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Progression through CEO succession:

Literature review and quantitative study of
succession's effect on USOs' human capital
and development

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Submission date: May 2016
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Preface

This master thesis is written by Karl Fjelde Nevland, Sondre Malde Pedersen and Henrik Løken Wille, three graduate M.Sc. students from the Norwegian School of Entrepreneurship at NTNU, the spring 2016.

The authors all have founding experience from leading high-tech start ups in a university environment, which made the topic of CEOs in university spin offs (USO) a natural choice. We were motivated to help entrepreneurs as ourselves to handle the often limited performance of CEOs in USOs, by exploring how a CEO succession could affect the commercial progress of an USO. The thesis benefited highly from being positioned in Norway's technology capital, Trondheim, with a strong academic community for USO research and the origin of most Norwegian USOs.

The thesis consists of two papers, a literature review and an empirical study. The papers complement each other, but are designed to communicate independently. The format is chosen as it facilitates sharing of information and is well suited for publishing.

We investigate what human capital USO CEOs need for the USO to perform at different development stages, CEO successions role in acquiring this and its effect on a USOs commercial progress. From this work we have greatly broadened our insight in what USOs need and how they develop. The authors have learned a great deal from collecting the extensive amount of data that lay the foundation for a quantitative study. The comprehensive statistical analysis of the empirical data gave a deep theoretical and practical knowledge in statistical methods and models that can be utilized later in our careers.

As final remark, during this study we found that there exist no research on CEO succession in USOs and few generalizable studies on USOs, and we hope that our quantitative discoveries can be of help to other entrepreneurs, USOs and policy makers as well as to inspire other researchers to explore this field.

We want to sincerely thank our mentor, and guide through both papers, Roger Sørheim for insights, knowledge and experience with USOs. We would also like to thank Ph.Ds. in Statistics Øyvind Salvesen, Håkon Bakka and Mette Langaas as the work could not be done without their statistical insights and advice. Lastly, we are thankful for the advices and suggestions from Ph.D. candidate Marius Tuft Mathisen.

The authors

Trondheim, May 20th 2016

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Summary in norwegian

Universitets spin-offs (USO) representerer en potensielt viktig kilde for verdiskapning og har hatt signifikant vekst i antall de siste ti årene. USOer er komplekse enheter av radikal natur, ofte med potensiale til å rokke hele industrier. Likevel er USOer begrenset av manglende ressurser grunnet miljøet de har opphav i, noe som fører til at de underpresterer sammenlignet med andre typer oppstarter.

Siden USOer har begrensede ressurser, er deres mest verdifulle ressurs den menneskelige kapitalen. Etter hvert som firmaet utvikler seg vil nye utfordringer og ny menneskelig kapital bli relevant. På grunn av sin knappe ressursbase, er USOer spesielt avhengige av den menneskelige kapitalen til den daglige lederen, som har størst innflytelse og ansvar for at selskapet presterer. Å ha en leder med rett kompetanse til rett tid, blir derfor essensielt for å ha kommersiell fremgang. Lederbytte (CEO succession) blir følgelig en effektiv metode for å skaffe livsviktige ressurser.

Selv om USOers svake prestasjon kan kommer av utilstrekkelig lederskap, har ikke lederbytte blitt adressert direkte i USO-litteraturen. Masteroppgaven ønsker derfor å adressere dette fenomenet for å øke ytelsen til USOer og lukke litteraturgapet ved å samle relevant litteratur og utføre en kvantitativ studie.

Masteren utforsker hvilke behov for menneskelig kapital som oppstår når en USO utvikler seg, om lederbytter kan dekke disse og hvordan lederbyttet påvirker kommersiell fremgang. Studien er skrevet som to forskningsartikler. Den første er et litteraturstudie, som samler og diskuterer litteratur om lederbytte i USOer for å finne ut om lederbytter kan dekke behov som oppstår når bedriften utvikler seg og hvordan lederbyttet påvirker fremgang. Forskningsartikkel to er et kvantitativ studie av 201 USOer og 425 daglig ledere. Den bygger på funnene og proposisjonene fra første forskningsartikkel og finner hvilke menneskelig kapital som anskaffes gjennom lederbytte i forskjellige faser, samt hvilken effekt den har på kommersiell utvikling.

Målet i første artikkel er å utforske hvordan litteraturen beskriver lederbytter kan dekke USOens behov for menneskelig kapital og påvirker selskapets utvikling. For å svare på dette ble det gjennomført et litteratursøk som resulterte i en oversikt over den mest relevante litteraturen om USO-utvikling, lederbytte og behov for menneskelig kapital. Det kom 28 artikler ut av søket, hvorav ingen direkte adresserte lederbytte i USOer. Dette bekrefter et gap i litteraturen som beskriver lederbytte i USOer. Artiklene la grunnlaget for en diskusjon rundt hvilken menneskelig kapital USOer må anskaffe for å dekke ressursbehovene sine etterhvert som de utvikler seg. Diskusjonen leder til et sett med proposisjoner som presiserer hvilke tidligere jobberfaringer daglig leder bør ha for å lede USOen etter hvert som den utvikler seg.

For å hjelpe USOer og fylle gapet om lederbytte i litteraturen, ble resultatene og hypotesene fra artikkel ens litteraturstudiet tilpasset empirisk testing i forskningsartikkel 2. Anskaffelsen av menneskelig kapital studeres her empirisk og sammenlignes med anbefalingene gjort i litteraturen. Menneskelig kapital operasjonaliseres gjennom arbeidserfaring, og USO progresjon gjennom faser basert på Vohoras livssyklus modell. Analysen bruker

regresjonsanalyse for å undersøke utviklingen av arbeidserfaring ervervet gjennom lederbytte av administrerende direktør og effekten dette har på kommersielle fremgang. Forskningen viser at når firmaet utvikler seg, fjernes akademisk erfaring gjennom lederbytter, mens ledelses og kommersiellerfaring anskaffes. Lederbytte viser seg å signifikant øke den kommersielle progresjonen for de observerte bedriftene.

Bidraget fra de to forskningsartiklene er å øke den kommersielle progresjonen til USOer ved å hjelpe beslutningstagere, TTOer og USOene selv til å forstå firmaets behov for ny menneskelig kapital og hvordan dette kan oppnås gjennom lederbytte. Forskningen viser behovet for lederbytte ved å belyse hvordan erfaringene til den første lederen, sjelden dekker alle kravene i ulike faser av firmautviklingen. Implikasjonene for disse blir å skape metoder for bedriftene å få tilgang til ledere med rett erfaring og gjennomføre de nødvendige lederbyttene.

Tidligere forskning på USOer har vært begrenset av mangel på kvantitativ data, som har resultert i ugeneraliserbar anekdotiske studier og den dag i dag finnes det ingen forskning som adresserer lederbytter i USOer. Denne forskningen løser denne mangelen på kvantitativ data ved å ta i bruk FORNY-databasen som inneholder nesten alle forskningsbaserte oppstartsbedrifter siden 1995 og inneholder 417 USOer. Det akademiske bidraget er å introdusere robust, kvantitativ longitudinell forskning til en anekdotisk USO litteratur og være den første til å åpne den sorte boksen om lederbytter i USOer.

Summary in english

University spin offs (USO) represent an important source for wealth and job creation in our society and have seen a significant growth in the last 10 years. These are companies based on technology with potential to disrupt industries. Still, USOs are known to underperform compared to other independent new ventures, as their environments lack resources needed to develop.

Their lack in resources increase the importance of the USOs' intangible resources, namely human capital. The USO's CEO has the overall responsibility for opportunity recognition and progression, and the USO depends on his human capital as it greatyly influences the firm's performance. As the firm develops, new tasks and challenges arise, requiring new human capital to handle them. Having a CEO with the right human capital at the right time, therefore becomes crucial for USOs to commercially progress, but as their first CEOs seldom has the needed human capital, a CEO succession could be conducted to acquire the right human capital.

Even though the CEO lacking human capital may cause USO's underperformance, and replacement is a viable solution, CEO succession has never been addressed in the USO literature.

This master thesis wishes to address CEO succession by gathering literature and conducting a quantitative study, to close the literature gap about USO CEO succession and increase the USOs performance. The study investigates what human capital needs that arise as the USO develop, if CEO succession can fulfill these and how succession affects commercial progression. The thesis is written in two papers. Paper one is a literature review, collecting and discussing theory and former research on CEO successions. Paper two is a quantitative study, producing empirical evidence for how CEO succession affects the USO.

In the first paper the goal is to use literature to describe how a CEO succession can fulfill the arising human capital needs and how succession affects the development of USOs.
To answer this a literature search was conducted, to get an understanding of the most relevant literature regarding USO development, its human capital needs and the effect of CEO succession. None of the relevant 28 articles directly addressed CEO succession in USOs, confirming a gap in the USO literature. Due to the lack of literature, the study linked emerging needs in a USOs' lifecycle to different human capital. This framework was used to investigate how CEO succession can fulfil these needs and enhance progression.

The paper showed that CEO succession should be used to fulfil the need to acquire managerial, commercial, industry and entrepreneurial work experience, while also removing unnecessary academic work experience.

Paper two is motivated by filling the gap in succession literature found in the first study, and discover how CEO succession affects human capital and the commercial progress. The paper investigates this by revising the propositions from paper one into hypotheses for empirical testing and testing them with data from 201 USOs in a regression model. The acquisition of

the recommended work experiences in different development stages are analysed along with the progression of succession firms versus no-succession firms. The regression proved that as USOs evolve, USOs conducting successions proves to progress further commercially than USOs that do not and that CEO succession removes academic experience, while acquiring managerial and commercial experience. These findings are the first contribution to the CEO succession field in USO literature.

The contribution of the two papers to increase the USOs' commercial progression by helping policy makers, TTOs and the USOs themselves to better understand how CEO succession can fulfil the firm's need for new human capital and progress. The research exposes how the experience of their initial CEOs seldom fits the requirements for developing the USO, and should be replaced**.** The core implications for these parties is to create means for the USOs to access CEOs with the needed work experiences and dare to execute the necessary CEO successions.

Earlier research on USOs has been restrained by a lack of quantitative data, resulting in ungeneralizable anecdotal works, and to this date there exists no research addressing CEO successions in USOs. This research resolves the lack of quantitative studies by accessing the FORNY database, comprising practically all research based startups in Norway since 1995, with 417 USOs. The academic contribution is introducing robust quantitative longitudinal research to the mostly anecdotal USO literature, being the first to open the black box of CEO successions in USOs.

Progression through CEO succession: A literature review of succession's effect on USOs' human capital and development

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Spring 2016

Abstract

University spin-offs (USO) have in recent years had a significant growth in represent an important source for job creation and wealth. Still, university spin-offs is found to significantly underperform compared to other new ventures. Researchers argue that USOs special starting conditions result in additional obstacles in becoming a profitable venture, one being the academic CEO. This study explores how a university spin-off can use CEO succession in order to fulfill their incomplete resource endowment and be used as a mean to cope with the underperformance of USOs. The study is conducted as a literature review, utilizing the resource-based theory together with the human capital theory in order to examine the different attributes of human capital needed as the USO develops. The needs are linked to Vohora et al.'s (2004) stage model as human capital attributes; academic, industry, commercial, managerial and entrepreneurial work experience and it is discussed how these can be fulfilled with a CEO succession. As a result, the study found that a CEO succession represents an efficient way of acquiring the resources and human capital needed for the USO to progress commercially. Further, based on the literature, this study proposes that USOs that conduct succession will develop faster and reach develop further than USOs that don't. This study contributes to close the existing gap on literature about CEO succession in USOs, paving the way for research on CEO succession as a mean for progression for USOs. The results have implications for USOs, policy makers, investors and researchers.

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1. Introduction

Commercialization of research through creation of university spin-offs has in the recent years seen a significantly growth, and represent a potentially important source for wealth and job creation (Vohora et al., 2004, Mustar et al., 2006, O'Shea et al., 2008). USOs often have a radical nature operating in emerging industries with high disruption potential. This makes the phenomenon more interesting than just the USOs direct impact on economy and employment (Rasmussen et al., 2012).

USOs perform significantly lower than independent new venture in terms of revenue growth and net cash flow (Ensley and Hmieleski, 2005, Wennberg et al., 2011) and emerge from a non-commercial environment that typically lacks business and commercial resources (Mustar et al., 2006). According to Vohora et al. (2004) the development and creation of these ventures faces a huge challenge in achieving sustainable returns and financial profitability. The majority of the USOs created often are small firms that use a long time to grow, and Rasmussen et al. (2012) theories that it could be the result of different starting conditions of the USOs compared to corporate companies.

Cooper and Bruno (1977) and Mustar et al. (2006) found that the CEO's primary assets of skills and knowledge are crucial for new USOs and can make the difference in new venture success, either through risk-taking propensity (e.g., Stewart Jr and Roth, 2001, Stewart Jr and Roth, 2004), need for achievement (e.g., Begley and Boyd, 1987, Stewart et al., 1999), high self-efficacy (e.g., Chen et al., 1998), or the ability to recognize opportunities where others do not (e.g., Alvarez and Busenitz, 2001). Gurdon and Samsom (2010) along with Ensley et al. (2006) found that poor leadership and lack of central resources might be a central reason for the underperformance of the USOs. This implies that the human capital of the CEO is essential to the USO's development as the CEO is the one who has the overall responsibility for the performance (Offstein and Gnyawali, 2005), is heavily involved in the daily operation and execution of activities (Bruton et al., 1997, Wasserman, 2003)

A CEO succession may be able to solve many of the obstacles mentioned for the USOs, as it is a way to acquire the resources needed to develop. A common perception is that rapidly growing firms quickly outpace their founders' managerial capabilities and should be replaced (Buchele, 1967, Tashakori, 1980, Drucker, 2014, Clifford and Cavanagh, 1985). Founders are typically succeeded by experienced or professional managers to cope with increased complexity of the CEO tasks (Buchele, 1967, Tashakori, 1980, Drucker, 2014, Clifford and Cavanagh, 1985). Replacing the leader is an effective way of changing the firm towards a market-orientation, which is crucial to achieve commercial success (Roberts, 1989, Berry, 1996).

Even though the literature explains that the underperformance of USOs is due to the human capital of the CEO and lack of resources (Gurdon and Samsom, 2010, Ensley et al., 2006, Mustar et al., 2006). The literature review reveals that no researchers have investigated how a CEO succession can be an effective mean to solve this in a USO context. This study will therefore be the first of its kind, investigating how a CEO succession can affect the development and human capital of a USO. Therefore contributing to the literature by addressing the call for how a USO reconfigure their resource base and evolve in their early stages (Wright et al., 2012, Heirman and Clarysse, 2004) through succession. The following research questions are therefore put forward:

RQ1: *How can CEO succession fulfill the human capital needs as USOs develop?*
RQ2: *How does CEO succession affect the development of USOs?*

To answer the research questions a literature review is conducted in order to synthesize the literature regarding CEO successions in USOs and contribute to the understanding of CEO succession and its effect.

The paper discusses what different types of human capital a CEO needs in different stages in order for the USO to successfully develop, examining how a CEO succession can be used to acquire this human capital. Work experience is used as the operationalization of human capital, and forms the foundation for the resources the USO needs in order to overcome critical junctures between development stages. The junctures are from Vohora et al.'s (2004) stage model that is used as a framework for the USO development and progress. The stages and junctures represents a set of specific resource needs and challenges the USOs face as they develop. The results from the literature review are unanimously coherent regarding that the human capital needs to evolve as the USOs progress (Wasserman, 2003, Vohora et al., 2004, Ambos and Birkinshaw, 2010). Furthermore, this change in need for human capital forms a potential basis for a CEO replacement, where deliberate CEO succession can be an effective way to meet the new human capital needs.

This paper is structured as follows. First, the theoretical foundation is presented together with this study's definition of a USO in order to avoid misinterpretations of such a key element. To give an understanding of the USO's development path, the stage model by Vohora et al. (2004) and resource-based theory, together with the human capital theory will be explained. The paper will continue with presenting and explaining the method used in the literature review, before a discussion of the findings together with theory, results in a set of propositions. Finally, conclusion together with implication and limitation and further research are provided and explained.

2. Theory and definitions

In this section, the definition of a USO and the underlying theories used to interpret the literature review is presented. This paper draws upon the resource-based theory, human capital theory and Vohora et al.'s (2004) stage model, and will be used to form the framework for the discussion.

2.1 Defining USO

The university spinoffs have almost as many definitions as there are researchers researching it according to Pirnay et al. (2003). In order to prevent misinterpretations and delimits, boundaries are defined of the concept. A loose definition of such a key element can be harmful both for future research and lead to misapplication of the term (Pirnay et al., 2003). The goal in section 2.1 is therefore to explain this study's definition of a USO to prevent these misinterpretations and allow other researchers to build on upon this study.

In order to do so, this section will present the different perspectives and definitions used to describe USOs to simplify the complexity around it, before arriving at this study's definition of a USO by utilizing the common elements from these different perspectives.

The nature of spin-offs

Understanding the USOs essence is fundamental in order to address and understand the challenges associated with them. Based on an analysis of previous literature Wright (2007) identified three main theoretical perspectives to define USOs, while Djokovic and Souitaris (2008) on the other hand defines the USOs from their core elements.

The three main theoretical perspectives define USOs either from (Wright, 2007) perspectives: *resource-based, business model or institutional.* The *resource-based perspective* focuses on how competitive advantage can be created through the spin-offs resources. Here spin-offs can be distinguished based on their resource configuration (Wright, 2007). The *business model perspective* focus on internal activities and distinguishes based on business and revenue model*,* while the *institutional perspective* looks at the connection between the venture and parent organization and makes the distinctions based on how the knowledge is transferred and linked to the parent organization.

Djokovic and Souitaris (2008) believe a definition should specify the outcome of the spin-off concept. Djokovic and Souitaris (2008) focused on different components of a spin-offs and found three elements; *the outcome, the parties involved* and *the core element*. The *outcome* focuses on the evolution of the spin-off and the *core elements* focus on what elements that are transferred between the parent institution and the spin-off, including individuals and knowledge. While the *parties involved* define USOs with the elements involved in creating them, such as parent

organization, entrepreneur and technology originator.

All these ways to define USOs helps illustrates some of the complexity and heterogeneity of a USO definition. Still, three dimensions are common in the in all the perspectives: (i) A *parent organization* from which the USO originates from, (ii) the *individuals involved* in the USO, and (iii) the nature of the technology origin and how this *knowledge is transferred* to the USO. These three dimensions is seen as essential in defining the USO phenomena and to form the definition of a USO in this study, as they all represents critical components for creating a USO.

(i) Parent organization

This dimension revolves around the parent organization or institution the spin-off originates from. Where Clarysse et al. (2000) defined the institution as a *technical school, private/public R&D or university*. Rogers et al. (2001) on the other hand, had a more open definition, also including private corporations and defined the institution as a ‘‘parent organization’’. While Pirnay et al. (2003) and Smilor et al. (1990) defines it as a ‘‘university’’.

The different interpretations of the parent organization may cause limitations due to the different resources needed by private corporations compared to independent research institutions (Löfsten and Lindelöf, 2005). The different resource needs is a result of contrasting focus, where independent research institutions is to a greater extended focused on public benefits and research, rather than profits.

This study will only focus on the independent research institutions and universities as they often are closely linked. Both independent research institutions and universities spin-offs are found to underperform due to lack of access to central resources compared to private corporations. They represent a huge commercial potential, argued to face similar challenges in the development process.

(ii) Individuals involved

The individuals involved in a USO are typically referred to as founders and two different aspects appear in regards their role in the definitions. (i) The founders’ employment prior to the spin-off. (ii) The founders’ affiliation to the spin-off’s parent organization

Both Rogers et al. (2001) and Steffensen et al. (2000) states that the spin-off must be formed by individuals who are formerly employed be the parent organisation. While neither Pirnay et al. (2003) nor Clarysse et al. (2000) does specify the nature of the founders occupation prior to the spin-off in their definitions. Smilor et al. (1990) and Franklin et al. (2001) on the other hand states that the founder can both be a founder from the parent organization or an surrogate entrepreneur from the outside. A surrogate entrepreneur is not affiliated with the technology, but founds the spin-off (Radosevich, 1995).

Looking at the founders' affiliation to the parent organization, Nicolaou and Birley (2003) states that the founder can still be affiliated with the parent organization during the spin-off. While Smilor et al. (1990) and Rogers et al. (2001) states the opposite in their definition, implying that founder cannot be affiliated with the parent organization during the spin-offs. In Nicolaou and Birley (2003) definition, the founder has to be the a academic inventor, including researchers, faculty and graduates, but excludes staff. Along with the rest defined by Nicolaou and Birley (2003), Smilor et al. (1990) also includes staff in his definition.

This study will include surrogate founders together with academic founder as these represent an important part of the USO literature. Using a surrogate entrepreneur is often done if the institution's technology transfer office is involved in the spin-off. Where the founder can both be affiliated or not with the parent organization through the spin-off process.

(iii) Knowledge transfer

Wright (2007) states that USOs are dependent on transferring the delegation of an institution's intellectual property (IP) or form of licensing agreement. This is coherent with Rogers et al. (2001) and Nicolaou and Birley (2003) who states that a spin-off is founded based on a core technology. Implying that knowledge must be transferred from the parent organization, but does not specify if it is IP, codified or tacit knowledge. While Pirnay et al. (2003) takes it a step further and define USOs as "new firms to exploit commercially some knowledge, technology or research results".

Following this, Pirnay et al. (2003) distinguish between two types of spin-offs, product development oriented and service providers. Spin-offs based on technology or codified knowledge mainly forms product development oriented firms, while USOs based on tacit knowledge mainly are service providers. The characteristics and condition of these two types of spin-offs are quite different. Product-orientated spin-offs have a high need to acquire resources and follows a development path associated with Vohora et al.'s (2004) stage model, and an international potential due to their radical nature (Pirnay et al., 2003). The service providers on the other side have low resource and financial needs with a local to national potential.

This study will therefore focus on USOs originating from specific research results that develops into product oriented firms, as these also have a more complex development path and resource need, generally found in universities and independent research institutes. This complexity puts more pressure on the CEO's human capital, increasing the need to bring in new knowledge and may therefore better answer the research question on successions effect on human capital. Service providers are therefore excluded.

This study's definition of a USO

Considering all the three dimensions and core elements, this study will build on the work of Pirnay et al. (2003), expanding the definition to also include independent research institutes. Following this the definition of USO in this study is defined as:

New firms created to commercialize knowledge, technology or research results developed within a university or an independent research institute.

New firms is here defined as an autonomous structure, pursuing profit making activities that is neither an extension nor controlled subsidiary of the university, but have their own distinct legal status (Pirnay et al., 2003). Focusing on product orientated USOs, excluding private corporations due to the different resources need (Löfsten and Lindelöf, 2005).

2.2 Stage model

A USO travel through different stages in its lifetime and the ideal mode of leadership in organizations depends on the firms current stage in the life cycle (Kaulio, 2003). Life cycle models are suited for explaining and understanding the development of a USO and are used by several authors (Vohora et al., 2004, Ambos and Birkinshaw, 2010, Wright et al., 2012, Rasmussen, 2011). Life cycle models focus on how a firm progress from it's initial stages until it is established and sustainable. This makes such models ideal for studying how the human capital needs evolves as the USO develops.

Vohora et al.'s (2004) stage model is chosen as its one of the few models that focus solely on USOs and is highly cited in this field of research (Lockett et al., 2005, Mustar et al., 2006, Wright, 2007, Rasmussen, 2011). The stage model is based upon five distinctive stages together with four junctures that represents respective challenges and resource needs the USO needs to overcome in order to proceed to the next stage. The USO has to pass through the previous stage in order to progress to the next, but each stage have nonlinear and iterative processes which can revisit and repeat earlier decisions and activities. Vohora et al.'s (2004) stage model can therefore be used to pinpoint why a CEO succession is likely to occur based on the changing human capital needs. The model is illustrated in figure 2.1, and shows how the USO develops through the stages and critical junctures.

The research stage is the first stage in the model. Here the valuable intellectual property (IP) is created by academics and generates the opportunity for commercialization. The IP is often developed within the university and is strongly related to the researcher's know-how and research. To proceed to the next stage, the USO has to overcome *the opportunity recognition juncture.* This juncture requires the ability to

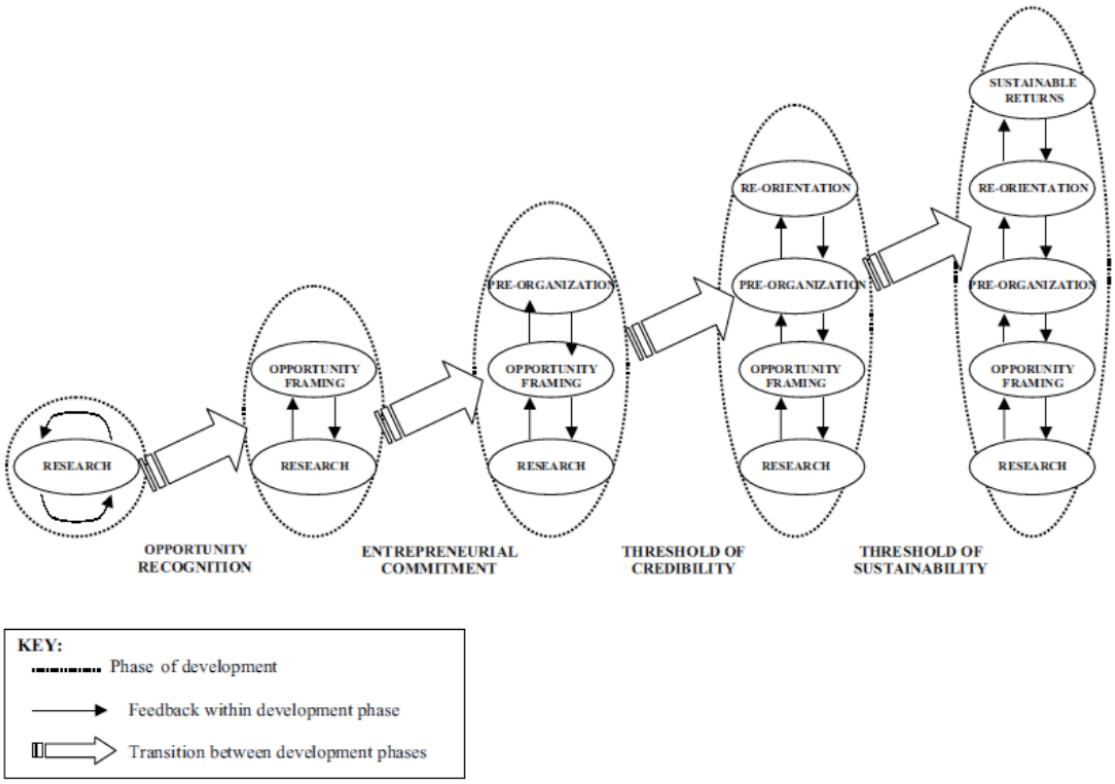

Figure 2.1: Vohora et al. (2004) stage model

synthesize scientific knowledge with an understanding of the markets. Meaning that a commercial need has been identified.

The opportunity framing stage is the next stage in the model. Here the technology or service is screened to validate and evaluate the commercial value (Wright, 2007) where the technology transfer office (TTO) often is involved. The next stage is the pre-organization stage, but in order to reach this stage the USO have to pass *the entrepreneurial commitment juncture.* This juncture represents the hurdle to go from a secure academic existence to a full time entrepreneur. The challenges are lack of entrepreneurial experience, academic role models, self-awareness of personal limitations or insufficient network for finding surrogate entrepreneurs.

The pre-organization stage is the third stage and described by Vohora et al. (2004) as the stage with the steepest learning curve for the academic entrepreneur. The stage involves developing and implementing strategic plans among the top management team (TMT). This includes important decisions on which resources and capabilities to acquire or develop. To reach the next stage, the USO has to overcome *the threshold of credibility juncture.* This junctures represents the challenges with acquiring the initial stocks of resources for the USO's business to begin to function. Where Wright (2007) describes financing as a key resource.

The reorientation stage is the stage where the USO manages to offer a potential value to the customer and starts generating revenue. Here

the challenge lies in the ability continuously acquire, integrate and reconfigure resources in order to transition through *the venture sustainability juncture* before the last stage.

The sustainable return stage is the final stage, where the USO attains sustainable returns and the uncertainties from earlier stages are addressed to create a more precise business model. New challenges will arise of a organizational and managerial manner as the firms grows in network, partners and personnel.

Vohora et al. (2004) makes a valuable framework in regards to this study, but it does not come without limitations. Rasmussen (2011) argues that such models fail to explain how the ventures transition from one stage to the next and this paper will try to explain this transition with succession. The model is based on nine USOs (Vohora et al. (2004) and it lacks an explanation of the amount of time USOs spend in each stage, along with questions regarding the developments non-linearity. Still, the model is highly cited and the only model built around USOs. The model gives a unique insight of the development process of USOs and will be used, as a framework to link human capital needs to, in order to investigate how a CEO succession affects human capital and the USO as the USO develops.

2.3 Resource-based theory and the CEO

This study will draw upon the resource-based theory as it is used to explain how new ventures with limited resources can obtain sustainable competitive advantages.

The resource-based theory views the company and its CEO as a bundle of resources (Amit and Schoemaker, 1993), where Barney (1991) used intangible and tangible organizational resources and capabilities attributes as an explanation for superior performance (Mustar et al., 2006, Barney, 2001). The intangible resources will be the focus of this paper as each individual in a new venture brings in different resources. These resources may be different due to the differences in the individual's background such as education, social ties and cognitive sense (Brush et al., 2001). This makes the CEO of the USOs particularly interesting because this individual has the overall responsibility for the venture, generally involved in coordination and execution of daily operations (Bruton et al., 1997, Miller and Toulouse, 1986, Wasserman, 2003).

Still, the vast majority of new ventures have incomplete initial resource endowments (Brush et al., 2001). This means that it is crucial for USOs to create identify, create, develop and accumulate resources (Sirmon et al., 2011). Still, the ability to attract resources is described by

Brush et al. (2001) as one of the greatest challenges for a new venture. As the firm develops these resource needs evolve (Vohora et al., 2004), meaning a CEO fitting for one stage, may not fit for another. New ventures must be able to transfer the personal resources and strengths into organizational resources to provide a unique advantage and basis for continued growth (Brush et al., 2001). This is further supported by Sirmon et al. (2011) emphasizing that a CEO must be able to implement strategies that generate positive returns. To do this the CEO must be able to orchestrate the firm's capabilities and assets to achieve competitive advantage (Sirmon et al., 2011). This implies that two CEOs with the same background and work experience will affect the USO differently, as the ability to orchestrate assets is uniquely tied to each individual.

2.4 Human capital and the CEO

To focus the resource based theory on the CEO, human capital is used to categorize the attributes of the leader. Becker (1975) defined human capital as skills and knowledge that individuals acquire through investments in schooling, on-the-job training, and other types of experience. It defines variables related to the CEO's competence, as *experience,* which will be utilized to explore the relationship between the CEO's background and succession.

Cooper and Bruno (1977) and Mustar et al. (2006) found that the CEO's primary assets of skills and knowledge are crucial for a new USO. As it's competitive advantage is likely to be based upon skills and knowledge of the CEO. Becker (1975) distinguishes the conceptualizations of human capital attributes as work experience and education that may or may not lead to skills and knowledge (Unger et al., 2011) and investment or outcomes bound to a specific task (Unger et al., 2011).

The experiences is categorized under *academic work experience,* used for product development and often present in the USOs due to their nature (Cooper et al., 1994), *managerial work experience,* that can prepare the CEO for a range of organizational hurdles (McGee and Dowling, 1994), *commercial work experience* with practical experience from sales and marketing (Roberts, 1989), *entrepreneurial work experience* with situational experience and a valuable human network (Mosey and Wright, 2007) and *Industry work experience* that can reduce knowledge hurdles and reduces the liability of newness (Cooper et al., 1994, Vohora et al., 2004).

Through the lens of human capital the need for succession becomes clear by assuming that the individuals in the venture attempt to maximize their economic benefits based on their investment in human capital (Becker, 1975). This is because they want to receive higher compensation and less risk for their human capital investments

are people who are highly educated often choose not to become entrepreneurs (Unger et al., 2011). This is highly transferable to a USO setting, were the USO's founders likely are specialized academics with Ph.Ds. who have invested more than average in their human capital and therefore expect higher compensation for their human capital investments (Cassar, 2006).

2.4.1 The importance of the CEO's human capital

Several authors argue that the CEO plays a crucial part in a new venture success, either through risk-taking propensity (e.g., Stewart Jr and Roth, 2001, Stewart Jr and Roth, 2004), need for achievement (e.g., Begley and Boyd, 1987, Stewart et al., 1999), high self-efficacy (e.g., Chen et al., 1998), or the ability to recognize opportunities where others do not (e.g., Alvarez and Busenitz, 2001). Cooper et al. (1994) findings showed that the CEO's human capital and background appeared to be significantly related both to growth and to marginal survival. This also supported by Ma et al. (2015) findings revealing that new start-ups rely heavily on the founders' personal capabilities in sensing opportunities. Individuals have different intangible resources and the research based theory states that the different combinations of resources makes it possible for some to seek opportunities, where others do not.

In small ventures such as a USO, the CEO has a substantial influence on the USO's development and performance (Offstein and Gnyawali, 2005), heavily involved in the daily operation and execution activities (Bruton et al., 1997, Wasserman, 2003). The CEO can therefore be argued to be most important individual in a USO as he is responsible realizing their potential and for displaying effective leadership behavior (Hmieleski and Ensley, 2007) and therefore need to have overlapping skills and knowledge to the rest of the top management team.

Human capital will in this study use previous work experience as a proxy. This is a valid and widely used approach for measuring human capital (Unger et al., 2011) as there is found to be a strong relationship between human capital investments and potential outcome.

3. Method

In order to address and discuss the research questions, a literature review has been conducted to find relevant literature relating human capital, USO development and CEO succession.

3.1 Research Methodology

Because of the gap empirical research on USOs, Shane (2004) recommend to approach USO literature with a phenomenon oriented method, where multiple theoretical frameworks are combined to create an understanding of the research topic. In this paper general succession literature is used in a USO context. Since little has been written on CEO succession in USOs, the literature

and the study is conducted using an exploratory research design.

The literature review is made up of three parts. (i) A unstructured literature search to get an initial understanding of the characteristics of USOs, where the highly acknowledged publications from Rothaermel et al. (2007), Mustar et al. (2006) and Rasmussen et al. (2012) is reviewed. (ii) Following this a structured literature search is done to find articles explicitly explaining CEO succession in USOs. The articles are evaluated, reviewed and only the most relevant kept. (iii) Finally to be able to discuss factors from startup literature up against succession in USOs there was conducted a semi-structured literature search on CEO succession in startups.

3.2 Structured literature search

The structured literature search was conducted using the web platform Web of Knowledge. Web of Knowledge is a database containing leading journals from a large range of publishers (Rasmussen et al., 2012). Web of Knowledge is chosen as search platform since it comprises all the journals that one of the biggest contributors to USO research, Rasmussen et al. (2012) proposed as good sources for USO literature.

The search strings [1] were made broad to include all the relevant literature on the topic. The structured search was done in four steps. (i) Including relevant articles in the search string. (ii) Limiting the results to relevant publications. (iii) Screening the articles and (iv) reevaluating the articles labeled uncertain.

The first part of the search string is based upon the search string from Rasmussen et al. (2012). Six often used words for the origin of a USO, nine synonyms for spin outs, ten for CEO and seven acronyms for USOs are used to capture different terminology describing USOs. To include different terminologies for succession, 21 different words for succession were coded into the string. The entire search was based on hits in "topic", except for the name of the relevant journals. This gave 3693 articles from more than 100 research areas, with the majority from business economics with 2030 articles, followed engineering with 381 and educational research with 319 articles. Most of the research areas were distinctly irrelevant for the study like biotechnology, applied microbiology and surgery. To limit the results only relevant journals were included.

In the second part, the relevant journals were chosen using Rasmussen et al. (2012) propositions for journals dealing with USO literature. Rasmussen et al. (2012) chose these based upon the top cited journals from 127 relevant USO articles. Using these journals the results were reduced from 3693 to 307 articles. The top three journals they originated from was the Journal of business venturing with 76 articles followed by Technovation with 39 and

[1] Appendix 1 shows the search words in details.

the Research Policy with 37 articles[2].

In the third part, as the search string was constructed to be broad, many of the articles were outside the scope of the study. To eliminate the irrelevant articles the titles and abstracts of the articles were screened to see if they met a set of requirements:

1. Does the article describe USOs or similar types of firms?
2. Does it address:
    a. CEO successions?
    b. CEO succession and human capital?
    c. Human capital and the development of a new venture?

Each of the remaining 307 articles was label as relevant, uncertain or not relevant by one of the researchers. Where 19 was marked *relevant,* 31 *uncertain* and 257 was labeled as *not relevant*.

Finally, the title, abstract, and conclusion of the articles marked *uncertain* were read by a different researcher than the one who labeled it. The reason for this is that different readers will evaluate the research questions differently, which creates a bias. Of the 31 uncertain articles, 9 were labeled as relevant when read by another researcher.

[2] Appendix 2 illustrates the journals used to limit the search results

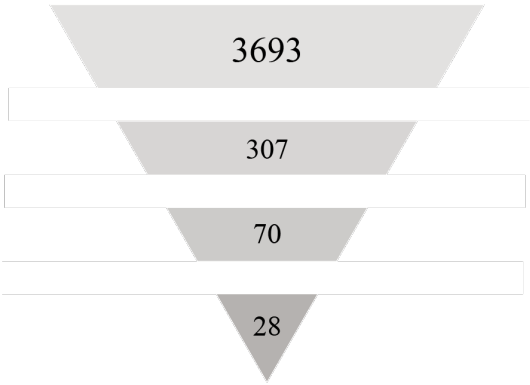

Figure 3.1: The literature review's article funnel: Creating a sufficient search string and executing the search in Web of Knowledge (3693 articles). Limiting the result to relevant journals from title and abstract (307 articles). Screening the articles abstract and conclusion (70 articles). Reading the relevant articles in full length and writing summary, which would be used in the literary review(28 articles).

This resulted in a total of 28 articles that was considered relevant to this study. Further, a backward snowballing process was initiated from the obtained articles. Meaning that the articles from the literature review referred to several articles that concerned relevant topics for this study and was therefore also examined.

The conclusion from the structured literature review is that there are few articles explaining CEO succession, especially in USO context and how this can affect the USO's development.

3.3 Result and source

The structured literature search revealed 28 articles considered relevant to this study that were read and analyzed. Appendix 3 consists of a list of the

articles and key findings.

Publishing source

The highest number of articles was found in Journal of Business Venturing and Technovation. This is consistent with Rasmussen et al.'s (2012) review on USO literature where both Journal of Business Venturing and Technovation are among top journals in number of articles.

To show the relative importance of a journal within a research field, citations per article is listed in table 3.1. The citation per article also called impact factor, is an average of the citations done the last two years of the articles published in that journal. SCImago Journal Rank (SJR Indicator) is a measure for scientific influence that additional to taking the number of citations into account, also calculate the prestige of the journal that cite the article. For being such a narrow field of research, all the journals score adequately with an impact factor of over 1 for each journal. R&D management, Journal of Technology transfer and Technology Analysis & Strategic Management have a SJR Indicator below 1, but does only account for 7 articles combined and will not influence the validity of the results significantly.

Journal	**# of articles**	**Cites per article**	**SJR**
Journal of Business Venturing	6	4.62	5.56
Technovation	6	3.08	1.42
Research Policy	3	3.91	3.91
R&D Management	3	1.39	0.69
Journal of Technology transfer	2	1.21	0.83
Organization Science	2	4.17	8.1
Management Science	2	2.81	3.39
Technology Analysis & Strategic Management	2	1.18	0.52
Journal of Management	1	6.37	7.23
Entrepreneurship theory and practice	1	3.53	2.81
Strategic Management journal	1	3.87	6.39

Table 3.1: The number of articles from the different journals with SJR and Citations

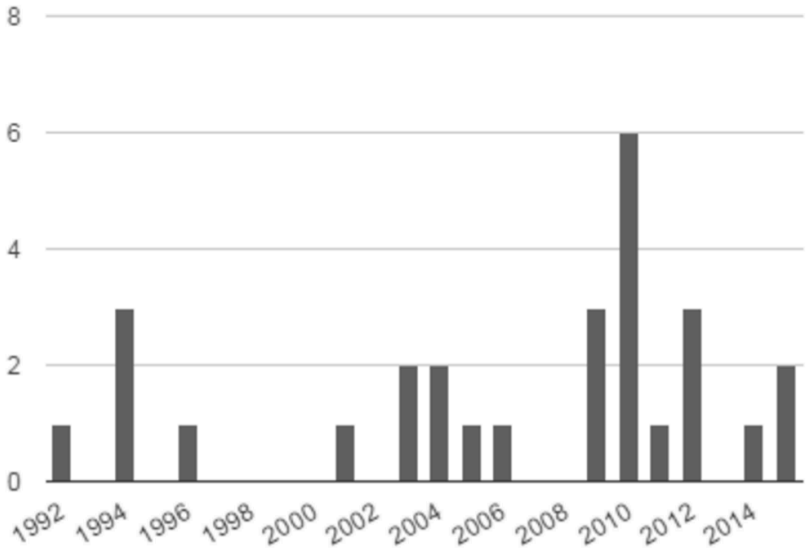

Figure 3.2: Number of articles published each year between 1992-2015

Time of publication

When examining the time of publication for these articles, they are spread out over the span from 1992 to 2015 and is illustrated in figure 3.2.

There seems to be an increasing focus on the subject due to the increasing number of articles published since 2002. The last half of the time span accounts for 22 of the 28 articles, with a publication peak in 2010. This matches the findings of Rasmussen et al. (2012) and the significant increase in amount of USOs after the IP policy changes in universities.

Distribution of themes

As none of the articles addressed CEO succession in USOs directly, the articles were grouped in Human Capital and Venture Development articles. Figure 3.3 illustrates the distribution of the key themes. 12 (43%) of the articles reviewed are directly tied to the relationship between human capital and venture development in regards of succession. While 6 (21%) are focused just on operationalization of human capital and 4 (15%) just on venture development. The remaining 6 (21%) of the articles regarded other triggers to succession and venture development and were considered important to show the bigger picture regarding succession. This is deemed a relevant distribution.

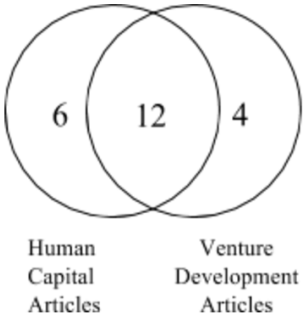

Figure 3.3: The distribution of key themes in the articles

3.4 Key findings

From the analysis a few key findings stood out regarding operationalization of the relationship between human capital, succession and the development of USOs. Human capital is mainly described in the literature through work experiences such as: academic, managerial, commercial, industry and entrepreneurial experience (Cooper et al., 1994, Unger et al., 2011). Academic work experience is the most described experience in the literature, which is natural as most USOs are established by academics (Rasmussen et al., 2012).

Venture development is operationalized through Vohora et al.'s (2004) stage model combined with needs and milestones from other literature that help pinpoint needs as the venture develops.

The literature review confirms that there exist little to none literature directly addressing CEO succession in USOs.

The publishing sources, the relevant literature, the distribution of content and the key findings within them are applicable for a discussion about the relationship between human capital and USO development. This paper will therefore further investigate the development of human capital and how this can be tied to CEO succession in USOs. This will be done by discussing the relation between different experiences in relation to the junctures and stages of Vohora et al.'s (2004) stage model.

4. Discussion

The discussion is divided in two parts. Part one will discuss RQ1, how CEO succession can fulfill the different human capital needs as the USO develops. The second part will address RQ2, examining how a CEO succession can affect the USO development.

4. 1 Part 1: The CEOs experienc

The literature agrees that USOs have an evolving and changing need in experiences as the firm develops (Vohora et al., 2004, Ambos and Birkinshaw, 2010, Wright et al., 2012). The different work experiences from literature, *academic, managerial, commercial, industry* and *entrepreneurial* will be discussed and then connected to the stages in Vohora et al.'s (2004) stage model according to what the stages need.

Academic work experience

Academic work experience is gained from working as a researcher at either a university or independent research institute, which includes researchers, professors and Ph.D. candidates.

The USO CEOs generally have more than average *academic work experience* (Pirnay et al., 2003) as technical development remains a major task of the CEO at the early stage of the firm. The experience is therefore relevant for the early product focused stages (Clarysse and Moray, 2004). Clarysse and Moray (2004) also conclude that the need

for academic experience drops after the completion of the product, meaning that academics are not suited for managing the USO further into commercialization. This is supported by Berry (1996) findings that ventures dominated by technologist fail to evolve towards a market orientation, meaning that the USO will not benefit from having an academic CEO.

Individuals attempt to maximize their economic benefits based on their investment in human capital (Becker, 1975). Since a startup represents high risk and initially low income, individuals who are highly educated often choose not to become entrepreneurs (Unger et al., 2011). This is highly transferable to USOs where founders likely are specialized academics with Ph.Ds. who have invested more than average in their human capital and therefore expect higher compensation for their human capital investments (Cassar, 2006). USOs also continue unsuccessful for longer periods of time than established firms (Lowe and Ziedonis, 2006), making USOs appear unattractive for academics to commit. Following this, Jain et al. (2009) found that taking the leap into the world of commercialization represents a non-trivial challenge for scientists and that business and academic experience seldom appear together. A CEO with academic experience will have a greater challenge in orchestrating the commercial assets and resources than an individual with a broad business experience (Smilor et al., 1990). Further stating that researchers engaging in entrepreneurial activities often take a hybrid role to preserve their academic role identity (Jain et al., 2009), keeping them from committing fully to the venture.

A USOs first stage is about intellectual property, technical development (Vohora et al., 2004) and identifying technology (Ambos and Birkinshaw, 2010) and requires an academic CEO (Clarysse and Moray, 2004) from the inside of the firm (Cooper et al., 1994). This is usually due to the fact that the technology is embodied in the academic's specific knowledge and work (Knockaert et al., 2011). Still, this need for academic experience is reduced after the opportunity recognition juncture as the venture moves towards market orientation. The academics nature of risk avoidance and the lack of commercial mindset, makes CEOs with academic experience something that should be replaced if the USO wants successful commercial development, in means of sales and revenue growth. Therefore, the following proposition is put forth:

Proposition 1a:
In order to develop, USOs do not need to acquire academic work experience through CEO succession.

Managerial work experience

The literature use multiple different terms to describe managing a business and employees, literature describing organizational, business or managerial experience, but is in this study referred to as managerial experience. Managerial experience is defined as experience in the role of forming and managing a business, and is independent of the industry of application (Bower, 2003), and reconfiguring existing resources to get new competences, which can become competitive advantages (Eisenhardt et al., 2000). The experience is used for business development, finding partners, bundling resources and acquiring funding (Bower, 2003, McGee and Dowling, 1994, Smilor et al., 1990) and is gained from commercial activities in previous positions, orchestrating and organizing personnel.

Managerial experience has been shown in many cases to be used in new business to ease the burden of rapid growth, which comes to surface particularly in the finance, marketing and personnel areas. Inadequate performance in these areas is defined by Oakey et al. (1988) to be in high risk for becoming "a bottleneck to growth" and include the challenges with raising capital, finding and penetrating new markets (Cooper et al., 1994, McGee and Dowling, 1994, Berry, 1996). Attracting investors is described as one of the greatest challenges for a new venture (Brush et al., 2001) and Moray and Clarysse (2005) research showed that early-stage venture capital funds use managerial experience on the entrepreneurial team as a main criteria to consider investment.

An academic founder usually enters the business environment with scarce or non-existent set of managerial experience and awareness (Bower, 2003). Smilor et al. (1990) study on managerial experience, showed that 3/4 of the ventures faced difficulties due to a confirmed lack of managerial experience. To help the venture to achieve a marketing orientation, a development in organizational practice must happen to ensure the ventures survival and success in the long term (Berry, 1996).

The pre-organization stage in Vohora et al.'s (2004) stage model is where proof of viability and market is chosen. This stage focus is on acquiring external funding and fine-tuning business management (Clarysse and Moray, 2004). The threshold of credibility juncture follows the stage, where first sales increase the complexity of the CEO's task considerably (Wasserman, 2003). The challenges caused by these milestones could all be eased by managerial experience, an experience that is rare in the first CEO in a USO (Hmieleski and Ensley, 2007, Ensley et al., 2006b, Smilor et al., 1990). Thus, the following proposition is put forth:

Proposition 1b:
In order to develop, USOs should acquire managerial work experience through CEO succession.

Commercial experience

Commercial experience is gained from working with sales or marketing and enables the firm to see itself from the customer's perspective and achieve a marketing-orientation (Roberts, 1989). Commercial experience is related to previous work experience involving sales and marketing tasks, along with contact with customers, manufacturing and suppliers. Although multiple authors have stressed the importance of marketing-orientation to achieve corporate success (Oakey, 1991, Roberts, 1989), this is a challenge for USOs technical entrepreneurs, as they rarely possess commercial experience (Berry, 1996). The need for commercial experience is also increased by the R&D intensive environment of the USOs (Rasmussen et al., 2012) as this experience connects the R&D with client needs (Bower, 2003). Roberts, (1989) discovered that getting a CEO with commercial experience would transform firms toward this marketing-orientation and would ensure the ventures survival and success in the long term (Berry, 1996), but because of the nature to the USO's CEO the orientation is often neglected (Oakey, 1991).

A CEO lacking *commercial experience* will face challenges in Vohora et al.'s (2004) 3rd juncture (Wasserman, 2003, Smilor et al., 1990), *threshold of credibility*, which is recognized by the completion of the product development, finding market fit and first sale. This is because reaching these milestones will require a CEO skillset change from a narrow technological to a broad including sale and marketing (Wasserman, 2003) and will help the venture to transform towards the marketing-orientation (Roberts, 1989). As commercial experience connects R&D with the needs of the customer (Bower, 2003), it is not only valuable in marketing stages, but also in the research and opportunity framing stage. This is backed up by Visintin and Pittino (2014) that found that commercial experience combined with academic experience results in superior levels of performance in terms of growth. Based on this, the following proposition is put forward:

Proposition 1c:
In order to develop, USOs should acquire commercial experience through CEO succession.

Industry experience

Industry experience is gained from previous work in the same or a similar industry, and includes knowledge bases, experiences and relationships that directly and can significantly reduce the *liability of newness* (Cooper et al., 1994, Vohora et al., 2004). Still, the industry experience must be from a closely related industry or the value of the experience may be low (Karaevli, 2007).

Industry experience is a result of prior market knowledge and

network, which is rare in an academic USO CEO (Bower, 2003). This previous experience from working in a relevant industry develops the capabilities of sensing opportunities (Ma et al., 2015) and solving challenges as their ventures evolves that could not be foreseen at the time of founding (Cooper et al., 1994). Especially for USOs developing competency for refinement of opportunity (Wright et al., 2012), business models and applications become less challenging by introducing industry experience (Bower, 2003). Prior managerial experience in similar industries or with similar technologies is an important prerequisite for the successful use of R&D cooperative arrangements by new high-technology ventures (McGee and Dowling, 1994).

Bower (2003) found that industry experience was needed to develop the competency of opportunity refinement was difficult for academic founders due to limited market knowledge and network, and no previous experience with professional investors and their requirements. This difficulty is deemed by Wright et al. (2012) to be a distinctive challenge for CEO's with academic experience.

Industry experience seems not to be directly connected to a specific stage, but is described to have a positive attribute from the start as it reduces the liability of newness (Cooper et al., 1994). This work experience also solves USO specific challenges by developing competency for opportunity refinement (Wright et al., 2012), business models and applications areas (Bower, 2003). Industry experience is therefore important in both product development and commercialization, and argued to be acquired as early as possible.

Proposition 1d:
In order to develop, USOs should acquire industry experience through CEO succession.

Entrepreneurial experience

Entrepreneurial experience is gained from being a founder or having a position in a venture (Mosey and Wright, 2007, Ucbasaran et al., 2008) younger than 10 years old, which is the average time for start ups to accelerate growth (Lawton Smith and Ho, 2006). Earlier relationships and experiences eases the access to external human resources such as experienced board members and venture capital (Mosey et al., 2006, Wright et al., 2006), valuable for USOs in the first three stages (Research, Opportunity framing, Pre-organization). The experience is therefore positively linked to the performance of USOs, but mostly as a result of their network (Davidsson and Honig, 2003).

There are patterns of recurring events in most ventures (Kaulio, 2003) and situation based knowledge from previous start up is therefore undeniably of value the second time around (Wright

et al., 2007). Still, Santarelli and Tran (2013) argue that previous entrepreneurial experience may create overconfidence in out fashioned strategies that worked earlier instead of creating new ones. Santarelli and Tran (2013) also found that this experience may also increase risk aversion, which can become a challenge for the development of the USO.

Even though entrepreneurial experience seems to be situationally dependent and may not always be of value, it could be beneficial in the early stages of a firm, the opportunity framing and pre-organization stage, as it is associated with (i) gaining venture capital (Wright et al., 2007) and (ii) building the team and (iii) handling unforeseen situations. Therefore the following proposition is put forward:

Proposition 1e:
In order to develop, USOs should acquire entrepreneurial experience through CEO succession.

4.2 Part 2: Successions role in acquiring new experience

So far it seems that CEOs need some experiences and possibly are better off without other experiences in order for the USO to develop. Since no USO literature explicitly describes CEO succession, three options for USO CEOs are proposed from the literature in order to match the CEO's human capital to the development stage of the firm. (i) They can hire an experienced manager from the start with competence to take the USO through product development to sustainable returns. (ii) The initial CEO can learn and be coached to become a late stage CEO. (iii) The CEO is replaced in a CEO succession as he is outpaced by a better suited CEO for the current stage.

USOs have difficulties in finding and hiring experienced CEOs initially, due to the limited and homogenous network they origin from (Ensley and Hmieleski, 2005). Their network is often restricted to academic environments, where the succeeders are lacking needed experiences, especially commercial experience (Knockaert et al., 2011). The experienced CEO for his part, will pursue maximum profit for his human capital (Becker, 1975), and is not likely to be motivated by the potential low wages and risks associated with the USO's early stages (Mustar et al., 2006).

Coaching the first CEO is suggested as a mean to cope with the increasing complexity of CEO tasks as the USO evolve (Clarysse and Moray, 2004). The founders of USOs are often academics (Rasmussen et al., 2012), which combined with other work experiences, are found to be a profitable combination (Visintin and Pittino, 2014). Still there are multiple challenges linked to the academics mindset. Academic CEOs often take on a hybrid role trying to preserve their academic integrity, meaning they are not committing entirely to the business, thus slowing down the commercial development (Jain et al., 2009). This coincides with academics wish to

maximize the return on their extensive human capital (Becker, 1975), making them reluctant to commit fully to high risk projects like starting USOs (Unger et al., 2011).

According to the literature, the first CEO in a USO should be replaced in order to become a more prepared and risk taking firm. This is due to his often one-sided background, low willingness to change and misalignments with a high-risk role.

In the argumentation leading to the preceding propositions, the benefits of acquiring managerial, commercial, industry and entrepreneurial experience have been stressed, and create multiple reasons for conducting CEO successions in USOs. CEO successions in startups are done to keep momentum (Wasserman, 2003), unlike in corporations where CEO successions are done to break momentum in periods of poor firm performance (Dalton and Kesner, 1985, Friedman and Singh, 1989). Changing the CEO is an effective way to transform to a market orientation, which is essential to achieve commercial success (Berry, 1996, Roberts, 1989, Ambos and Birkinshaw, 2010).

In addition to acquiring valuable experience, CEO succession has other benefits. The new CEO does not only bring in value in means of the explicit work experience, but also in means of a new mindset and reorganization of existing resources. Different CEOs will also bundle and orchestrate the existing resources in the firm differently, creating different values and competitive advantages from the same firm resources (Sirmon et al., 2011). An academic is likely orchestrate the resources and assets of the firm better than a commercial CEO in the research phase, while the CEO with commercial experience is likely to orchestrate the firm better in the sales phase. Conducting a CEO succession does also not necessarily mean that one removes the experience of the initial CEO. Wasserman (2003) found that more than half of the succeeding CEOs stayed in the company. This implies that succession can add knowledge and competence to the company without removing any, which makes the succession net experience adding.

Based on the previous propositions together with the literature discussed above, CEO succession seems effective in bringing new resources and a mean for the USO to reach a new orientation. The following proposition is put forth:

Proposition 2:
In order to gain commercial progress a USO should succeed the CEO at least once.

6. Conclusion

The literature review found a gap in literature dealing with CEO succession in USOs. No researchers have explored how succession impacts the USOs development and its human capital. The

goal of this paper has consequently been to investigate CEO succession as a mean for USOs to perform better. This was done by using resource-based theory as theoretical lens and utilizing human capital theory to explore the evolving needs in the CEO's human capital as the USO develop. Using previous work experience as proxies on human capital to resolve the needs and development challenges presented in Vohora et al.'s (2004) stage model. Further, this study showed how CEO succession can resolve this. Answering both research questions:

RQ1: *How can CEO successions fulfill the human capital needs as the USO develops?*
RQ2: *How does CEO successions affect the development of USOs?*

Based on the research questions the paper discuss several interesting points regarding the disadvantages of the initial CEOs, the experiences needed as the firm reaches new stages and the effect of a succession. The initial CEO often has *academic work experience* resulting in limited and homogenous network, risk averse nature and reluctance to commit fully. These factors have proved to hinder a USO to reach its full commercial potential after the first stage in Vohora et al.'s (2004) stage model. This is due to the lack of other experiences to overcome the development challenges faced by the USOs in order to progress.

These work experiences are *managerial, commercial, industry and entrepreneurial* where all become beneficial at different stages to be able to progress to the next stage. While academic work experience is found to become a hinder for the commercial progress as the USO develops.

Managerial experience is most often mentioned in literature and seems to be needed from stage three, the pre organization stage, as it is needed to organize the team, fine-tune business plans, get sales and external capital. The sales part in this stage also requires *commercial experience*.

Commercial experience comes from experience with sales and marketing and is, according to the stage model, not needed before the first sale in the pre organization stage, but literature stresses its importance from the beginning of the venture. *Academic work experience* has synergy effects with *commercial experience* and initial opportunities may be lost if commercial experience is not present from early on. *Commercial experience* should therefore be acquired in the stage two, the opportunity framing stage.

Entrepreneurial experience should be also be acquired from the opportunity framing stage as it may contain situational knowledge and help acquire financing as well as personnel from previous network.

Industry experience reduces the liability of newness, finds opportunities and business models. The experience may therefore be valuable in all stages and should be acquired as early as

possible.

Several authors argue that a CEO succession is an effective way of achieving a needed transition towards a market orientation (Berry, 1996, Roberts, 1989, Ambos and Birkinshaw, 2010). This along with the changing human capital need implies that a CEO succession in itself could be beneficial for a USO due to their limited starting conditions.

The conclusion has several implications for *policy makers, founders, TTOs and USOs*. There are work experience that should be acquired at certain times that can help USOs with the challenge of surviving and reaching commercial success. The literature indicates that a succession seems to be a preferable way to acquire these experiences. Policy makers and TTOs should therefore make support mechanisms that facilitate networks to ease the access to more diversely experienced CEOs could who could succeed the ones they have. *TTOs* should also be aware of the experiences that are needed in the later stages so they can aid the USOs in actively finding CEOs with right experiences

By pinpointing the different stages together with their human capital needs, it also enables the entrepreneurs involved in a USO to better prepare for challenges and to see CEO succession as a positive mean for progress. The proposed findings about the experiences also allows for USOs to analyze their own situation and stage to determine if a succession is a good option or not.

7. Limitations and further research

This study is conducted as a literature review. Further research should therefore try to answer the research question and the propositions with empirical research. There is a call for more more quantitative studies in the USO literature (Djokovic and Souitaris, 2008) and testing the research question together with its propositions on real life cases will definitely contribute to the theory, as succession in USOs is a field that has never been explored. Following this, limitations and possibilities for further research will be presented.

Resource based theory and human capital: By using the research based theory and human capital as the theoretical lens one can argue that the study is limited by the lack of external and contextual factors (Rasmussen, 2011). Through categorizing the different findings as resources and capabilities, linked to stages the complexity may be underestimated and could therefore be an interesting field to look further into.

This study often presents that succession is done because a lack of one distinct work experience, where it could be due to multiple reasons. CEO succession is also just one of many ways of acquiring the resources, experiences and capabilities described and this

should be looked further into. The human capital theory is also constricted regarding capturing personal traits of the individuals, following this one can argue that the study should have included a psychology dimension.

Method applied: The literature search was only based on one database, namely Web of Knowledge. Following the selected journals found in the literature review done by Rasmussen et al. (2012) may have restricted the search. The restriction increased the quality and relevance of the search. Still, this might have excluded some relevant articles. Further, the screening method may have lead to exclusion of relevant articles. The reverse snowballing method used does not capture recently published work, only older articles.

Framework: The framework in this study is based on the stage model to Vohora et al. (2004), were stage models and life-cycle theories have been criticized by Rasmussen (2011) for not accommodating the possibility of several ways to reach the same goal. Further Rasmussen (2011) argues that the models fail to explain how the venture moves from one stage to the other. They also find it hard to find objective criteria to demonstrate that the USO moves from one stage to the next. There are also multiple other models for explaining the evolution and progress of a startup and could be looked further into.

Study the entire top management team (TMT): This study has focused on the CEO and the CEO's human capital in relation to the USO's development. One can therefore argue that even though the CEO is the most influential person in the USO, the USO consists of a team. Recent scholars (Klotz et al., 2014) argue that new ventures is started by teams and decisions is made together, implying that the team is more important regarding the development and performance of the USO. As the succeeded CEO often continues in the USO in another position after the CEO succession (Wasserman, 2003), looking at the entire TMT through the USO development would most likely influence the findings, and the authors encourages to further research this area.

8. Acknowledgments

The authors would like to give a sincere thanks to Professor Roger Sørheim from the Norwegian University of Science and Technology for valuable guidance and feedback during the process of writing the paper.

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Appendix 1: Search strings

Search words	TS: Research Policy OR Academy of management journal OR Journal of Business Venturing OR Management Science OR Journal of Technology transfer OR Strategic Management journal OR Technovation OR R&D Management OR Small Business Economics OR Industrial and Corporate change OR Administrative science quarterly OR Entrepreneurship theory and practice OR Academy of Management OR Journal of Management OR Organization Science OR Technology Analysis & Strategic Management	&	TS: Leader* OR CEO* OR Founder* OR Entrepreneur* OR TMT* OR Top Management team* OR Founder-CEO* OR Manager* OR Executive* OR Administrative*	&	TS: Succession OR Replace* OR Change* OR Switch* OR Changing OR Follow* OR founder-succession* OR founder-replace* OR Leader-succession OR CEO-succession OR Founder-succession OR Entrepreneur-succession* OR TMT-succession* OR Top Management team-succession* OR Manager-succession* OR swap* OR interchange OR supersede* OR take-over OR supervene OR succeed* OR transition*	&	TS: NTBF* OR RBSO* OR USO* OR SBEF* OR NTBV* OR HTBF* OR SBEF*	OR	TS: Spin-off* OR Spin-out* OR Spinoff* OR Spinout* OR Venture* OR New Firm* OR Entrepreneur* OR Start-up* OR Startup*	&	TS: Technology based OR Technology-based* OR University-based* OR university based* OR Research based OR research-based* OR science based* OR science-based* OR Academic* OR University*
Articles	30,606		822,177		22,153,182		61,677		148,488		4,519,352

Appendix 2: Selected journals and number of articles

Journal	No. Articles step 2	No. Articles step 4
Journal of Business Venturing	76	6
TECHNOVATION	39	6
Research Policy	37	3
Small Business Economics	23	
R&D Management	22	3
Strategic Management journal	19	1
Journal of Management	18	1
Organization Science	16	2
Management Science	13	2
Technology Analysis & Strategic Management	10	2
Journal of Technology transfer	10	2
Entrepreneurship theory and practice	10	1
Industrial and Corporate change	9	
Academy of Management (Journal, Review, Perspectives)	3	
Administrative science quarterly	2	

Appendix 3: Article summaries from the literature review

Author	*Published*	*Title*	*Key findings*
Helfat, Constance E. & Martin, Jeffrey A.	2015	Dynamic Managerial Capabilities: Review and Assessment of Managerial Impact on Strategic Change	In means of firm performance managers social capital and human capital lead to different outcomes.
Ma, Xiaofeng; Zhou, Zhao & Fan, Xiuhong	2015	The process of dynamic capability emergence in technology start-ups – an exploratory longitudinal study in China	The evolutionary path of start-ups is different than that of well-established firms. For a start-up: (1) capabilities of sensing opportunities come from the entrepreneur's existent knowledge and past experience. The sensing is also swiftly adapted in response to feedback over time; (2) unique competences and seizing opportunities lay in the orchestration of external resources
Visintin, Francesca & Pittino, Daniel	2014	Founding team composition and early performance of university Based spin-off companies	Differentiated founding team has positive effect on USO performance, but if the team size is large this effect is reduced. Highlight the need for surrogate entrepreneurs in USOs.
Conceicao, Oscarina, Fontes, Margarida & Calapez, Teresa	2012	The commercialisation decisions of research-based spin-off: Targeting the market for technologies	Introduces conditions that influence USO ability to operate in the technology market, based on the nature of the knowledge.
Quigley, Timothy J. & Hambrick, Donald C.	2012	When the former ceo stays on as board chair: effects on successor discretion, strategic change, and performance	To keep the former CEO on the board tend to keep the company on the same track. To keep the former CEO inhibits growth in ROA, but also prevent large drops. When the former CEO disappears from the board the opposite happens.
van Burg, Elco; de Jager, Sjoerd; Reymen, Isabelle M. M. J.; Cloodt, Myriam	2012	Design principles for corporate venture transition processes in established technology firms	Discuss when a venture should be spun out. The criterion for transition timing is whether the corporate venture is making first sales or not.
Wennberg, Karl; Wiklund, Johan & Wright, Mike	2011	The effectiveness of university knowledge spillovers: Performance differences between university spinoffs and corporate spinoffs	There are 14 Corporate spinn offs (CSO)s per USO. CSOs outperform USOs in terms of growth of employees and sales
Ambos, Tina C., Birkinshaw, Julian	2010	How Do New Ventures Evolve? An Inductive Study of Archetype Changes in Science-Based Ventures	Introduces a new lens for venture evolution. Splits it up in archetypes where each is defined by a distinct set of activities and focus. Introduces internal conflict as a cause for succession

Appendix 3: Article summaries from the literature review

Author	*Published*	*Title*	*Key findings*
Bjornali, Ekaterina S. & Gulbrandsen, Magnus	2010	Exploring board formation and evolution of board composition in academic spin-offs	Why professional and expereinced CEOs and leader should succeed.
Bonardo, Damiano, Paleari, Stefano & Vismara, Silvio	2010	The M&A dynamics of European science-based entrepreneurial firms	How university affiliation negatively affected the propensity for acquisition due to the lack of business experience
Gilsing, Victor A., van Burg, Elco & Romme, A. Georges L.	2010	Policy principles for the creation and success of corporate and academic spin-offs	Connects founding and success with factors and causal mechanisms that are unique for a academic spin.
Gurdon, Michael A. & Samsom, Karel J.	2010	A longitudinal study of success and failure among scientist-started ventures	Connects access to capital and effective combination of management as common factors for sucessful ventures started by scientists. The scientists who was successful pursue new ventures
McKelvie, Alexander & Wiklund, Johan	2010	Advancing Firm Growth Research: A Focus on Growth Mode Instead of Growth Rate	Suggest how growth research can focus on growth mode (organic, acquisition, hybrid), instead of focus on growth rate.
Eggers, J. P. & Kaplan, Sarah	2009	Cognition and Renewal: Comparing CEO and Organizational Effects on Incumbent Adaptation to Technical Change	Introduces how the CEOs experience with industry, organizational and busiess affects a venture in technology market
Jain, Sanjay, George, Gerard & Maltarich, Mark	2009	Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity	University scientists take actively keep their academic role identity even as they take part in in technology transfer. The scientist does not fully commmit but adopt a hybrid role.
McGee, J. E. & Dowling, M. J.	2009	Understanding technology management as a dynamic capability: A framework for technology management activities	Propose a framework for how technology management is affected dynamic capabilities
Lowe, R. A. & Ziedonis, A. A.	2006	Over optimism and the performance of entrepreneurial firms	Entrepreneurs continue unsuccessful development efforts for longer time than established firms, which is consistent with entrepreneurial overoptimism in technology development with uncertain market prospects.

Appendix 3: Article summaries from the literature review

Author	*Published*	*Title*	*Key findings*
Klofsten, M.	2005	New venture ideas: An analysis of their origin and early development	Agrees with previous research that link ideas and business opportunities with the skills base of the founders
Clarysse, B. & Moray, N.	2004	A process study of entrepreneurial team formation: the case of a research-based spin-off	Introduces the conspet of internal conflicts in TMT; Human capital needed for reaching new phases
Vohora, A.; Wright, M.; Lockett, A.	2004	Critical junctures in the development of university high-tech spinout companies	Presents a stage model for USOs consising of phases and junctures. Explains needs for each stage
Bower, D. J.	2003	Business model fashion and the academic spinout firm	Introduces dynamic capabilities and that these require capabilites in the CEO to become competitive advanteges(used in why business exprience is needed)
Kaulio, M. A.	2003	Initial conditions or process of development? Critical incidents in the early stages of new ventures	There multiple other models for explaining the evolution and progress of a startup. They can be categorized into four categories: Milestones and time pacing, Venture capital financing, Growth and Market entry models.
Westhead, P.; Wright, M. & Ucbasaran, D.	2001	The internationalization of new and small firms: A resource-based view	Firms with older founders, with more resources, larger networks, and considerable management know-how are significantly more likely to be exporters. Variables related to general human capital and the ability to raise capital did not significantly predict the subsequent propensity to export.
Berry, M. M. J.	1996	Technical entrepreneurship, strategic awareness and corporate transformation in small high-tech firms	Highligths the need for organizational experience for moving from product to marketdriven managment philosophy.
Cooper, A. C., Gimenogascon, F. J.& Woo, C. Y.	1994	Initial human and financial capital as predictors of new venture performance	Explains the relation between human capital and performance. Introduces categories for human captial in experiences, ways to measure therese and how they infleunce performance
Robinson, P. B. & Sexton, E. A.	1994	The effect of education and experience on self-employment success	Education increase entrepreneurship and earning from entrepreneurship.

Appendix 3: Article summaries from the literature review

Author	*Published*	*Title*	*Key findings*
Hambrick, D. C. & Daveni, R. A.	1992	Top team deterioration as part of the downward spiral of large corporate bankruptcies	Propose that TMT deficiencies cause corporate deterioration, while corporate deterioration also brings TMT deterioration, through voluntary departures, scapegoating, and limited resources for attracting new executive talent.

Progression through CEO succession: A quantitative study of succession's effect on USOs' human capital and development

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Abstract

University spin-offs (USO) have in recent years had a substantial growth in numbers and represent an important potential for job and wealth creation. Still, USOs is found to significantly underperform compared to other new ventures. The literature argue that their special starting conditions results in additional obstacles in becoming a profitable venture, one being the nature of the academic CEO. CEO succession is an effective solution to many of the challenges USOs face, by introducing managerial, commercial, industry and entrepreneurial experience. Still, no researchers have investigated CEO succession in USOs, and there is a general scarcity of longitudinal quantitative studies on the USO phenomenon. The study is motivated to help USOs to perform better and close the gap on quantitative studies on USOs and CEO succession in USOs. The gap is closed with a regression analysis based on detailed and consistent longitudinal data collected from 201 Norwegian USOs and 425 CEOs from the unique FORNY database. The analysis proves that managerial and commercial work experience is acquired through CEO succession as the USO progress commercially, in sense of achieving sales and revenue growth. On the other hand the acquisition of academic experience through CEO succession is significantly reduced as the USOs develop. The research shows that USOs that conduct successions have far better odds for reaching far in the commercial progress, compared to USOs that do not replace their CEO. The possible benefits by replacing an unsatisfactory CEO will have implications for both entrepreneurs, TTOs, universities and investors.

1. Introduction

Wealth creation through commercialization of research, represents an important source for wealth and job creation (Vohora et al., 2004, Mustar et al., 2006, O'Shea et al., 2008), and has created highly successful firms (Shane, 2004). The increasing pressure on universities and research institutes to commercialize their research has led to a substantial increase of university spin-offs (USOs) over the past decade (Knockaert et al., 2011). USOs are often R&D intensive firms, characterized by a radical nature in emerging industries, which makes them interesting independent of their purely economical impact (Rasmussen et al., 2012). Ever since the US Bayh-Dole act gave institutions property rights to inventions in 1980, there has been a growth in university spin-offs (Wright, 2007, Shane, 2004). The growth is also been observed in Europe (Rothaermel et al., 2007, Wright, 2007) where many countries, including Norway, have adopted similar policies and strategies for stimulating the growth of USOs (Rasmussen et al., 2013)

Still, studies have found that the majority of USOs remains small firms that use long time to grow, generating no sustainable wealth (Rasmussen et al., 2012, Wright, 2007, Mustar et al., 2008, Wright et al., 2012). They also perform significantly lower in terms of revenue growth and net cash flow compared to independent new ventures (Ensley and Hmieleski, 2005, Wennberg et al., 2011). Consequently, researchers and policymakers have debated the actual impact of USOs (Rasmussen et al., 2012).

The special starting conditions compared to independent and corporate spinouts is by many researchers theorized as one of the reason why USOs underperform compared to independent new ventures (Vohora et al., 2004, Mustar et al., 2006, Rasmussen et al., 2012). Emerging from a non-commercial environment with limited business and commercial resources (Mustar et al., 2006), the commercialization represents a non-trivial challenge for the academics and scientists often present in USOs (Jain et al., 2009). They have also invested heavily in their human capital, and wish to maximize the return on the investment (Becker, 1975). Starting a business is associated with a high risk with initially low income and represent a big hinder for academics and scientists with large investments in their human capital (Becker, 1975, Unger et al., 2011). Still, some researchers argues that the most important challenge for the USOs lays in the founders human resources and knowledge base (Franklin et al., 2001, Ensley and Hmieleski, 2005, Knockaert et al., 2011). Franklin et al. (2001) and Ensley and Hmieleski (2005) found that the USO's management team start off and remains largely homogeneous. Implying that they select team members from their network and surroundings, who like themselves often lack

diversified experience like for example commercial experience, resulting in a homogeneous resource pool in terms of their knowledge and human capital (Knockaert et al., 2011). Homogeneity is a problem for new ventures, such as USOs. Since they are dependent of access, development and integration of new and existing knowledge in order to reconfigure their capabilities as the firm develops, thereby potentially enhance their progress (Brush et al., 2001, Lockett et al., 2005).

Their initial small size and generally scarce resource pool makes USOs relay heavily on the human capital of their founders (Shane, 2004, Mustar et al., 2006, Hmieleski and Ensley, 2007, Criaco et al., 2014). The CEO is responsible for realizing the USOs potential and for displaying effective leadership behavior (Hmieleski and Ensley, 2007). The CEO's human capital therefore has a substantial influence on the USO's development and performance (Offstein and Gnyawali, 2005), where he is heavily involved in the daily operation and execution of activities (Bruton et al., 1997, Wasserman, 2003). Researchers have found that the initial decisions and strategies chosen will be strongly correlated with the knowledge and human capital of the CEO (Cooper and Bruno, 1977), which is found to likely affect the USO's long-term performance (Moray and Clarysse, 2005, Brush et al., 2001, Unger et al., 2011, Cooper and Bruno, 1977). The findings from Ensley et al. (2006) suggest that poor leadership and the lack of central resources might be the main reason for the underperformance of USOs.

Given the importance of the CEO and the often unsatisfactory human capital of CEOs in USOs, CEO succession could be an efficient way of meeting many of the USO's challenges. A general perception in the literature is that rapidly growing firms soon outpace their founders' managerial capabilities and therefore should be replaced (Buchele, 1967, Drucker, 2014, Clifford and Cavanagh, 1985). Vohora et al. (2004) describes the development of an USO as a path through distinct stages of development, where the USO needs to fulfill different resource and capability requirements to progress to the next stage. The transitions between the stages are called junctures, where the USO is in need of different resources and capabilities to develop. This empirical study will investigate how acquiring human capital through CEO succession can be a way of fulfilling these junctures and help USOs to have commercial progress.

Succession is a way for USOs to enrich its human capital, where experienced personnel succeed founders from the industry or professional managers (Buchele, 1967, Tashakori, 1980, Clifford and Cavanagh, 1985). It reduces the "liability of newness" (Cooper et al., 1994), which is related to the USO's inexperience and access to central resources (Vohora et al., 2004). As the USO start doing sales or grow their organization, the complexity of the

CEO tasks are greatly increased, and early stage CEOs will likely to be outpaced (Wasserman, 2003, Buchele, 1967, Drucker, 2014, Clifford and Cavanagh, 1985). To be successful, high-tech firms also need to transform from a product-orientation to a market-orientation, and replacing the CEO is an effective way of changing this orientation (Berry, 1999, Roberts, 1989).

Even though establishment of USOs from academic and independent research institutions is increasing and the potential for wealth creation is enormous, the entrepreneurship literature regarding USOs is still an under research topic (Mustar et al., 2006, Djokovic and Souitaris, 2008, Knockaert et al., 2011). Most of the research performed mostly relies on anecdotal evidence of a university or case studies, which is difficult to generalize (Rasmussen et al., 2012). USO literature explicitly addressing CEO succession is non-existent (Nevland et al., 2016) and there is a call for quantitative studies on USOs (Djokovic and Souitaris, 2008, Rasmussen et al., 2013). This study approach this gap by producing empirical results based on longitudinal quantitative data to better understand the development of USOs and the human capital within. This helps to answer (i) Wright et al.'s (2012) call for research explaining more about how USOs reconfigure their resource base, (ii) Hmieleski and Ensley's (2007) call for research on executive team composition variables that are likely to interact with performance and (iii) Heirman and Clarysse's (2004) need for further research on how different types of research based start ups evolve during their early growth path.

Furthermore, given that USOs perform poorly, CEOs impact in the USOs (Shane, 2004, Mustar et al., 2006, Hmieleski and Ensley, 2007, Criaco et al., 2014, Cooper and Bruno, 1977), and the benefits possible to achieve by doing CEO succession (Cooper et al., 1994, Wasserman, 2003, Buchele, 1967, Drucker, 2014, Clifford and Cavanagh, 1985) this study is motivated to investigate CEO succession as a mean to cope with the underperformance of USOs. Following this, the research questions (RQ) are raised to examine CEO successions effect on USO's human capital and development:

RQ: *How does CEO succession affect:*

1. The human capital in USOs?
2.The USO commercial progress?

This study will therefore investigate the change in human capital in CEO successions and the effect of this. The fundament of the study is that CEO successions are done as a rational choice to acquire resources and competences to solve challenges that occur as the USO proceed. A CEO succession is a result of the firm's need to adjust their human capital to match the stage they currently are in, or about to reach.

In order to do this, the paper will draw upon the resource-based theory together with the human capital theory

introduced by (Becker, 1975) and proximate this through the CEOs work experiences. Further the paper builds upon Vohora et al.'s (2004) stage model to operationalize the USO's development. The study is based upon detailed and consistent longitudinal data from 201 Norwegian USOs with 425 USO CEOs from the FORNY database, to answer the call for a quantitative approach. To find the effect of CEO succession, the data are analyzed using binary and ordinal regression models.

The analysis reveal clear patterns in what work experiences that are acquired through CEO successions in the different stages. The employment of CEOs with academic work experience is considerably reduced from the early development stages to the later development stages. While managerial and commercial work experience is acquired considerably more often as the USO evolve. The results also show that USOs that have conducted CEO successions have significantly higher odds for reaching first sale and sustainable returns, than USOs that have not conducted a CEO succession.

This study gives a unique insight in the dynamics in USOs´ CEO succession, a field that has never been investigated before, and compares this with what is considered best practice by theory. The results should therefore be of interest for entrepreneurs, investors, policy makers and scholars.

2. Frame of reference and hypothesis development

This section will start by briefly defining some key elements of this study. This is to build a transparent study and form a foundation for further research. The resource-based theory and human capital theory is chosen as the paper's theoretical lens.

2.1 Defining a University spin-off

Several different definitions of USO have been used in the entrepreneurship literature, resulting in a lack of consensus among researchers and scholars as how to define it (Pirnay et al., 2003). Misinterpretation of such a key element can be harmful for future research (Pirnay et al., 2003), leading scholars to use the same terms to describe different phenomena. Building on the work of Pirnay et al. (2003) and Löfsten and Lindelöf (2005), this study expands the definition to also include independent research institutes as they often are closely linked with universities, the paper defines a USO as:

> *New firms created to commercialize knowledge, technology or research results developed within a university or an independent research institute.*

New firms is defined as an autonomous structure pursuing profit making activities that is neither an extension nor controlled subsidiary of the university but have it own distinct legal status (Pirnay et al., 2003). This study will

focus on product development orientated spin-offs, excluding service providers and private corporation due to the different resource need (Löfsten and Lindelöf, 2005, Pirnay et al., 2003) and student spin-offs as they are less likely to have produced specific research results to found a USO upon.

This definition is beneficial as it also includes surrogate entrepreneurs along with the academic founder and focusing on the huge potential from these kinds of firms and the challenges faced by universities and independent research institutes.

2.2 Conceptual framework

This study's theoretical framework is based upon Vohora et al. (2004) stage model. This model is highly cited and based on the development of nine British USOs. It describes different stages together with the most critical challenges and barriers for a USO to overcome in order to further develop (Wright et al., 2007). The model is therefore highly relevant since it can be argued that the USOs used in this study follow a similar development path.

The stage model (Vohora et al., 2004) presents five distinct stages separated by four critical junctures where the junctures represents a set of goals and challenges the USO has to accomplish in order to proceed to the next stage. Vohora et al. (2004) explains the process as a non-linear and iterative process. Meaning that it is possible for the USO to revisit and repeat earlier decisions and activities. A representation of Vohora et al.'s (2004) stage model is presented in figure 2.1.

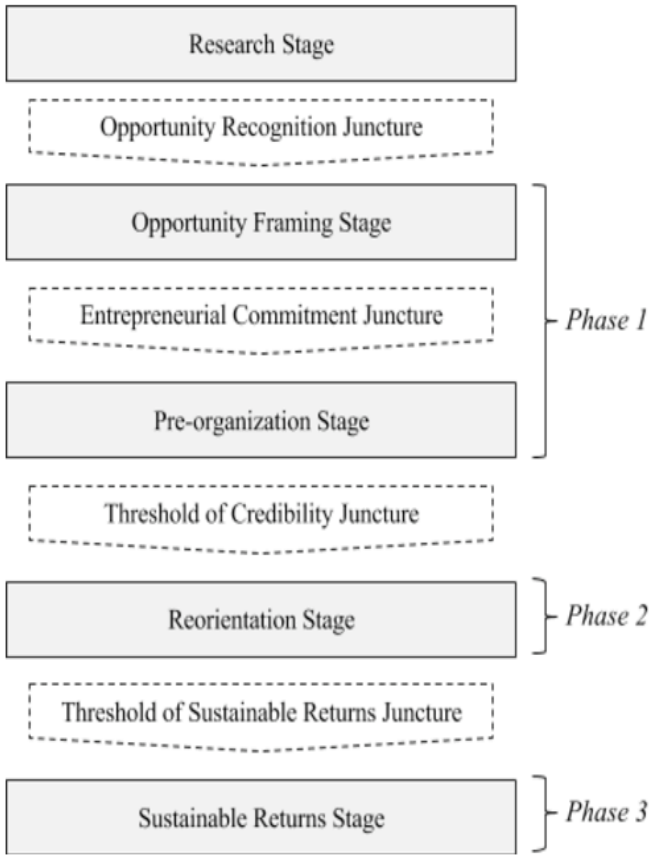

Figure 2.1: Vohora et al. (2004) stage model together with this study's conceptual framework, the phases.

By simplifying Vohora et al.'s (2004) model this study has developed a framework that enables to track the development of the USOs in three phases due to the implications in the empirical modeling. *The research stage* is not considered in this study since the firms in the FORNY database is argued to have already passed this stage, as the application for the FORNY program requires a business plan. *The opportunity framing stage* and *pre-organization stage* are merged for practical implications, since they both are very

alike and before sales. Merging *the opportunity-framing stage* and *pre-organization stage*, leaves three stages which will from now referred to as *phases*, namely: *phase 1*, *phase 2*, *phase 3* and is illustrated in table 2.1 and figure 2.1.

Phase and description	Activities
Phase 1: A merge of opportunity-framing and pre-organization stage	- Feasibility studies - Business plan creation - First proof of viability - Market is chosen - Cooperation and identifying potential partners
Phase 2: Pre-orientation stage	- First sale - Changing from a product focus to market focus
Phase 3: Sustainable returns stage	- Managing growth - Focus on business operations - Generate sustainable returns

Table 2.1: The phases in this study's conceptual framework.

As seen in the Table 2.1 and as Vohora et al. (2004) describes, there are different activities and focus in the different phases. Consequently, there is need for different resources and capabilities in the different phases. The ones in this study are presented in the next section and linked to the study's theoretical framework.

2.3 CEO succession's effect on human capital

The fundamental assumption in the study is that CEOs predominantly are replaced based on their lack of human capital, and the successor is chosen based on his or her human capital. Human capital refers to the skills and knowledge a person has acquired through investments in experience and education (Becker, 1975). It is associated with individual's ability to accumulate new skills and knowledge through learning-by-doing as well as adapting to new situations (Gimeno et al., 1997, Ucbasaran et al., 2008, Wright et al., 2007) resulting in increased productiveness (Parker, 2006) and autonomous behavior (Gimeno et al., 1997). Measuring skills and knowledge has thus been known to be difficult and therefore the paper will use human capital investments such as previous work experience, as proxies for human capital. Work experience is frequently used by researchers and scholars key as indicator of general human capital (Castanias and Helfat, 1992, Ucbasaran et al., 2008, Ganotakis, 2012), and is considered reasonable and generally accepted (Unger et al., 2011).

The USO's resource and capability needs develop as it progresses commercially (Vohora et al., 2004) and the CEO's tasks become more complex (Wasserman, 2003). The CEO must then be able to orchestrate and bundle the USO's assets efficiently to be able to progress further through the different

stages of development (Sirmon et al., 2011). In addition the CEO must be able to acquire new resources, as the initial resources available are usually insufficient for new ventures (Brush et al., 2001). The findings from the literature review (Nevland et al., 2016) shows that several different CEO capabilities are relevant to cope with the development of the USO, being: *academic, managerial, commercial, industrial and entrepreneurial work experience*. These will be used to form this paper's hypotheses.

2.2.1 Academic work experience

Due to the nature of the USOs university origin, academic experience has a strong presence in USOs, especially in their early stages where technology development is a major task for the CEO (Clarysse, 2004). Individuals with academic work experience are usually researchers, professors and scholars. Studies has shown that these individuals with high education, expect higher compensation for their human capital investments (Becker, 1975, Cassar, 2006) and this poorly matches the high risk profile of a start up. Their level of education might lead them to overestimate their abilities, and thereby overlook the need to seek advice or additional information, resulting in fewer opportunities, contacts and poorer basis for decisions making (Ucbasaran et al., 2008). This leads them not to become entrepreneurs (Unger et al., 2011) or as Jain et al. (2009) found, that they tend to take a hybrid role to preserve their academic role and not commit fully. Lowe and Ziedonis (2006) found that USOs continues unsuccessfully in longer periods than established firms, which supports Ucbasaran et al. (2008) findings, indicating that highly educated individuals tend to want to stay longer in control of their USO due to their personality traits.

It seems that for many researchers commercialization represents a non-trivial challenge as the business and academic identities are viewed as the opposite of each other (Jain et al., 2009) and they seldom manage to turn the firm to the market-orientation crucial in later phases (Berry, 1999). This mismatch is one of the reasons why Clarysse and Moray (2004) conclude that the need for academic experience drops after the completion of the product. Disregarding the academic's nature, their experience is useful for the technical part of the first stage of the USO development as they often are the inventor (Knockaert et al., 2011). Still, the literature indicates that as the USO develop, a CEO with academic work experience could lead to several drawbacks due to the scientific focus, lack of other needed experiences, risk aversion and willingness to give up the control of the company. Based on this, the following hypothesis is put forward:

1.1 As the USO develops, they acquire less academic work experience through CEO succession.

2.2.2 Managerial work experience

Managerial experience is associated with leadership experience and the ability to manage a firm's personnel and partners (Ganotakis, 2012) and the literature also references this as business or organizational experience. Managerial experience involves leading employees and coordinating complex operations and resources, together with making strategic decisions across the whole firm (Cooper et al., 1994). This is expected to enhance an individual's understanding of the markets (Ganotakis, 2012) and help the CEO prepare for a wide range of challenges (McGee and Dowling, 1994). Among researchers, managerial work experience is found to be positive related to the USO's development (Ucbasaran et al., 2008, Vohora et al., 2004, Wright et al., 2012, Ganotakis, 2012, Gurdon and Samsom, 2010). The research from Moray and Clarysse (2005) and Clarysse (2005) agrees that managerial experience increases the chances for a USO to attract venture capital, which is considered the most important resource for success (Wright et al., 2006).

A CEO with managerial experience increase the credibility of the USO, that often is a problem for new ventures (Vohora et al., 2004). Berry (1996) states that the it is unlikely for a firm to go from a product-orientated towards a market-orientated venture in the later phases unless it adopts a strategic management approach which is a result of managerial experience. Therefore it is argued that managerial experience is positively related with a growing organization and contributes positively to a USO development with taking the business idea to life and brings in venture capital and personnel. Therefore the following hypothesis is put forward:

1.2 As USOs develop, they acquire managerial work experience through CEO succession.

2.2.3 Commercial work experience

In order to achieve success and development, technical intensive firms must transform themselves toward a marketing strategy (Roberts, 1989, Oakey, 1991). Commercial experience is related to previous work experience involving sales and marketing tasks, along with contact with customers, manufactures and suppliers. Commercial experience is considered important as it: (i) Enhances the individual's ability to successfully recognize opportunities based on their new technology (Park and Bae, 2004, Aspelund et al., 2005, Ganotakis, 2012). (ii) Assist in identification of markets where the product will be as radical as possible compared to competitors and substitutes. Therefore it contributes to developing a better differentiation strategy and obtaining a superb competitive advantage (Park and Bae, 2004, Aspelund et al., 2005, Ganotakis, 2012). Commercial experience and general management expertise often go hand in hand (Berry, 1999), as the CEO of small companies often is responsible for both.

To be able to understand the

customer and market, commercial work experience may be essential for CEOs to change the USO towards a more market-orientated firm and bring their product to market (Berry, 1999, Wright, 2007, Ucbasaran et al., 2008). USOs are found to be lead by technical entrepreneurs with little commercial experience and therefore needs to be acquired from elsewhere (Roberts, 1989, Berry, 1999). This is also supported by Berry (1996) who found that the empirical tendency is that the new CEOs from outside the firm acquired through succession had a strong marketing background. Thus, the following hypothesis is put forward:

1.3 As USOs develop, they acquire commercial work experience through CEO succession.

2.2.4 Industry and Entrepreneurial work experience

Industry experience is related to previous work in the same or a similar industry. It is known to directly reduce the liability of newness (Cooper et al., 1994, Vohora et al., 2004) where industry experience includes knowledge bases, relationships and experiences of an individual. It is also related with higher growth rates and better survival possibilities (Brüderl et al., 1992, Brüderl and Preisendörfer, 2000, Bosma et al., 2004). Individuals with experience in similar markets is generally believed to have better knowledge of underdeveloped parts of the marked, together with existing relationships with potential customers and suppliers (Shane, 2000). This is also supported by Bower (2003), who argues that prior industrial work experience is important when CEOs and founders make strategic decisions of applications areas and markets to pursue. Industrial work experience is thus arguably important in all the phases. Based on this the following hypothesis made:

1.4 As USOs develop, they acquire industry work experience through CEO succession.

Entrepreneurial work experience is gained through previously starting a company or being involved in a new venture and is believed to have a positive relation to the development of another new venture (Mosey and Wright, 2007, Ucbasaran et al., 2008). The knowledge gain from previously starting companies can arguably be helpful the second time around (Wright et al., 2007) and can be beneficial in several ways: (i) Individuals with entrepreneurial work experience has gained direct knowledge about the entrepreneurial process allowing for stronger preparation that makes them more likely to deal with unforeseen problems as the USO develops (Cooper et al., 1994). (ii) Entrepreneurial experience often enables access to external human capital through network, which may increase the chances of getting external finance such as seed funds and venture capital (Mosey et al., 2006). On the other side, Santarelli and Tran (2013) suggest that individuals with entrepreneurial experience may be

less willing to take risk and more cautions. They also suggest that they might be overconfident and not adopt new strategies, but relying on routines and strategies that have worked in the past. Entrepreneurial work experience is as managerial experience, known to increase the chances of getting capital, which is found by Wright et al. (2006) the be the most beneficial resource in order for USO to succeed.

There are raised some concerns in the literature, but the majority is positive, as entrepreneurial work experience helps to deal with unforeseen challenges, networking and increases the chances of getting external finance. Thus, the following hypothesis is put forth:

1.5 As USOs develop, they acquire entrepreneurial work experience through CEO succession.

2.2.6 CEO succession's effect on USO development

As explained by Kaulio (2003), the ideal mode of leadership depends on the stage the organization is in. Meaning that different stages require different resources and capabilities, together with strategies and focus (Vohora et al., 2004). Still, several researchers suggest that it is not solely the explicit knowledge and skills that help a firm develop. Ambos and Birkinshaw (2010) found that high-technology firms had to transform themselves through what they called a *critical event,* towards marketing orientated strategy. This is also reinforced by Roberts (1989) who found that a CEO succession transformed the firm dramatically towards a market-orientation. Indicating that the new orientation that comes with a succession might be just as important as the explicit knowledge and resources. This is also emphasized by Berry (1996) who states that small high-tech firms, such as USOs must change their management practice to achieve success. Management practices must be implemented to evolve from a technology orientation towards a market orientation (Berry, 1999).

After CEO successions Wasserman (2003) found that over half of the replaced CEOs stayed in the firm afterwards. Implying that a CEO succession can be a way for the USO to acquire knowledge and resources since the knowledge and skills possessed by the previous CEO stays in the company. CEO succession can therefore both be used to acquire needed knowledge and resources along with changing the orientation of the USO. Furthermore, it is argued that a CEO succession in itself can have a positive impact on the USO development, and help the USO progress through the described phases. Therefore, the following hypothesis is put forward, where commercial progress is in terms of sales and revenue growth:

2. CEO succession enhances USOs commercial progression.

3. Method

Data on the individual CEO's human capital and USOs progression is collected to investigate what human capital is acquired through succession as the USO develops. The CEO's human capital is measured from the CEO's work experience, and the development is operationalized with phases from the conceptual framework abbreviated from Vohora et al's (2004).

In the hypotheses from RQ1, this study investigates the human capital change caused by succession in CEO experience as the firm evolves to new phases. The CEO's experiences are coded binary if they possess the experience or not. The *phase* the CEO *enters* the firm is coded orderly from 1 to 3, based on the conceptual framework. In the analysis chapter these variables are analyzed using a Mann-Whitney Test and a regression model to statistically substantiate the trends and test the hypotheses. Each CEO work experience is analyzed respectively as dependent variable (DV) with phase as independent variable (IV). This is to check that the analyzed work experience (DV) is not just a proxy for one of the other work experiences. The remaining CEO work experiences, that are not the dependent variable (DV), are used as control variables in RQ1.

In RQ2 the USOs that have experienced succession are compared to the ones that have not. The comparison is based on the final phase of the firm, to see if CEO succession impacts how far they progress commercially. To do this the *final phase* was used as the DV, and the IV was if the USO had experienced a succession or not, in an ordinal regression. This is to investigate if USOs that conduct CEO successions have better odds for reaching higher phases than USOs that does not. The control variables are work experiences of all the previous CEOs in a USO, firm age, technology transfer office (TTO) experience, venture capital and industries.

This chapter will describe what firms that are analyzed, how the mentioned variables are collected, why the variables are chosen and what variables that are excluded.

3.1 Sample context

This study is built upon the FORNY-database, from the Norwegian governmental funded research support program led by the Research Council of Norway. The FORNY-program was established in 1995 with the purpose to commercializing research results from publicly funded research institutions and was closed in 2012, followed by a new program FORNY2020. The accumulated value creation from the program is estimated to surpass NOK 15 billions in 2017, generated through 417 ventures and 424 licensing agreements (Rasmussen et al., 2013).

The program has experienced some changes during its time and in 2003 a new legislation was introduced in Norway. Prior the legislation in 2003, the intellectual property rights from the research belonged to the researchers.

While the new legislation in 2003 granted the intellectual property rights from the research to the University that it originated from (Rasmussen et al., 2013). Following this, the universities established new technology transfer offices (TTOs) with the objective to be commercialization agents on behalf for the universities for the inventions created and establishment of USOs (Rasmussen et al., 2013). Since the FORNY-program was initiated already before the new legislation came in 2003, it gives reason to believe that the program includes the vast majority of all USOs established after 2003 in Norway (Rasmussen et al., 2013). This gives rise to a outstanding dataset for studying USOs.

The dataset is gathered from several locations in Norway and contains a wide range of industry sectors. This variety and scope of program, allows for several external control factors such as cultural, economical and environmental variables. The database also prevents a survivor bias, as it also contains ventures that have ceased to exist. Still, the data is subject to censoring which is because the value of the data is only partially known. This is due to USOs continuous to develop and lives on beyond the observed time frame provided by the dataset.

3.2 Data collection

This study has collected data from 201 USOs and 425 CEOs, where the data collection was performed in two steps. First, data was collected on the firm level, before collecting data about the CEOs in each firm on an individual level. Both the selection of firms and the data collection process will be explained in the next sections.

3.2.1 Selection of firms

The USOs that was collected from the database based on the following criteria from the USO-definition: (i) The firm originate from an academic environment (university or an independent research institute). (ii) The firm is based around a technology, excluding service providers. (iii) The firm is not a student startup.

Rasmussen et al. (2012) proposed that USOs often are R&D intensive technology firms, and these firms are of interest in the study. This excludes firms that originate from corporate research- or R&D-centers, in addition to service companies and other non-technological firms. All the firms in the sample originate from universities, independent research institutions or colleges.

This study will focus on all firms established from 1999 till 2011 in the FORNY program due to limited data on the firms before 1999 and insufficient longitudinal data on the companies after 2011. Of the 371 firms on the initial list, 121 were excluded based on these criteria. If the organization number was reused from another firm, only the CEOs registered subsequent of the FORNY-application are considered valid.

Microsoft Office Excel was used to gather the relevant firms and list the CEOs in each firm.

3.2.2 Firm-level data collection process.

First a general coding template for collecting information for each FORNY-USO was created. The template was created in Microsoft Office Excel and was used to track the development of each of the chosen USOs. The template is presented in appendix 1 and contains static information about the USO and coding of the CEOs that has been in the firm. The static information was collected from the FORNY database using a macro created to extract the information need to conduct this study.

Of the 201 USOs in this study, 125 of them had conducted one or more CEO successions and 76 USOs with no CEO succession. The average age for the observed time period is 8.2 years for the succession USOs and 6.1 years for the USOs without succession, showing that the succession firms are older. The combined average age is 7.4 years.

3.2.3 Individual-level data collection process

First a list of all the CEO successions in each USO was gathered using the corporate announcements from the national business register [1] where the companies are obliged to inform about CEO changes. The second step involved gathering data of the human capital for all the CEOs for each USO. This information was stored in the respectively coding template for each firm described in the previous section.

In order to find the relevant information of the human capital of the CEO, multiple sources were used to confirm each other.

Finding the CEO's experience: This study uses previous experience as a proxy on human capital and this was collected using (i) LinkedIn, (ii) the firm's web page (iii) news articles in the FORNY database (iv) google search on the CEO name with or without the company name. Each category of experience was labeled as a binary variable. *Yes* if it was stated that the CEO had previous work experience within this category, if nothing was stated about the specific work experience it was categorized as *no.* It is assumed that acquiring new knowledge takes time, therefore, if the CEO held a position for a specific experience for less than half a year, it was not registered. There was not done any grading of the experience, only a registration of the presence of the particular experience. The experiences were as mentioned, *academic, managerial, commercial, industry* and *entrepreneurial work experience*.

Finding the CEO's succession phase: The phase of the USO is appointed to the CEO at the time of the CEO employment, whether she is replacing another CEO or she is the first CEO. This is done in opposition to appointing the phase at the time when the CEO is dismissed, to describe the mechanisms of bringing in new CEOs, rather than the investigating the impact

[1] Brønnøysundregisterne - https://www.brreg.no/

of the CEO. The USOs annual report, its FORNY-database description and annual financial statements were used to define the phase of the USO.

Finding the firm's final phase: To find out at how far the USO has reached, the final phase of the firm is coded using the phases criteria presented for CEOs starting phase. If the USO is discontinued, because of acquisition or termination, the phase at this event is coded. If the USO still is active in 2014, the phase is defined from the firm's current phase.

*Verification***:** To verify that the variables were coded consistently, a sample of 20 firms was coded initially. The results were compared and discussed to calibrate the coding, before the remaining 181 firms were coded.

Firms with insufficient information about one or more of the CEO background were excluded from the sample. Firms with missing establishment information, seemingly discontinued USO-activities or other large irregularities in the firm information were also excluded. Based on this 49 of the 250 firms were excluded. The final sample contained 201 firms with 425 CEOs.

3.3 Variables

This section will present the different variables coded both on micro and macro level to make the analysis. The criteria and operationalization of each variable will be explained. Firstly the dependent variables are presented. The different categories of work experiences is used as dependent variable to answer RQ1: "*How does CEO succession affect the human capital in USOs?"*, while the phase variable is used as dependent variable to explore RQ2: "*How does CEO succession affect the USO commercial progress*?". Secondly the independent variables are presented, before finally the control variables are presented.

3.3.1 Dependent variables

Both USO's commercial progress and human capital is being analyzed. Experiences are used as a measure on human capital and phases are used as a measure of the USO's commercial progress.

Experiences

The focus for RQ1, is the experiences that are acquired through CEO succession as the firm evolves. The work experiences are *academic-, managerial-, commercial-, industry- and entrepreneurial work experience*.

Academic work experience is set as yes if the CEO holds a Ph.D. degree or worked as a researcher, disregarding the field.

Managerial experience is set as yes if the CEO previously employment within managing, leading or organizing people. Due to their positions nature, project manager and firm manager is also counted as managerial experience.

Commercial experience is set as yes if the CEO has a previous employment within marketing or sales related tasks, where they had to communicate with outside

manufacturers, customers or suppliers.

Industry experience is set as yes if the CEO previously has worked in the same or similar industry or with the same technology field, customers, suppliers or manufacturers.

Entrepreneurial experience is set as yes if the CEO previously has been founder or employed in a firm that has existed for less than ten years at the time of employment. Ten years is chosen as it's described as the average time it takes before a firm starts to accelerate (Lawton and Ho, 2006).

Phases

For RQ1 and RQ2 the timing of the successions and how far the USO evolves is relevant. USO's commercial progress is operationalized through the phase variable. The phases describe three different stages as the USO develops, based on this study's conceptual framework. The phases are *phase 1*: The product development phase, *phase 2*: First sales and *phase 3*: Sales growth.

Phase 1 is the period before the first sale. This is considered a product development phase, where academic experience is central. This phase absorbs what Vohora et al. (2004) calls the opportunity framing stage, and the pre-organization stage. The phase is set to 1 if the sales income is zero in the annual report and the database's *completed first sale* variable confirm no sales, and is controlled by the history of the firm describing product development from the database and the company's news archive.

Phase 2 is the phase after the first sale and is based on Vohora et al.'s (2004) threshold of credibility juncture and pre-orientation stage. Where the first sale is considered an important milestone due to the increasing complexity when transferring between developing a product and selling it. This requires different capabilities, addressed by multiple researchers (Wasserman, 2003, Vohora et al., 2004, Roberts, 1989, Ambos and Birkinshaw, 2010). The phase is set to 2 if there is sales income in the annual or the database's *completed first sale* variable confirms a sale. The sales must be a commercial sale, and not consulting hours or funding. If the sales are considerable and growing, the USO is moving into phase 3.

Phase 3 is the growth phase for the company and is based on entering Vohora et al.'s (2004) sustainable return stage where the sale income is sustainable and growing. A more precise business model solves early uncertainties. The complexity increases even more as the USO grows, as the CEO needs to cope with the increased organizational complexity (Vohora et al., 2004, Ambos and Birkinshaw, 2010). The phase is set to 3 if a USO has had income base of 1 MNOK with a growth over three years in their annual reports. Some companies seemed to have large growing revenues, without being classified as phase 3 as the income comes from funding and not from sales.

3.3.2 Control variables

This section is divided in two, where the first part presents the control variables for RQ1 and followed by the second part explaining the control variables for RQ2. To account for other variables impacting the results, the following control variables are chosen:

In *RQ1:* "*How does CEO succession affect the human capital in USOs?"* each hypothesis is analyzed with one work experience as DV. For each analyzed work experiences, the other four work experience variables are used as control variables.

The remaining experiences: A CEO with multiple work experiences is not necessarily chosen because of one experience (DV). To make sure the DV is a result of the needs of the phases and not just a proxy of one of the other work experiences, the other experiences are chosen as control variables. E.G a CEO is acquired for his commercial experience, but he also has entrepreneurial experience.

In research RQ2, "*How does CEO succession affect the human capital in USOs?" firm age* and *accumulated work experience, TTO, Bio/Pharma industry* and *venture capital* is used as control variables. *Firm age:* is time spent to reach the last recorded phase. For most firms this is the age of the firm in 2014. For the USOs that have been acquired or been discontinued earlier, it is the age at the time of the exit event. If a firm has experienced a succession or not, should be correlated with the age of the firm, as young firms not necessarily have had enough time to replace the first CEO. The average age difference between succession firms and no-succession firms is 2.1 years and will most likely have an impact on the results.

Accumulated work experience: is the total work experience of all the CEOs of each firm is coded into a binary variable. 1 if one or more of the CEOs have the specific work experience and 0 if not. The phase progression might be explained by some of the work experiences that have been present in the USO, rather than the succession in itself. This will help explain if it is the succession per se or some of the specific experience the firm have brought in that predict the phase best.

TTO: TTO is chosen as control variable as we want to see the independent effect of the succession, not the effect of the resources around the USO. CEOs with TTO experience are assumed to have access to a larger resource pool than independent CEOs, both in means of university resources, TTO commercialization resources and people around them with complementary human capital. As this can give a head start into the first phases, it is evaluated as a relevant control variable. 44% of the USOs in the analysis have had a TTO CEO at one point. *Bio / Pharma:* USOs that are in biotechnical or pharmaceutical industries are likely to spend longer time and more resources in the product development phase because of the strict regulations for clinical trials

and verification (Mustar et al., 2006). This variable is expected to be negatively correlated to high phases. 27% of the USOs in the dataset have Bio or Pharma labeled as their industry.

Software: In the software industry the product development periods are moving faster and require less resources than other industries (Druilhe and Garnsey, 2004). As they are expected to move through the phases faster and with another resource requirement, it should be controlled for. 35% of the USOs of the analyzed firms are labeled as ICT industry.

Venture capital (VC): is chosen as control variable as it is a key driver for USO performance (Colombo and Grilli, 2010, Gimmon and Levie, 2010), and is expected to affect the phase development. As this variable also is expected to be closely linked to CEO succession it is important to include in the model to see how succession behave independent of VC. VC is also linked to human capital, as VC invest in CEOs with specific types of human capital, such as managerial or commercial experience (Gurdon and Samsom, 2010, Colombo and Grilli, 2010, Gimmon and Levie, 2010). Of the firms in the analysis 31% of them have received venture capital.

3.3.3 Excluded variables

Variables with low impact and prediction power have been excluded, as this is preferable to keep the results in the models as reliable as possible (Green, 1991).

Education, is shown to have little or inconsistent effect on firm development (Avermaete et al., 2004, Bosma et al., 2004), even though Hambrick and Mason (1984) viewed education, in addition to work experience, as proxy for psychological constructs such as beliefs and values. Education was originally measured, but shown to correlate highly with the work experience, and would not add enough to the value of the results that would justify the inconsistency effect the data has on the modeling firm development.

Top management team (TMT) Human Capital (HC), the choice of only looking on a firm's CEO can be seen as a limitation as many new startups do not have any clear leader and choices are made democratically (Klotz et al., 2014). Thomas (1988) and Hambrick and Daveni (1992) found that it is hard to measure the CEO's effect on firm performance, in comparison to the TMT. Still the CEO is seen as a reflection of the whole team and is the one with the highest influence on the firm (Karaevli, 2007, Hambrick and Mason, 1984). This combined with uncertain information about registered team members actual involvement and lack of available information about them, ended with the choice of excluding the team's human capital. This is a limitation to the research and is discussed further in *8. Limitations and further research.*

3.4 Methodical limitations

In order to investigate the hypotheses quantitatively, several simplifications and operationalizations have been made

that might limit the results.

Linkedin[2]*:* was used as this study main source for information regarding the CEOs. It proved to be a valuable source of information, but not without some limitations. First, the information on linkedin is uploaded by the users themselves, which may lead to incomplete or biased information as the platform is used to attract job offers and business opportunities. This was discovered during the data collection, where some of the CEO's background occasionally was incomplete or non-existing on linkedin. Extensive search in news archives and web searches was used to crosscheck their background. If some information was missing or not found, the USO they belong to was left out of the study. However it is argued that linkedin is a good source for the information about the CEO's background, as it was found that many CEOs included experiences from USOs that failed. The information on linkedin is public and giving false information in a job setting is considered extremely negative. An alternative to using linkedin was using a survey but since the response rate often is low, a survey would most likely lower the sample size. The information would also not be public, increasing the possibility for false information and therefore not chosen.

Time dimension: A yearly time discretization was used in this study since the USO's annual reports from the national business register[3] is used to study the financials of the USOs. This has led to some implications regarding the succession timing. Each succession has therefore been linked to the year it happen instead of the actual date. This leads to some limitations regarding how long each individual has held its CEO position. If the CEO had the position for more than six months before being succeeded, the CEO was coded as the CEO for that year, where the incoming CEO would be coded as new from the next year.

Binary variables: Choosing binary variables also poses some limitations as it does not differentiate between the investment size and the quality of the CEO's human capital. The problem arises when one CEO has held a position as Head of marketing for a decade and another CEO has held such a position for only one year and in the data appear equal. Becker (1975) argues that experience is gained over time, therefore it is natural to assume that the first mentioned CEO would have a "stronger" experience than the CEO who only have had such a position for a year. Using a continuous variable instead of a binary variable would therefore strengthen the method in this study, since it allows for weighting the variables, taking industry specificity into account.

The causal relationship in the statistical models: Based on the coded database, the statistical models used are not able to determine the causal

[2] https://www.linkedin.com/

[3] Brønnøysundregistrene: http://brreg.no/

relationship between the independent and dependent variables. This means the statistics does not explain if acquiring managerial experience is the reason for a higher phase or if the higher phase is the reason for acquiring managerial experience. The causal relationship in literature explains that hiring a better CEO gives firms commercial progression: USOs have to acquire the resources to overcome the junctures and evolve to the next stage, stated by Vohora et al. (2004), the main framework of this paper. Berry (1999) and Roberts (1989) support this by finding that the firm has to change management to achieve progress. CEO succession literature also states that firms are likely to stagnate if the firms do not replace the founder (Wasserman, 2003, Buchele, 1967, Drucker, 2014, Clifford and Cavanagh, 1985).

Venture capital (VC): Coding only when a company receives venture capital might pose a challenge since it does not take into account the different types of VC. Governmental VC might have different motivations regarding return on investments and investment incentives compared to private VC funds. Governmental VC's might be due to politics invest in certain industrial sectors, promoting innovation in these sectors instead of focusing on profit.

Classification of the phase 1 & 2: The classification of phases was based on the sales income listed in the USO's annual report. Using the sales income as an indicator for the USO's first sale proven to sometimes be difficult. Some USOs conducted consultancy while developing the product/service resulting in income for USO, while others accounted soft funding such as governmental soft funds as sales income. Because of this, the sales income had to be cross examined with the USOs news archive and the board statement in the annual reports in order to be better understand the sales income. This led to some assumption based on the available information.

Classification of the phase 3: Phase 3 is time based, whereas the other two are not. This can create a bias, where firms have to spend at least 3 years getting to phase 3. The bias is limited as the average age of the coded firms is 7,4 years, so the average firm could have reached phase 3. It is also not likely for a firm to reach high growth in less than three years (Lawton Smith and Ho, 2006).

The use of phases: The use of phases does not necessarily explain the progress for all firms. Some USOs aim at an exit event in means of acquisition or merger. Because of their radical nature, this may happen before the USO reach their potential. The USO can still be in technology development when acquired and thus not follow a phase progress in their development as used in this study described here.

Interaction effects: Many of the CEO coded in the dataset had a combination of several human capitals and the interaction effects of these different combinations were not tracked in this study. As several researchers

(Wright et al., 2007, Colombo and Grilli, 2010, Ganotakis, 2012) investigates such combinations of human capital, it might affect the results.

Overlapping experiences: Some previous employments could leave to multiple types of work experience, which may influence the results. This was typically found for individuals with previous employment from investment companies and TTOs, both involving commercial and managerial experience. A more detailed or strict classification of the different work experiences could be preferable. The different combinations of work experiences seems to be linked with certain CEO types and could prove to create a basis of CEO typologies if researched further, as one may be better equipped to choose successor based on personality and not only the human capital.

4. Analysis

This section explains how the collected data was analyzed and its results. As the two research questions looks at different aspects of succession, the analyses are done separately. First, a presentation of the analysis concerning RQ1 will be presented. Investigating the effect of CEO succession on the human capital of the CEO as the USOs commercially progress. Followed by the analysis of RQ2 investigating successions effect on progress of USOs.

4.1 RQ1 - CEO succession's effect on the human capital

This section will examine what kind of work experience that is brought in through CEO succession in different phases. First a descriptive analysis is presented along with a significance test. The significance test is a Mann-Whitney Test and is conducted to see if there is a clear trend in the acquisition of the different work experiences as the USO goes through phase 1 to 3. Then a binary regression is conducted to see if the trend still is present when adding control variables to the model. A correlation matrix is used to substantiate the results as it shows the correlation between the variables. The regression is done in in two models. Model 1 with the work experience as dependent variable (DV) and phase as independent variable (IV). Model 2 has the same work experience as DV, with phase as IV along with the other work experiences as control variables.

4.1.1 Descriptive development

The CEOs acquired in each phase was mapped with their experience (figure 4.1) to show the development of the experiences as USOs evolve.

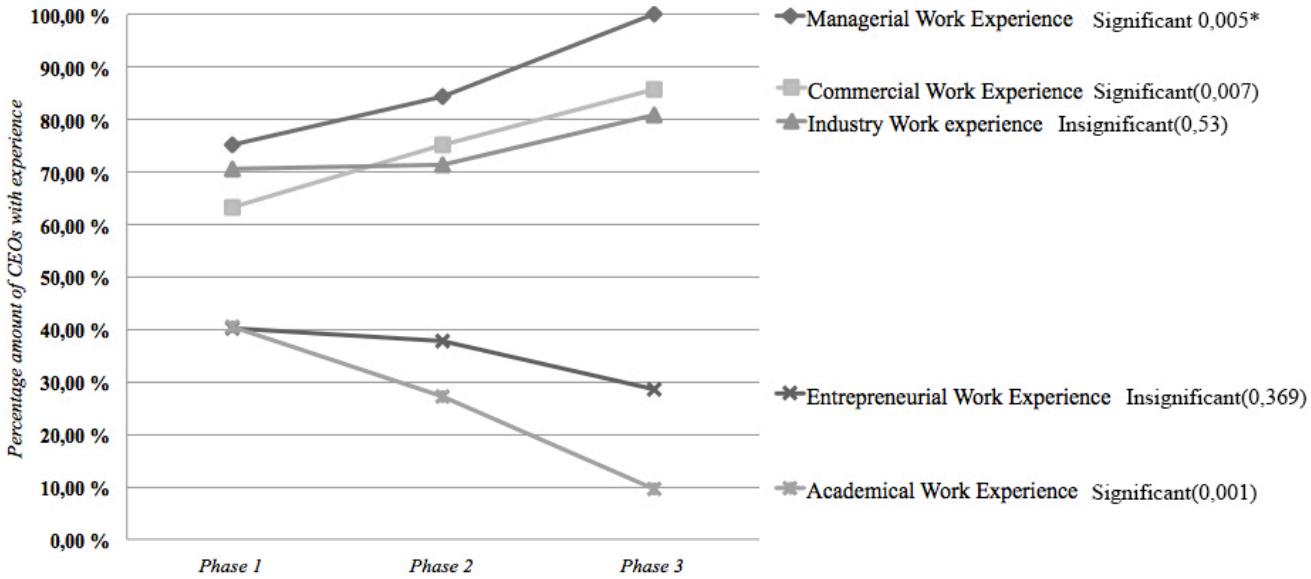

Figure 4.1: The figure shows the share of specific work experiences brought in at each phase by the succeeding CEOs. Significance or insignificance of growth is indicated. The original table is in appendix 8. * = asymptotic sig 2 tail.

The results in figure 4.1 show that the amount of three work experiences (DVs) increase as the firm develops, while two work experiences decrease. The largest changes are the increase of *managerial and commercial experience* and the decrease in *academic work experience*. *Industry work experience increases* and *entrepreneurial experience* decreases, but not as clear as the others. The high occurrence of *managerial work experience* (75%) already in phase 1 is different to Smilor et al.'s (1990) findings from UT-Austin, where ¾ of the USOs lack *managerial experience*. This could highlight the contextual differences between the US and Europe (Wright et al., 2007), but also just be a result of the 26 years that has passed and the changes in policy that has been introduced since then.

The trends for *Academic*, *managerial* and *commercial* are all significant, with significance values lower than 0,01, showing that their development is not random. *Industry* and *entrepreneurial experience* had insignificant values, both having over 0,36 in significance, meaning the increase or decrease was not substantial enough to exclude that the change in experience as the firm develops is random.

Managerial work experience is deemed asymptotic when used in a logarithmic prediction as it grows to 100% in the last phase, and may cause distortion in significance. Mann Whitney's test can calculate asymptotic data and was therefore used to verify the validity of the development.

4.1.2 Correlation matrix

To discover how the DV and IVs are related to each other, a correlation matrix (table 4.1) gives an estimate of the degree of association between each of the variables, but without taking potential dependencies into account.

		Academic exp.	*Commercial* exp.	*Managerial* exp.	*Industry* exp.	*Entrepreneuri -al* exp.
Commercial experience	*Correlation*	-,396				
	Sig. (2-tailed)	,000				
Managerial experience	*Correlation*	-,308	,614			
	Sig. (2-tailed)	,000	,000			
Industry experience	*Correlation*	-,157	,278	,369		
	Sig. (2-tailed)	,001	,000	,000		
Entrepreneuri-al experience	*Correlation*	-,186	,424	,319	,178	
	Sig. (2-tailed)	,000	,000	,000	,000	
CEO acquisition phase	*Correlation*	-,164	,134	,146	,039	-,048
	Sig. (2-tailed)	,001	,006	,003	,417	,321

Table 4.1: Correlations matrix for all experiences and the start phase for the CEO. N=425

The correlation between the *phase* and the work experiences are all significantly correlated, but with a value of <0,2, deemed as weak correlations, and may indicate a weak relation to development.

Worth noting: (i) High correlation between *commercial work experience* and *managerial work experience*, (0.614) which is natural as managerial work experience often has a commercial component. The correlation is close to multicollinearity which is at 0.8 for social sciences (Kutner et al., 2005), meaning they could be so closely linked, that it affects the results of the regression.

(ii) *Industry* and *entrepreneurial work experience* is the only data not significantly correlated to the phase, which fits with the insignificance in the descriptive analysis (iii) *Venture Capital* correlates moderately (0,386) which is natural as the later in the life of the firm, the bigger chance of the firm being funded.

To exclude the possibility for multicollinearity between Commercial and Managerial experience, a variance inflation factor (VIF) test was done[4], where the acceptance threshold is 10, and the maximum VIF in the dataset ended up at 1.9 (Kutner et al., 2005), meaning it should not affect the regression model noteworthy.

[4] VIF tests found in appendix 3

DV experience:		*Academic work experience*	*Managerial work experience*	*Commercial work experience*	*Industry work experience*	*Entrepreneurial work experience*
Step 1						
Phase:	OR	**,485****	**2,387****	**1,812****	1,180	,831
	Sig	,001	,003	,007	,417	,321
H & L:		.451	.	.	.	,648
Nagelkerke:		,040	,039	,027	,002	,003
Step 2						
Phase:		**,563****	**2,117****	1,424	,927	**,604****
		,01	,048	,212	,730	,013
Academic work experience:			,702	**,254****	,863	,825
			,286	,0	,570	,457
Managerial work experience:		,625		**16,924****	4,2**	2,11
		,144		,0	,0	,08
Commercial work experience:		**,255****	**17,056****		1,372	**7,268****
		,0	,0		,327	,0
Industry work experience:		,856	**4,15****	1,408		1,364
		,548	,0	,298		,258
Entrepreneurial work experience:		,870	2,055	**7,318****	1,335	
		,592	,102	,0	,295	
H&L:		.451	,794	,803	,082	,412
Nagelkerke:		,226	,546	,574	,177	,279

Table 4.2: Results from the binary regression. The DV in each analysis is on the top, and the rows show the OR and p-value for the variables. **: Significant 0.05 level.

4.1.3 Regression analysis

As the work experiences (DVs) are all binary, a binary regression is a natural choice. This examines if there is a pattern in how the amount of each work experience develop as the USO evolve from phase 1 to 3. It also finds how strong this connection is when taking the other experiences of the CEO into account.

The most relevant output of the analysis is the Odds ratio (OR) and significance (p) for phase that predicts

the experience. Odds ratio represents the relationship between the odds for the dependent variable to occur given the independent variable is present versus if the independent variable is absent. An odds ratio close to 1, means that the odds for having the experience (DV) is close to equal in all the phases.
Validity of using binary regression is verified by a Hosmer and Lemeshow test that measures whether the model's predicted
values are different from the observed values, which shows that the model is a good fit by being significant over .05.

To find the prediction power of the model, Nagelkerke is used. If the Nagelkerke increases, it indicates that the prediction of the model is better.

The regression is done in two steps and the results in shown in table 4.2[5]. The first step predicts the work experience by themselves based on phases, and the second step includes the other work experiences as control variables.

4.1.3.1 Academic Background

The regressions significance of 0,001 shows that *academic work experience* and *phase* is significantly related. The OR less than one (0,485) supports the descriptive analysis in that while the USO develops, *academic work experience* is significantly less acquired.

Adding the other experiences in step 2, changes the OR of the *Phases* closer to 1 (OR=0,563), but is still significant. The *Phases* prediction power therefore becomes marginally weaker and shows that the other variables also influence the prediction of *academic experience*. Among the other experiences the *commercial work experience* (OR=0,255) is the only significant and the most influential in predicting *academic experience*, and is also negatively related. This means that if the CEO possess *commercial experience*, he most likely does not have *academic experience* and visa versa. This is natural as an academic career seldom requires selling or marketing, and they don't appear together.

The other experiences are also related negatively to predicting *academic work experience*, but are deemed insignificant, meaning no conclusions can be drawn upon their influence.

The descriptive analysis, the Mann Whitney test and the regressions, all support that *academic work experience* is reduced as the USO develops, making *the hypothesis supported*.

4.1.3.2 Managerial Experience

From the binary regression in step 1, the significance of 0,003 shows that *managerial work experience* and *phase* is significantly related, and that the experience increases with each phase with a positive OR of 2,387.

Introducing the other experiences in step 2*,* the OR of *managerial work experience* decreases to 2,117, but is still significant. This decrease is the smallest

[5] Whole regression model in appendix 5

compared to the other experiences' regression models, which shows a strong connection between *phase* and *managerial work experience*. *Commercial* and *Industry work experience* are the only significant of the experiences, meaning that they also influence the prediction of *managerial experience*. The introduction of *managerial work experience* may therefore not only be a result of the phase, as it might be acquired as an appendix from a CEO with *commercial* or *industry work experience*.

The descriptive analysis, the Mann Whitney test, and the regressions, supports that *managerial work experience* is brought in as the USO develops, making *the hypothesis supported*.

4.1.3.3 Commercial experience

Step 1 in the binary regression shows that acquisition of *commercial work experience* increases (OR=1,812) significantly (P=,007) along with *phase*.

Introducing the other most correlated variables in step 2, decrease the impact (OR: 1,424) and making the *phases* insignificant (p: ,212). At the same time *academic*, *managerial* and *entrepreneurial work experience* become better predictors of *commercial experience*, than the *phase*. *Managerial work experience* being the best predictor (OR: 16,9). This can indicate that *commercial work experience* might be acquired as an attachment to *managerial experience*, instead of being acquired intentionally by itself. Still, this does not rule out the fact that *commercial work experience* is acquired as the USO progress. Nagelkerke and Hosmer and Lemeshow test validate the regression model.

The descriptive analysis and the Mann Whitney test support that *commercial work experience* is acquired through CEO succession as the USO develops, but the regression analysis does not, making *the hypothesis partly supported*.

Note: The experience is positively and strongly related to *managerial work experienc*e, making it plausible that *commercial work experience* is acquired as a result of acquiring *managerial work experience*.

4.1.3.4 Industry experience

The binary regressions shows that acquisition of *industry work experience* increases (OR: 1,18) insignificantly (p: ,417) along with *phase*.

Taking the other experiences into account in step 2, decreases phases impact to (OR: ,927), making it negative, but the *phase* is still insignificant (p: ,73), showing that *phase* and *industry work experience* has little correlation.

Managerial work experience is the only significant predictor of *industry work experience*, and has a positive relationship (OR: 4,2), this could be because it is more attractive to recruit managers from the same industry (McGee and Dowling, 1994), than finding a manager in a distant industry. Nagelkerke validate the model with and

Hosmer and Lemeshow test validate these results.

The descriptive analysis, the Mann Whitney test or the regression analysis does not supports that *industry work experience* is brought in as the USO develops, making *the hypothesis not supported*.

Note: *industry work experience* may be an appendix to *managerial experience*.

4.1.3.5 Entrepreneurial experience

The binary regressions shows that acquisition of *entrepreneurial experience* decreases (OR:, 831) insignificantly (p:, 321) along with *phase*.

Taking the other experiences into account in step 2, increases phases impact to (OR:, 604) and *phase* becomes significant (p = ,013), showing that *phase* together with the other experience is a better predictor for *entrepreneurial work experience* than the development alone.

Commercial work experience is a significant predictor of *entrepreneurial work experience*, and has a stronger relationship than phase (OR: 7,26). This could mean that *entrepreneurial work experience* is brought in as a result of acquiring a CEO with *commercial work experience*.

Nagelkerke validate the model with and Hosmer and Lemeshow test validate these results. The descriptive analysis, the Mann Whitney test or the regression analysis does not supports that *entrepreneurial work experience* is acquired as the USO develops, making *the hypothesis not supported*.

Note: This is surprising as the literature suggests that *entrepreneurial work experience* should be acquired. The experience is positively and strongly related to *commercial experience*, and not to phase, making it plausible that *entrepreneurial experience* comes as an appendix of the *commercial experience*.

4.1.3.6 Other Findings

Adding the other variables in step 2 shows that the experience combination increases the Nagelkerke and shows that predicting one experience is more accurate when predicting with the other experiences, than just using only the phase of the CEO. This means that there are some combinations of experience in CEOs more common than others, indicating CEO typologies that should be further researched into.

4.2 RQ2: CEO succession's effect on commercial progress

This section will examine how succession affects the phase the USOs reach. First a Mann-Whitney Test is conducted to see if there is a clear trend that succession firms reach higher phases than no-succession firms. Then an ordinal regression is conducted to find the odds for reaching a high phase as a succession firm versus a no-succession firm. This regression is done with three models. Model 1 predicts the odds for reaching a higher phase based on if the firm has conducted a succession or not. Model 2 use accumulated CEO

work experience as covariates, while model 3 include control variables. The analysis supports that succession firms have higher odds for reaching a high phase.

Ordinal regression: The ordinal regression analysis is a generalization of the binary regression. Ordinal regression is suited for analyzing categorical dependent variables with more than two outcomes that are ordered. In this paper the three phases were coded 1, 2 or 3 and the numerical values do not represent anything other than the order.

For each independent variable the ordinal regression estimates an odds ratio (OR) for reaching a *high phase* in the order of outcomes. *High phase* can be defined as 2&3 or just as 3. As the definition of *high phase* might create a difference in the results, a parallel lines test is conducted. If the *parallel lines test* is significant, the ordinal regression is not valid.

The Model Fitting Information tells if the introduction of a set of variables to a model, improves its ability to predict the outcome. If significant, there is an improvement in the predicting of the outcome by using these variables, versus not. *The Goodness of fit* tests the observed data for consistency with the model used. If significant, it suggests that the observed data does not fit the model.

Descriptive analysis and Mann-Whitney Test

The descriptive figure 4.2 shows that most (57,9%) no-succession firms don't reach beyond phase 1, while its most common for succession firms to reach phase 2 (39,2%). The Mann-Whitney Test is significant with an exact two-tailed significance of 0,007. This means that there is a significant trend between having a succession and reaching higher phases. As succession might just be a proxy for other variables an ordinal regression with control variables needs to be conducted.

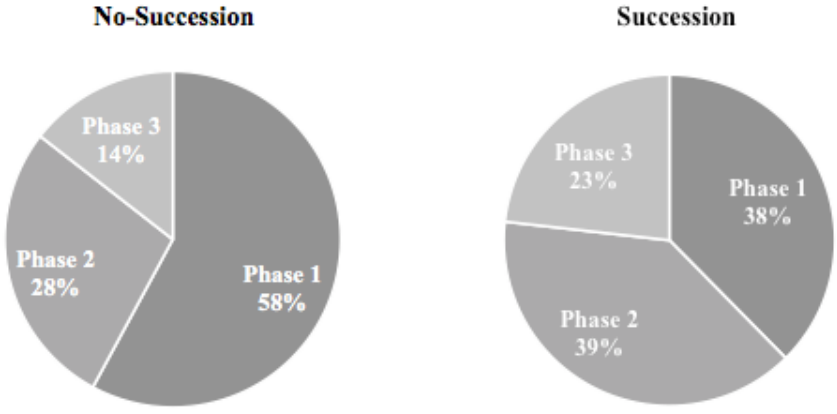

Figure 4.2: The final phase reached, grouped by if the USO conducted a succession or not.

Correlation matrix

The correlation matrix in appendix 7 confirms the connection between doing successions and the different accumulated work experiences. As the no-succession firms only have the work experiences for one CEO, they naturally have fewer of the accumulated work experiences. This results in a relatively high correlation between most of the accumulated experiences and the succession variable (0,281 to 0,444). The exception is the accumulated academic work experience variable (-0,019). Apparently this variable is so common in the no-succession group that it does not come out at correlated with succession even though the no-succession firms only have one CEO accumulated. As in the correlation matrix in RQ1, commercial and managerial experience is closely linked (0,704). This effect will naturally be even more significant when looking at the accumulated work experiences, and is expected.

There is a high correlation between succession and getting venture capital (0,445). This result is expected, as venture capitalists often want to put in their own people or make the management more professional. This is also found in other studies (Wasserman, 2003).

Ordinal Regression[6]

Table 4.3 [7] presents the ordinal regression in three steps with the final phase of the USO as DV, with a model for each step. In model 1 the succession variable is analyzed alone. In model 2 the succession variable is analyzed together with the accumulated work experience of all the former CEOs of the USO. In model 3 the control variables are included.

The most relevant output of the analysis is the Odds ratio (OR). The table shows the odds ratio for reaching a *high phase* versus a *low phase* when the firm has conducted a CEO succession. The same goes for the control variables.

[6] The whole regression is found in appendix 7

[7] The table has been converted from showing the log odds for reaching a high phase to showing the odds ratio.

Independent variables		Model 1	Model 2	Model 3
Succession conducted	OR	**2,14****	**3,00****	**2,01***
	p	0,007	0,001	0,071
Acc. academic wxp	OR		1,51	**1,80****
	p		0,148	0,051
Acc. Managerial wxp	OR		0,85	0,79
	p		0,739	0,640
Acc. Commercial wxp	OR		0,68	0,79
	p		0,423	0,656
Acc. Industry wxp	OR		1,38	1,40
	p		0,414	0,411
Acc. Entrepreneurial wxp	OR		0,65	0,73
	p		0,217	0,414
Control Variables				
Firm age	OR			1,07
	p			0,147
Venture Captial	OR			**2,32****
	p			0,015
TTO	OR			0,87
	p			0,062
Bio / Pharma	OR			**0,28****
	p			0,001
Software	OR			1,36
	p			0,349
Validation of the model				
Negelkerke		0,042	0,090	0,245
Test of parallel lines P-value		0,508	0,992	0,432
Model Fitting Information P-value		0,006	0,011	0,000
Goodness-of-Fit P-value (Pearson)		0,507	0,653	0,681

Table 4.3: The odds ratio and p-value for reachin a high phase for independent and control variables. *Significant at the 0,1 level **Significant at the 0,05 level

The odds for reaching a high phase

The succession firms have higher odds for reaching a high phase in all the models. The p-value is under the 0,05 significance level in the two first models, and under the 0,1 significance level in model 3. In model 3 the odds for reaching a higher phase for succession firms is 2,01 times higher than for no-succession firms. This analysis shows that succession is strongly linked to reaching higher phases. This *supports* hypothesis 2, *CEO succession enhances USOs commercial progression.*

In *model 1* succession firms have 2,14 times higher odds for reaching a high phase than no-succession firms.

In *model 2* the work experiences that have been present through former CEOs is included, and the significance of succession increased. Succession firms have 3,00 times higher odds for reaching a high phase than no-succession firms. The p-value is significant at 0,001, below the 0,5-level. None of the accumulated work experiences have any significant results.

In *model 3* the control variable Bio/pharma is the the most significant at 0,001, with a 0,28 odds for reaching a high phase if the firm is making a Bio/pharma product. The Venture Capital variable increase the odds for for reaching a high phase by 2,32, with a p-value of 0,015. This supports the choice of using these variables as control variables, as they obviously affect the results. The age of the firm was expected to have a positive and significant effect in the ordinal regression models, as it takes time to develop and move through the stages of commercialization, which makes an older firm more likely to have reached a higher phase. The analysis shows that industry and venture capital are better predictors than time, as the age of the firm is not significant.

An interesting result is the significance of the *accumulated academic work experience variable*. With an odds ratio of 1,83 and a p-value of 0,051, this suggest that you have higher odds for reaching a high phase if *academic work experience* has been present in the CEO role at some point. This is coherent with the literature as the academic is beneficial in the early stages before succeeded by a more experienced CEO.

By adding the control variables the significance of the succession variable is reduced. In step 3 the odds for reaching a high phase as a succession firm is 2,01 with a p-value of 0,071. This is slightly above the 0,05 level, but still significant at the 0,1 level.

The descriptive ordinal regression supports H2, *CEO succession enhances USOs commercial progression.*

5. Results and Discussion

RQ1 - ***How does CEO succession affect the human capital in USOs?***		
H1.1	*As the USO develops, less academic work experience is acquired through CEO succession*	Supported
H1.2	*As the USO develops, managerial work experience is acquired through CEO succession*	Supported
H1.3	*As the USO develops, commercial work experience is acquired through CEO succession*	Partly supported
H1.4	*As USOs develop, they acquire industry work experience through CEO succession*	Not supported
H1.5	*As USOs develop, they acquire entrepreneurial work experience through CEO succession*	Not supported
RQ2 - ***How does CEO succession affect The USO commercial progress?***		
H2	*CEO succession enhances USOs commercial progression*	Supported

Table 4.4: Summary of the hypotheses and which ones that are supported

The following section will discuss whether or not the analysis have found support for each hypothesis, and use human capital, succession and venture development theory to explain the results from the descriptive, ordinal and binary analysis. The hypotheses will be discussed one by one, first the hypotheses from research question 1, then the hypothesis from research question 2.

Hypothesis 1.1: ***As the USO develops, less academic work experience is acquired through CEO succession*** **- Supported.**

The fall in acquisition of *academic work experience* fits the literature. *Academic work experience* is mostly needed for developing the technology in the early phases (Clarysse, 2004, Vohora et al., 2004), but is reduced as the need for commercialization and business resources becomes more important in the following phases (Jain et al., 2009). Vohora et. al (2004) also specifies that in the later phases the *academic work experience* should be removed, as the experience is related to risk aversion. The results show that the USOs take this into account, and stop recruiting CEOs with academic background. This removal of academics can create a gap between the commercial and technology

departments, which will be discussed in hypothesis 1.3.

Commercial work experience is significantly and negatively related to the presence of *academic work experience*, meaning few academics have *commercial work experience*. This indicates that there are two CEO groups that rarely overlap: the academic CEOs and the commercial CEOs. Aspelund et al. (2005) suggested that *commercial experience* is needed by the academic to recognize possibilities and create products that cover customer needs. The academic and commercial CEO might be the best of two worlds, but given the correlation between *commercial* and *academic work experience* this type of CEO is difficult to acquire.

The increase in acquisition of *managerial* and *commercial work experience* combined with the reduction of acquired *academic experience* implies that not only is *academic work experience* less acquired, it is also actively removed from the CEO chair as the USO develop. This is coherent with the points from the discussion where (i) academics are conceived as risk averse (Vohora et al., 2004), (ii) academics do not have the needed commercial experience desired in higher phases (Roberts, 1989, Oakey, 1991), (iii) academics require high rewards for their human capital, thus have difficulties committing to a startup (Vohora et al., 2004, Jain et al., 2009, Becker, 1975, Unger et al., 2011).

The reduction in acquisition of academic work experience does not necessarily mean *academic work experience* is irrelevant to the USO, but indicates that it is not perceived to be beneficial for the CEO to have this experience in later phases. This is supported by the findings in the ordinal regression, where USOs develop further commercially if *academic work experience* has been present in the CEO role at some point. As the academic CEO is succeeded, half of the firms keep the former CEO in other positions (Wasserman, 2003), which preserve the advantages of *academic experience*.

This hypothesis is supported.

Hypothesis 1.2: ***As the USO develops, managerial work experience is acquired through CEO succession*** **- Supported.**

CEOs with *Managerial work experience* is acquired as the firm develops, and all the CEOs hired in phase 3 had this type of experience. This fits the literature. The first appointed USO CEO seldom have the enough *managerial experience* (Clarysse and Moray, 2004), but *managerial work experience* is needed to evolve the firm into a market-oriented firm, a transition that rarely works out without having *managerial experience* (Berry, 1999). Managerial work experience is also found to be positive related to USO development, and attracting venture capital (Ucbasaran et al., 2008, Vohora et al., 2004, Wright et al., 2012, Ganotakis, 2012, Gurdon and Samsom, 2010, Clarysse and Moray, 2005, Clarysse, 2005). That the amount of CEOs with *managerial experience* in phase 1 is high (75%) and still

significantly increase through the phases demonstrate how fundamental earlier leader experience is to leading a USO.

Managerial work experience is also significantly and positively correlated with *commercial* and *industry work experience* in the regression and the correlation matrix. These three experiences may therefore be a result of each other. The strong connection between *managerial experience* and phase even with the other experiences as control variables, may suggest that both *commercial* and *industry experience* could be a result of acquiring a CEO with *managerial experience*.

This hypothesis is supported.

Hypothesis 1.3: ***As the USO develops, commercial work experience is acquired through CEO succession*** **- Partly supported.**

Commercial work experience is acquired as the firm develops and almost 90% percent of the CEOs acquired in phase 3 have *commercial experience*. This fits the literature, as *commercial experience* is essential for the CEO to bring the product to the market and transform the USO to a market-oriented firm (Wright, 2007, Ucbasaran et al., 2008). Market orientation is needed for a USO to achieve success and develop itself and succession is the best method to gain this experience (Roberts, 1989, Oakey, 1991). The late introduction of *commercial experience*, may not be positive as it may result in that the firm misses initial business opportunities and focuses on less ideal markets.

Commercial work experience does not relate significantly to the *phase* development in the regression model, but it relates significantly to the other work experiences. *Managerial work experience* is the strongest predictor for *commercial work experience*. Therefore *commercial work experience* may be the result of bringing in a CEO with *managerial work experience*. The strong correlation is not surprising as job positions that involve managing can have a commercial component.

Academic work experience is negatively correlated with *commercial work experience*, also in the early phases. The literature states that this is less than ideal as the cognitive distance between commercial and technology departments has a negative effect on the development of the firm (Knockaert et al., 2010) and *commercial work experience* combined with *academic work experience* has shown to create superior growth (Visintin and Pittino, 2014). This is supported by Colombo and Grilli (2010) stating that *commercial experience* without a technical part as the *academic work experience*, may reduce the value of the experience and slow down the development. Acquiring *commercial experience* earlier, instead of later may therefore be beneficial.

This hypothesis is partly supported, as it clearly acquired through CEO succession, but may be a result of other experiences being acquired, not the firm development.

Hypothesis 1.4: ***As the USO develops, industry work experience is acquired through CEO succession*** **- Not supported**

Acquisition of *industry work experience* is not significantly related to the USO development. This contradicts what is recommended by the literature, as *industry experience* has a strong significant effect on venture survival and predictor of future success (Brüderl et al., 1992).

Factors that could lead to failure in supporting the hypothesis: (i) The goal of the succession could be to acquire specific skills, like managing or marketing skills, rather than "having worked in the industry before". This would make the presence of *industry work experience* more random, increasing the chance for insignificance (Parrino, 1997). (ii) Firms in high growth environment can benefit from hiring CEOs from outside the firm and industry to bring in new knowledge, management styles and perspectives (Karaevli, 2007). As high levels of outsiderness means remoteness to the industry, the CEO is therefore likely to lack industry specific skills (Karaevli, 2007).

Over 70% of the CEO acquisitions have *industry experience* in all the phases and the insignificant result may come from that industry experience is needed just as much in all the phases. Its knowledge about customers, competitors and suppliers is valuable in both selling and creating the product and it reduces the liability of newness (Cooper et al., 1994, Vohora et al., 2004) leading to higher growth rates and better survival possibilities (Brüderl et al., 1992, Brüderl and Preisendörfer, 2000, Bosma et al., 2004 1002), making it valuable in all phases.

Industry experience is significantly related to *managerial work experience*, indicating that *industry work experience* can be a result of acquiring *managerial work experience*. McGee and Dowling (1994) found that a combination of *industry* and *managerial work experience* was positively related to higher sales growth. Cooper et al. (1994) also concluded that *managerial work experience* is weakly or not related to success if its from another industry. *Managerial work experience* should therefore be accompanied by *industry work experience* to achieve significant impact on performance.

This hypothesis is not supported.

Hypothesis 1.5: ***As the USO develops, entrepreneurial work experience is acquired through CEO succession*** **- Not supported**

Entrepreneurial work experience is the least frequent work experience in phase 1, only present in 40.1% of the hired CEOs. As the USO continues to develop the share of hired CEOs with *entrepreneurial experience* actually decrease. This contradicts what is recommended by literature, as *entrepreneurial work experience* provides unique insight in the entrepreneurial process and access to external human capital, which increases

the chance for getting external finance (Mosey et al., 2006, Wright et al., 2006).

The decrease can be explained by that entrepreneurs are motivated by achievement, self-efficacy and the ability to recognize opportunities, which is prominent in the early phase of the firm, but as it develops can become less prominent (e.g., Stewart Jr and Roth, 2001, Stewart Jr and Roth, 2004), (e.g., Begley and Boyd, 1987, Stewart et al., 1999), (e.g., Chen et al., 1998), (e.g., Alvarez and Busenitz, 2001), which may stop CEOs with *entrepreneurial experience* from wanting to join a firm in later phases. *Entrepreneurial work experience* is also found to decrease risk willingness, which could seem negative (Santarelli and Tran, 2013). Other priorities may outweigh the need for acquiring *entrepreneurial experience* as the firm develops. Experiences like *managerial* and *commercial work experience* could be more important when acquiring a CEO in later phases (Vohora et al., 2004). The decrease in acquisition of *entrepreneurial experience* is justified because CEOs with this experience do not want to join and is not attractive to acquire in later phases. Still USOs could benefit from starting off with more *entrepreneurial work experienced* CEOs in the first phase.

This hypothesis is not supported.

Hypothesis 2: *CEO succession enhances USOs commercial progression* – Supported

The prior discussion of hypotheses 1.1 to 1.5 uses related literature to suggest how succession has a positive effect on the development of a USO. The ordinal regression also shows that the odds for reaching a high phase as a succession firm is estimated to be between 2-3 times higher compared to a no-succession firm. As the succession firms develop further than no-succession firms, one can argue that the changes they make are beneficial for development. In other words, acquiring *managerial* and *commercial work experience* helps the USO to cope with the challenges of higher stages. *Academic work experience* is seen as redundant as the USO develops, and is rarely acquired in higher phases. Because succession firm progress further commercially than no-succession firms, the human capital changes they do are fruitful.

Multiple authors suggest that for a technology firm to be successful it needs to transform into a market-oriented firm (Roberts, 1989, Berry, 1999) and bringing in a new CEO is an effective means to change the orientation of the firm. Further, without a change in management style as the firm grows, a high-tech firm is unlikely to be successful (Berry, 1999). A successful transformation into a market-oriented strategy through succession could help explain why succession firms develop further than no-succession firms. The

results support this literature by indicating that it is not solely the explicit skills and competence a new CEO brings that develops the firm, but the new orientation that comes with such an event.

Bringing in a new CEO does not necessarily mean removing the competence of the previous CEO. In Wasserman (2003) study of founder-CEO succession, more than half of the replaced CEOs stayed within the firm. This means that a CEO succession in many cases adds competence to the USO without removing enthusiasm and the competence of the founder. The added skillset can help explain why succession firms develop further than no-succession firms do.

USOs are often homogenous in nature, as they are found to recruit team members based on their own networks. This leads to a homogeneous result in terms of education, industry experience and skills (Knockaert et al., 2011). An outside succession increases the heterogeneity, which can increase the performance in dynamic environments (Hmieleski and Ensley, 2007), where USOs often operate (Rasmussen et al., 2012). An outside CEO succession will contribute to the heterogeneity and thereby help increase the performance of the USO. The improved phase progression of succession firms can be a result of this increased heterogeneity.

Clarysse and Moray (2004) suggest that coaching the founder can increase the performance of a firm more than just replacement of the CEO. They argue that engineers will gain the maturity to become proficient CEOs, and that the necessary skills are acquired in short time. Coaching is also more cost efficient than hiring outside managers. Still the results in this study show that firms that do successions develop further than the USOs that do not. This can imply two things: either the no-succession firms do not prioritize coaching, or it does not have significant impact on the development.

Part time projects for single entrepreneurs are more likely to remain no-succession firms (Ucbasaran et al., 2008), and do not seem to be as aggressive and growth-oriented as other firms (Doutriaux, 1987). Whereas succession firms at some point in time have made a strategic evaluation and engaged a new person to lead the venture. There seems to be negative correlation between closeness to academic life and growth (Doutriaux, 1987). CEOs with *academic work experience* tend to take a hybrid role both as researcher and businessmen trying to preserve their academic identity (Jain et al., 2009). This lack of commitment in no-succession firms, as described by Vohora et al. (2004) in the *entrepreneurial commitment juncture,* can explain why no-succession firms do not develop as far as the succession firms.

The reasons above for why successions firms outperform no-succession firms are also supported in the regression model with accumulated work experiences. The model

demonstrates that succession is not just a proxy for acquiring one of the work experiences, but shows that succession in itself has a positive effect on development. This can, for example be due to different resource needs in each USO. A work experience that caused progression in one USO, might not be the experience that caused progression in another. One USO might see the need for a CEO with specific industry experience, while another needs general marketing experience. The one thing they have in common is that both recognize a need, and do the necessary measures to meet them: a CEO succession. In this case the CEO succession is the common mean to fulfill a resource need.

CEO succession will also acquire resources that are beyond the scope of this study, like the network, social skills, motivation and the tacit knowledge of the CEO, making succession a proxy for these resources. As it also brings these resources, the CEO succession results in commercial progress independent of what work experiences that have been acquired.

This hypothesis is supported.

6. Implications

The results from RQ1 show significant development trends in human capital, and RQ2 underpin that USOs benefit form these changes in regards to the commercial progress. Based on these results and relevant literature the following implications are presented:

USO entrepreneurial teams and CEOs: This paper highlights the need for acquiring different human capital and resources as the USO develops and the results gives a clear indication on what human capital that should be. For USO CEOs, it implies that he or she have to be aware of the need for a changed mind- and skillset as the USO move from a technology orientation to an market orientation. This means that the CEO have to evaluate whether if he or she possess the needed experience and skills to further develop the USO or if a succession could be beneficial. This especially holds if it is a CEO with academic work experience, where this study shows that they often is succeeded with a individual with managerial and commercial experience. Industry experience is also found to be highly present in all the phases in this study and is valuable for a USO in all phases, based on the literature. USOs should not be afraid to replace a CEO to keep up their momentum in the development.

TTOs and Universities: Already in the initial phases of a USOs life the TTOs should begin to plan for a non-academic CEO. Most USOs will replace their CEO, and will rarely bring in a new academic CEO. USOs tend to recruit team members and CEOs from their own network which contributes to homogeneous management composition lacking managerial and commercial experience (Franklin et al., 2001, Ensley and Hmieleski, 2005, Knockaert et al.,

2011). As USOs have trouble recruiting relevant CEOs in from their network, universities should create and make use of their extensive alumni network to recruit CEOs before the USO moves too far away from the university. By also establishing bonds with alumni groups from top business schools together with seed funds and venture capital firms, USOs can extend their reach and find candidates from a broader specter of needed work experience.

Policy makers (politicians, research council, Innovation Norway): As the study has proved clear development trends in CEO succession human capital, and a positive link between succession and USO development, CEO succession arguably deserves more attention among the policy makers. The policy makers should realize the importance of acquisition of the right CEO at the right time for USOs, and the difficulties USOs have finding the right CEO due to their limited university network. Organizations aiding USOs in development, like Innovation Norway and The Norwegian Research Council, should use their unique overview of the startup landscape to help USOs find CEOs with the right commercial or managerial work experience. Before granting funding, these organizations should also challenge the USOs to examine what experiences that are crucial to progress and help to create a plan to acquire these competences.

Investors: Investors tend to be drivers for replacement of the CEO, by making demands regarding the leadership in their investment objects and providing the resources to bring in suited management (Wasserman, 2003). To optimize the USO, the investors should continue to take initiative to CEO replacement, bringing in commercial, managerial and industry experience. As investors investing in early phase start ups often invest based on the human capital of the entrepreneurial team (Colombo and Grilli, 2010), and CEO succession is a natural part of the USO development, investors should at the same time be careful not to loose the human capital they originally invested in. This can be avoided by e.g. moving an academic CEO over to a CTO position, instead of removing the individual from the firm.

Research implications: A challenge with research on this area is that most studies are anecdotal and case based (Rasmussen et al., 2012). This study approaches this challenge by producing empirical results to better understand USOs and their organization of human capital throughout its development. This study contributes to the literature by describing what kinds of human capital USOs perceive to need in different phases. This helps to answer (i)(Wright et al., 2012) call for research explaining more about how USOs reconfigure their resource base. (ii) Hmieleski and Ensley (2007) calls for research on executive team composition variables that are likely to interact with performance of the start up, and this study is a step on the way to finding this

out. It also touches on (iii) Heirman and Clarysse (2004) suggestions for further research on how different types of research based start ups evolve during their early growth path, and (iv) Unger et al. (2011) call for more context on human capital when linking an entrepreneur to success.

Implications for non-USOs: As many high tech firms experience the same challenges and development path as USOs, the prior implications may also be relevant for firms with technological founders without the needed commercial or managerial experience.

7. Conclusion

This study has investigated the kinds of work experiences that are acquired through CEO succession in different stages of a USO's lifetime and what effect succession has on a USO's commercial progress. The paper contributes by addressing the lack of quantitative USO studies, addressing the unexplored field of CEO successions in USOs and helping USOs to achieve commercial progression. The paper proves that USOs acquire managerial and commercial work experience through CEO succession as the USO develops. While acquiring these kinds of experiences the USOs significantly reduce the acquisition of academic experience when developing. The significant findings prove that USOs that conduct CEO succession reach further in the commercial development than firms that do not.

8. Limitations and further research

The FORNY database proves to be a solid foundation for quantitative studies on USOs. Respectively, suggestions for further research and limitations will be presented.

Study the entire top management team (TMT): This study has focused on the CEO and the CEO's human capital in relation to the USO's development. One can therefore argue that even though the CEO is the most influential person in the USO, the USO consists of a team. Recent scholars (Klotz et al., 2014) argues that new ventures are started by teams and decisions are made together implying that the team is more important regarding the development and performance of the USO. As the succeeded CEO often continue in the USO in another position after the CEO succession (Wasserman, 2003). Looking at the entire TMT through the USO development would most likely influence the results, and the authors encourage to further research this area.

Institutional differences: There are some institutional differences between the European countries and the US according to Wright (2007). This means that the results from this study is highly generalizable for only European countries since the FORNY database contains Norwegian USOs, and the authors encourage other researchers to do similar studies in a US context as this might influence the results.

Acknowledgement

This study is a part of a master thesis at the NTNU school of Entrepreneurship at the Norwegian University of Science and Technology. The authors would like to sincerely thank our supervisor Professor Roger Sørheim for valuable input and guidance. Following this, the authors will also like to thanks to Ph. D. candidate Marius Tuft Mathisen along with Ph. D. candidate Håkon Bakka, Professor Øyvind Salvesen and Professor Mette Langaas for help with interpretation and modeling of the statistics.

The authors send their gratitude to their spouses and life partners for their support in spite of all the missed dinners and appointments.

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Appendix 1: Coding template

Company:						
Org.nr						
FORNY-ID						
General Information:		*Comments:*				
Founding year:		Year Founded				
University:		Name of University				
TTO:		Were TTO involved				
Specific Technology:		Yes/No (1/0)				
Venture Capital:		Yes/No (1/0)				
Year of Venture Capital		Year of acquired capital				
Biotech:		Yes/No (1/0)				
Software:		Yes/No (1/0)				
Service:		Yes/No (1/0)				
CEO CODING						
VARIABLES YEAR	**år**	**år**	**år**	**år**	**år**	**år**
CEO Name:						
Years as CEO						
Entrepreneurial experience:						
Type of education:						
Academic (Phd)						
Comment:						
Work experience:						
Commercial						
Managerial						
Industry						
Promoted internaly						
TTO experience						
Comment:						
Succession timing						
Year of Venture Capital						
Year of aquired						
Comment:						
Company phase (1,2 or 3):						
Comment:						

Appendix 2 – Mann Whitney significance tests

Ap 2a: Academic work experience

Ranks

StartPhase	Acad. Exp.	N	Mean Rank	Sum of Ranks
	,0	270	223,56	60361,00
	1,0	155	194,61	30164,00
	Total	425		

Test Statistics[a]

	StartPhase
Mann-Whitney U	18074,000
Wilcoxon W	30164,000
Z	-3,188
Asymp. Sig. (2-tailed)	,001
Exact Sig. (2-tailed)	,001
Exact Sig. (1-tailed)	,001
Point Probability	,000

a. Grouping Variable: AcadEdu

Ap. 2b: Commercial work experience

Ranks

StartPhase	ComExp	N	Mean Rank	Sum of Ranks
	,0	142	196,33	27879,00
	1,0	283	221,36	62646,00
	Total	425		

Test Statistics[a]	
	StartPhase
Mann-Whitney U	17726,000
Wilcoxon W	27879,000
Z	-2,701
Asymp. Sig. (2-tailed)	,007
Exact Sig. (2-tailed)	,007
Exact Sig. (1-tailed)	,003
Point Probability	,000

a. Grouping Variable: ComExp

Ap. 2c: Managerial work experience

Ranks				
StartPhase	ManExp	N	Mean Rank	Sum of Ranks
	,0	93	190,06	17676,00
	1,0	332	219,42	72849,00
	Total	425		

Test Statistics[a]	
	StartPhase
Mann-Whitney U	13305,000
Wilcoxon W	17676,000
Z	-2,776
Asymp. Sig. (2-tailed)	,005
Exact Sig. (2-tailed)	,006
Exact Sig. (1-tailed)	,002
Point Probability	,000

a. Grouping Variable: ManExp

Ap. 2d: Industry work experience

Ranks

StartPhase	IndExp	N	Mean Rank	Sum of Ranks
	,0	122	208,66	25456,00
	1,0	303	214,75	65069,00
	Total	425		

Test Statistics[a]

	StartPhase
Mann-Whitney U	17953,000
Wilcoxon W	25456,000
Z	-,631
Asymp. Sig. (2-tailed)	,528
Exact Sig. (2-tailed)	,530
Exact Sig. (1-tailed)	,275
Point Probability	,014

a. Grouping Variable: IndExp

Ap. 2e: Entrepreneurial work experience

Ranks

StartPhase	EntrExp	N	Mean Rank	Sum of Ranks
	,0	259	215,97	55937,00
	1,0	166	208,36	34588,00
	Total	425		

Test Statistics[a]

	StartPhase
Mann-Whitney U	20727,000
Wilcoxon W	34588,000
Z	-,849

Asymp. Sig. (2-tailed)	,396
Exact Sig. (2-tailed)	,405
Exact Sig. (1-tailed)	,205
Point Probability	,011

a. Grouping Variable: EntrExp

Appendix 3 – VIF tests

Ap. 3a Phase CEO is acquired (Coded as "Start phase")

Coefficients[a]			
Model 1		Collinearity Statistics	
		Tolerance	VIF
	AcadExp	,835	1,197
	ComExp	,526	1,902
	ManExp	,574	1,742
	IndExp	,857	1,167
	EntrExp	,813	1,230

a. Dependent Variable: StartPhase

Ap. 3b Academic work experience

Coefficients[a]			
Model 1		Collinearity Statistics	
		Tolerance	VIF
	ComExp	,558	1,792
	ManExp	,573	1,746
	IndExp	,858	1,166
	EntrExp	,800	1,249
	StartPhase	,960	1,041

a. Dependent Variable: AcadEdu

Ap. 3c Managerial work experience

Coefficients[a]			
Model 1		Collinearity Statistics	
		Tolerance	VIF
	IndExp	,916	1,092
	EntrExp	,804	1,243
	StartPhase	,953	1,049
	AcadEdu	,827	1,209
	ComExp	,679	1,472

a. Dependent Variable: ManExp

Ap. 3c Commercial work experience

Coefficients[a]			
Model 1		Collinearity Statistics	
		Tolerance	VIF
	ManExp	,739	1,352
	IndExp	,858	1,165
	EntrExp	,875	1,143
	StartPhase	,950	1,052
	AcadEdu	,878	1,139

a. Dependent Variable: ComExp

Ap. 3d Industry work experience

Coefficients[a]			
Model 1		Collinearity Statistics	
		Tolerance	VIF
	EntrExp	,801	1,248
	StartPhase	,947	1,056
	AcadEdu	,825	1,213
	ComExp	,525	1,906
	ManExp	,609	1,641

a. Dependent Variable: IndExp

Ap. 3f Industry work experience

Coefficients[a]			
Model 1		Collinearity Statistics	
		Tolerance	VIF
	StartPhase	,962	1,039
	AcadEdu	,824	1,213
	ComExp	,573	1,745
	ManExp	,573	1,744
	IndExp	,859	1,165

a. Dependent Variable: EntrExp

Appendix 4: Binary regressions RQ1

Academic Work Experience

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	425	100,0
	Missing Cases	0	,0
	Total	425	100,0
Unselected Cases		0	,0
Total		425	100,0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
,0	0
1,0	1

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			Acadexp		Percentage
	Observed		,0	1,0	Correct
Step 0	AcadExp	,0	270	0	100,0
		1,0	155	0	,0
	Overall Percentage				63,5

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-,555	,101	30,331	1	,000	,574

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	StartPhase	11,444	1	,001
	Overall Statistics		11,444	1	,001

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	12,517	1	,000
	Block	12,517	1	,000
	Model	12,517	1	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	545,149[a]	,029	,040

hha. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	,569	1	,451

Contingency Table for Hosmer and Lemeshow Test

		Acadexp = .0		Acadexp = 1.0		
		Observed	Expected	Observed	Expected	Total
Step 1	1	19	18,092	2	2,908	21
	2	56	57,817	21	19,183	77
	3	195	194,092	132	132,908	327

Classification Table[a]

			Predicted		
			Acadexp		Percentage
	Observed		,0	1,0	Correct
Step 1	Acadexp	,0	270	0	100,0
		1,0	155	0	,0
	Overall Percentage				63,5

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	StartPhase	-,725	,221	10,758	1	,001	,485
	Constant	,346	,285	1,477	1	,224	1,413

a. Variable(s) entered on step 1: StartPhase.

Block 2: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	63,634	4	,000
	Block	63,634	4	,000
	Model	76,152	5	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	481,514[a]	,164	,224

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	13,535	7	,060

Contingency Table for Hosmer and Lemeshow Test

		Acadexp = .0		Acadexp = 1.0		
		Observed	Expected	Observed	Expected	Total
Step 1	1	40	36,629	2	5,371	42
	2	25	27,266	8	5,734	33
	3	66	72,450	29	22,550	95
	4	49	49,327	18	17,673	67
	5	36	31,251	8	12,749	44

	6	13	14,413	16	14,587	29
	7	21	17,538	23	26,462	44
	8	13	9,870	18	21,130	31
	9	7	11,256	33	28,744	40

Classification Table[a]

			Predicted		
			Acadexp		Percentage
	Observed		,0	1,0	Correct
Step 1	Acadexp	,0	224	46	83,0
		1,0	70	85	54,8
	Overall Percentage				72,7

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	StartPhase	-,579	,237	5,962	1	,015	,560
	ComExp	-1,394	,292	22,760	1	,000	,248
	ManExp	-,400	,327	1,496	1	,221	,671
	IndExp	-,170	,259	,430	1	,512	,844
	EntrExp	-,141	,259	,295	1	,587	,869
	Constant	1,517	,372	16,658	1	,000	4,558

a. Variable(s) entered on step 1: ComExp, ManExp, IndExp, EntrExp.

Managerial Work Experience

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	425	100,0
	Missing Cases	0	,0
	Total	425	100,0
Unselected Cases		0	,0
Total		425	100,0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding	
Original Value	Internal Value
,0	0
1,0	1

Block 0: Beginning Block

Classification Table[a,b]					
			Predicted		
			ManExp		Percentage
	Observed		,0	1,0	Correct
Step 0	ManExp	,0	0	93	,0
		1,0	0	332	100,0
	Overall Percentage				78,1

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	1,273	,117	117,645	1	,000	3,570

Variables not in the Equation					
			Score	df	Sig.
Step 0	Variables	StartPhase	9,032	1	,003
	Overall Statistics		9,032	1	,003

Block 1: Method = Enter

Omnibus Tests of Model Coefficients			
	Chi-square	df	Sig.

Step 1	Step	10,725	1	,001
	Block	10,725	1	,001
	Model	10,725	1	,001

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	435,877[a]	,025	,038

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	,000	0	.

Contingency Table for Hosmer and Lemeshow Test

		ManExp = .0		ManExp = 1.0		
		Observed	Expected	Observed	Expected	Total
Step 1	1	81	82,198	246	244,802	327
	2	12	10,802	86	87,198	98

Classification Table[a]

			Predicted		
			ManExp		Percentage
	Observed		,0	1,0	Correct
Step 1	ManExp	,0	0	93	,0
		1,0	0	332	100,0
	Overall Percentage				78,1

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	StartPhase	,857	,297	8,317	1	,004	2,356

	Constant	,234	,362	,419	1	,517	1,264

a. Variable(s) entered on step 1: StartPhase.

Block 2: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	181,397	4	,000
	Block	181,397	4	,000
	Model	192,123	5	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	254,480[a]	,364	,559

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	6,384	8	,604

Contingency Table for Hosmer and Lemeshow Test

		ManExp = .0		ManExp = 1.0		
		Observed	Expected	Observed	Expected	Total
Step 1	1	33	33,332	8	7,668	41
	2	33	31,629	21	22,371	54
	3	16	16,620	28	27,380	44
	4	5	5,641	46	45,359	51
	5	0	1,017	20	18,983	20
	6	3	1,987	48	49,013	51
	7	0	,997	41	40,003	41

8	0	,265	14	13,735	14
9	3	1,178	66	67,822	69
10	0	,335	40	39,665	40

Classification Table[a]

			Predicted		
			ManExp		Percentage
	Observed		,0	1,0	Correct
Step 1	ManExp	,0	51	42	54,8
		1,0	14	318	95,8
	Overall Percentage				86,8

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	StartPhase	,743	,383	3,758	1	,053	2,102
	Acadexp	-,265	,338	,617	1	,432	,767
	ComExp	2,930	,401	53,341	1	,000	18,730
	IndExp	1,479	,328	20,376	1	,000	4,390
	EntrExp	,847	,456	3,452	1	,063	2,334
	Constant	-1,947	,598	10,592	1	,001	,143

a. Variable(s) entered on step 1: Acadexp, ComExp, IndExp, EntrExp.

Commercial Work Experience

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	425	100,0
	Missing Cases	0	,0
	Total	425	100,0
Unselected Cases		0	,0
Total		425	100,0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding	
Original Value	Internal Value
,0	0
1,0	1

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			ComExp		Percentage
	Observed		,0	1,0	Correct
Step 0	ComExp	,0	0	142	,0
		1,0	0	283	100,0
	Overall Percentage				66,6

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	,690	,103	44,968	1	,000	1,993

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	StartPhase	7,669	1	,006
	Overall Statistics		7,669	1	,006

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	8,320	1	,004
	Block	8,320	1	,004
	Model	8,320	1	,004

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	533,177[a]	,019	,027

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	,000	0	.

Contingency Table for Hosmer and Lemeshow Test

		ComExp = .0		ComExp = 1.0		
		Observed	Expected	Observed	Expected	Total
Step 1	1	120	120,156	207	206,844	327
	2	22	21,844	76	76,156	98

Classification Table[a]

			Predicted		
			ComExp		Percentage
	Observed		,0	1,0	Correct
Step 1	ComExp	,0	0	142	,0
		1,0	0	283	100,0
	Overall Percentage				66,6

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	StartPhase	,595	,219	7,347	1	,007	1,812
	Constant	-,051	,285	,033	1	,857	,950

a. Variable(s) entered on step 1: StartPhase.

Block 2: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	220,521	4	,000
	Block	220,521	4	,000
	Model	228,841	5	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	312,657[a]	,416	,578

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	7,634	8	,470

Contingency Table for Hosmer and Lemeshow Test

		ComExp = .0		ComExp = 1.0		
		Observed	Expected	Observed	Expected	Total
Step 1	1	48	46,997	1	2,003	49
	2	32	32,426	6	5,574	38
	3	23	23,106	21	20,894	44
	4	9	11,621	25	22,379	34
	5	16	12,902	48	51,098	64
	6	5	5,392	28	27,608	33
	7	3	5,347	40	37,653	43
	8	3	1,038	17	18,962	20
	9	2	2,383	66	65,617	68

10	1	,788	31	31,212	32

Classification Table[a]

			Predicted		
			ComExp		Percentage
	Observed		,0	1,0	Correct
Step 1	ComExp	,0	103	39	72,5
		1,0	28	255	90,1
	Overall Percentage				84,2

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	StartPhase	,350	,285	1,507	1	,220	1,418
	Acadexp	-1,400	,292	22,955	1	,000	,247
	ManExp	2,926	,399	53,844	1	,000	18,652
	IndExp	,311	,332	,879	1	,348	1,365
	EntrExp	1,939	,355	29,791	1	,000	6,951
	Constant	-2,210	,539	16,825	1	,000	,110

a. Variable(s) entered on step 1: Acadexp, ManExp, IndExp, EntrExp.

Industry Work Experience

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	425	100,0
	Missing Cases	0	,0
	Total	425	100,0
Unselected Cases		0	,0
Total		425	100,0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
,0	0

1,0	1

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			IndExp		Percentage
	Observed		,0	1,0	Correct
Step 0	IndExp	,0	0	122	,0
		1,0	0	303	100,0
	Overall Percentage				71,3

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	,910	,107	71,982	1	,000	2,484

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	StartPhase	,662	1	,416
	Overall Statistics		,662	1	,416

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	,679	1	,410
	Block	,679	1	,410
	Model	,679	1	,410

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	508,894[a]	,002	,002

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	,000	0	.

Contingency Table for Hosmer and Lemeshow Test

		IndExp = .0		IndExp = 1.0		
		Observed	Expected	Observed	Expected	Total
Step 1	1	96	96,876	231	230,124	327
	2	26	25,124	72	72,876	98

Classification Table[a]

			Predicted		
			IndExp		Percentage
	Observed		,0	1,0	Correct
Step 1	IndExp	,0	0	122	,0
		1,0	0	303	100,0
	Overall Percentage				71,3

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	StartPhase	,165	,204	,660	1	,417	1,180
	Constant	,700	,278	6,347	1	,012	2,013

a. Variable(s) entered on step 1: StartPhase.

Block 2: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	56,375	4	,000
	Block	56,375	4	,000
	Model	57,054	5	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	452,519[a]	,126	,180

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	12,598	7	,083

Contingency Table for Hosmer and Lemeshow Test

		IndExp = .0		IndExp = 1.0		
		Observed	Expected	Observed	Expected	Total
Step 1	1	39	35,317	17	20,683	56
	2	18	21,871	23	19,129	41
	3	12	12,632	36	35,368	48
	4	5	10,191	40	34,809	45
	5	10	5,416	16	20,584	26
	6	13	12,050	48	48,950	61
	7	6	7,224	34	32,776	40
	8	3	4,371	23	21,629	26
	9	16	12,928	66	69,072	82

Classification Table[a]

		Predicted	
	Observed	IndExp	Percentage

			,0	1,0	Correct
Step 1	IndExp	,0	55	67	45,1
		1,0	34	269	88,8
	Overall Percentage				76,2

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	StartPhase	-,077	,220	,122	1	,727	,926
	Acadexp	-,160	,260	,379	1	,538	,852
	ManExp	1,482	,323	20,986	1	,000	4,401
	ComExp	,284	,326	,759	1	,384	1,328
	EntrExp	,274	,276	,986	1	,321	1,315
	Constant	-,287	,386	,553	1	,457	,750

a. Variable(s) entered on step 1: Acadexp, ManExp, ComExp, EntrExp.

Entrepreneurial Work Experience

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	425	100,0
	Missing Cases	0	,0
	Total	425	100,0
Unselected Cases		0	,0
Total		425	100,0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
,0	0
1,0	1

Block 0: Beginning Block

Classification Table[a,b]

	Observed		Predicted		
			EntrExp		Percentage
			,0	1,0	Correct
Step 0	EntrExp	,0	259	0	100,0
		1,0	166	0	,0
	Overall Percentage				60,9

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-,445	,099	20,018	1	,000	,641

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	StartPhase	,988	1	,320
	Overall Statistics		,988	1	,320

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	1,004	1	,316
	Block	1,004	1	,316
	Model	1,004	1	,316

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	567,655[a]	,002	,003

a. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	,208	1	,648

Contingency Table for Hosmer and Lemeshow Test						
		EntrExp = .0		EntrExp = 1.0		
		Observed	Expected	Observed	Expected	Total
Step 1	1	15	14,326	6	6,674	21
	2	48	49,347	29	27,653	77
	3	196	195,326	131	131,674	327

Classification Table[a]					
			Predicted		
			EntrExp		Percentage
	Observed		,0	1,0	Correct
Step 1	EntrExp	,0	259	0	100,0
		1,0	166	0	,0
	Overall Percentage				60,9

a. The cut value is .500

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	StartPhase	-,185	,186	,984	1	,321	,831
	Constant	-,210	,256	,670	1	,413	,811

a. Variable(s) entered on step 1: StartPhase.

Block 2: Method = Enter

Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	97,653	4	,000

	Block	97,653	4	,000
	Model	98,656	5	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	470,003[a]	,207	,281

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	7,584	7	,371

Contingency Table for Hosmer and Lemeshow Test

		EntrExp = .0		EntrExp = 1.0		
		Observed	Expected	Observed	Expected	Total
Step 1	1	44	43,643	2	2,357	46
	2	38	39,684	5	3,316	43
	3	30	30,003	5	4,997	35
	4	33	30,478	9	11,522	42
	5	18	14,547	7	10,453	25
	6	17	22,541	27	21,459	44
	7	13	13,338	16	15,662	29
	8	18	20,521	29	26,479	47
	9	48	44,245	66	69,755	114

Classification Table[a]

			Predicted		
			EntrExp		Percentage
	Observed		,0	1,0	Correct
Step 1	EntrExp	,0	180	79	69,5
		1,0	55	111	66,9
	Overall Percentage				68,5

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	StartPhase	-,506	,203	6,243	1	,012	,603
	Acadexp	-,200	,259	,599	1	,439	,818
	ManExp	,865	,442	3,826	1	,050	2,375
	ComExp	1,938	,355	29,749	1	,000	6,945
	IndExp	,295	,276	1,143	1	,285	1,343
	Constant	-2,136	,493	18,797	1	,000	,118

a. Variable(s) entered on step 1: Acadexp, ManExp, ComExp, IndExp.

Appendix 5: Descriptive results RQ2

	# reached phase 1	**# reached phase 2**	**# reached phase 3**
No-succession firms	44 (57,9%)	21 (27,6%)	11 (14,5%)
Succession firms	47 (37,6%)	49 (39,2%)	29 (23,2%)
Total	91	70	40

Table 4.2.1: The final phase reached, grouped in succession and no-succession USOs

Appendix 6: Corrolation Matrix RQ2

Pearson Correlations

		Phase reached	Succession firm	AcadExp Acc.	ManExp Acc.	ComExp Acc.	IndExp Acc.	EntrExp Acc.	Firm Age	Venture Capital	TTO	Medtech, Pharma or Bio	Software
Phase reached	Correlation	1	,184**	,117	-,039	-,057	,021	-,086	,271**	,266**	-,123	-,268**	,160*
	Sig. (2-tailed)		,009	,098	,585	,425	,762	,225	,000	,000	,082	,000	,023
	N	201	201	201	201	201	201	201	201	201	201	201	201
Succession firm	Correlation	,184**	1	-,019	,369**	,444**	,281**	,338**	,300**	,438**	,179*	,056	-,055
	Sig. (2-tailed)	,009		,794	,000	,000	,000	,000	,000	,000	,011	,430	,442
AcadExp Acc.	Correlation	,117	-,019	1	-,168*	-,210**	-,202**	-,152*	,125	,049	-,070	,122	-,057
	Sig. (2-tailed)	,098	,794		,017	,003	,004	,031	,077	,489	,321	,085	,422
ManExp Acc.	Correlation	-,039	,369**	-,168*	1	,704**	,469**	,444**	-,025	,156*	,302**	,028	-,122
	Sig. (2-tailed)	,585	,000	,017		,000	,000	,000	,727	,027	,000	,690	,084
ComExp Acc.	Correlation	-,057	,444**	-,210**	,704**	1	,421**	,613**	-,020	,176*	,355**	,021	-,171*
	Sig. (2-tailed)	,425	,000	,003	,000		,000	,000	,782	,012	,000	,768	,015
IndExp Acc.	Correlation	,021	,281**	-,202**	,469**	,421**	1	,379**	-,012	,110	,236**	-,020	-,035
	Sig. (2-tailed)	,762	,000	,004	,000	,000		,000	,863	,121	,001	,780	,619
EntrExp Acc.	Correlation	-,086	,338**	-,152*	,444**	,613**	,379**	1	-,020	,170*	,472**	,066	-,105
	Sig. (2-tailed)	,225	,000	,031	,000	,000	,000		,774	,016	,000	,354	,137
FirmAge	Correlation	,271**	,300**	,125	-,025	-,020	-,012	-,020	1	,362**	-,184**	-,068	,003
	Sig. (2-tailed)	,000	,000	,077	,727	,782	,863	,774		,000	,009	,339	,969
Venture Capital	Correlation	,266**	,438**	,049	,156*	,176*	,110	,170*	,362**	1	,045	-,047	-,156*
	Sig. (2-tailed)	,000	,000	,489	,027	,012	,121	,016	,000		,522	,511	,027
TTO	Correlation	-,123	,179*	-,070	,302**	,355**	,236**	,472**	-,184**	,045	1	,160*	-,126
	Sig. (2-tailed)	,082	,011	,321	,000	,000	,001	,000	,009	,522		,023	,075
Medtech, Pharma or Bio	Correlation	-,268**	,056	,122	,028	,021	-,020	,066	-,068	-,047	,160*	1	-,443**
	Sig. (2-tailed)	,000	,430	,085	,690	,768	,780	,354	,339	,511	,023		,000
Software	Correlation	,160*	-,055	-,057	-,122	-,171*	-,035	-,105	,003	-,156*	-,126	-,443**	1
	Sig. (2-tailed)	,023	,442	,422	,084	,015	,619	,137	,969	,027	,075	,000	

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed). Acc. = Accumulated

Appendix 7: Ordinal regression RQ 2

Case Processing Summary			
		N	Marginal Percentage
Phase Reached	1,0	91	45,3%
	2,0	70	34,8%
	3,0	40	19,9%
Succession firm	,0	76	37,8%
	1,0	125	62,2%
AcadExp acc.	,0	87	43,3%
	1,0	114	56,7%
ComExp acc.	,0	59	29,4%
	1,0	142	70,6%
ManExp acc.	,0	41	20,4%
	1,0	160	79,6%
IndExp acc.	,0	42	20,9%
	1,0	159	79,1%
EntrExp acc.	,0	89	44,3%
	1,0	112	55,7%
Software acc.	,00	131	65,2%
	1,00	70	34,8%
Pharma, Med- or Biotech	,00	147	73,1%
	1,00	54	26,9%
TTO	,0	112	55,7%
	1,0	89	44,3%
Venture Capital	,0	137	68,2%
	1,0	64	31,8%
Valid		201	100,0%
Missing		0	
Total		201	

AcadEdu = Academic Work experience, ComExp = Commercial Work Experience, ManExp = Managerial Work Experience, IndExp = Industry Work Experience, EntrExp = Industry Work Experience, acc. = accumulated

Step 1: PLUM - Ordinal Regression

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	26,515			
Final	19,002	7,513	1	,006

Link function: Logit.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	,440	1	,507
Deviance	,437	1	,508

Link function: Logit.

Pseudo R-Square

Cox and Snell	,037
Nagelkerke	,042
McFadden	,018

Link function: Logit.

Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Thr.	Phase reached = 1	-,477	,179	7,136	1	,008	-,827	-,127
	Phase reached = 2	1,150	,197	34,036	1	,000	,764	1,536
Loc.	Succession firm = 0	-,763	,281	7,379	1	,007	-1,314	-,213
	Succession firm = 1	0[a]	.	.	0	.		

Link function: Logit. Thr. = Threshold, Loc = Location, acc. = accumulated

a. This parameter is set to zero because it is redundant.

Test of Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	19,002			
General	18,564	,437	1	,508

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.[a]

a. Link function: Logit.

Step 2: PLUM - Ordinal Regression

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	142,158			
Final	125,556	16,602	6	,011

Link function: Logit.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	59,009	64	,653
Deviance	58,667	64	,665

Link function: Logit.

Pseudo R-Square

Cox and Snell	,079
Nagelkerke	,090
McFadden	,039

Link function: Logit.

Parameter Estimates

			Std.				95% Confidence Interval	
		Estimate	Error	Wald	df	Sig.	Lower Bound	Upper Bound
Thr.	Phase reached= 1	-,515	,245	4,406	1	,036	-,996	-,034
	Phase reached= 2	1,166	,259	20,239	1	,000	,658	1,674
Loc.	Succession firm= 0	-1,097	,331	10,957	1	,001	-1,746	-,447
	Succession firm= 1	0[a]	.	.	0	.	.	.
	AcadExp acc.= 0	-,410	,283	2,098	1	,148	-,964	,145
	AcadExp acc.=1	0[a]	.	.	0	.	.	.
	ComExp acc.= 0	,392	,489	,641	1	,423	-,567	1,350
	ComExp acc.= 1	0[a]	.	.	0	.	.	.
	ManExp acc.= 0	,164	,492	,111	1	,739	-,801	1,129
	ManExp acc.= 1	0[a]	.	.	0	.	.	.
	IndExp acc. = 0	-,322	,394	,667	1	,414	-1,094	,451
	IndExp acc.= 0	0[a]	.	.	0	.	.	.
	EntrExp acc.= 0	,433	,351	1,523	1	,217	-,255	1,120
	EntrExp acc.= 1	0[a]	.	.	0	.	.	.

Link function: Logit. Thr. = Threshold, Loc = Location, acc. = accumulated

a. This parameter is set to zero because it is redundant.

Test of Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	125,556			
General	124,741	,815	6	,992

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.[a]

a. Link function: Logit.

Step 3: PLUM - Ordinal Regression

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	393,220			
Final	344,640	48,580	11	,000

Link function: Logit.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	320,349	333	,681
Deviance	321,014	333	,672

Link function: Logit.

Pseudo R-Square

Cox and Snell	,215
Nagelkerke	,245
McFadden	,115

Link function: Logit.

Parameter Estimates

							95% Confidence Interval	
		Estimate	Std. Error	Wald	Df	Sig.	Lower Bound	Upper Bound
Thr.	Phase reached = 1	,175	,664	,069	1	,792	-1,126	1,475
	Phase reached = 2	2,074	,679	9,332	1	,002	,743	3,405
Loc.	Firm age	,068	,047	2,105	1	,147	-,024	,159
	Succession firm = 0	-,696	,386	3,252	1	,071	-1,452	,060
	Succession firm = 1	0[a]	.	.	0	.	.	.
	AcadExp acc.= 0	-,587	,301	3,808	1	,051	-1,178	,003
	AcadExp acc. = 1	0[a]	.	.	0	.	.	.
	ComExp acc. = 0	,233	,524	,198	1	,656	-,793	1,259
	ComExp acc. = 1	0[a]	.	.	0	.	.	.
	ManExp acc. = 0	,239	,509	,219	1	,640	-,760	1,237
	ManExp acc. = 1	0[a]	.	.	0	.	.	.
	IndExp acc. = 0	-,336	,409	,676	1	,411	-1,138	,465
	IndExp acc. = 1	0[a]	.	.	0	.	.	.
	EntrExp acc. = 0	,321	,393	,667	1	,414	-,449	1,091
	EntrExp acc. = 1	0[a]	.	.	0	.	.	.
	Software = 0	-,309	,330	,877	1	,349	-,956	,338
	Software = 1	0[a]	.	.	0	.	.	.
	Pharma, Med- or Biotech = 0	1,259	,390	10,442	1	,001	,496	2,023
	Pharma, Med- or Biotech = 1	0[a]	.	.	0	.	.	.
	TTO = 0	,145	,332	,191	1	,662	-,506	,795
	TTO = 1	0[a]	.	.	0	.	.	.
	Venture Capital = 0	-,840	,346	5,897	1	,015	-1,518	-,162
	Venture Capital = 1	0[a]	.	.	0	.	.	.

Link function: Logit. Thr. = Threshold, Loc = Location, acc. = accumulated

a. This parameter is set to zero because it is redundant.

Test of Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	344,640			
General	333,498	11,142	11	,431

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.[a]

a. Link function: Logit.

Appendix 8: Descriptive development of each experience

Amount of experience at each phase	**Phase 1**	**Phase 2**	**Phase 3**
Managerial Work Experience	75,20 %	84,40 %	100 %
Commercial Work Experience	63,30 %	75,30 %	85,70 %
Industry Work experience	70,60 %	71,40 %	81 %
Entrepreneurial Work Experience	40,10 %	37,70 %	28,60 %
Academical Work Experience	40,40 %	27,30 %	9,50 %