) works on creating value out of research results from NTNU and the Central Norway Regional Health Authority (HMN) (NTNU Technology Transfer AS, 2020). NTNU TTO is a separate company established in 2003, and manages the intellectual property of NTNU and HMN. NTNU TTO has the main responsibility for commercializing technology originating from the two institutions.

NTNU TTO is notified about all ideas, projects, work results and inventions from NTNU and HMN, assesses the commercial potential, and acts as a professional advisor and contributor to the commercial development of the projects. If NTNU TTO doesn't find a commercial potential, the inventors have the rights to commercialize their inventions on their own initiative (NTNU, 2010). If NTNU TTO does find commercial potential in the project, NTNU TTO works on developing a commercialization plan for the project - often working towards a license agreement or the establishment of a spin-off company. During the project phase, NTNU TTO offers support on market evaluation, IP strategy, funding, investor and industry contacts, and company establishment (NTNU Technology Transfer AS, 2020). If a new company is established, NTNU TTO may take equity in the company and/or seats in the board.

Since NTNU TTO was established in 2003, there has been 146 university spin-offs, 163 license agreements, and 239 patent applications from NTNU and HMN (NTNU Technology Transfer AS, 2020). A total number of 2076 ideas have been received. The spin-offs have in total received 1.8 GNOK in funding.

3.6.3 Funding opportunities for commercialization of research

During the project phase from research or idea to market, many hours of work and also often laboratory testing is required, which is costly. The Research Council of Norway (NRC), as well as NTNU itself, offers funding specifically for the initial development of research based commercial ideas to help bring the inventions to market. NTNU Discovery and FORNY are the two most relevant funding schemes for research based innovations at NTNU. NTNU Discovery is a support scheme for outstanding ideas based on concrete research results from employees at NTNU (NTNU Discovery, 2020), providing initial financial support to quality assure the idea. FORNY is a publicly funded support scheme from NRC, investing in projects with high commercial potential. The FORNY support scheme helps bringing promising research results closer to market, across all industries (The Research Council of Norway, 2020a). NTNU TTO has special access to these funding opportunities, and the continuation of a project where NTNU TTO is involved may depend on whether the project has been funded by such a scheme or not.

One of the support schemes from NRC is the Norwegian Centres of Excellence (CoE). The CoEs focus on targeted, long-term research of high international calibre, and may receive financial support for a total of ten years (The Research Council of Norway, 2020b). NTNU hosts six CoEs, and is partner in three other centres (NTNU, 2020c).

3.6.4   Deep technology research at NTNU

The research community within deep technologies at NTNU has been chosen as case for this study. As mentioned in Section 3.2.2, deep technologies are based on scientific discoveries, engineering innovation, chemistry, materials science, physics, mathematics, and/or medicine (Gaddy et al., 2017). NTNU conducts research in all these fields. The Faculty of Natural Sciences, Faculty of Engineering, and Faculty of Information Technology and Electrical Engineering conduct research in these fields, and the community within these fields of research has been chosen as case for this thesis.

3.6.5   Presentation of the interviewees

This section presents the background information about the interviewees selected for the study. This information provides the reader with the relevant context of the interviewees, to better understand the analysis and conclusions drawn from the interviews. This information is also useful when evaluating the transferability of the results from the study to other academics, research communities, or universities.

In the following tables (Table 3.2, 3.3, 3.4, 3.5, 3.6 and 3.7), information about each of the interviewees is presented. This information includes gender, field of research, academic experience and current stage of career, attitudes towards entrepreneurship, and influence from their friends, peers, or leaders. This information provides only the context of each of the interviewees, and will be used in Chapter 4 when data from each of the interviews is analysed and put in context with the academics' backgrounds and their research community, as well as the theoretical framework.

Gender	Female
Field of research	Chemistry and materials science
Academic experience	PhD and professor, currently in the middle of her career. When being a PhD student, there was no focus on commercialization activities, and they didn't receive any training or courses on commercialization.
Entrepreneurial activity	Inventor and co-founder of a university spin-off from NTNU within her field of research.
Attitudes for entrepreneurship	When doing research at NTNU, she didn't have any plans about commercialization nor creating a start-up company. After knowing about the possibilities to start up a company, she and her colleague decided to take the chance, as such opportunities don't come often. In the worst case scenario, they would learn a lot.
Role model influence	There was an older male professor in another research field at her department that had already established a company a couple of years earlier. His company wasn't successful, but he had experience in working with NTNU TTO as well as advice to offer regarding potential competition from other countries. She was also in contact with other founders.

Table 3.2: *Background information of entrepreneurial academic 1*

Gender	Male
Field of research	Cybernetics and robotics
Academic experience	Master and PhD in cybernetics, currently in the beginning of his career. He has been part of one of NTNU's Centres of Excellence (CoE). He always imagined himself getting a job in industry rather than continue working in academia.
Entrepreneurial activity	Inventor and co-founder of a university spin-off from NTNU, together with his supervisors with prior experience. During his PhD studies, he received training on entrepreneurship related topics, and the management expected that some of the PhD students explored commercial opportunities.
Attitudes for entrepreneurship	When starting up the company, he didn't believe he had the necessary skills and competences to run it. He had the impression that an entrepreneur was someone who had to sacrifice a lot to be able to run their company, with little spare time and little economic security nor predictability. When the opportunity to start working in his own company arose, it was a natural choice because the sacrifices didn't seem to be that big, and that the experience from working in a start-up company made it all worth it.
Role model influence	His two male supervisors were eager on entrepreneurship, with prior successful experience as start-up founders. There has to some degree been people around him he could discuss with and learn from.

Table 3.3: *Background information of entrepreneurial academic 2*

Gender	Male
Field of research	Photonics and sensors
Academic experience	PhD and postdoc in the US. Currently professor at NTNU, late in his career.
Entrepreneurial activity	Inventor and co-founder of a start-up based on his research, together with his research director. Today, he is partly involved in the company as an advisor.
Attitudes for entrepreneurship	During his PhD studies in the US, there was an increased emphasis on commercialization of research, and close connections to industry. He didn't believe he had the skills to start a company himself, but running one's own business was seen as positive.
Role model influence	In the US, there were many start-ups founded by his friends, peers, and older colleagues, both successful and unsuccessful.

Table 3.4: *Background information of entrepreneurial academic 3*

Gender	Male
Field of research	Materials science
Academic experience	Master and researcher in materials science at NTNU, with one year abroad. He is currently in his early career. He has been involved in a range of student organizational work and entrepreneurial initiatives.
Entrepreneurial activity	Researcher in a commercialization project from NTNU TTO, and potential future founder if the project continues as a spin-off. He has had the commercial interest from the beginning of the project.
Attitudes for entrepreneurship	He got interested in entrepreneurship years before starting his university studies. At this time, he didn't have many thoughts on his abilities to run a company; these reflections came later on.
Role model influence	He has been aware of companies that have been spun out from academia, as well as the academics who have continued working in the spin-offs. Several of his research group members have taken part in spin-off creation from the university. He has been positively influenced by specifically entrepreneurial academic 5 and a student entrepreneur. Additionally, his entrepreneurial brother has acted as a role model, however, not in the academic setting.

Table 3.5: *Background information of entrepreneurial academic 4*

Gender	Male
Field of research	Engineering and medicine
Academic experience	He has a PhD in related field, has been working at NTNU TTO, and has been involved in a range of student organizational work during his studies. Has also studied entrepreneurship abroad. Currently in his early/mid career.
Entrepreneurial activity	Working in a spin-off from NTNU related to his fields of study. The company was established with assistance from NTNU TTO, with a board of directors and advisors.
Attitudes for entrepreneurship	He always wanted to work with medical technologies, and took own initiatives to commercialization activities.
Role model influence	He learned about opportunities for entrepreneurship from fellow students. He was also in contact with a doctor who had pursued a career as a consultant, as well as working for a TTO. The two of them were a bit in contact, where he received coaching.

Table 3.6: *Background information of entrepreneurial academic 5*

Gender	Male
Field of research	Marine technology, robotics, computer science and cybernetics
Academic experience	Master and PhD at NTNU, and has been a professor for more than 20 years, where he has been part of one of NTNU's Centres of Excellence. Has also had scientific advisory roles in industry.
Entrepreneurial activity	Has been an inventor and co-founder of both a university spin-off and start-up based on his own research (before the Bayh-Dole Act). Both have been successful.
Attitudes for entrepreneurship	There was no focus on commercialization when he was a student, but he and his fellow students were quite certain they would be able to start a company. Now, there seem to be an increasing trend and culture for entrepreneurship in his research community at NTNU, where he supports entrepreneurial activities.
Role model influence	Fellow students inspired him to be entrepreneurial. They met, discussed, and came up with ideas. Together they discussed about establishing new companies.

Table 3.7: *Background information of entrepreneurial academic 6*

Chapter 4

Case study analysis

This chapter presents an analysis of the case study data obtained through the interviews and secondary data. Based on the case study keywords analysis (Table 3.1) and the theoretical framework (Figure 2.1), the author has developed a model for the role modeling process for the case of this study, with the context of the deep technology research community at NTNU, as illustrated in Figure 4.1. In this model, the author has added some of the patterns from the study to the already existing framework, giving an overview of the findings from the study.

As shown in Figure 4.1, the role modeling process in the deep technology research community at NTNU is affected by several factors. Firstly, the process depends on the attributes of both the academic and his/her role models, and the similarities and differences between the two. This will be analysed in Section 4.1. Their similarities and differences may affect the academic in his/her perception of the role model and their activities. Both the perception of the role model, as well as the concrete activities of the role model observed by the academic, influence the role modeling process and outcomes. This can be seen as different functions of the role models, and will be analysed in Section 4.2. The effect on the role aspirants' expectancy, value, and behaviour as a result of the different role model functions will be analysed in Section 4.3.

4.1   Who are the role models?

All of the academics interviewed could mention role models or people influencing them towards entrepreneurial activities. These were academics who had shown entrepreneurial behaviour prior to the academic being interviewed, or peers with common interests in entrepreneurship.
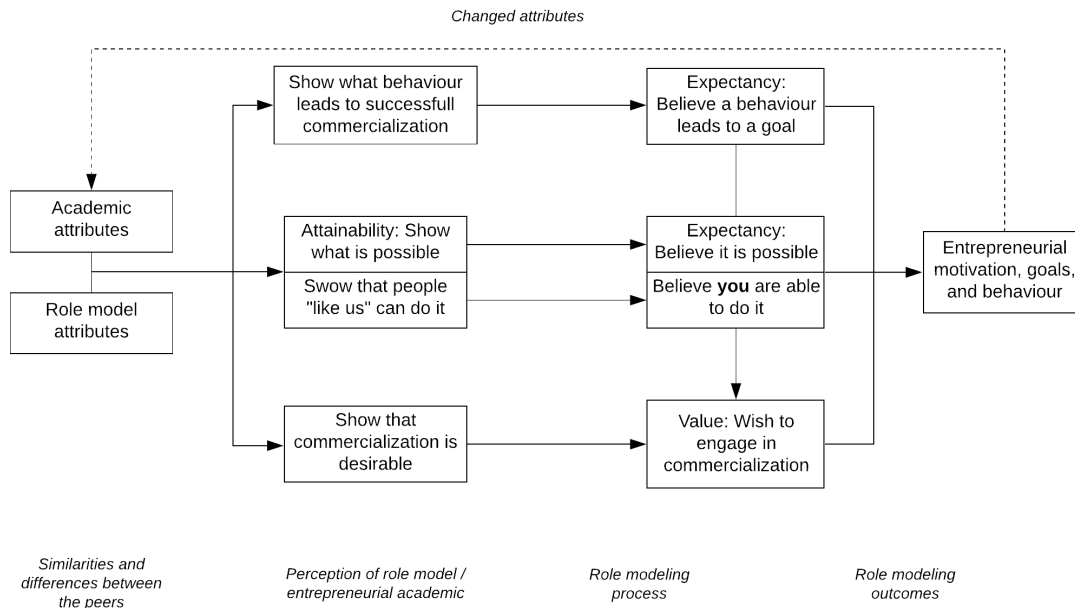
Figure 4.1: *Overview of the role modeling process in the deep technology community at NTNU. The process is divided into four parts: 1) The attributes of the role model and the role aspirant, and the similarities between the two, 2) the functions of the role model, 3) the role aspirant's changed perceptions as a result of the role model functions, and 4) changed entrepreneurial motivation, goals, and behaviour as a final result*

For entrepreneurial academic 1, the older professor in the same research department had tried to commercialize his research a few years before entrepreneurial academic 1, and was not successful in the process. Entrepreneurial academic 2 had two supervisors during his PhD work who have acted as role models and influenced him towards entrepreneurship, one of them being entrepreneurial academic 6. In addition, the university department and the CoE consisted of many people with entrepreneurial mindsets and knowledge who also played an important role in this process. For entrepreneurial academic 3, there were both fellow students and older academics whom he had seen acting entrepreneurially. In this case, the community of entrepreneurial academics consisted of many role models.

The first entrepreneurial role model of entrepreneurial academic 4 was his brother. In the academic context, he mentions both student entrepreneurs as well as academic entrepreneurs as someone to look upon as role models, specifically mentioning entrepreneurial academic 5 as well as a student entrepreneur he got to know of through Spark NTNU. Also for entrepreneurial academic 5, fellow students have acted as

someone influencing him during his studies, followed by the doctor working in the consultancy business. Entrepreneurial academic 6 acted as someone paving the way for commercialization at NTNU, and during his studies, he had fellow students around him influencing him towards these activities. For him, students acted more as influencers than the older academic who had been entrepreneurial.

Both entrepreneurial academic 3, 4, 5 and 6 mention fellow students as influencers. Entrepreneurial academic 4 and 5 are both in their early career, and at the time they got influenced towards entrepreneurial activities, they were both students. Similarly, entrepreneurial academic 3 and 6, who now are in the late stage of their careers, got influenced by students while they were students themselves. For entrepreneurial academic 3, this was by fellow PhD students when he was a PhD student himself, and for entrepreneurial academic 6, the people influencing him were his fellow master level students. Only entrepreneurial academic 1 was an established researcher the first time she considered entrepreneurial activities. The older professor she had seen carry out entrepreneurial activities had a similar position as herself, as a researcher/professor. Based on these findings, it may look like the interviewees have been influenced by people with a similar position, or not too far away from themselves in their career path. When mentioning their role models in this setting, most of the interviewees were talking about people influencing their desire to become an entrepreneur. According to Turner et al. (1994), people generally want to be like people similar to themselves, which could be the reason why the interviewees mentioned people in similar situations like themselves.

In the following sections, the term "role model" is used when describing people positively influencing the academics towards entrepreneurial activities, regardless of whether they have used this term themselves when describing the people around them.

4.1.1 Similarities between the role model and role aspirant

The entrepreneurial academics being interviewed were asked about similarities between themselves and their role models, as illustrated in Figure 4.2. In general, the academics didn't see many similarities between themselves and their role models, however, objectively they seem to share some characteristics. Such characteristics can be gender, education, research groups or fields, or personal traits. As already mentioned in Section 4.1, the academics seem to be influenced by people in similar life situation or not too far away in their career paths.

Entrepreneurial academic 1 didn't see any similarities between herself and the older
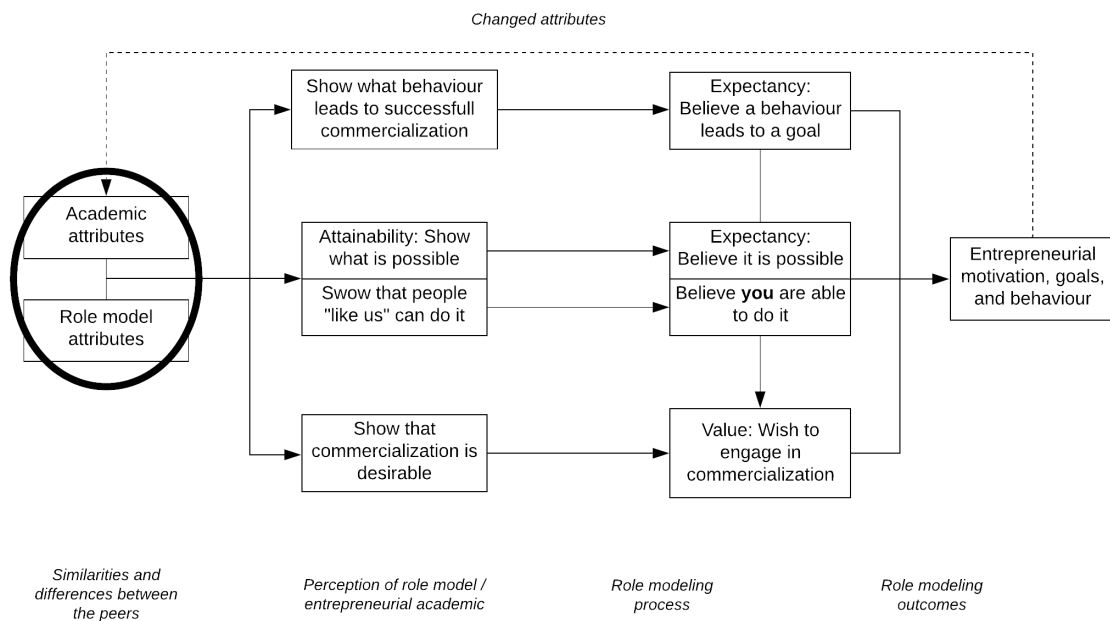
Figure 4.2: *Similarities and differences between the role model and the role aspirant, being analysed in Section 4.1*

professor. However, they were working in the same department at the same university, both being researchers in the process of commercializing research. Other than that, the professor was of another country of origin, opposite gender, and much older. Entrepreneurial academic 2 describes his two PhD supervisors as quite different, both with their respective strengths and weaknesses, and he didn't see any similarities between them and himself. However, they were still researchers of the same gender, working in the same academic field. Although he didn't see them as someone he would like to become himself, he admired both of them. He mentioned that they had many qualities, as well as knowledge, that he could learn from. Neither entrepreneurial academic 3 could see similarities between himself and the people around him influencing him, although they were of course working in the same field at the same university, and some of them were also at the PhD level. He could potentially see themselves as someone searching for opportunities and being adventurous, and these were personality characteristics they had in common.

For entrepreneurial academic 4, his brother is family and thus from the same inner circle. Between himself and entrepreneurial academic 5, whom he mentions as someone who could have acted as a role model to him, he didn't knew the person too well to see any similarities between the two. However, he mentions a few characteristics of entrepreneurial academic 5 that he seems to possess himself as well: "he

knows what he is doing", "he is down to earth", "friendly", and "not the flashy entre-preneur". Regarding the student entrepreneur who also acted as a role model, these are qualities describing him as well. All three of them are of the same gender, at the same university, have been involved in similar student organizational work, and are approximately at the same age.

There exist similarities between entrepreneurial academic 5 and his role model. The doctor who started working as a consultant had studied medicine prior to his current role. This field of study was similar to entrepreneurial academic 5, and both of them wanted to do something different than being a doctor. Thus, the role model had been in the same situation as entrepreneurial academic 5 when he went out of the more common medical profession and into commercialization and consultancy, and at that time he was at a similar age and life situation as entrepreneurial academic 5 during the role modeling process. Based on the descriptions from entrepreneurial academic 5, they both seem like someone who take initiatives and question the status quo.

Both entrepreneurial academic 4 and 5 mention role models close to themselves in age, however, a bit more experienced than themselves. Their role models are people who have taken the next step in a career they seem to pursue themselves. For entrepreneurial academic 1, 2 and 3, their role models seem to be older people and/or people not as close to them in their career. These academics started pursuing an entrepreneurial path when they were more experienced than entrepreneurial academic 4 and 5. While academic 4 and 5 started their entrepreneurial journey as students, the other academics waited until they had at least a PhD. At this stage, the bigger difference in career or age may not have seemed as big as when they were younger and with less experience, potentially making them able to relate to their role models even though they weren't as similar to themselves as what has been the case for academic 4 and 5.

Entrepreneurial academic 6 was surrounded by student peers during his studies, where they were in the same field, same age, and the same situation, and these were people he wanted to be connected with. He is now approaching the late stage of his career, and at the time he got infleuenced towards entrepreneurial activities, there was not much focus on commercialization from universities. Thus, there were very few people around him who had pursued such a career. He mentions there was one older professor who had been entrepreneurial, but he didn't feel like he had influenced him at all. At this time he was a student, and similar to academic 4 and 5, it may be that he was more likely to be influenced by people at his own age rather than older academics. Unlike academic 4 and 5, academic 6 didn't see entrepreneurial role models with

slightly more experience than himself, simply because they didn't exist. This could be the reason why he got influenced only by people at the same age, rather than by people with more experience.

4.2 Role model functions

From the case study data, as seen in Table 3.1, several functions of the role models have been mentioned. In this section, the different functions of the role models will be analysed. The role model functions being analysed are illustrated in Figure 4.3.
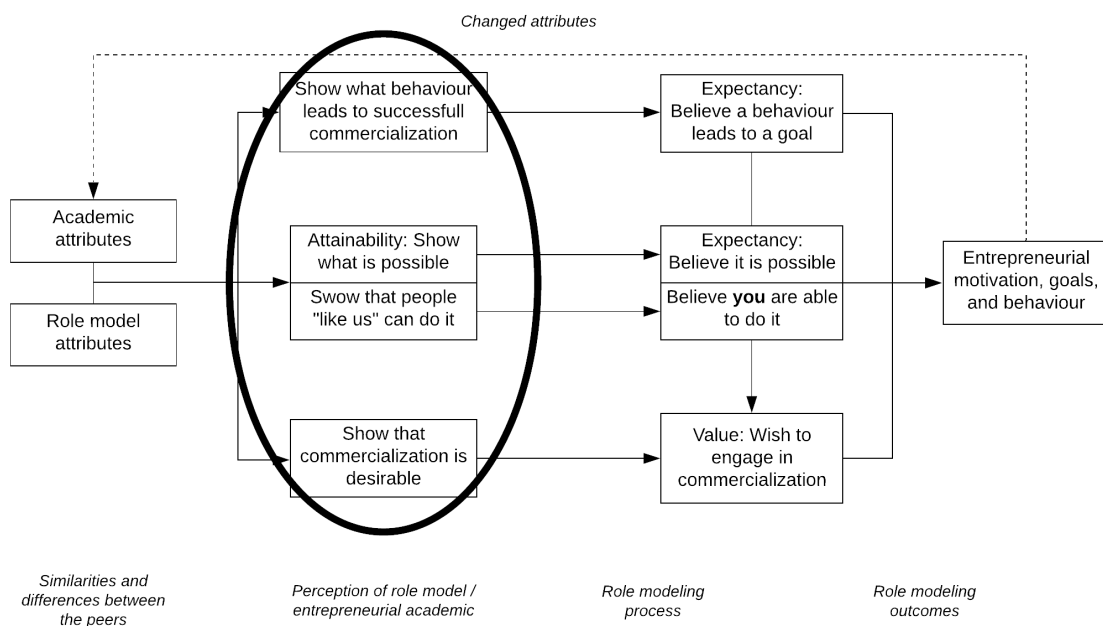
Figure 4.3: *The role model functions being analysed in Section 4.2*

4.2.1 Behavioural models

Some of the role models have shared a common goal with the entrepreneurial academics, although with a varying degree of achievement of these goals. Regardless of their success, this function of the role model can be seen as a behavioural model, showing what behaviour leads to the goal.

Both of the supervisors of entrepreneurial academic 2 had been involved in starting up a company to solve industry problems. Entrepreneurial academic 2 mentioned that he had always been a practical guy who imagined himself applying his knowledge in industry rather than in academia. His two supervisors had already done something

similar to this when they left academia to apply their knowledge in a start-up solving industrial problems. It may be that the role aspirant and the role models shared a common goal: apply knowledge in industry. If this was the case, the role models may have acted as **behavioural models** showing how this goal could be achieved. According to Morgenroth et al. (2015), the degree to which the role model has reached the role aspirant's goal, i.e. the *goal embodiment*, is linked to the motivation the role model is capable of passing on to the role aspirant. When being successful as entrepreneurs, solving industry problems with their knowledge, they had a high degree of goal achievement, which in turn may have increased the vicarious learning from the role models and increased the expectancy of the role aspirant.

Behavioural models represent *how* these goals are achieved, where the role aspirant is able to learn what to do and how to do it, in order to achieve the same goal as the role model (Morgenroth et al., 2015). For entrepreneurial academic 5, his role model had left the traditional career as a doctor and pursued a career in industry. This may have been a goal entrepreneurial academic 5 possessed himself, thus his role model may have had a high degree of goal embodiment on this matter. His role model taught him what he had done to get to where he was today, showing what kind of behaviour was necessary to achieve the goal. One of the decisions his role model had taken was to start working for a TTO. After learning about his journey, entrepreneurial academic 5 thought this was a smart move in order to achieve what he wanted, and thus working in a TTO became a milestone to him on his way to work on medical technologies, which was his ultimate goal.

Entrepreneurial academic 5 acted as a role model to entrepreneurial academic 4, and one of the things entrepreneurial academic 4 mentions, is that he could learn more concrete about how everything is done, and what the process looks like. Especially for entrepreneurial academic 4, 5 and 6, the academic and their role model seem to have shared common goals and also being in a comparable process of pursuing them, due to their similarities in age and career. For entrepreneurial 4 and 5, their role models were a bit more experienced, and they could hence observe what they had already done to get where they were. This could have further increased their function as behavioural models, where the academics observe and learn what they do to achieve a goal that is closely related to a goal they possess themselves. For entrepreneurial academic 6, his fellow students had all the similar experiences, and none of them had achieved the goal they all shared. In other words, they had low degree of goal embodiment. This may imply that academic 6 didn't learn how the goal was achieved from his fellow students, but they could rather have influenced him in other aspects.

Entrepreneurial academic 3 was surrounded by many people who had founded companies, to an even higher degree than the other academics being interviewed in the study. Among the older people around, who had been successful, he could of course see that they had high incomes, but also that they worked long hours. He could see that to become successful and reach the goal, you had to work hard, and that it would require you to go all in. In this way, he could see what kind of behaviour was necessary, and not only the glorious picture as someone he would like to become. When also showing how to get there, the entrepreneurs may have acted as behavioural models, showing what kind of behaviour was necessary. In addition to the successful companies, entrepreneurial academic 3 observed people who didn't succeed. However, they may still have had common goals. These people may not have had a high degree of goal embodiment, due to the fact that they didn't succeed, but entrepreneurial academic 3 could still be able to learn from their mistakes.

Similarly, for entrepreneurial academic 1, the older professor hadn't been successful in the process. Still, they seem to have shared a common goal: commercializing research results. Even though he didn't succeed, the older professor may still have been able to show what kind of behaviour is necessary to reach the goal, as he had many experiences from this process. Additionally, entrepreneurial 1 seem to value learning from failure, and his failure may have been something she admired because she could learn something from it.

4.2.2 Attainability

As mentioned in the section above, the role models may have acted as someone who show what behaviour leads to a goal. However, this isn't the only function of the role models being mentioned by the interviewees. One thing is to show what behaviour leads to a goal - another one is to show it actually *is* possible to achieve the goal. Role models showing what is possible or attainable to the role aspirant could be a separate function of the role model.

Someone who "shows what is possible" is a function mentioned by several of the interviewees during the interviews. Entrepreneurial academic 5 mentioned this a couple of times regarding the doctor he looked upon as a role model. His role model showed him that it was possible for a doctor to contribute with something in business, although he hadn't studied anything related to business or engineering. His role model showed him that being a consultant and working with commercialization was possible also for someone like them, being medical students. When seeing someone sharing a

social identity with yourself, and seeing this person succeed in the goals you possess, it is natural to become more confident that you are able to do the same thing yourself. According to Venkataraman (2004), there is no better way to make a challenging venture creation process seem feasible than knowing somebody who has already done it. If someone with your background and capabilities are able to do it, why shouldn't you be able to succeed as well?

According to Morgenroth et al. (2015), having a shared social identity or background is important when it comes to showing the attainability of a goal. To be able to show what is attainable, and for the role aspirant to change his/her beliefs in being able to achieve what the role model has achieved, there must exist some sort of social identity between the role model and role aspirant. For entrepreneurial academic 5, this can be the fact that they both had been medical students wanting to pursue a different career. They were also in a similar life situation, making it easier to relate to each other.

Role models acting as someone who shows what is possible seems to be the case for entrepreneurial academic 4 as well. Especially from one of the student technology entrepreneurs, he could see that it was possible for a student to start up companies. As he was a student himself, they shared the social identity of being a student at the same university. It is easier to connect with people at the same age and position, and easier to imagine oneself being able to achieve the same goals as someone with the same prerequisites for achieving the goal. Both entrepreneurial academic 4 and 5 seem to share this perception of their role models, and they are also the two interviewees with the closest shared social identity with their role models.

Entrepreneurial academic 1 observed successful academics commercializing research, in addition to the older professor who didn't succeed. She mentioned that seeing these entrepreneurs commercialize their research showed that it's possible to have success. These people can be seen as someone representing what is possible or achievable to her. These founders were other academics at NTNU, and a potentially shared social identity could be the fact that they were both researchers at the same university in the process of commercializing research. When seeing another researcher become an entrepreneur, this could signal to the researcher that this is possible for her as well.

According to Morgenroth et al. (2015), the shared social identity can also be a potential future similarity, where the role aspirants can imagine themselves having the position or competences of their role model in the future. Entrepreneurial academic 2 mentions his two supervisors as potential role models. Compared to entrepreneurial academic 4 and 5, and their respective role models, entrepreneurial academic 2

didn't share the same close social identity with his role models, but he still mentions that he could see what was possible from observing them. Having similar academic background and being in the same research group may be the shared social identity necessary for entrepreneurial academic 2 to see a potential future similarity between himself and his role models. Such a future similarity could also have been the case for entrepreneurial academic 3, observing older successful entrepreneurs from academia. Both entrepreneurial academic 2 and 3 could have seen this potential future similarity with their role models, based on the similar background and potentially a similar future career.

As mentioned above, there possibly exist a shared social identity between entrepreneurial academic 5 and his role model. There could also be a potential future similarity between the two. His role model had paved the way for a doctor pursuing a career in business, where it could be possible to imagine himself having a similar position in the future. This could have increased the vicarious learning from the role model, showing what do do to achieve the goal, and can be linked to acting as a behavioural model. Seeing that another doctor had pursued a career in business may have decreased his barriers for doing the same, as the role model had already showed that this could be possible. The role model may have changed the perception of external barriers, which according to Morgenroth et al. (2015) is a function of a role model with the same social identity. Hence, it seems like entrepreneurial academic 5 could have a shared social identity with his role model, and at the same time see a potential future similarity, which again could increase the possibility of the role model showing the attainability of this goal.

Entrepreneurial academic 4 seem to share many characteristics with entrepreneurial academic 5, who is also his role model, and a potential future similarity can be seen also here. Additionally, he observed other successful companies around him, composed of more experienced academics. He mentions that these companies acted as proof of the possible, clearly showing that commercialization of research and deep technology from NTNU is possible. However, he mentions that the single companies and their employees didn't have that much of an influence on him, but rather that they were part of the bigger picture. Without any of them being present, it would have taken more creativity and effort to think about entrepreneurship as an option for him:

> *You can see that there are possibilities, so this becomes **one** of several possible options for your career.*

Entrepreneurial academic 4 differentiates between different people showing "what is possible", as illustrated with the two blocks of "Attainability" in Figure 4.3. The

student entrepreneur, with whom he shares more of a social identity with, seems to influence what he finds attainable for himself, showing that running a company is possible for a student without plenty of years of experience. The older and more experienced academics show it is possible to spin out a company from research results, and that this could be a possible future option for him. However, these people aren't acting in the same way as the student when it comes to attainability. It could be that the people going into the category of a potential future similarity (i.e. more experienced academics) act as someone showing what is possible in general, while the people with whom he shares a social identity with show that it is possible for *him* to do it as well. Such different functions of the role models, depending on the role aspirant's perception of similarities, will be further analysed in Section 4.2.4.

4.2.3 Desirability

The role models may have shown what is possible and what kind of behaviour is necessary to achieve a goal. However, the entrepreneurial intention and behaviour is also a result of what the academics find desirable.

There exist various impressions of who an entrepreneur is and what she/he does. Before entrepreneurial academic 2 started his PhD, his impression of an entrepreneur was different than what it is today. He mentioned that he believed an entrepreneur was someone who had to sacrifice much more, indicating that this was a career he may not have considered as desirable as he now thinks it is. Today, he finds the experience from working in a start-up worth the few downsides of the work. It is possible to assume that his two supervisors have acted as role models showing what is *desirable*, which could have influenced the academic's perceptions of desirability as well. This can be linked to theory by Turner et al. (1994) who suggest that people generally want to be like the people we are surrounded with, given that there is a shared group membership or similarity. The role aspirant and his role models were working closely in a common research group, and this could have been the necessary group affiliation for them to influence what the role aspirant found desirable. Entrepreneurial academic 2 mentions that in general, professors who have already been working in industry before coming back to academia are seen as more sought after by the students. Thus he might have found these two academics more attractive than academics without prior industry experience, which could, in turn, further increase the desirability of becoming an entrepreneur like them.

Interestingly, both entrepreneurial academic 1 and 6 mentioned they had seen older academics being entrepreneurial, similar to the case for entrepreneurial academic 2.

Entrepreneurial academic 1 and 6 mentioned that these people didn't influence them towards what they found attainable or desirable, but that they could rather learn from their experiences, as mentioned in Section 4.2.1. For entrepreneurial academic 2, it seems like the older entrepreneurial academics he observed have influenced both his attainability and desirability towards entrepreneurship, to a higher degree than what was the case for entrepreneurial academic 1 and 6 when observing older academic entrepreneurs. What differentiates entrepreneurial academic 2 from 1 and 6, in relation to the older entrepreneurial academics they observed, is that academic 2 worked closely with the older academics. This in-group, or potential future similarity, could have affected their influence on his attainability and desirability towards entrepreneurship, which was not the case for academic 1 and 6.

Entrepreneurial academic 3 was surrounded by people starting up companies during his time in the US. He described that running your own business was seen as the greatest thing you could do, and that this was looked upon as extremely positive. People with their own companies were admired, even the entrepreneurs with smaller companies without any relation to technology or research. Running your own business was in general very positive, and highly desirable. This kind of culture was also something influencing entrepreneurial academic 3 in his perceptions of entrepreneurship as a desirable career. However, whether this influence comes from specific role models or the culture itself, remains unknown.

Entrepreneurial academic 5 got interested in entrepreneurship from students he interacted with through common student organizational activities. It is possible to believe that these students, with whom he had a shared social belonging with, have influenced him towards a higher desirability for entrepreneurship, consistent with the theory by Turner et al. (1994) who suggest that people generally want to be like the people in our in-group. Similarly, entrepreneurial academic 6 got interested in entrepreneurship as a student, when discussing with fellow students about this topic. Neither of them had experience with entrepreneurship, but they were all in the same in-group with shared social identity and belonging. Entrepreneurial academic 6 wanted to be connected with these students, and this desire for belonging may have been one factor increasing their influence on his desirability. It seems like these students, who shared a social identity with entrepreneurial academic 5 and 6, were able to influence their desirability towards entrepreneurship to a higher level than other role models without this shared social identity.

4.2.4   Different role models possess different functions

As mentioned in Section 4.2.2, entrepreneurial academic 4 mentioned that different role models had different influence on his entrepreneurial motivation, intentions, and self-efficacy. Experienced researchers who spun out companies showed that this was a possible career path in general. The student entrepreneurs acted more as motivation, where he could see that people with the same prerequisites as him were able to run a company, showing that this was possible for him as well. Different effects of different role models, based on the different relation to the role aspirant, is an interesting topic that deserves more analysis.

Entrepreneurial academic 4 mentions that the companies and people spinning out companies have shown that this is a possible career. However, they don't necessarily act as inspirational sources. He mentions an older professor spinning out a company in his field of research:

> *He cannot inspire me in any way, because I cannot relate to him. It's difficult to relate to him because the difference in age and competence between the two of us is too big (...) Of course he will be able to do it, because he has years of experience. That doesn't say anything about my abilities to do the same, as a student with less experience.*

Entrepreneurial academic 4 mentions that the experienced researchers act more as someone showing possible careers, while they cannot inspire him to pursue an entrepreneurial career himself. Student entrepreneurs seem to influence and motivate him in a different way, where they act more as inspirational sources. When seeing students, or people with similar position and experiences as himself, it shows attainability in another way:

> *If **he** can do it, then certainly I can as well!*

It may look like the people he is surrounded with in everyday life have higher influence on his motivations and intentions to become an entrepreneur. People with similar background show there are real possibilities for people in this situation. Entrepreneurial academic 4 mentions that the fact that they are both *students* is of great importance, as people in this position are someone he can more easily relate to. Interestingly, he thinks that when he gets more experienced himself, older and more experienced academics can potentially have the same influence on him as students have had so far. Because the relation to more experienced academics is closer when he is more experienced himself, it may be that it is the degree to which it is possible

to relate to the role model that determines the specific functions of the role model.

Also entrepreneurial academic 5 and 6, in the similar social setting as students, seem to have been influenced by other students in terms of desirability and attainability. It doesn't seem like other entrepreneurial academics have the same influence on them. For entrepreneurial academic 6, the older academic who had been entrepreneurial didn't influence him much, but he could rather learn from his experiences. The people who influenced his desirability and intentions to become an entrepreneur were the students he was surrounded with in everyday life. The students were on the same academic level, had similar expertise and experiences, and he could more easily relate to them than to older academics. He mentioned it was easier to discuss ideas and get motivated to bring the ideas to life with them, and he also wanted to be part of their connections, as mentioned in Section 4.2.3.

These observations indicate that the specific functions of the role models on their role aspirant may be dependent on the social relation and similarities between the role model and the role aspirant, and interestingly, that the same role model can act differently depending on the role aspirant. According to the role modeling framework proposed by Morgenroth et al. (2015), shared attributes between the role model and the role aspirant, such as shared group membership and similarities, plays a key role in the perception of the role model and further the role modeling process and outcomes. As indicated in Figure 4.1, these similarities or differences may affect what influence the role models have on their role aspirant; either as someone showing what behaviour leads to a goal, showing what is possible in general, showing what is possible for people with their experience/background, or as someone influencing what the role aspirant finds desirable.

4.3 The role modeling process and outcomes

As shown in Figure 4.1, the role modeling process and outcomes are results of the initial role model and role aspirant attributes, as well as the functions of the role model in relation to their similarities. This section analyses the process and outcomes based on changed expectancy and value for the role aspirant.

As mentioned in the previous sections, the role models may have acted as someone showing what behaviour leads to a goal (Section 4.2.1), that commercialization of research is possible (Section 4.2.2), shown that commercialization of research is desirable (Section 4.2.3), or given proof that the role aspirants are capable of engaging in

commercialization activities themselves (Section 4.2.4). These different functions of the role model are illustrated in Figure 4.3. According to the model developed by the author based on the theoretical framework, these functions of the role model lead to different outcomes. The outcomes of the role modeling process, illustrated in Figure 4.4, will be analysed in the following sections.
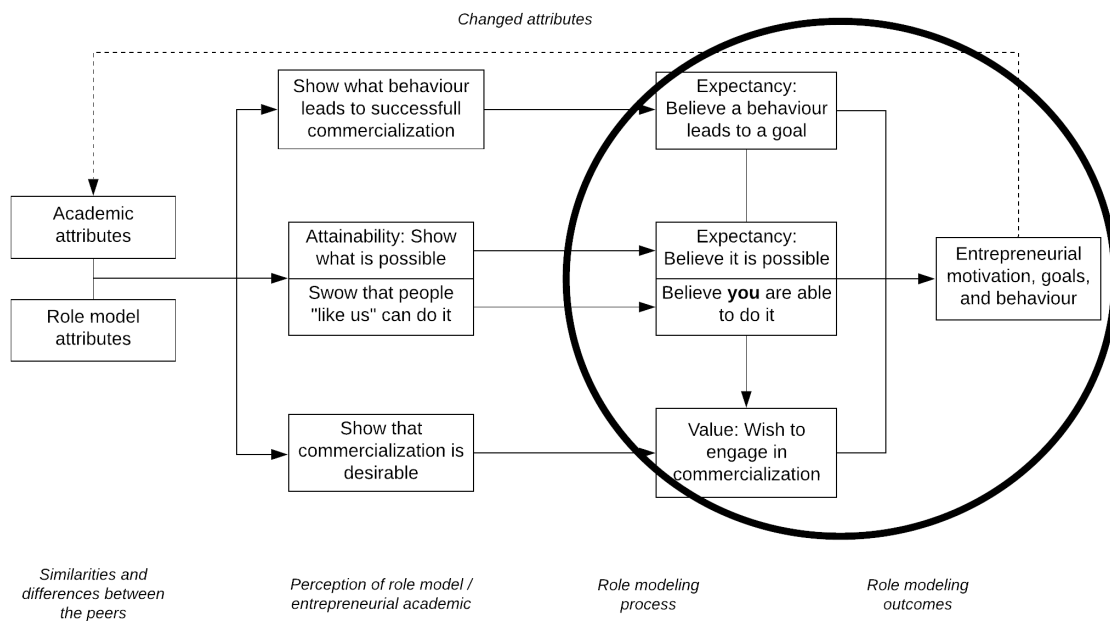

Figure 4.4: *The outcomes of the role modeling process being analysed in Section 4.3*

4.3.1 What do they learn?

There seems to be a vague understanding of exactly what the academics learn from their role models. For entrepreneurial academic 1, the older professor had already been through the process of research commercialization, and even though he didn't succeed, he had valuable learnings that entrepreneurial academic 1 could learn from. These skills weren't directly related to the technical feasibility of the commercialization process, as their processes were different, but rather how to have good discussions with NTNU TTO and things to be aware of related to the business aspect of her technology. The older professor specifically gave her advice in fields where he had failed himself, such as the competition landscape. Similar learnings were also mentioned by entrepreneurial academic 6 in relation to the older academic. The older academic had many learnings from his journey, and entrepreneurial academic 6 could learn from his experiences. However, this itself wasn't something influencing him towards entre-

preneurship, rather supporting him when he already had the interest and intentions. Both entrepreneurial 1 and 6 mentions this learning from people much older than themselves, where they didn't feel influence towards motivation, but rather specific learnings from their experience.

Other academics mention that they learned a bit about risk management, what is important to focus on, as well as mindset. The academics mention that they didn't learn that much concrete about commercialization from their role models, except from special occasions or events where they were able to sit down and ask deeper questions. This was something that prepared them for the entire process. Otherwise, the role models acted more as inspirational sources, where the academics didn't learn anything concrete, but rather could see what was possible.

4.3.2   From goal embodiment to expectancy and behaviour

As mentioned in Section 4.2.1, the role models have shown what behaviour is necessary for succeeding in commercialization of research. This indicates that the role models have changed the expectancy of the role aspirant. The role aspirants have learned, seen, and started to believe what behaviour leads to the goal of commercializing research. This can be seen as outcome expectations; the belief that a certain behaviour will lead to a certain outcome (Bandura, 1997; Eccles and Wigfield, 2002), and the role aspirants may have increased their beliefs in being able to perform the behaviours necessary to achieve the goal. What seem to be a common factor, is that more experienced, and in many cases older, entrepreneurial academics have shown what behaviour leads to successful commercialization.

Both entrepreneurial academic 1, 2 and 3 mention that they could observe the behaviours of the entrepreneurial people around them, and that they could learn from what they had done right or wrong. This could be seen in the outcomes of their behaviours, such as successful or unsuccessful commercialization. Entrepreneurial academic 1 mention that the older professor had told her about his experiences with NTNU TTO, and it seems like she has changed her beliefs in what behaviour is beneficial in collaborations with NTNU TTO. Entrepreneurial academic 2 and 3 both observed successful entrepreneurs, and it seems like they have learned what behaviour leads to successful commercialization from observing the entrepreneurial people around them. Common for all of them is that the people acting as behavioural models had more experience than themselves, and had been in the situation where the academic was heading. As entrepreneurial academic 1 had observed an unsuccessful

entrepreneur, while academic 2 and 3 observed successful entrepreneurs, it may seem like the degree of success is not important for the outcomes. The academics could still be able to learn and believe what behaviour leads to successful commercialization, regardless of the success or failure of the people they observed.

Entrepreneurial academic 1 mentions that she changed some of her behaviour based on the conversations and learnings from her behavioural model. Regarding other advice and learnings she received from her behavioural model, she did not change behaviour, but regretted this in retrospect:

> *We considered ourselves as people who didn't have the competencies to be the CEO of the company. However, the professor I talked to advised us to take on the leadership ourselves. In retrospect, I've seen that this was a very good advice that we didn't follow.*

It may look like this advice was something she had to experience herself before learning what behaviour would lead to successful commercialization. Similarly, entrepreneurial academic 2 and 3 mention that they had to learn some of the aspects of their commercialization journey by just starting doing it themselves.

Especially entrepreneurial academic 4 and 5 have directly discussed with their role models about the topics they wanted to learn from them, where they seem to have learned what behaviour is needed from them in commercialization processes. Entrepreneurial academic 5 even changed behaviour based on this, where he followed the footsteps of his role model regarding choice of intermediate career steps. Based on their conversations, his intermediate goal became to work for a TTO, similar to his role model. This can be seen as changed entrepreneurial goals and behaviour, as shown in the last step in Figure 4.4. Entrepreneurial academic 4 is still early in his career, and it is not clear whether or not a changed expectancy from his role model will change his entrepreneurial behaviour.

4.3.3 From attainability to expectancy and behaviour

Especially entrepreneurial academic 2 seem to have changed expectancies about entrepreneurship after observing role models who show the attainability of research commercialization. More specifically, it may seem like his expectations of risk related to being an entrepreneur has changed during his entrepreneurial journey. Before learning about entrepreneurship, he thought of an entrepreneur as someone who needed to make many sacrifices, with high risk of failure and low economic predictability. Now, this impression seem to be changed:

*I think many people from academia believe that there is a bigger risk than
what is actually the case. I think many have an impression similar to
what I had; that entrepreneurs are someone who sacrifice most of their
life.*

According to Bandura (1997), changed perception of possible barriers can lead to
changed *expectancy*; the perceived probability of success. When entrepreneurial aca-
demic 2 decreased his perception of possible barriers, this could have been one of the
factors for increasing his expectancy and especially self-efficacy; the individual's belief
that he is able to perform what is necessary to produce the desired outcome. However,
whether this is a result from having role models showing what is attainable, or from
going through his own experiences as an entrepreneur, remains unknown.

Regarding the effect of role models showing the attainability of research commercial-
ization, as mentioned in Section 4.2.2 and 4.2.4, and their effect on the role aspirants'
expectancies, there seem to be different outcomes depending on the type of attain-
ability the role model has shown. The author has differentiated these two forms of
attainability into the following, as illustrated in Figure 4.1:

1. Show that commercialization of research is possible

2. Show that people "like us" are able to successfully commercialize research

The two forms of attainability differ in terms of the subjective perceptions of the role
aspirant. Academics can see that commercialization of research is possible in general,
but if the entrepreneurs they observe are not similar to themselves, they may not
believe they are able to do it even though it is possible in general. When observing
someone similar enough to themselves, they may increase their expectancies regarding
their own abilities to successfully commercialise research. From this form of attainab-
ility they may believe that *they* are able to do it, and that it is not only people with
more experience that are able to be successful in research commercialization.

As mentioned in Section 4.2.2, seeing "what is possible" was mentioned by several of
the academics as a function of their role model. Entrepreneurial academic 1, 2 and
3 seem to have seen what was possible for a researcher with regards to commercial-
ization, and they don't seem to differentiate between the two forms of attainability
and expectancy outcomes. On the other hand, entrepreneurial academic 4 and 5 seem
to have observed both forms of attainability. Both entrepreneurial academic 4 and
5 had seen older, more experiences academics commercialize research, but they men-
tion that this didn't make them believe that they were able to do it themselves. In
addition to the more experienced academics, they also observed people more similar

to themselves who had engaged in commercialization activities. For entrepreneurial academic 4, this was a student entrepreneur and entrepreneurial academic 5. Entrepreneurial academic 5 observed a doctor who had started working in a TTO and became a consultant. All these role models were more similar to the role aspirant than the experienced entrepreneurs, and it seems like the two types of role models have influenced their expectancies differently.

Unlike entrepreneurial academic 1, 2 and 3, neither entrepreneurial academic 4 nor 5 were experienced researchers themselves. Entrepreneurial academic 1, 2 and 3 had more experience as researchers, and were thus having a more similar background to the entrepreneurial academics they observed. This could have been enough for them to familiarize themselves with the entrepreneurial academics, and for them to believe they were able to commercialize research themselves. For entrepreneurial academic 4 and 5, it may be that they needed to get other proof that it was possible also for them to successfully commercialize research, as the differences between themselves and the more experienced entrepreneurial academics were too big. It could be that the role models more similar to themselves increased their entrepreneurial self-efficacy, while the more experienced academics "only" showed that commercialization of research is a possibility in the future.

4.3.4 From desirability to value and behaviour

As mentioned in Section 4.2.3, some of the role models have shown the academics what is desirable, and have influenced the academics' desirability towards entrepreneurship. When the role models have shown what is desirable, this may have changed the *value* of such behaviour for the academic. Value is seen as the perceived desirability of a goal and its related behaviours (Morgenroth et al., 2015), and changed value could thus be a result when the role model has shown the desirability of commercialization activities and influenced the academic's desirability towards these activities.

For entrepreneurial academic 4, the interest for entrepreneurship came in early age, and his values could have resulted from observing his older brother. For entrepreneurial academic 5 and 6, their fellow students and friends during their studies seem to have influenced what they found desirable. Especially entrepreneurial academic 6 mentions that he probably wouldn't have grown the interest for entrepreneurship at this stage without his fellow entrepreneurial students being present. Also entrepreneurial academic 3 believes he was influenced by having friends running their own companies. He mentions that this influenced what he saw as a desirable job. What seems to be common for these academics, is that desirability towards entrepreneur-

ship comes from someone close to themselves; friends or family, and that these are the first people to influence them towards entrepreneurship. This could be related to the theory by Turner et al. (1994), who suggest that people generally want to be like people in their in-group. Interestingly, both entrepreneurial academic 4 and 6 mention older, more experienced academics they had observed, and none of them felt like they had influenced them towards entrepreneurship. It seems to be the people closer to them in age and experience, whom they can more easily relate to, who influence their desirability towards commercialization activities.

4.3.5   Value as a result of expectancy

When the academics have been influenced by their close friends, whom they share a social identity with, it may seem like the academics' change in desirability is a direct effect of the role models showing what is desirable, and that they adapt some of these values as part of being in the same in-group, as described by Turner et al. (1994). This could be the case for entrepreneurial academic 4 and 6, being influenced by fellow students. For the academics not sharing such a social group affiliation, the effect on changed value may be a result of increased expectancy, arising from a role model showing what is possible or what behaviour leads to the goal, as illustrated in Figure 4.1. When the academics increase their beliefs in being able to commercialize research, by means of increased entrepreneurial self-efficacy or outcome expectancies, this may result in further increased desirability to do so, because they believe they are able to master it. This can be seen as a change in value for the academics.

Before starting his entrepreneurial journey, entrepreneurial academic 2 didn't think of entrepreneurship as a desired career for him, having the impression that a life as an entrepreneur was not desirable. This impression seems to have changed, and could have been the result of learning more about what an entrepreneurial career involved, and seen the reduced risk. His two supervisors could have influenced him in this process towards reduced perceived risk by showing more specifically what an entrepreneurial career involved. This again may have increased his desirability towards entrepreneurship, as some of the risk factors were reduced. Thus, it may be that his increased expectancy lead to increased desirability. The increased desirability as a result of increased expectancy may come from the role models, however, other factors such as entrepreneurial courses or training may also be the reason behind the increased expectancy of entrepreneurial academic 2.

Both entrepreneurial academic 4 and 5 seem to have increased their motivation and desirability towards commercialization from learning specific behaviour from their role

models. This increased motivation and desirability could come directly from the role models showing what is desirable, but also as a result of the role models showing what is possible for them to achieve, and how to achieve it. The latter could result in increased expectancy towards entrepreneurship, and increased entrepreneurial self-efficacy. Furthermore, this increased expectancy could affect their value in terms of desirability for entrepreneurship. Hence, it may look like desirability for entrepreneurship is a result of both role models showing a desirable career, but also from role models increasing expectancy, where the increased expectancy is an intermediate towards increased desirability, as illustrated in Figure 4.1.

4.4 Answer to the research questions

In this section, the author aims to provide answers to the research questions based on the findings from the study. As a reminder, the research questions were as follows:

> **RQ1:** *How are academics' entrepreneurial intentions and behaviours influenced by academic entrepreneurial role models?*

> **RQ2:** *What are the direct and indirect functions of influence from the role model to the role aspirant?*

4.4.1 Answer to research question 1

The first research question sought to explore to which extent entrepreneurial models have changed the academic's entrepreneurial intention and/or behaviour, focusing on the outcome of the role aspirant. The findings from this study show that all the academics who had acted entrepreneurially could mention role models or people influencing them towards this behaviour. Some of the interviewees mentioned explicitly that they didn't think they would have pursued an entrepreneurial career if it hadn't been for the entrepreneurial academics influencing them.

What seem to be a common factor, is that the academics who felt inspired by their role models towards entrepreneurship got their motivation from friends or people similar to themselves, and at an early stage of their career. At this stage, they were more likely to get influenced on what they found *desirable*. Some of the academics also seem to have been influenced on their perceived probability of success, especially when observing someone similar to themselves pursuing an entrepreneurial journey. Academics without this shared social identity seem to value the experiences from those who have already been through the process of commercializing research.

It may seem like the academics' entrepreneurial intention and motivation are influenced by someone sharing their social identity, something usually happening early in their career. Their entrepreneurial behaviours seem to be influenced by all factors; learning what behaviour leads to successful commercialization, seeing someone act as possibility proof, and seeing what is desirable (given that they don't have a strong sense of desirability already). Their desirability may also come as a result of increased expectancy towards research commercialization.

4.4.2 Answer to research question 2

Research question 2 sought to understand the specific functions of the role models, i.e. how different actions or characteristics of them influenced the role aspirant in different ways, and what specific functions they have on the role aspirant's intention, motivation and behaviour, focusing on the role model. The findings from this study show that the role models seem to have influenced both intentions, motivation and behaviour of the role aspirant. The findings indicate that the role models have showed what is attainable, shown how to achieve the goal, increased self-efficacy, acted as someone showing what is desirable, and changed perceived barriers. However, this study shows that these functions vary depending on the relation between the role model and the role aspirant, as shown in Table 4.1

Interestingly, the specific influence from the role models seem to differ depending on the role aspirant's attributes and similarities with their role model. Having a shared social identity or a potential future similarity seem to influence the academics in terms of desirability towards entrepreneurship, as well as in their entrepreneurial self-efficacy. Role models without such a shared relation only seem to show that commercialization is a possible career path, as well as what behaviour is necessary in the process. Common for several of the academics being studied, is that the increased self-efficacy comes from role models similar to themselves, and that these role models are the ones who inspire and motivate them the most towards commercialization activities.

Relation 1	The role model influences the desirability and motivation of becoming an entrepreneur, and increases entrepreneurial self-efficacy by showing it is possible to become an entrepreneur for someone with the same experience as the role model and the role aspirant
Relation 2	More experience to learn from, where the role aspirant can learn how commercialization of research can be done. Additionally, the role model can show that commercialization of research is possible
Relation 3	The role aspirant can learn from their role model's experiences, but the role model doesn't motivate the academics towards commercialization, nor makes them believe they are able to do it themselves

Table 4.1: *The generalized role modeling outcomes for the respective relations between the role model and the role aspirant. Relation 1 refers to the same age, a shared social identity, or similar experience. Relation 2 refers to a potential future similarity, while Relation 3 refers to a greater difference in age, and few other shared characteristics*

Chapter 5

Discussion

In this chapter, the key findings and the contribution to existing literature will be discussed. Additionally, the applicability and interest of the findings beyond the case being studied will be discussed.

5.1 Why a study on the influence of academic entrepreneurial role models?

By focusing on qualitative data on the role modeling process in academic entrepreneurship, this study provides additional understanding of how role models influence academics towards commercialization activities. As outlined by Prodan and Drnovsek (2010), the number of studies on the processes leading to the emergence of university spin-offs, and specifically the emergence of academics' entrepreneurial intentions, is limited. The studies on academic entrepreneurial role models in this process is even more scarce (Maurset, 2018). This study is an addition to the very limited qualitative studies on role model influence on entrepreneurial behaviour, thus contributing to existing literature on the topic.

Firstly, the study has provided an understanding of the effect entrepreneurial role models have on the academics' entrepreneurial behaviour, and not only on entrepreneurial intentions. While most existing literature focus on the link between role models and entrepreneurial intentions (Auken et al., 2006; Guerrero et al., 2016; Krueger et al., 2000; Smilor et al., 2007; Urbano et al., 2017), this study has investigated the role modeling processes on academics who have already engaged in commercialization activities and thus shown entrepreneurial behaviour. The findings from this study show that all the academics who had acted entrepreneurially had observed other academics being entrepreneurial before them, where some also stated that they would not

have become entrepreneurs if their role models hadn't been present, supporting the findings from existing literature on the effect of entrepreneurial role models (Bosma et al., 2012; Huyghe and Knockaert, 2015; Prodan and Drnovsek, 2010). Even though the number of participants in the study is limited, and no general conclusion can be drawn based on the findings, this indicates that role models do affect entrepreneurial behaviour positively.

Furthermore, the study supports existing knowledge on the specific functions of the role models, i.e. *how* role models influence academics towards commercialization activities. Previous findings on role model functions suggest the most dominant function of role models to be "learning by example" (Bosma et al., 2012). The findings from this study complement the findings from Bosma et al. (2012) by breaking down the suggested role model functions into a more detailed explanation; showing that role models can act as behavioural models, show what is possible, increase entrepreneurial self-efficacy, and increase motivation and desirability towards commercialization. More importantly, the study shows how these functions may vary depending on the relation between the role model and the academic. The importance of the relation between the role model and role aspirant further complements theory from Bosma et al. (2012), Morgenroth et al. (2015) and Chen et al. (1998), suggesting that similarities or dissimilarities between the role model and the role aspirant act as moderators in the role modeling process.

Previous studies have shown conflicting findings regarding the direct or indirect influence of role models, and especially the role of self-efficacy as an intermediate (Feder and Niţu-Antonie, 2017; Huyghe and Knockaert, 2015; Krueger et al., 2000; Prodan and Drnovsek, 2010). This study shows that different role models act differently, and have different functions, depending on the relation between the role model and the role aspirant. This could be one of the reason for the conflicting findings in existing literature. Role models with certain relations to the academics may be able to increase their self-efficacy by showing the attainability of commercialization activities for people similar to the academics, and it may be their increased self-efficacy that leads them to commercialization activities. This is consistent with the findings of Huyghe and Knockaert (2015), who argue that it is the increased self-efficacy that increases entrepreneurial intentions. The findings from this study also show that role models without such a relation to the academics aren't able to influence them in the same way. This supports the findings presented by Prodan and Drnovsek (2010), showing a lack of significant correlation between role models and self-efficacy. This may be a result of the role models having different relations to the academics, hence having different functions of influence than what was found by Huyghe and Knock-

aert (2015). Thus, the findings from this study has contributed on the debated topic about the role of self-efficacy in the role modeling process. The findings from the study provides a possible explanation to the conflicting findings in existing literature, given that the relations between the role models and the role aspirants being studied in previous studies are not consistent throughout the studies.

5.2 How do entrepreneurial role models influence academics towards commercialization?

The key findings from this study show that entrepreneurial role models influence other academics in at least one of the following ways: 1) By sharing their experiences and showing what behaviour leads to successful commercialization, 2) by acting as possibility proof, showing that commercialization of research is possible, 3) by acting as proof of the academic being able to successfully engage in commercialization activities, and 4) by showing that commercialization is desirable. Function 2 and 3 look similar, but differ in the way that some entrepreneurial academics aren't able to show a less experienced academic that research commercialization is possible for him/her. By seeing someone similar to oneself, with related experience or at similar age, the academics seem to find it easier to relate to the entrepreneurial role models, and more easily believe they are able to successfully engage in commercialization activities themselves. Role models with less similarities to their role aspirant may still show that commercialization is possible, but they may act more as someone showing possible future careers rather than motivating the academics towards commercialization activities.

The more similarities between the academics and their role models, the more they seem to influence desirability and entrepreneurial self-efficacy. The more experienced the role models are, often corresponding to greater difference between the role model and the role aspirant, the more they seem to influence on the behavioural level, showing what behaviour leads to successful commercialization, or pass on their knowledge and experience to the role aspirant. These findings support the theory of role modeling proposed by Morgenroth et al. (2015), suggesting that role models who have achieved the goal are more capable of acting as a behavioural model, while role models sharing a social identity with the role aspirant are able to show the attainability of a goal and increase the role aspirant's self-efficacy. The findings from the study further supports the theory by Turner et al. (1994), suggesting that people with a shared group membership, such as students in a related field or academics in a similar position, are able to influence the desirability of a goal.

5.3 How do universities increase commercialization?

As discussed in the sections above, this study has provided a better understanding of how entrepreneurial role models influence the individual academics towards commercialization activities. Influencing the individual academic towards commercialization could be beneficial when looking at how universities can increase their commercialization rate, as the academics usually possess the necessary expertise and knowledge to disseminate their inventions to the rest of society. As this study shows, having entrepreneurial role models who influence the individual academic towards commercialization activities is one way of increasing university commercialization.

However, as stated by Van Burg et al. (2008), having role models showing their presence is only one of several factors influencing academics towards commercialization activities. The findings from this study also show that there exist other factors that potentially could increase commercialization rate from universities, such as courses and training on commercialization, available lab facilities to test new ideas, reduced time pressure, reduced risk of leaving an academic position, support from the research group or department, and support from the university TTO. Furthermore, external factors for university commercialization should be taken into account, such as available funding that could reduce perceived barriers. While this study has focused on the influence of role models on the individual researchers, all these factors should be taken into account when investigating how universities can increase their commercialization rate.

5.4 May the findings be of interest for other research communities?

The deep technology research community at NTNU consists of many individual factors that makes it not directly transferable to other research communities or universities. Additionally, the subjective opinions of the academics being interviewed represent their own perceptions and experiences, and would not be similar to any other research community. However, some similarities do exist, and some of the findings may be of relevance to other cases.

Firstly, many research communities consist of entrepreneurial academics who have shown entrepreneurial behaviour, where other academics observe these entrepreneurial role models. Secondly, commercialization of research, and especially deep technology, often involves similar risks and processes, and the context where an academic

will leave academia to explore an opportunity for commercialization will often be similar, regardless of the research community or university. Thirdly, many research communities consist of both students, PhD students, postdocs, researchers and professors, where the academics tend to continue working in the same or related research groups for a long time, being influenced by academics at all ages.

Especially some of the findings from the study may be of interest for other research communities. Firstly, the academics seem to have role models similar to themselves, either with respect to research field, age, personalities or experience. This could be of interest for research communities who want to increase role model influence on their academics, as they can facilitate for role model influence among peers in similar settings. Secondly, academics seem to be influenced by role models towards entrepreneurial behaviour in different ways, depending on their relation to their role model This could be of interest for other research communities when facilitating for a specific type of role model influence on their academics.

Most of the role modeling processes and outcomes discussed in this thesis are to some extent independent of the specific research community at NTNU, and could be transferable to other research communities. On the other hand, the influence of role models are part of the culture at the given university and research community, and consequently the contextual factor for each research community must be taken into consideration when evaluating the transferability of the study to other universities.

Chapter 6

Conclusion

The purpose of this study has been to investigate how academic entrepreneurial role models contribute to increased commercialization rate from universities. The study aimed at providing an in-depth understanding of *how* academics get influenced by their entrepreneurial peers, and how role models change the academic's engagement in entrepreneurial activities leading to increased commercialization rate. To investigate this topic, a single case study on the deep technology research community at NTNU was performed, consisting of individual interviews with 6 entrepreneurial academics in the research community. By studying their process towards commercialization, and the influence of entrepreneurial role models, the study has provided supporting findings to existing literature on the effect of role models on entrepreneurial behaviour, as well as additional insights into how different role models influence academics in different ways.

The findings from this study show that the role modeling process varies depending on the relation between the academics and their role model. When they share a social identity or a potential future similarity, the role model seem to influence the academic's desirability and motivation towards entrepreneurship. When such a similarity is not present, the role model could rather influence the academic by showing what behaviours and skills are necessary to be successful in the commercialization process, given that the role model has more experience than the academic on this topic.

By providing an understanding of how *different* role models influence the academics differently, the study provides a possible explanation to the conflicting findings in existing literature regarding the role of self-efficacy as an intermediate in the role modeling process. The findings from this study show that role models who have succeeded in research commercialization, and who share a social identity with the

academic, seem to influence their entrepreneurial self-efficacy to a higher degree than what is the case for successful role models not sharing such a social identity. Thus, increased self-efficacy may be a result of the role modeling process for academics observing role models they can relate to. Role models without this relation, or without experience in research commercialization, may not increase the self-efficacy of the academics directly, but they may influence their outcome expectancies or desirability towards commercialization activities.

These findings show that the role of self-efficacy varies depending on the relation between the role model and the role aspirant. While existing studies have included role models and role aspirants with varying relations, the findings from this study suggest that the relation between the role model and the role aspirant should be taken into account when investigating the role of self-efficacy in the role modeling process.

6.1 Implications

Universities who want to increase their commercialization rate face several challenges on this topic: 1) The academics may not find commercialization activities desirable, 2) the academics may not believe they are able to become entrepreneurs, and 3) the academics may find the barriers for commercialization too big. All these challenges are related to each other, and can partly be addressed with the presence of entrepreneurial role models in the university ecosystem.

For **university managers**, offering good arrangements for academics who want to explore a commercial opportunity could potentially reduce the barriers for an academic to engage in commercialization activities. This could involve having the opportunity to take long term leave of absence, with the possibility of returning to their academic position after pursuing the commercial opportunity. Today, there is a huge risk for researchers with a permanent position to leave academia, as they have no guarantee for their future career if the commercial opportunity doesn't succeed. Having researchers with permanent positions taking long term leave could additionally contribute positively to academia. There are many younger researchers who are able to replace the academics during their long term absence to get valuable experience, and the academics returning to academia after a commercial adventure would have gained valuable experience to further increase university commercialization. If such opportunities are available, university managers should emphasize having role models showing other academics that this opportunity is desirable.

Additionally, entrepreneurial student organizations and available lab facilities where master and PhD students, as well as researchers, can get together and try out new ideas, could also be a valuable contribution when creating a culture where entrepreneurship is seen as something desirable. University managers can support such initiatives, facilitating for academics to meet with entrepreneurial role models at all ages and positions.

The **university TTO** plays an important role when addressing the challenge of academics not believing they are able to become entrepreneurs, where the TTOs can assist the academics on the topics they know little about. Such support could involve market validation, incorporation, and the establishment of a suitable executive team. When assisting the academics in the areas where they feel they have limited knowledge and capabilities to succeed, they feel more confident that they are able to succeed on the areas where they do excel. This touches upon the third challenge. When the TTO show all support that is available, this could decrease the barriers associated with commercialization of research, hence increase the number of academics who find commercialization of research desirable and attainable.

University departments and research groups play an important role when fostering a culture among their academics. As the results from this study show, academics seem to be influenced by people in their in-group, of which their peers in the same research group or department can be part. When having a culture where entrepreneurship is seen as a normal career path, the choice of becoming an entrepreneur may seem easier and come more natural. The university departments and research groups can facilitate for having entrepreneurial academics at all ages present in the research group and/or department, clearly showing this option to the rest of their peers. Having different entrepreneurial role models present would increase the chances of academics observing people similar to themselves, which in turn could influence the role modeling processes.

For entrepreneurial **academics** who want to influence other academics towards commercialization activities, they should firstly be aware of for *whom* they potentially act as a role model, as the role aspirant's perception of the role model affects the influence of the role model. Given that the role aspirant has a shared social identity with the role model, or a strong potential future similarity, the role model could be able to influence what the role aspirant finds desirable. This is of interest when the role aspirant doesn't have any existing intentions or motivations for entrepreneurship. Given that the role aspirant already has entrepreneurial intentions and/or motivation, a role model with similar social identity or experience could be able to influence the

role aspirant's beliefs in being able to be entrepreneurs him/herself.

For entrepreneurial academics who want to influence other academics where no such shared social identity exist, or where there is a bigger difference in age or experience between the two, the entrepreneurial academic could still be able to influence the other academic, however, possibly not in the same way as if they were having more similar social identity or experience. The findings from this study suggest that role models are capable of showing what behaviour leads to a successful outcome, regardless of the similarities between the role model and the role aspirant. This implies that e.g. older academics who want to influence their younger students towards entrepreneurship can teach or show them what they have done to reach their goals of becoming an entrepreneur. If the younger students or academics are already motivated towards entrepreneurship, this may be a successful strategy. If they are not, the role model may use other role models who share a social identity with the role aspirant as additional motivators, where they can influence the role aspirants' desirability towards entrepreneurship as well as increasing their self-efficacy.

6.2 Limitations

The findings from this study show that different role models influence academics differently. However, the study has only investigated the deep technology research community at NTNU, and the findings could be different in other research communities either at NTNU or at other universities. Academics in research fields with different commercialization processes and barriers could perceive the situations differently, and it is not given that the findings from this study would explain the situation in other research fields. It may be that academics who experience lower barriers for commercialization, which could be the case for software or computer science, have a different perception of and influence from their peers.

This study was conducted in Norway, and the situation could be different in other countries. Firstly, the culture of the specific place or country could affect the role modeling process, both with regards to the interaction between academics as well as to the academics' attitudes to being influenced towards commercialization activities. Secondly, the commercialization process could vary from country to country, and is in some countries not facilitated by a TTO. In these communities, the academics may be influenced by their peers in another way. Similar studies on the role modeling process should be conducted in several research fields, universities and countries to explore whether the findings are general or specific to the given community and culture.

The findings from this study provide a possible explanation to the conflicting findings in existing literature by showing that the role of self-efficacy varies depending on the relation between the role model and the role aspirant. However, these findings are only a result of a qualitative study on a very limited number of academics. Further studies with more academics should be conducted in order to investigate whether the relation between the role model and the role aspirant could be an explanation to the conflicting findings in existing literature.

6.3   Suggestions for further research

This study has only investigated the role modeling process from the perspective of academics who already have shown entrepreneurial behaviour, and their perception of people influencing them in this process. Even though the study has provided insights on how academics are influenced towards entrepreneurial behaviour, there are still many factors influencing the individual academic towards commercialization that deserve more analysis.

Throughout the interviews and data analysis, the author has looked into both entrepreneurial intention, motivation, and behaviour. From the interviews and secondary data, it may seem like universities and policymakers focus on creating an innovation mindset among academics, with the belief that academics with interests in innovation and entrepreneurship will increase commercialization rates. However, as previous studies have shown, entrepreneurial intentions don't necessarily lead to entrepreneurial behaviour (Schlaegel and Koenig, 2014). There seems to be a gap in the literature about the relation between innovation mindset, entrepreneurial intentions, motivation for entrepreneurship, and entrepreneurial behaviour in the academic context.

There exist several potential scenarios regarding the entrepreneurial mindsets, interests, intentions and behaviours of academics. One scenario could be that very few academics have the entrepreneurial interest and intentions, but that most of them do progress with entrepreneurial activities. Another scenario could be that most researchers already have the entrepreneurial intentions and motivation, however, very few of them actually show the entrepreneurial behaviour. If the first scenario is the case for the academic context, university managers may do well in putting effort on increasing the entrepreneurial interests and intentions among their academics. If the second scenario is the case, an increased effort on mindset and interests may not result in the desired outcome, however, effort on transferring entrepreneurial intentions to actions could be favourable. It would be of interest to university managers and

policymakers to know where the bottleneck is, to be able to put in the right effort to increase commercialization rates from universities.

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Appendix A

Interview guide

Project: The influence of entrepreneurial role models in commercialization of research from universities

This is an interview guide to be used for semi-structured interviews with entrepreneurial academics at NTNU, or previously employed academics at NTNU.

Main research question:
How does entrepreneurial role models influence researchers towards entrepreneurial activities?

Information

- Present yourself and the project, and the reason for contacting the interviewee

- Inform about confidentiality and anonymity

- Ask if anything is unclear, or if she/he has any questions

- Inform about audio recording

- Make sure the interviewee has read, understood and signed the consent form of the information letter

- Start the audio recording

Introduction
Ask the interviewee to tell about:

- Her/himself

- Her/his job

- The choices she/he has made to end up in this job

Follow-up questions

- If changes in job/responsibilities: Ask about the reason for these

    - Were there specific people influencing her/him in these choices?

    - Were there other people in the research group who had changed jobs like this?

    - Were there other people around who had changed jobs or started a company?

Entrepreneurial activities in the interviewees job (background information)
Based on background information about the interviewee, ask about:

- The entrepreneurial activities she/he has been involved in

    - Clarify "entrepreneurial activities": start-up/spin-off creating, licensing, interest, advice, etc.

    - How does she/he find these activities? (motivating, challenging, boring, not what she/he expected)

    - How did the perception of these activities change over time?

- Why did she/he decide to engage in these activities?

- How did she/he perceive her/himself as a successful entrepreneur before starting? (perceived probability of success, desirability of the goal)

Entrepreneurial role models (main questions)

- How did the managers of the interviewee relate to entrepreneurship during the early years of the interviewee's research career?

- Who were the entrepreneurial people (either in her/his group, at NTNU, or outside NTNU) during the early years of her/his research career?

    - Who were the people influencing the interviewee towards entrepreneurial activities?

- How did the interviewee perceive these people?

    - What similarities could she/he at that time see between the role model and her/himself?

    - How closely did they work? How did they interact?

- How did they influence her/him? Their behaviours, showing the possible, desirable actions?

- How did the role model change the interviewee's:

  - Perceived probability of success?

  - Desirability of entrepreneurship?

- What are the similarities between the role model and the interviewee at this point (compared to when they first met)?

Summary

- Sum up your understanding of what the interviewee has told – is this correct?

- Something the interviewee wants to add?

- Does she/he know of other potential interviewees?

- Thank the interviewee and inform about the process further: transcribing of interview and sent to the interviewee for feedback.

- Does she/he want to be informed about the findings?

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