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The champion's human capital and its role throughout the USO's development

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Abbreviations

CEO = Chief Executive Officer

DV = Dependent Variable

EHC = Entrepreneurial Human Capital

HC = Human Capital

HCT = Human Capital Theory

IHC = Industry-specific Human Capital

IV = Independent Variable

KBT = Knowledge-Based Theory

M = Mean

MIHC = Management Industry-specific Human Capital

RBT = Research-Based Theory

SE = Standard Error Mean

TIHC = Technological Industry-specific Human Capital

TTO = Technology transfer office

UHC = University Human Capital

USO = University spin-off

VC = Venture Capital

Preface

This master thesis was written by Sebastian Vendrig and Thor Rikard Borgevad during the spring of 2015. Both studied at NTNUs School of Entrepreneurship, which is a part of the Department of Industrial Economics and Technology Management at NTNU.

The reader will find two scientific articles which complement each other in this thesis. Both of the articles are constructed to communicate independently. However, the first article is more thorough in terms of descriptions and definitions. Thus, it can be enjoyed by readers not familiar with the university spin-off environment. The first article presents a theoretical study of university spin-offs in the context of Resource-based Theory, Human Capital Theory and Knowledge-based Theory. The second article present a quantitative study of 120 Norwegian university spin-offs. The authors chose this format as it is more suited for publishing, which facilitates sharing of information.

The authors wish to express their deepest gratitude towards their main supervisor Ph. D. candidate Marius Tuft Mathisen for invaluable and inspirational guidance. The author would also like to thank Professor Roger Sørheim for his contribution.

The process of writing this thesis has given the authors a great amount of knowledge on the concept of human capital and the effect it has on the development of a university spin-off. Conducting the literature study gave insights and depth within a new interesting field. Data collection and analysis in the empirical study gave useful insight into the methods of scientific research and empirical data. As quantitative empirical study was not a part of the curriculum of the authors, a great amount of time and effort were spent on understanding how such studies are conducted. However, applying quantitative method gave the authors the opportunity to use their mathematical and statistical knowledge in practice. Both are satisfied with the choice of topic and methods used, and are convinced that the newly gained knowledge will serve well in their upcoming careers.

Trondheim, May 10th 2015

Summary in Norwegian

Universitets spin-offs (USOer) er nye oppstarter opprettet for å kommersialisere kunnskap, teknologi eller forskningsresultater utviklet på et universitet. Fenomenet USOer har i de senere årene blitt en stadig viktigere måte å overføre teknologi og kunnskap fra universitetet til kommersiell og samfunnsmessig verdi. USOer er preget av å stamme fra et ikke-kommersielt miljø, der entreprenøren av oppstarten ofte er en forsker med lite kunnskap innenfor forretningsutvikling. Forskning har vist at USOer har høyere overlevelsesrater enn andre typer oppstarter, men USOene blir sjeldent høytstående bedrifter. En USO har ofte svært begrenset med ressurser, spesielt i de tidlige fasene. Tidligere studier har indikert at menneskelig kapital er en av de viktigste ressursene til USOer og at denne ressursen har en stor påvirkning på utviklingen til oppstarten. I og med at USOer svært ofte består av kun noen få medlemmer, er det argumentert for at lederen i oppstarten har stor påvirkningskraft ovenfor bedriften. På bakgrunn av dette mener forfatterne at mer innsikt og kunnskap om betydningen til den menneskelige kapitalen til lederen i forbindelse med USOers framtidige utvikling vil bidra til at denne type selskap kan prestere bedre i fremtiden.

Denne masteroppgaven består av to artikler. Første artikkel er en litteraturgjennomgang for å samle teoretiske bidrag vedrørende hvordan forskjellige typer menneskelig kapital påvirker utviklingen til USOer. Den andre artikkelen undersøker forfatterne empirisk hvordan menneskelig kapital har påvirket 120 norske USOer fra 2001 til 2011.

Artikkel 1 identifiserer hvilke type menneskelig kapital som kjennetegner og er viktig i en USO ved å bruke ressursbasert, kunnskapsbasert og menneskelig kapital teori . De identifiserte typene ble kategorisert i tre kategorier, entreprenøriell erfaring, bransjespesifikk erfaring og universitets erfaring. Hvordan disse kategoriene påvirket utviklingen av en USO ble så drøftet ved å bruke Vohoras fase modell som rammeverk for USOens utvikling. Forfatterne argumenterte for at lederen, som strategisk beslutningstager, burde være en med erfaring fra næringslivet, og dermed enten ha entreprenøriell eller bransjespesifikk erfaring. Teknisk erfaring, i form av universitets erfaring, ble funnet som den menneskelige kapital med minst bidrag til utviklingen av USOen.

Artikkel 2 baserer seg på funnene fra artikkel 1, og tester empirisk hvordan de tre typene menneskelig kapital påvirket utviklingen til USOene. I regi av Forskningsrådet, med et utvalg på 120 oppstarter med opphav fra de 4 største teknologiske universitetene i Norge (NTNU, UiO, UiB og UiT), utførte vi diverse analyser for å finne en sammenheng mellom lederens menneskelige kapital og USOens utvikling. Funnene indikerer, overraskende nok, at teknisk erfaring, i form av universitets erfaring eller teknologisk bransjespesifikk erfaring, er positivt relatert til å skaffe ekstern kapital, noe som argumenteres for å være en av de viktigste milepælene for en USOs utvikling. Et annet funn var at den menneskelige kapitalen generell økte utover i utviklingen til USOen. Den høyeste økningen var i ledelse kunnskap i form av entreprenøriell erfaring eller administrerende bransjespesifikk erfaring.

Exploring the champion's human capital and its effect throughout the university spin-off's development: A literature review

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Abstract

After the universities was granted the property rights of federally funded research when the Bayh-Dole act was passed in 1980, university spin-offs has increased as a way of commercializing research results. Due to the distinctive origin, coming from the non-commercial environment of the university and the challenges this raises, this phenomenon attract increasing amount of attention from researchers. This article explores the role of the champion in university spin-offs, and its contribution to USO development. This is done by comparing the main attributes of the different human capital to the different managerial needs of the USO at different development stages; from firm formation to accomplishing sustainable returns. The framework illustrating the development of the USO are based on Vohora et al.'s (2004) stage model. The article is based on a literature review exploring the specific human capital of the champion and the knowledge and capabilities this provides to the USO. The human capital that are discussed in this study are industry-specific, university and entrepreneurial human capital. The literature review of this study provides a literary basis that enabled a discussion of the USO champion at different stages of development that should be of interest to researchers, TTOs and entrepreneurs.

1. Introduction

The phenomena university spin-offs (USOs) represent an important, but still underdeveloped, option to generate wealth from the commercialization of research (Shane, 2004, Wright et al., 2007, Ganotakis, 2012, Vohora et al., 2004). The number of spin-offs generated by universities has increased significantly in the US since the Bayh-Dole Act was passed in 1980 (Wright et al., 2007). The Bayh-Dole Act gave academic institutions the property rights to federally

funded inventions in the US, giving the universities greater incentive to license their technology (Shane, 2004). The increase of university entrepreneurship can also be observed in Europe (Rothaermel et al., 2007). This noticeable increase of USOs made this kind of spin-offs an increasingly important phenomenon for both industrialized countries and the research organizations they originated from (Wright et al., 2007, Shane, 2004). However, the exploration of these spin-offs that origin from universities, being a non-commercial environment, raises new

entrepreneurial challenges (Vohora et al., 2004).

New ventures in general face a lot of barriers during the early stages. The novelty of the firm and inexperience of the entrepreneur constrains the new venture to grow and become an established actor in the market (Singh et al., 1986, Stinchcombe and March, 1965, Vohora et al., 2004). In addition to these barriers USOs face two other difficulties. First, due to the nature of USOs, most of the founders and the surrounding team are typically academic, with little experience in the market and working with business development. Second, the culture and value of the academic environment is not built to commercialize scientific discoveries, as it is a non-commercial environment with a main mission to contribute to society through the pursuit of education, learning, and research (Vohora et al., 2004). Studies have shown that the human capital possessed by a USO is very important for their performance (Unger et al., 2011). Since the venture is in its early-stage, human capital is one of the few resources they possess. Another factor which is essential for the development of the USO is the *champion*. Based on findings from Olofsson and Wahlbin (1984), Klofsten et al. (1988) and Vohora et al. (2004), this paper defines a champion as; the person who coordinates and manages the different inputs of resources, skills and entrepreneurial capacity, and make the strategic decisions about the ventures future development. According to Clarysse and Moray (2004) the role of the champion is absolutely vital for the future development of the venture, and Schon (1963: 84) state that “the new idea either finds a champion or dies”.

This research aims to link the champion’s human capital with the development of the USO, and by that try to find out which type of human capital the champion of the USO should possess in order to create a successful USO. Using Vohora et al.’s (2004) phase model as a framework and link it with human capital theory, knowledge-

based theory and resource-based theory this paper will address the research question:

How does the human capital of the champion affect the development of the USO?

This paper contributes to the understanding of the USO phenomenon while suggesting which human capital the champion should possess through the different phases of USO development. Awareness about contributions from different human capital of the champion into the USO should be of interest to universities, technology transfer offices (TTOs), policymakers and entrepreneurs themselves, as it may increase the development of successful spin-offs.

The rest of the paper is structured as follows. First, the theoretical foundation of this topic is explored. Vohora et al.’s (2004) phase model is explained to give an understanding of the USO development. Resource-based theory (RBT) is used in order to find out which resources that is vital for a USO. Human capital theory (HCT) is chosen as the theoretical lens as it explains the experience and knowledge of the champion. Knowledge-based theory (KBT) is also presented as knowledge is a key component of human capital and highlighted, from the RBT, as one of the main resources for a USO. Second, USO and champion are defined in order to avoid misinterpretations between the reader and the authors. Third, the method used in the structured literature review is explained, followed by analysis and results of the literature. Fourth, a discussion relating the theory with the findings from the literature review is conducted. Finally, conclusion, limitations and further research are provided.

2. Theory and definitions

2.1 Theory

This section will describe the theories that constitute the theoretical framework of this study. The theories that will be used in this

paper are resource-based, knowledge-based and human capital theory, and Vohora et al.'s (2004) stage-based development model. This will then be used to form the framework on which the discussion is based.

2.1.1 Stage development of USOs

Different units and analysis are used by researchers in order to find a operationalization for success for USOs (Rasmussen et al., 2012, Hayter, 2011). Some look at the financial return on the human capital of the entrepreneur as a measure of USO success (Unger et al., 2011). Instead of looking at the financial performance of a USO to indicate if the start-up is successful or not, other researchers (Vanaelst et al., 2006, Heirman and Clarysse, 2004b) measured the success of new ventures by looking at typical “entrepreneurial events”. These events are often milestones new firms have to go through. For one start-up, receiving venture capital can be considered as a success, whereas for another firm that are more mature, reaching the break-even point can be looked at as success. This paper will therefore link the human capital of the champion and how this serves the USO to develop. In order to do so it is necessary to understand the general characteristics of this development.

USOs are often characterized by its distinctive stages of development (Nicolaou and Birley, 2003). The literature has defined development stages with reference to founding date (Clarysse and Moray, 2004), main business activities (Ndonzuau et al., 2002), and critical resources needed (Wright et al., 2004). Research has shown that the dynamics of these development stages are related to the dynamics of the entrepreneurial team (Clarysse and Moray, 2004). This means that the development of the USO is affected by the changes within the entrepreneurial team.

Different models are created that look at the development of new ventures (Smith et al., 1985, Van de Ven et al., 1984, Flamholtz and Randle, 1990, Miller, 1984). According to Vohora et al. (2004), USOs face two fundamentally different difficulties when it comes to achieving sustainable returns and financial profitability compared to other new firms. First, a USO evolves from a university, which is a non-commercial environment. As universities typically lack the necessary resources and commercial skills, a USO face challenges in achieving sustainable returns. Second, typical key stakeholders in USOs (e.g. the university, academic inventor or venture capitalists) might have conflicting objectives that affect the transition between development phases. Determination of market, venture strategy and expertise needed are all factors that are affected by the objective (e.g. profit or prestige) of the stakeholders.

Vohora et al. (2004) addressed these differences and made a non-linear model based on empirical investigations on USOs. The model divides USO development into five phases and four critical junctures. Each phase is characterized by a specific group of activities that the venture has to accomplish in order to proceed to the next phase of development (Wright et al., 2007). According to Vohora et al. (2004), the critical junctures are the shift when the challenges from one phase are overcome and the USO proceeds to a new phase. The junctures are characterized by given barriers the USO has to overcome in order to develop further. These junctures are surpassed by developing resources and capabilities. The figure below gives an overview of the different phases and critical junctures USOs go through.

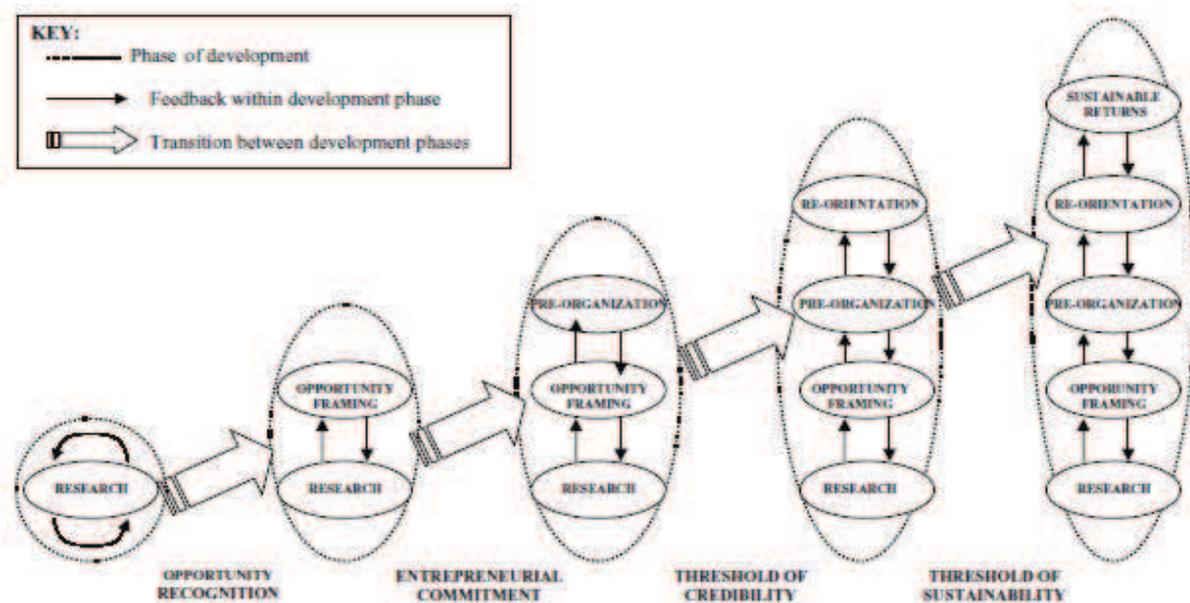


Figure 1: (Vohora et al., 2004)'s stage model

Research phase is the first phase in Vohora et al.'s (2004) development model. In this phase valuable intellectual property (IP) and know-how is created. For a USO this IP and know-how is often developed within the university. In order for the USO to reach the opportunity-framing phase, the venture needs to overcome the critical juncture of *opportunity recognition*. To pass this juncture the venture has to find a match between an unfulfilled commercial need and a satisfying solution that meets the needs others have overlooked (Ucbasaran et al., 2003). However, even though a commercial need has been identified, the actual commercial value for the solution to that need has not yet been evaluated. The necessity for the evaluation of the commercial value initiates the opportunity-framing phase (Vohora et al., 2004).

Opportunity-framing is the second phase, where the potential commercial application of the technology outside the laboratory, and its actual commercial value, are evaluated (Wright et al., 2007, Vohora et al., 2004). In this phase the USO progresses from the commercial opportunity having been recognized to the formative steps needed to create a new venture. The main parties involved in these two first phases are the

founder(s) and the TTO. Since a USO is built upon new research, the venture often has to go into a market push situation rather than market pull. This means that the venture has to create its own demand. Due to this, many USOs are founded without a clearly defined market in mind. So instead of defining a specific market, USOs tend to find application areas where their venture can create value. For the USO to reach the next phase of development it has to pass the *entrepreneurial commitment juncture*. During this juncture someone commits their time and binds themselves to a certain course of events (Wright et al., 2007). This juncture arises due to the necessity of committing a venture champion to a certain course of events.

Pre-organization is the third phase. This phase is characterized by the management of the USO creating a strategic plan, involving resources and capabilities to be developed and acquired. For the USO to develop past this phase it has to overcome the *threshold of credibility juncture*. This juncture is characterized by the lack of ability to obtain key resources due to the absence of credibility. This makes it difficult for the firm to acquire finance, which is the key resource enabling the transition of the firm from a pre-organization

phase to the reorientation phase (Wright et al., 2007).

Reorientation is the fourth phase, and is characterized by the USO being dependent on continuously finding, acquiring and reconfiguring resources in order to serve the market due to the discovery of new information and knowledge. The last juncture, which is the result of the reorientation phase, is the *sustainable returns juncture*, where the USO need the ability to continuously reconfigure its resources, capabilities and social capital in order to utilize new information, knowledge and resources (Vohora et al., 2004).

Sustainability is the final phase, where the venture achieves sustainable returns. The focus in this phase is on acquiring and reconfiguring resources. For a USO, that often is established in a fast changing market, the development of capabilities is a necessity to stay successfully.

Vohora et al.'s (2004) stage-based model identifies particular stages of firm development, specific barriers, and key challenges a USO faces and need to overcome in order develop and gain success. This makes it a valuable framework to use when looking at which type of human capital that are needed in different points of a USOs development.

2.1.2 Resource-based theory

Resource-based theory has emerged as an important frameworks regarding strategic management research. It focuses on the venture's internal resources and capabilities to explain its competitive advantage. Another important framework regarding strategic management is the industry analysis framework created by Porter (1986). This framework view the firm's industry position as the main source of competitive advantage, and how the industry characteristics are the primary determinants of superior profits for the firm. Industry analysis discovers the profit potential of different industry participants by focusing on the external competitive barriers and forces that prevail in different product/market segments. It

has been argued that the theory is incomplete because it treats the firm as a black box, meaning that they treat the firm as faceless and as a unitary actor (Amit and Schoemaker, 1993). Many USOs have not defined their marked or made any sales, an analysis based on the USOs position in the industry would in these cases make less sense than focusing on the USO's resources and how this contribute to its development. This study look at the contribution to USO development from the entrepreneurial champion as an internal resource of the firm, hence this paper will use the resource-based theory as a framework, and not the industry analysis framework.

Resource-based theory (RBT) relates a venture's superior performance to the venture's organizational resources and capabilities. The resource-based theory highlights the heterogeneity of a firm, concentrate on factor market imperfections, look at the degree of specialization, and focus on the limited transferability of the firms' resources (Amit and Schoemaker, 1993). Barney et al. (2001) show that a firm's resources are the fundamental determinants of competitive advantage and explain how the firm might use these resources in order to achieve this.

Resources are defined, by most resource-based scholars, as all tangible and intangible assets that a firm access (Mustar et al., 2006). Due to this, a variety of resource categories exists. Barney (1991) has categorized the resources as: physical capital, human capital and organizational capital, while Grant (1991) categorized the resources as: tangible, intangible and personnel-based resources.

According to Barney (1991) and Alvarez and Busenitz (2001), competitive advantage is obtained when the firm implements a value creating strategy or possesses a resource, neither of which can be shared with any potential competitors, creating heterogeneity in the market. According to Peteraf (1993), heterogeneity is the most basic condition in order for a resource to create a

competitive advantage, and is the fundamental concept of strategic management. The RBT assume that the resources a firm possess differ from one firm to another, and that competitive advantage is achieved by bundling the available resources together differently. However, the theory claims that resource heterogeneity is not alone sufficient to create sustainable competitive advantage, but that it also has to be inimitable in order to create a sustainable competitive advantage (Barney, 1991). If the resource is not inimitable other firms might imitate it, making the resource homogeneous.

Various definitions have been made as to when competitive advantage is *sustainable*. Michael (1985) suggested that a competitive advantage is sustainable when it last over a certain amount of time, while Rumelt (1984) meant that a competitive advantage became sustainable when competitors were not able to duplicated it after several tries. None of these definitions explain what will happen with the firm's sustainable competitive advantage if another firm comes up with a disruptive innovation that makes the firm's strategy irrelevant. An example of this is the introduction of the MP3 player, this technology made CD's less competitive. It should therefore also include that the firms' strategy has to be non-substitutable in order to be complete.

Barney (1991) has taken this into consideration and argues that a resource, contained by a firm, only is capable to create sustainable competitive advantage if it is: valuable, rare, inimitable and non-substitutable by competitors (VRIN). According to Barney (1991) a resource is *valuable* when it enables the firm to implement strategies that improves the firms efficiency and *rare* when the number of other firms that possess this resource is fewer than the number of firms needed to create perfect competition dynamics in the particular industry.

There exist three elements that can make a resource *inimitable*:

1. The unique historical conditions linked to the resource.
2. The connection between a firm's resource and the firm's advantage is causally ambiguous.
3. The resource that creates the competitive advantage is socially complex.

In short terms, this means that the resource is costly to recreate and that it is immobile. The last factor a resource needs to generate sustainable competitive advantage is that it has to be *non-substitutable*. For a resource to be non-substitutable there cannot exist similar resources that can help the competitors in implementing the same strategy.

Dynamic capabilities

As the USO is developing it has to continually reconfigure its resources in order to develop into a competitive business (Vohora et al., 2004), which makes dynamic capabilities essential.

Grant (1991) created a clear distinction between resources and capabilities. He looked at the resources as the basic unit of analysis and the capabilities as a way to use a set of resources in order to perform an organizational task or activity whose purpose is to improve the productivity of the other resources possessed by the firm. Amit and Schoemaker (1993: 35) defines capabilities as "*a firm's capacity to deploy resources, usually in combination, using organizational processes, to effect a desired end*" and Makadok and Barney (2001) defined it as "an organizationally embedded non-transferable firm-specific resource whose purpose is to improve the productivity of the other resources possessed by the firm". Teece et al. (1997) divided capabilities into two dimension, current capabilities and dynamic capabilities. They defined dynamic capabilities as "*the firm's ability to integrate, build, and reconfigure internal and external competences*

to address rapidly changing environments". The introduction of dynamic capabilities came because resource-based theory could not adequately explain why and how some ventures could have competitive advantage in unpredictable and rapid changing environments (Eisenhardt and Martin, 2000). In the situations where the firm's leaders need to 'integrate, build, and reconfigure internal and external competencies to address rapidly changing environments' dynamic capabilities has become the source of sustained competitive advantage (Teece et al., 1997, Eisenhardt and Martin, 2000). These situations often occur with USOs due to their operation in such markets. Hence it can be argued that dynamic capabilities are critical for USOs in order to create competitive advantage.

RBT and entrepreneurship

Resource-based theory largely fails to integrate creativity and the entrepreneurial act due to limited amount of research on the relationship between resource-based theory and entrepreneurship (Barney et al., 2001). Barney's (1991) framework on RBT do not explain how entrepreneurs manage to build sustainable competitive advantage with limited amount of resources and no stable organization. Alvarez and Busenitz (2001) examined the role of entrepreneurial resources within the RBT and made some suggestions on how these resources might be unique to entrepreneurship. They identified the issues related to the

distinctive domain of entrepreneurship by having a focus on resources connected with opportunity-framing and the ability to organize these resources into a new venture in order to create heterogeneous outputs that could make the venture superior in the market. Alvarez and Busenitz (2001) used RBT in order to show how entrepreneurship in general is based on the founder's unique awareness of opportunities, the ability to get access of the resources needed to utilize the opportunity, and the ability to recombine homogeneous inputs into heterogeneous outputs in an organizational way.

Most of the typologies of resources are created to fit in the context of well-established and large firms, not new ventures with few resources (Mustar et al., 2006). Brush (2001) acknowledges this and identified a set of key resources for new ventures. The resources they found most relevant was: capital, organizational systems, management know-how, employees, owner's expertise and reputation, technology, physical resources, leadership, organizational structure and culture or informal systems. Brush et al. (2001) further categorized these resources needed in new ventures into six groups: technological, social, organizational, financial, physical and human resources. Mustar et al. (2006) continued to build on this work and narrowed the categories into four remaining as seen in table 1.

Resource	Definition
Social	Defined by Brush et al. (2001) as the firm's industry and financial contacts, while Lee et al. (2001) defined it as the firm's social capital.
Technological	Firms-specific products and technology (Borch et al., 1999), such as the venture's innovativeness, scope of technology, R&D quality or legitimacy, and its position in the product development cycle (Mustar et al., 2006).
Financial	The venture's type and amount of financing with a differentiation between capitals, loans and reserved profits (Mustar et al., 2006).
Human	The attributes that from the personnel and managers associated to the venture, and are often measured as: background of the founder(s), size of the founding team, professional management experience, and organisational size (Mustar et al., 2006).

Table 1: Key resources for new ventures

For new ventures at inception, the only skills and knowledge available are embedded in the founding team (Zhao et al., 2013). This statement is supported by Cooper and Bruno (1977), which states that *“Any competitive advantage that a new firm achieves is likely to be based upon what the founders can do better than others”*. Therefore, this paper will look at how the knowledge and human capital of the entrepreneurial champion contribute to value creating and development of the USO based on its resources. Drucker (1985) addressed the importance of this in his quote *“[t]here is no such thing as a ‘resource’ until a man finds a use for something in nature. Until then, every plant is a weed and every mineral just another rock”*.

2.1.3 Knowledge-based theory

Knowledge-based theory is an extension of RBT where the general assumption is that knowledge, as a resource, is the key in order to establish competitive advantage (Lockett and Wright, 2005, De Boer et al., 1999). The importance of knowledge in the process of sustaining and improving the firm's competitive advantage, makes acquiring and utilizing knowledge a managerial task of high importance (Inkpen, 1998, Abou-Zeid, 2002). Since new firms, such as USOs, are characterized by having scarce resources, it is

not controversial to say that the importance of the knowledge at the entrepreneur's disposal is greater than for a more established firm due to the lack of other resources that can be used to sustain competitive advantage. This section will therefore mainly focus on types of knowledge necessary to the business development and where the USO might access this information.

According to Howells (1996) and Djokovic and Souitaris (2008), knowledge can be divided into two categories: *codified* knowledge and *tacit* knowledge. *Codified* knowledge is generally separated from the human brain that generated it, and can take forms such as a publication, a computer program, an experimentation, a technical artefact and equipment (Pirnay et al., 2003). This kind of knowledge is often protected through patents or copyrights. *Tacit* knowledge is linked to the individual and his/her personal knowledge (Pirnay et al., 2003). This knowledge takes form as capabilities, expertise and experience.

As mentioned earlier young firms such as USOs are small organizations where the champion is involved in executing daily operations. The champion therefore need access to both tacit and codified knowledge concerning a wide range of disciplines to manage the developing business and gain sustainable competitive advantage (Chrisman,

1999, Premaratne, 2001). Widding (2005) call this business knowledge, and separates it into four subcategories:

1. Product knowledge
Refer to knowledge about a technology, production or service.
2. Market knowledge
Refer to the commercial functions of the firm, such as sales and marketing.
3. Organizational knowledge
Refer to the functions regarding internal management of the venture, concerning for example company structure and routines and general management.
4. Finance knowledge
Relate to three things, funding, internal finance management and tax planning concerning the firm.

Product knowledge is the principal contribution from the university and is what the USO is based on. This knowledge can both be codified or tacit in the form of e.g. a concrete technological solution or expertise within a technological field, respectively. The latter three subcategories is mainly tacit knowledge that has to be obtained either through education or personal experience, it can alternatively be provided to the USO through external parties or by including someone with this knowledge in the entrepreneurial team.

Business knowledge might be obtained or accessed by the champion or USO from different sources. Widding (2005) separates these sources, or reservoirs, into three different types:

1. Internal knowledge reservoirs
2. Semi-internal knowledge reservoirs
3. External knowledge reservoirs

Internal knowledge reservoirs contain the employees, including the champion, of the USO. This source is probably the one that is applied the most by the USO, and is therefore the most important (Buckman, 1998, Amit and Belcourt, 1999).

Semi-internal knowledge reservoirs include actors that either has ownership or responsibility concerning the USO, but is not a part of the executing team of the USO (Widding, 2005). This might be investors or board members.

External knowledge reservoirs refers to the social network of the USO. This reservoir contains people in the network of the USO that is not a part of, or has no interests in the USO itself. This might include contacts that the champion or other members of the USO has gained through past employments or encounters that they can learn from.

2.1.4 Human Capital Theory

As mentioned earlier, human capital has been argued to be especially important for USOs. Unger et al. (2011) has done a literature review on the link between human capital and success in entrepreneurial firms. Their findings concluded that most researchers agree that human capital attributes are a critical resource for success, and that the experience of the entrepreneurs are very important when it comes to evaluation of the firm's potential. This is because new ventures have formed less routine and capabilities than more established firms. More established companies can use their internal systems and routines that they have developed over time when facing challenges. On the contrary, new ventures, due to their lack of information and routines, have to make more entrepreneurial decisions and solve problems from scratch (Unger et al., 2011). High human capital can help the new venture to learn new roles and tasks and to adapt to new situations fast (Weick, 1996). So in order to understand the development of new ventures, an understanding of human capital is essential (Mustar et al., 2006, Cooper and Bruno, 1977). Human capital comprises the stock of

knowledge and skills that resides within individuals (Becker, 1975). These individuals can develop their human capital over time and transfer this knowledge between each other.

The concept of human capital

Human capital theory was originally developed by Becker (1975) in order to estimate employee's income distribution concerning their investments in human capital. Unger et al. (2011) defines human capital as skills and knowledge that individuals acquire through investments in schooling, on-the-job training, and other types of experience. Becker (1975) divides human capital into two aspects:

1. *Human capital investments versus outcomes of human capital investments*
2. *Task-related human capital versus non-task-related and general versus firm-specific human capital*

Human capital investments are investment in personal experience and knowledge gained through work or education, both on a company and individual level. A company may invest in human capital either through employing someone with certain knowledge or skills or educate their own employees (Becker, 1975). On an individual level, the individual invests in education or a specific type of experience (Becker, 1975). The outcome of human capital investment is the return of investment that the firm or individual can expect. On a company level this might be that the firm get employees that can contribute to the firm achieving certain tasks or goals. On the individual level, outcome of human capital investment might be that the individual acquire knowledge and skills to get a higher value in return for their efforts (Becker, 1975). An example is a company hiring a person with a master degree, which is an investment made in order to obtain the experience and knowledge that person has obtained through his/her education. Further investments can be made through training of that person. The goal for the firm is that this

investment will result in new knowledge and skills (the outcome of the investment), which can be used to create competitive advantage for the firm.

Human capital theory states that the economic performance and the productivity of a person will be based on the amount of investment that this person has made in his/her human capital. Becker's (1975) theory about human capital assumes that individuals attempt to receive a compensation for their investment in human capital. Meaning that people, given their human capital, tries to maximize their economic benefits.

Two branches of human capital are *task-related* and *non-task-related* human capital and *general* and *firm-specific* human capital. The first relates to if the human capital is specific to a task or not. The other branch are more general and focus on if the human capital are specific to performing in a specific professional position or not.

Task-related human capital is investments or outcomes that are related to a specific task, meaning that the *investment* or the *outcome* of the human capital needs to have a pre-defined task (Unger et al., 2011). An example could be to hire a person to take care of the accounting, in this case the investment (hiring someone with accounting-knowledge) is related to a specific task (do the accounting of the firm). Non-task-related human capital is more general and relate to a wider set of skills. Examples are; general education and employment experience (Unger et al., 2011).

Becker (1975) made the distinction between *General* human capital and *firm-specific* human capital. Firm-specific human capital involves skills and knowledge that can be used to obtain a productive value in only one particular profession. These skills and knowledge is often acquired through on-the-job training. Examples of firm-specific human capital are; industry-specific experience, start-up experience or technical experience. General human capital relate to the general aspects of human capital such as age, amount of education and experience. For example, if two

people has management experience, this is their specific human capital. If one person has two years of experience on the job, while the other has 5 years, they have a difference in the general experience. Even though the two has the same specific experience, one person will have more general experience as he/she have worked for a longer period, which might improve the efficiency and quality of the work. General human capital can be transferred to other jobs, while firm-specific human capital cannot be transferred to other professions, meaning that a high firm-specific human capital, contained by a worker, will not have any effect on the performance or the productivity if the employee works in another sector.

HCT and entrepreneurship

According to human capital theory a firm or a new venture who has invested a lot in their human capital will experience more growth and profits than their competitors who have invested less in their human capital. The new venture that have invested more in their human capital will therefore expect more in return as they want to receive higher compensation for their human capital investments (Cassar, 2006). Bruderl et al. (1992) argue that this conclusion can be used for entrepreneurs as well. Therefore, an entrepreneur with high general and specific human capital can be assumed to have higher measures of performance than the entrepreneurs with less general and specific human capital. For an entrepreneur, the general human capital will be the same as for any other employee, namely general education and work experience. While the specific human capital for an entrepreneur refers to “*those skills that the entrepreneur is able to apply directly to his role as a self-employed individual*” (Ganotakis, 2012).

2.2 Definitions

2.2.1 The champion of a USO

The objective of this research is to discover how the champion’s human capital contribute to the USO development. In order to do so, it is

necessary to understand the function and role of the venture champion. When a new technology based spin-off is formed there is a need for someone to coordinate and manage the different inputs of resources, skills and entrepreneurial capacity according to the planned development of the venture (Olofsson and Wahlbin, 1984, Klofsten et al., 1988, Vohora et al., 2004). In most cases the venture champion take this role. A champion is an individual who informally emerges in an organization (Schon, 1963, Tushman and Nadler, 1986) and makes “a decisive contribution to the innovation by actively and enthusiastically promoting its progress through the critical [organizational] stages” (Achilladelis et al., 1971: 14). Earlier studies has shown that the presence of a champion is strongly linked to the success of USOs (Howell and Higgins, 1990). According to Schon (1963: 84), “the new idea either finds a champion or dies.”, and Clarysse and Moray (2004) argue that that the role of the champion is absolutely vital for the future development of a project.

In the entrepreneurial literature (i.e. Smilor et al. (1990), Pirnay et al. (2003), Nicolaou and Birley (2003), Clarysse et al. (2000), Radosevich (1995) and Franklin et al. (2001)) there is an agreement that a USO either can be championed by an inventor-entrepreneur (academic entrepreneur) or a surrogate entrepreneur from outside the parent institution. An inventor-entrepreneur is defined by Samson and Gurdon (1990) as “*an academic whose primary occupation, prior to playing a role in a venture start-up, and possibly concurrent with that process, was that of a lecturer or researcher affiliated with Higher Education Institute*”. A surrogate entrepreneur is defined by Franklin et al. (2001) as an “*individual (or organization) from outside the university assuming the role of the entrepreneur with the technology originator maintaining their position in the university*”. According to Franklin et al. (2001) the surrogate entrepreneur is typically a person leaving the industry to manage the USO, or a

serial entrepreneur, a person with previously start-up experience. These two different champions have dissimilar human capital, due to their different background. An academic champion tend to have a strong commitment to the technology (Radosevich, 1995), while a surrogate champion tend to have a more extensive industry experience and business knowledge (Politis et al., 2012). Arguably, there are reasons to believe that the development of the USO is affected by the obtained human capital of the venture champion.

An increasing number of studies in the entrepreneurial literature have emphasized the importance of the founding team, and not only the champion, as a key factor for success (Wright et al., 2007). Research has shown that different team dynamics affect the USO development, e.g. Zahra and Wiklund (2000) showed that the team “behavioural integration” lead to a significantly higher rate of new product introduction, and a study by Heirman and Clarysse (2004a) showed that founding teams with a high degree of sector-specific commercial experience showed a tendency to high growth rates in employments and revenues. However, the champion, as the principal decision maker, has the main role in the strategic decision making process. This makes the champion especially important concerning the development and performance of an organization (Offstein and Gnyawali, 2005). Besides having the overhead decision role, the champion is also responsible for hiring employees and exercise leadership, which is arguably related to the development of the venture. In addition, young firms such as

USOs, are small organization where the champion generally is involved in coordinating and execution of daily operations (Bruton et al., 1997, Miller and Toulouse, 1986, Wasserman, 2003). USOs also tend to be more complex than other entrepreneurial start-ups in general, since the spin-off is often based on complex research and have to deal with external partners like TTOs and university policies (Vohora et al., 2004). The champions therefore have more influential in USOs compared to larger firms. Hence, this study only looks at the champion of the USO and not the entire founding team.

2.2.2 University Spin-offs

According to Pirnay et al. (2003), most authors do not clearly define a USO and other related spin-offs. The loose definitions and multiple terms that are created to describe more or less the same phenomenon contribute to misinterpretations, and might “lead to situations where researchers use the same concept (USO) for studying and describing different realities” (Pirnay et al., 2003). It is therefore necessary to define the USO for the purpose of this research to ensure comparability between research results.

The nature of the spin-offs

In order to understand and address the challenges associated with spin-offs it is important to understand their essence (Wright et al., 2007). When defining spin-offs, there are some perspectives that are mainly applied. Wright et al. (2007) has identified three main perspectives as seen in table 2.

Perspective	Focus on:
Resource-based perspective	How the resources of the spin-off create competitive advantage. This perspective distinguishes the start-ups that look after external equity versus those that not.
Business model perspective	The internal activities and other key indicators making the new ventures different from other spin-offs. This perspective distinguishes the start-ups based on their business and revenue model. A typical distinction would be between exit oriented and revenue-oriented spin-offs.
Institutional perspective	The relationship between the spin-off and the institution of origin. This perspective looks at the link between the parent institution and the start-up. Distinctions can be made based on the knowledge transfer and the connection to the parent institution.

Table 2: Perspectives describing USOs, developed by Wright et al. (2007)

Perspective	Focus on:
Outcome	The firm formation of the spin-off
Involved parties	The involved parties of the Spin-off; parent organisation, the technology originator, the entrepreneur, and the venture investor.
Core elements	What elements that are transferred from the institution of origin to the spin-off, which mainly are knowledge or people.

Table 3: Perspectives describing USOs, developed by Djokovic and Souitaris (2008)

Djokovic and Souitaris (2008) has an altered focus compared to Wright et al. (2007) in their perspectives. While Wright et al. (2007) analysed earlier literature to identify some main theoretical perspectives, Djokovic and Souitaris (2008) focused on the individual components of a spin-off in order to create perspectives. Table 3 summarizes the main perspectives found by Djokovic and Souitaris (2008).

The perspectives that Djokovic and Souitaris (2008) and Wright et al. (2007) has in common is the focus on (i) *the institution in which the USO originates from*, (ii) *the founder(s) of the USO* and (iii) *the nature of the knowledge transfer that the USO is based on*. It can be argued that these three parameters are essential when defining a USO since its involve all of the critical components needed to create a USO, a connection with an institution, a founder(s)/inventor(s) and a concept the spin-off is built around. These parameters determines important conditions,

such as the need for external funding, separating the USO from other types of spin-offs. They also describe important parameters, such as the founders role, the link with the institution and type of knowledge the USO is based upon, that set the framework needed to discuss the effect of the leader in a USO separately. These perspectives will therefore form the definition of the USO in this study, as these parameters describe the complexity and heterogeneity of a USO.

Institutions

This perspective focuses on the institution that the spin-off originates from. One of the more open definitions is presented by Rogers et al. (2001), who stated the institution as a “parent organization”, which also includes private corporations. Clarysse et al. (2000) defined the institution of origin as a *university, technical school or public/private R&D department*. These definitions both include both private and public research institutions. Nicolaou and

Birley (2003) are more focused and define the institution as an “academic institution”, while Smilor et al. (1990) and Pirnay et al. (2003) defines it as a “university”.

The definition of USOs in this study will exclude institutions such as private corporations and research institutions since they are assumed to have a different need of resources than USOs due to their background (Löfsten and Lindelöf, 2005). This different need of resources stems from the different objectives, where universities are concerned about serving public benefit, while the private research institutions are, to a greater extend, focused on profits.

The founders

Two main aspects are often considered when the founder is discussed:

1. The occupation of the founder prior to the spin-off.
2. The connection between the founder and the parent organization during the spin-off.

Rogers et al. (2001) and Steffensen et al. (2000) describe the founder of the USO as a former employee of the parent institution, such as a researcher. While Franklin et al. (2001) and Smilor et al. (1990) state the founder of the spin-off also can be a surrogate entrepreneur from outside the parent institution. According to Shane (2004), surrogate entrepreneurs and investors are “accounting for the founding of more than half of all university spin-offs”. So in order to not exclude these spin-offs, and since this paper is focusing on the difference in the human capital of the entrepreneur this study will include firms with both an inventor-entrepreneur and a surrogate entrepreneur, keeping the background of the entrepreneur open.

Concerning the relationship between the founder and institution of origin, Nicolaou and Birley (2003) asserts that the founding member may or may not still be affiliated with the academic institution, while Rogers et al.

(2001) and Smilor et al. (1990) implies that if involved in the spin-off process, the researcher cannot be affiliated with the parent organization. In many USOs the inventor becomes the founder. However, as most of the USOs in the beginning have limited resources to pay salaries, many of the inventor-entrepreneurs choose to have a part-time job in the university beside their entrepreneurial job. Since the main focus of this study is on the human capital of the entrepreneur it has been chosen to include founders that also are affiliated with the academic institution.

Knowledge transfer

Rogers et al. (2001), Nicolaou and Birley (2003) and Wright et al. (2007) state that in order to be a spin-off, codified knowledge must be transferred from a parent organization through f. ex. licensing. Pirnay et al. (2003) on the other hand, define university spin-offs as firms where codified and/or tacit knowledge is transferred from the parent institution to be exploited commercially.

According to Pirnay et al. (2003) the USOs with its core business rooted on codified and technological knowledge are mainly oriented towards product development, while USOs purely based on tacit knowledge are mainly service providers. Table 4, based on Pirnay et al. (2003), show the general characteristics of product-oriented and service-oriented spin-offs.

Characteristics	Product-oriented spin-off	Service-oriented spin-off
Business conditions		
Barriers to enter the market	High	Low
Potential market	International	Local/national
Expected growth rate	High	Low/moderate
Development period	Long	Short
Required resources		
Financial needs	High	Low
Material needs	Moderate/High	Low
Intangible needs (networking and advice)	High	Moderate
Insight in the industry	High	High

Table 4: Characteristics of product-oriented and service-oriented spin-offs developed by Pirnay et al. (2003)

From table 4 one can see that conditions related to the development and required resources of the firm are different between the two types of spin-offs. This makes the two different types of spin-offs less comparable. From table 4 it can also be seen that the product-oriented spin-offs face more challenges, compared to service-oriented spin-offs, associated with Vohora et al.'s (2004) model which is central to this thesis. An example of this is the high need to acquire resources in a product-oriented spin-off, which are not necessarily there in service-oriented spin-offs.

This study will focus on product-oriented firms since they normally have a higher resource demand and a more complex development time than service-oriented firms. These firms also generally originate from specific research results.

Another issue relating to knowledge transfer is whether or not the transfer has to come directly from the institution into the spin-off. According to Roberts, from McMullan and Vesper (1987), a spin-off is considered a USO even if there is a period between the founder leaving the university and starting the company, as long as the company is based on research conducted while being employed at the university. Other studies, like McQueen and Wallmark (1982), exclude scenarios where the knowledge transfer to the spin-off happened after the founder departure from the institution for a period of time.

The definition of this study

Summarizing these three perspectives, the definition of a USO in this research will be as follows:

New product-oriented firms created to commercially exploit knowledge developed within a university or a public R&D, where the knowledge is transferred directly from the university.

New firms are defined as autonomous companies that are structured for pursuing profit making activities, and have a distinct legal status (Pirnay et al., 2003). Including only direct knowledge transfer excludes firms that are not founded directly the researchers left the institute of origin. These ventures are excluded since there are various degrees of information available concerning these firms and there are numerous conditions in the years between the employees left the institution until founding the firm that will be challenging to account for.

2.3 Framework of this paper

This study aims to explore the role of the champion in a USO and its development. In order to do so, this chapter, reviewing the relevant theory, is supposed to create a theoretical framework that enables a balanced discussion conducive to this research field. The theory that has been reviewed so far will

therefore, in this section, be put together to form the framework of the discussion.

The discussion will explore the champion of the USO as the strategic decision maker and coordinator of execution activities. As discussed by Aspelund et al. (2005), strategic management aim to utilize the technology or knowledge of the USO to the business opportunity that is pursued. This mean to align the resources that the USO access to create a strong and sustainable competitive advantage, based on the technology, to pursue a business opportunity. The champion in more established companies is mainly involved at the strategic level, setting the long term strategic plans for the company. In a USO on the other hand, a champion has to work on the strategic, tactical and operational level due to the scarce organizational resources of the firm, making the role relatively diverse. The USOs ability to develop into a profitable business is dependent on the strategic and tactical decisions that are made on the USO's behalf.

When considering the USO's development, this study will discuss how the champion contribute to overcome the different critical junctures described by Vohora et al. (2004). The only juncture that will not be given any attention is the opportunity recognition juncture. The reason for this is that the opportunity recognition juncture only involves the inventor or TTO at the university recognizing that there might be an application of their results outside an academic context. This initiates the process of developing the USO, but is not the result of strategic work in the development itself, which is the focus of this study.

As mentioned earlier, the USO often has scarce resources, which makes the USO especially dependent on the champion as its greatest resource next to the knowledge transferred from the university. Due to the iterative nature of the USO development, dynamic capabilities play a key role in enabling the USO to reach sustainable returns. The champion draws on its human capital and knowledge to develop strategies and acquire

the resources necessary to overcome the different critical junctures. This study will therefore discuss how the different human capital of the champion, and the knowledge it provides, help the USO create dynamic capabilities and acquire necessary resources to progress through the different critical junctures.

From knowledge-based theory it can be seen that every company is dependent on its reservoirs of business knowledge in order to develop. When discussing the knowledge that the human capital of the entrepreneur provide, one has to consider, not only the knowledge that the entrepreneur personally hold, but also external knowledge he/she might provide access to. This study will therefore explore how the human capital of the founder expands the USOs internal and external business knowledge reservoirs and how this help the USO overcome critical junctures.

When it comes to human capital it is a general consensus that the general human capital and specific human capital of the champion affect the performance of an organization (Criaco et al., 2014). The general human capital refer to the knowledge that the champion has gained through formal education and professional experience, and are applicable to a wide range of occupations (Gimeno et al., 1997, Colombo and Grilli, 2005). Specific human capital on the other hand, represent the specific skills and capabilities that the champion has obtained through education and work experience and are mainly applicable to occupations related to the one they are obtained in (Gimeno et al., 1997). This study has chosen to only include the specific human capital when describing the champion. This is because this study looks at the contribution to the USO in the form of aiding the USO to overcome different critical junctures that are dependent on specific skills and knowledge such as market knowledge and the ability to form effective strategies.

This study has also decided to further limit the scope to specific work experience because the effect of education is disputed

among researchers and inconsistent results (Avermaete et al., 2004, Bosma et al., 2004, Davidsson and Honig, 2003, Haber and Reichel, 2007, Mayer-Haug et al., 2013, Stuart and Abetti, 1990). Some researchers also argue that the actual effect of education arise from the signalling effect of the academic status on the surrounding key players rather than the skillset it provides to the champion (Dore, 1976).

3. Method and Analysis

The aim of this study is to create a systematic review of the literature on USOs, focusing on the contribution the champion have on the USO's development. This research is based on the same procedure as Rasmussen et al. (2012), although certain alterations have been made and will be discussed in this chapter.

The search platform of this study was Web of Knowledge¹, as this database covers most of the leading journals on academic entrepreneurship (Rasmussen et al., 2012). It was therefore assumed that using Web of knowledge would include most of the journals essential to this study.

The literature review were divided into three parts in order to find the most central articles concerning USOs, their champions and the resources associated with his/her human capital. First, a code string had to be created to obtain the most relevant articles to this study. The second part consists of a screening of the relevance of the different articles obtained. Last, the articles that were considered relevant was read and analysed.

3.1 Constructing the code string

Types of spin-offs and entrepreneurs

The code string that was tested addressed different types of firms and champions. In

order to get a broad scope of the firms included, their term was split into two and combined. The first part consisted of nine different terms concerning the origin of the new venture while the second part consisted of nine terms describing the nature of the firm. Five acronyms commonly used to describe the specific new ventures were also added to the code string. In order to identify papers that specifically studied the champion, eight various terms describing different types of entrepreneurs was added to the code string. It was found that many articles in the scope referred to a founding team instead of an entrepreneur. Founding and entrepreneurial team were therefore added to the code string.

The code string gave 4101 articles, but the articles found spanned over 100 research areas. A majority of the articles represented the field *business economics*, within the Web of Knowledge database, which contained 2385 articles. Among other research areas represented were *Engineering* and *Education educational research* with 587 and 552 articles respectively. However, many of the research areas were irrelevant for this study, such as *government law, chemistry, physics* and *art*. In order to exclude these from the literature search it was limited down to only containing articles published by journals relevant to this study.

The literature search was restricted to the publications identified by Rasmussen et al. (2012) (shown in appendix, figure 6), who did an analysis where the most cited journals in this field were found based on 127 relevant articles. However, restricting the search to only involve the publications from Rasmussen et al. (2012) also provide some weaknesses. First, Rasmussen et al.'s (2012) study is two years old. Journals might therefore have changed their focus area, and new journals might have been created since then. This is not an issue in most cases, but since USO is such a young research area with a lot of recent research, it could be a weakness. Second, the chance of excluding relevant articles published by other journals will be increased. The search was restricted in spite of these potential weaknesses since this restriction increased the general relevance of the search results. This again makes it possible to locate high quality articles

¹ Web of Knowledge is the world's largest collection of research data, books, journals, proceedings, publications and patents, with more than 90 million records covering 5,300 social science publications in 55 disciplines (REUTERS, T. 2014)

more efficiently. This limitation reduced the number of hits from 4101 to 621.

Limiting the search to resource and human capital

As this research focus on how the champion as a resource affects the USO's development the code string was further confined in order to increase the relevance of the obtained articles. Since this study focus on resource-based theory, knowledge-based theory and human capital theory, these terms were added to the code string. This focused the search to obtain 155 articles relevant to this paper's field of research. The search syntax can be seen in the appendix.

3.2 Screening of obtained articles

Screening by title and abstract

After the literature search it was conducted a screening of the articles by looking at the title, keywords and abstract in order to identify the articles with the highest contribution to this study. In order for this paper to have an effect, the greatest contributors to the research field concerning the role of the champion of the USO had to be identified. It was therefore decided to categorize the remaining articles into two categories: relevant, not relevant. In order to find the relevant articles from the list of 155 hits, three criteria's was made.

- 1) Does the article concern USOs or other related spin-offs?
- 2) Is the article compliant to the focus of this study?
- 3) Does the article explore the human resources in the firm?

During this screening, the articles that did not meet any of these criteria were discarded as irrelevant. The relevant category was therefore made open as it often is hard to be certain about the relevance of the article based on an abstract. This screening gave 37 relevant and 118 irrelevant articles.

Screening by introduction and conclusion

After the abstract screening it was decided to screen the articles based on the relevance of the theoretical and empirical contribution of the studies. A last screening focusing on the introduction and conclusion of the articles was then conducted. The criteria deciding the relevance of the articles remained the same as in the abstract screening. In this screening 12 articles were discarded as irrelevant. Through this screening process the number of articles considered as relevant was reduced from 155 to 25. A table with information and main contributions of the articles that were considered as relevant to this study can be found in the appendix. It is also important to mention that the 25 articles obtained in the screening process also sparked a snowballing effect. This means that the articles that were referred to in the articles obtained in this literature review were also examined, provided they concerned relevant topics.

3.3 Analysis of the literature review

This section will describe and illustrate the characteristics of the literature obtained by the approach described earlier in this chapter. This is done in order to assure that the reader of this study understands what the discussion of this study is based on.

The literature search done in this research was restricted to 15 journals. An analysis of the remaining 25 articles revealed that all the articles derived from only six different journals. The journal where the most articles were published was *Entrepreneurship Theory and Practice* (ETP), containing seven of the 25 articles. This indicates that the literature review was successful as the ETP journal is a peer-review academic journal in the field of entrepreneurship studies, while most literature in terms of USOs is published in policy journals. Figure 2 illustrates the distribution among the journals.

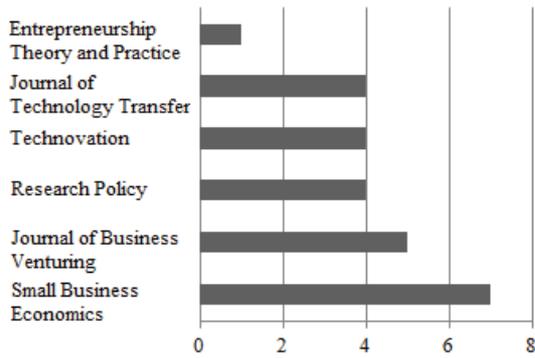


Figure 2: Distribution among the journals from the literature search

As a validity check the journals represented in this study were compared to the journals from the systematic literature reviews on university entrepreneurship done by Rothaermel et al. (2007) and Djokovic and Souitaris (2008). Five of the six journals in this research were listed in both Rothaermel et al. (2007) and Djokovic and Souitaris (2008) top list of articles published on this topic. With 7 out of 25 articles, *Entrepreneurship Theory and Practice (ETP)* was the journal that provided the most articles in this study. However, this journal was not identified by Rothaermel et al.'s (2007) and only one article originated from ETP in Djokovic and Souitaris (2008) literature review. A deeper investigation of the seven articles provided by ETP in this study showed that all of the articles were published between year 2007 and 2013. Since Rothaermel et al. (2007) and Djokovic and Souitaris (2008) literature review were conducted in 2007 and 2008 the articles in this study published by ETP were therefore most likely too recent to get included in the two previous literature reviews.

As the articles from ETP were published in recent years, it was of interest to see if this was a general trend for the sample of articles as a whole. An examination of the year of publication for all the articles in the sample was therefore performed. The analysis revealed that 20 of the 25 articles were less than 10 years old. These results, displayed in figure 3, indicate that this research field is generally novel and that it has grown significantly the

last 10 years. The increase in literature related to USOs was also observed by Rothaermel et al. (2007) and Rasmussen et al. (2012).

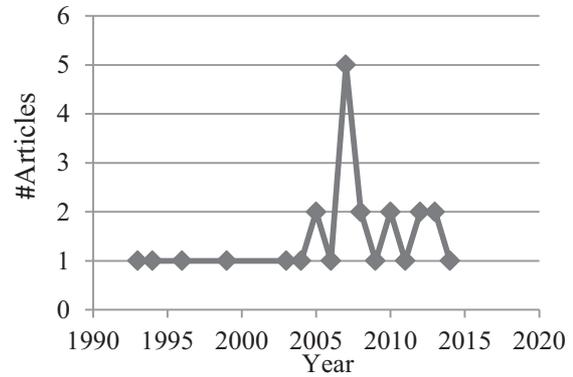


Figure 3: Number of articles ranked by year

Finding the number of articles focusing on the effect of different human resources on a USO was considered important. These articles describe the attributes of different human capital, which this study then can relate to the champion. It was therefore performed an analysis that found how many articles that focused on human resources. As seen in figure 4, 80% of the articles focused on the contribution of human resources to the USO. The remaining 20% involved the network and community surrounding the USO, and was considered relevant as it described the external knowledge reservoir of the USO.

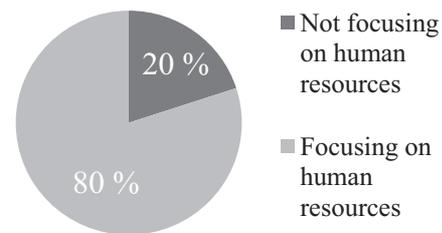


Figure 4: Percentage of articles focusing on human resources

The last thing that this study analyzes concerning the characteristics of the articles in the sample is what sort of human capital they generally focus on. This will illustrate what human capital that is perceived as important to USO development in this field of research, and illustrate how this study fits into the literary landscape.

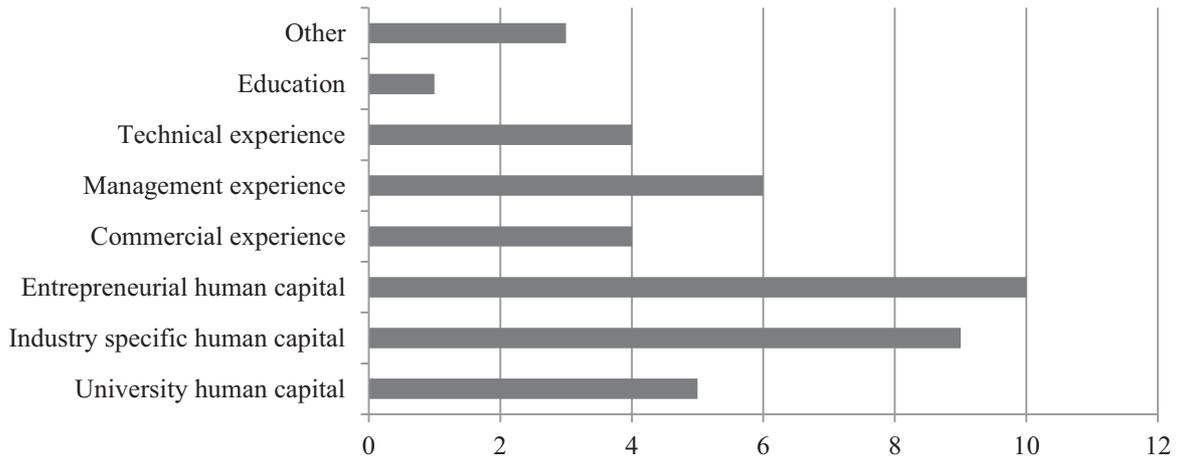


Figure 5: Types of human capital

As seen in figure 5 the most frequently studied type of human capital is entrepreneurial human capital (10), followed by industry-specific (9) and management human capital (6). However, both industry-specific human capital and entrepreneurial human capital often includes management experience in different regards. This taken into consideration, it can be argued that management experience is often a dimension of other types of human capital, such as industry-specific human capital. In the sample, 5 of the articles focused on university human capital. This type of human capital is often considered essential to USOs since their technology and entrepreneur often stem from a university.

As seen from this analysis, the sample of articles retrieved in this literature search is well suited for this study in many respects. The articles are published in journals that contribute to USO research which confirm their relevance. A majority of the articles focus on the human capital of the USO, which also is the focus of this study. Several of the studies has made a distinction between product-oriented and service-oriented spin-offs, which can potentially able this study to explore the distinctive needs of product-oriented spin-offs compared to the service-oriented spin-offs. The last analysis done also revealed that most articles focused on entrepreneurial human capital, industry-specific human capital, management experience, and university human

capital, which, as will be shown in the discussion, will form the focus for this study.

4. Discussion

As explained in chapter 2.3, the discussion will explore the contribution human capital to the champion has on the development of a USO. Concerning the development of USOs, this article uses the critical junctures described in Vohora et al.'s (2004) framework. The junctures that are focused on in this study is the entrepreneurial commitment juncture, credibility juncture and the sustainability juncture. The discussion will focus on how the human capital of the champion aids the USO to pass these junctures. Opportunity recognition will not be given much focus since this juncture involves a researcher or TTO realizing that their research results has an application outside their academic field which might hold a commercial value. This study does not consider this as a part of the business development, but rather the initiation previous to the business developing as a project.

From figure 5 in the analysis of the literature, it could be seen that a majority of the articles emphasized the role of four types of specific human capital; industry-specific human capital, entrepreneurial human capital, management human capital and university human capital. Both industry-specific human

capital and entrepreneurial human capital often include management experience in different regards. It can therefore be argued that management experience is a sub dimension of the other three human capitals, mentioned above. This study will therefore focus on entrepreneurial human capital, industry-specific human capital and university human capital. Criaco et al. (2014) also used this categorization and argued that these three human capitals characterized the USO. Table 5, which is based on Criaco et al. (2014), display the framework for this thesis.

Specific work experience

Industry-specific human capital (IHC)	This is experience and knowledge acquired from working in the same industry as the USO is operating in, either in technical or managerial positions.
University human capital (UHC)	University human capital is experience and knowledge gained from working with research and teaching at university-level.
Entrepreneurial human capital (EHC)	Entrepreneurial human capital is experience and knowledge gained from working in an entrepreneurial venture.

Table 5: Human capital framework

Industry-specific human capital

During the opportunity-framing phase, the USO might not have found the industry in which it will operate and commercialize their technology. A champion with IHC with experience from one specific industry has most likely built its knowledge reservoirs oriented towards that industry. Since the USO often consist of a small organization surrounding the champion, this result in the knowledge reservoirs of the firm being significantly dependent on the champion focusing it towards one specific industry. Although in this phase, the firm has to find the application area with the best commercial potential and the

possibilities to succeed independent of industry. If the champion has mainly access to knowledge concerning one specific industry, the USO might pursue the industry with a lower commercial potential simply due to scarce knowledge reservoirs covering the industry with the highest commercial potential.

Ganotakis (2012) and Cooper et al. (1994) found that industry-specific experience contributed significantly to the USOs success. It was argued that the success was due to the transit of external knowledge reservoirs to the USO, provided by the champion with IHC. This reservoir consisted of key players in the industry, such as suppliers and customers. This is further emphasized by Duchesneau and Gartner (1990) who says that that in order for a USO to be successful it is dependent on information and knowledge from different industry players, such as suppliers and customers. The external knowledge reservoirs can provide both product knowledge from competitors and suppliers and market knowledge from most of the industry but especially the customers. Widding (2005) underline the special importance of the customers as knowledge reservoirs as they ultimately decide if something provide a competitive advantage or not since it ultimately is the customers they are competing for. This knowledge can be used to build a stronger business case that is more credible to industry key players which may help the firm overcome the credibility juncture. Later this knowledge can be used to create competitive advantage that can help them to develop a sustainable operation.

It is known that industry key players develop their knowledge reservoirs by interacting with their surrounding community. If the champion has been part of the same community, the possibility of the network of external knowledge reservoirs of different industry key players and the USO intersecting increase. This increases the chances of different industry key players getting information about the USO. The effect of this is that when the USO reach out to them, the

possibility of them already knowing of the venture is higher, increasing the credibility of the USO.

The contribution of IHC to the USO overcoming the threshold of credibility might be greater if it is attained through a management position compared to a technical position. A management position often provide a more diverse access to both external product and market knowledge reservoirs since someone with this position often is dependent on interacting with people in both technical and commercial positions. The successful strategic management in the USO lies in the intersection of product development and the market opportunity (Aspelund et al., 2005). The diverse network of external knowledge reservoirs provide the champion with both product and market knowledge that help the champion to make strategic decision that take both aspects into account. This help the champion to develop a viable business case that take both the product and market aspect into consideration, creating credibility and later a sustainable income.

This is supported by Colombo et al. (2009) who found that IHC obtained from a technical position did not have any effect on e.g. attracting external funding. This might be due to the champion providing the USO with only internal and external product knowledge reservoirs since his/her network mainly consist of people in technical positions in the industry. This might bias the USO towards product development, neglecting the other aspects of the business development. Product knowledge is of course very important for the USO to develop competitive technology (Colombo and Grilli, 2005), but considering the strategic role of the champion, someone with technical IHC might not be suited to hold this position and might be more suited to be a technical developer or manager. This become apparent as the USO progress past the different critical junctures and the commercialization of the technology become a more central part of the operation.

Market knowledge about viable strategies and changing market environments might create less of a “trial and error” approach which makes the USO more efficient (Ganotakis, 2012, Cooper et al., 1994). First, the diverse external knowledge reservoirs help the champion to find information relevant to the USO about changing conditions in the market. Second, the internal and external knowledge reservoirs of the USO give insight into possible strategic decisions, viable in the industry it operates in. This makes the champion able to make strategic decisions that are successful more efficiently (West, 2007). This becomes especially important in order to overcome the sustainability juncture where the USO continuously has to reorganize its resources to emerging information in order to create sustainable returns.

Managing a USO might demand deeper organizational knowledge than having a management position in a more mature company. The reason for this is that mature firms has already developed organizational structures and routines concerning managing the firm (Unger et al., 2011), and managing these firms often consist only of being able to use these tools. This of course is dependent on what level the manager works. Considering a top manager of a large firm, they often has a profound understanding of organizational mechanisms. In a USO the champion has to develop these structures and tools from scratch, which means that the champion needs a deeper understanding of the purpose and resources needed for these tools to provide the desired effect. This might make the internal organizational knowledge, that champions with management IHC provide, insufficient in order to manage the USO. This makes the USO more dependent on the external knowledge reservoir, which might represent a sufficient organizational knowledge reservoir to create the necessary structure and routines. On the other hand, when the knowledge reservoir is external, the USO is not able to use it as efficiently as an internal which might reduce the USO’s efficiency.

West (2007) did not find a relationship between industry-specific experience and performance. Cooper et al. (1994) and Ganotakis (2012) on the other hand, found that industry-specific experience had a strong contribution. The difference between these two studies is that firms in the sample of West (2007) was outside technology clusters while the firms in Cooper et al. (1994) and Ganotakis (2012) study were part of such clusters. Being a part of technology clusters place the USO in an environment with of great amounts of business knowledge, mainly consisting of employees in other firms. The industry network of a champion with IHC enable the USO to access these external knowledge reservoirs, also called taking part in “knowledge spill-overs”. This gives the USO access to information about changes in the technological and competitive landscape (West, 2007). Since the USOs generally operate in high technology industries that change rapidly, this has great value to its competitive ability. This shows that a great value of industry-specific human capital lies in the ability to obtain updated information in the market efficiently and to exploit these changes as opportunities, being most effective in a technology cluster.

The great size and diversity of the external knowledge reservoir IHC champions provide concerning industry-specific product and market knowledge help the USO to identify changes in the market early. The great internal knowledge about viable industry-specific strategies that the champion provides to the USO can be used to utilize these changes as opportunities to grow and develop. Therefore, the IHC champion help the USO to become more efficient, by using the new information to make decisions fast and right the first time, helping the USO to attain sustainable returns.

University human capital

The main contribution of university human capital is product knowledge, which is obtained through research done at the university. The

USO often operates in new technology markets, and sometimes the USO even creates its own technological segment. Due to this, there are often few other researchers with the same product knowledge as the researcher. This creates heterogeneity in the market which has the potential to develop into a sustainable competitive advantage for the USO if it is able to find an application of great commercial value for the technology and making it inimitable by e.g. protecting it.

This profound internal product knowledge also enable the firm to adapt the technology to changing market conditions more efficiently since the one that holding it is involved in the decision making process of the firm. This makes the USO more dynamic.

In order to overcome the entrepreneurial commitment juncture, the USO needs a plan of how to create a product that is capable of forming a strong competitive advantage in order to create the conditions necessary for the USO to create sustainable returns. In order to do so, it is often necessary to adjust or modify the technology. It is possible to do this by using external knowledge reservoirs such as consultants or partners. However, this might be ineffective and expensive compared to the USO having internal product knowledge reservoirs provided by university human capital.

The opportunity-framing phase is driven by strategic analysis of the product’s commercial potential and viability in the different application areas which requires a variety of market knowledge. As the UHC comes from a non-commercial environment such as the university (Criaco et al., 2014), it do not provide this knowledge to the same degree as other human capital. It is also less likely that a UHC champion provide the USO with external market knowledge reservoirs since the researcher has used most of its efforts on academic work (Hsu, 2007), limiting its commercial focus and network to different industry players. This might result in an insufficient analysis of the commercial potential to the different application areas of

the technology that lead the USO to pursue a strategy that give the technology a reduced commercial value.

The lack of both internal and external market knowledge might also inhibit the USO in attaining the threshold of credibility as it reduces the champion's understanding of how to create a lucrative business case based on the technology. A business case with the lack of a high commercial value and a viable strategy to realize it might make industry key players lose faith in the venture, reducing the chance of getting investments.

Overcoming the credibility juncture involve, for many USOs, to obtain external funding. When it comes to the finance knowledge provided by the university human capital, Hsu (2007) and Politis et al. (2012) argues that researchers are likely to invested less in social relationships in the entrepreneurial and venture capital community. This reduces the chances of researchers having significant finance knowledge concerning how to attract venture capital. Gimmon and Levie (2010) for example found that technical experience did not contribute to attracting venture capital. On the other hand, they found that the probability of a venture capitalist actually investing when considering a USO as a potential investment object increased if the champion was a professor or held a PhD. When the internal product knowledge reservoir is of this magnitude it might provide a verification of the technology's viability to the venture capitalist, reducing the perceived risk of investing. Although, it might not be necessary for the professor or the one holding an PhD to be the champion of the USO in order to provide the internal product knowledge reservoir to convince the venture capitalist to invest. It is sufficient that he/she is part of the entrepreneurial team.

Politis et al. (2012) found that researchers are used to pursuing public funding which might increase the USOs finance knowledge concerning public funding and soft funding. Even though public funding is of great importance to the USO, it does not

necessarily provide the sufficient funds, which can be provided by the venture capitalist, to acquire the resources needed to overcome the credibility juncture.

University human capital enables the USO to differentiate from their competitors based on technical differentiation due to the profound product knowledge that this human capital provides the USO (Shrader and Siegel, 2007, Criaco et al., 2014, Politis et al., 2012). Also, this ability help the USO to innovate its products as new information emerge and changes in the market occur through the reorientation phase, helping the firm to overcome the sustainable returns juncture. This ability to reinnovate also makes the firm able to pursue new technological opportunities in the market and introduce new products. The introduction of new products might help the USO to reach sustainable returns, since their general cash flow increase and the firm get more experienced in bringing products to the market. This might make the business more efficient by reducing the relative production cost of the firm.

Entrepreneurial human capital

USOs often operate in knowledge-intensive industries, the acquisition of business knowledge and valid information can reduce the uncertainty linked with innovation and dynamic environments (McMullen and Shepherd, 2006). A champion with EHC often has a wide network spanning several industries, providing the USO with diverse and significant external knowledge reservoirs. Serial entrepreneurs also often possess the capabilities needed to acquire the necessary knowledge and information (Delmar and Shane, 2006). This helps the USO to identify commercial application areas for its technology and succeed the opportunity recognition.

When developing an entrepreneurial venture one often engage in the entrepreneurial community and build a network consisting of other entrepreneurs from different industries (Hsu, 2007). The first and second hand

network of the EHC champion therefore provides the USO with significant external business knowledge reservoirs spanning several industries. This makes the USO capable of exploring the commercial potential of its product in different industries efficiently and analyse the commercial value of the technology in the different markets more rapidly in the opportunity-framing phase. This may shorten the time the USO spends overcoming the entrepreneurial commitment juncture since the extensive business knowledge network enable the USO to access the necessary information more efficiently, and provide a thorough analysis on how to commercialize the technology.

The vast knowledge reservoir, spanning over several industries, provided to the USO through the champion with EHC increases the likelihood of industry key players having heard about the venture. This builds credibility for the USO, provided that they have a good reputation, since it provides a third party verification. Since the EHC champions has been involved in previous ventures, the chances of them having finance knowledge concerning attracting venture capital increases. This provides the USO with an internal finance knowledge reservoir concerning venture capital funding. The network obtained from interacting in the entrepreneurial community also provide the entrepreneur with external finance knowledge reservoirs concerning a variety of funding alternatives, helping the USO to fund their acquisition of resources. The extended network to other actors in the industry and venture capitalists and the internal and external finance knowledge reservoirs help the USO overcome the credibility juncture. This network gives access to both the necessary key players in the surroundings and the knowledge of how to obtain the necessary funding to acquire resources.

EHC champion provide an internal knowledge reservoir concerning developing a USO. This lowers the perceived risk of investing in the USO, provided that the

previous venture was successful, which makes a venture capitalist more inclined to invest in it. This makes the USO capable to acquire the necessary resources to overcome the threshold of credibility.

An important aspect concerning USO management is building an organization that is able to constantly innovate in order to respond to emerging information about the market and changing market conditions (Ganotakis, 2012). Holding organizational knowledge concerning USO management, the EHC champion provide an internal knowledge reservoir enabling the USO to innovate efficiently. This create a more dynamic organization capable to continually restructure its resources in the reorganization phase in order to overcome the sustainable returns juncture.

5. Conclusion

This study explores how the human capital of the champion and the knowledge that this provides, both internally and externally, help the USO to advance through the stage development that characterizes USOs (Nicolau and Birley, 2003). This has been done by using Vohora et al.'s (2004) stage model and focusing on the critical junctures and phases involving business development activities unique to USOs. These phases are the opportunity-framing phase, pre-organization phase and the reorientation phase. The critical junctures that are included in this study are the entrepreneurial commitment, threshold of credibility and the sustainable returns phase. This framework has then been used to illustrate the managerial need that emerges as the USO advance through the stages and how different human capital provides the knowledge necessary to cover this need and affect further development. By doing so, this study gives a deeper understanding of the research question:

How does the human capital of the champion affect the development of the USO?

The study argued several interesting points. The first is that the USO is most likely not served with a technical champion at any point in the development. The reason for this is the lack of other business knowledge besides product knowledge limiting its ability to create a holistic business strategy, inhibiting the USO's ability to fulfil its full commercial potential. This limitation becomes more significant as the venture advance through the development phases. However, the limitation is also significant during the opportunity-framing phase due to path dependency, where the decisions made in this early phase affect the later development. The champion, as the strategic decision maker should therefore be someone with a more coherent business knowledge. This can often be provided in different forms by entrepreneurial human capital or industry-specific human capital. It was found that both IHC and EHC champions contributed positively to attracting investors due to the network of external knowledge reservoirs. The IHC champion would also most likely make the USO more efficient due to their market knowledge. EHC champions can contribute to create a dynamic organization that enables the USO to change efficiently when necessary during the development. In the later stages, the implementation of the USOs strategy might be positively related with IHC due to knowledge of industry-specific strategy formation while EHC provide the knowledge of how to implement the strategy internally in the USO efficiently.

This article does not undermine the importance of having all three types of human capital present in the entrepreneurial team. However, some types are more fitted to perform as the champion in different phases. An example of this is the Norwegian university spin-off called Dynamic Rock Support. In this spin-off the inventor of the technological solution that formed the basis for the firm, being a researcher, was responsible for the technical development. The firm also had someone with industry-specific experience responsible for sales where this person was

able to utilize its customer network. Last, the firm had a serial entrepreneur as the champion where the business development skill was valuable. This firm experience strong development until it was sold to one of their competitors. This is not the only way of configuring the entrepreneurial team, but it is one alternative that follows the findings of this study.

This article illustrates, to governmental decision makers, the importance of providing a network to entrepreneurs in order to increase their business knowledge reservoirs, making them more equipped to develop functioning businesses, as a way of promoting entrepreneurship and economic growth.

The research question should be of interest to scholars, entrepreneurs and policy makers as spin-offs seldom become high-performing ventures (Wright et al., 2007). Thus, a greater understanding of the USO development is needed to increase the rate of successful spin-offs and design effective support mechanisms for USOs. Based on the findings several implications for scholars and policy makers are made.

This article show *TTOs and researchers* the importance of a champion with coherent business knowledge, also in the earlier phases, in order for the USO to achieve its commercial potential. It also poses surrogate entrepreneurs as viable champions of USOs as these entrepreneurs often provide the necessary business knowledge.

TTOs should as commercialization agents be aware of the different challenges that are linked with the different phases a USO passes. To overcome these challenges different sets of human capital is needed depending on the phase the USO is in. The findings from this paper suggest that the *TTOs* should aid the USO in search for a surrogate entrepreneur with management experience in the form of IHC or EHC to champion the venture.

Financial advisors should know the importance of having a champion on the team with a network to the industry or VC

environment in order for the USO to gain the credibility needed to be invested in.

This research shows the importance of the decisions made early in the venture. The policy makers should be aware of this and create a support structure that enables the spin-off to require the resources needed in order to make the right decisions early. An important factor to this aspect is the need for appropriate champion commitment to the spin-off.

6. Limitations & further research

As this study was a literature review, the findings of this article is only based upon earlier literature. Further research should try to answer the research question of this paper by doing empirically research, using the framework made in the paper. Testing the findings of this paper empirically will contribute to the literature about the USO phenomenon.

The development of USOs, as the context of this study, is in this study described by using Vohora et al.'s (2004) stage model. However, this model has been criticized of describing the USO's development as singular, meaning that the USO only are in one phase at a time, only having one focus. The critics argue that the USO can be in more than one stage at a time, having more than one focus. An example of this is that the USO can simultaneously be working on gaining credibility while doing research on the technology. Thus, be in the research phase and the opportunity phase at the same time. Following this, studies focusing on the effect of the champion's human capital on the USO could be done using other models, besides Vohora et al.'s (2004) model, describing USO development.

This study was restricted to the champion and its human capital without including the rest of the entrepreneurial team as a factor. In order to fully understand the distinctive role of the champion, the rest of the entrepreneurial team should be included in the

study. This way it would be possible to see how the team as a whole contribute to the USO's development, and what the distinctive contribution of the champion is.

A limitation of this study is that it only considers the champion's work experience. Therefore further research, both literary and empirical, should also be done considering education. This is especially necessary due to inconsistent results of the existing research. Following this, further research should also be done considering the student start-ups' ability to create competitive advantage, despite their lack of professional experience. Another limitation of this research is that it only considers three dimensions of specific human capital. Further research focusing on other human capital might therefore provide a more diverse understanding of human capital and its contribution on USO development.

When considering the human capital of the champion, this study has considered the human capital as static from the champion entering the USO, not considering what the champion learn from holding the position. This learning might make the human capital more diverse and therefore make it able to lead when the USO need different management during its development. Therefore further research including the learning perspective should be performed in order to create an understanding of how the human capital of the champion develops through the development of the USO.

As pointed out in this study, there is a difference in the contribution of the human capital of the champion if the USO is located in a technology clusters than outside. A more profound study of this difference might prove useful to entrepreneurs when considering where to locate the USO in order to give it the right premises in order to succeed.

The method used to find the most relevant articles relating to this article have some drawbacks. First, the literature search was limited to 15 publications found by Rasmussen et al. (2012) in a similar literature review. This might result in this study missing interesting views on USO development that are

published in other publications. However, a comparison of the publications used in this paper with the publications used in two other similar literature reviews (Rothaermel et al., 2007, Djokovic and Souitaris, 2008) was done, and no major differences were found. Thus, it is believed that the most relevant publications for this study is included. Second, this study restricted its code string to human capital and resource-based view as topics. Even though this is central concepts of this study, information and scientific results relevant to this study might be found in articles that does not include these concepts. Relating to this, the code string of this study did not include champion in the topic. This is certainly a limitation, although the code string did include terms such as entrepreneur and entrepreneurial team which are similar terminology. But this might have resulted in the study missing more focused studies on the champion role as a literary basis. Third, the first step of screening was done by looking at the title, keywords and abstract of the article. This may have discarded some articles as the article might have been wider than indicated in these sections.

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Appendix

Research Policy	Small Business Economics
Journal of Business Venturing	Entrepreneurship theory and practice
Journal of Technology transfer	Administrative science quarterly
Technovation	American economic review
Management Science	Academy of management review
Strategic Management journal	Organization science
R & D Management	Academy of management journal
Industrial and Corporate change	

Table 6: Journals included in the literature search

Search syntax used in the literature search

TOPIC: (((New technology based OR Technology based OR Technology-based OR research based* OR research-based* OR science-based* OR science based* OR Academic* OR University*) AND (Venture* OR Spin-off* OR Spin-out* OR Spinoff* OR Spinout* OR New firm OR Entrepreneur* OR Start-up* OR startup*)) OR (NTBF* OR RPSO* OR USO* OR SBEF* OR ASO*)) AND (((Academic OR Faculty OR Scientist OR Science based OR Surrogate OR Industry OR Student OR External OR Serial) AND (Entrepreneur*)) OR ((founding OR entrepreneurial) AND (team*)))AND TOPIC: ((human capital OR resource based OR RBV OR resource-based)) AND PUBLICATION NAME: ((Research Policy OR Journal of Business Venturing OR Journal of Technology transfer OR technovation OR Management Science OR strategic Management journal OR R & D Management OR Industrial and Corporate change OR small Business Economics OR Entrepreneurship theory and practice OR administrative science quarterly OR american economic review OR academy of management review OR organization science OR academy of management journal))

Literature summary

Reference	Research question	Theoretical framework	Sample and data	Analytical method	Main finding(s)
(Alshumaimri et al., 2012)	Is scientist entrepreneurship positively influenced by experience, gender, social capital, human capital, and university and other institutional policies encouraging commercialization activities?	None	272 questionnaires from, three universities in Saudi Arabia	Survey	“The paper finds that there are key elements to scientist entrepreneurship that provide a sharp contrast to what has been established in the literature based on studies from the OECD countries.”
(Aspelund et al., 2005)	To what extent do the resources, controlled by the entrepreneurs at the firm's inception, affect the new organization's ability to survive the first years?	Resource based view	80 Norwegian and Swedish technology-based start-ups	Longitudinal Study	Initial internal resources are antecedents of a new, technology-based firm's survival. Early strategy formation has long-term consequences for the firm's survival. High team heterogeneity and competence density is the key to performance. Presence of entrepreneurial experience in the entrepreneurial team does not have a positive effect on venture survival.
(Bjornali and Gulbrandsen, 2010)	(1) Which board members do ASOs add and why in the start-up stage? (2) When, why, and how do changes in board composition occur in the subsequent stages of growth?	Stage-based, resource dependence, and social network theories,	11 case studies from Norwegian and US spin-offs	Multiple case, inductive study	“The process of board formation is mainly driven by the social networks of the founders as social network theory predicts.” “The board at founding consists mainly of the scientist–entrepreneurs and people from the scientist–entrepreneurs’ networks.” “The board undergoes changes, related to development and overcoming junctures, as the ASO grows.”
(Brinckmann et al., 2011)	What role do the founding teams’ financial management competencies play for firm growth?	Resource-based view	181 NTBF from different German technology industry registrars.	Partial least squares regression (PLS) modelling	“A new venture team’s competence in external financing has a positive impact on Employment growth.” “Competence in financing through operations is found to be a significant predictor of the growth of both sales and employment.” “The finding also underlines the need for entrepreneurship scholars to look beyond the limited scope of external financing to identify sources that help in overcoming resource constraints.”

Reference	Research question	Theoretical framework	Sample and data	Analytical method	Main finding(s)
(Chorev and Anderson, 2006)	Which factors deemed critical for success in high-tech new ventures in Israel?	None	70 high-technology Israel start-up companies	Multiple stage methodology; Literature review, interviews and discussions, and questionnaire	Their main findings where that the idea, strategy, the core team's commitment, expertise and marketing are critical success factors, and management, customer relationships and research and development are important success factors. The economy, politics and the general business environment were considered the least important success factors.
(Colombo and Grilli, 2005)	What is the relation between the growth of new technology-based firms and the human capital of founders, when looking at the "wealth" and "capability" effects of human capital?	Human Capital	506 Italian Young firms that operate in high-tech industries	Quantitative analysis	Undergraduate and graduate education in economic and managerial fields and to lesser extent technical and scientific fields does positively affect growth. NTBFs established by individuals who have greater work experience in technical functions in the same industry of the new firm and have been involved in prior entrepreneurial ventures exhibit superior growth, with all else equal. Firms that have a founder that has managerial position in another firm are more likely to obtain external private equity financing. There are synergistic effects originating from the presence within the founding team of specific complementary capabilities.
(Cooper et al., 1994)	Is it possible to predict the performance of new ventures based on factors that can be observed at the time of start-up?	Resource based and human capital	1053 new ventures, representative of all industry sectors and geographical regions	Longitudinal study	Performance was enhances by level of education and racial minority was linked to lower probabilities of both marginal survival and growth. Gender was only significant in the growth equation, with higher growth for male entrepreneurs. Having parents that were business owners contributed to marginal survival. Number of partners seemed to be a significant contributor to high growth, but not to marginal survival. Business similarity seemed to be a significant determinant of both marginal survival and growth.

Reference	Research question	Theoretical framework	Sample and data	Analytical method	Main finding(s)
(Criaco et al., 2014)	How do founders' human capital characteristics influence the likelihood of USU survival?	Human capital	80 Catalan USUs	Quantitative analysis	Entrepreneurial education positively influences USU survival, while start-up experience has no effect. Entrepreneurs with industrial human capital are more likely to exit their firms, which has a negative impact on survival. University human capital has a positive impact on survival of the firm.
(Ganotakis, 2012)	How the founders' human capital is related to the performance of UK new technology based firms?	Human Capital	412 UK firms operating in high-tech manufacturing and services	Quantitative analysis	Human capital characteristics of an entrepreneurial team had a significant impact upon a company's performance. A significant inverted U relationship was found between general experience and a company's performance. A high level of technical education does not necessarily have a positive effect on performance, and it is important that this human capital is complemented by managerial capabilities in the team. Business education and commercial and managerial experience appears to enhance performance. Same-sector experience has a bigger positive impact on a firm's performance than those with experience from other industries. Strong evidence was found for the combination of technical education with commercial experience in an entrepreneurial team being able to lead to high levels of performance. Same-sector managerial experience in technical and/or commercial roles provides an advantage on performance. NTBFs founded by entrepreneurial teams seemed to perform better than those of a single entrepreneur.
(Gimmon and Levie, 2010)	What is the effect of founder's human capital on external investment in and survival of new technology-based ventures?	Human capital theory and signalling theory.	Random sample of 193 high-technology start-ups, all participants in the Israeli Technology Incubator Program	Hierarchical binary logistic regression based on surveys	The main finding was that "a technological background, had significant independent effects on survival, while personal indices such as age, gender and origin which have been used in the past as human capital proxies, did not... and that academic status made no significant difference to venture survival"

Reference	Research question	Theoretical framework	Sample and data	Analytical method	Main finding(s)
(Hsu, 2007)	how is the sourcing and valuation of VC funding varying among entrepreneurs with heterogeneous organizational capital?	None	Survey of 149 early stage technology-based start-up firms	Ordinary least squares regressions, empirical analysis	“Prior founding experience (especially financially successful experience) increases both the likelihood of VC funding via a direct tie and venture valuation. Second, founders' ability to recruit executives via their own social network (as opposed to the VC's network) is positively associated with venture valuation. Finally, in the emerging (at the time) Internet industry, founding teams with a doctoral degree holder are more likely to be funded via a direct VC tie and receive higher valuations, suggesting a signalling effect.”
(Kakati, 2003)	Which criteria's influence the performance of high-tech new ventures?	None	Survey from 27 venture capitalists	Cluster analysis	“The entrepreneur quality, resource-based capability, and competitive strategy are the critical determinants of the firm's viability and achievement... and successful entrepreneurs develop multiple resource-based capabilities to backup multiple-strategies to push their products through market.” Success is created if the venture is able to meet the requirements from the customers.
(Livesay et al., 1996)	Describe and make a typology of different inventors and categorise the motivations that underlie the choices made by inventors in the development of their technologies.	None	101 case studies collected through the ENERGY-RELATED INVENTIONS PROGRAM	Attitudinal analysis	Made some typologies for different types of inventors: industry specific inventors, professional inventors, entrepreneurs with technology, grantsmen and inveterate inventors. The industry specific inventors, professional inventors and entrepreneurs with technolog had a higher chance of success, while the 'grantsmen' and 'inveterate inventors' need support for the commercialization part of the venture.
(Martin et al., 2013)	Do entrepreneurship education and training (EET) help to create more or better entrepreneurs?	Human capital theory	Literature search from various electronic databases in the areas of general business and management education.	Quantitative review	Found that the “relationship between entrepreneurship education and training (EET) and entrepreneurship outcomes is stronger for academic-focused EET interventions than for training-focused EET interventions.”

Reference	Research question	Theoretical framework	Sample and data	Analytical method	Main finding(s)
(Moreno and Casillas, 2008)	Which variables influence the relationship between entrepreneurial orientation (EO) and firm performance?	Theory of Resources and Capabilities	Data from the database "Centra" containing 434 SME	Partial Least Squares	Found that there are a clear positive relation between EO and growth. Innovation was the dimension of EO with greatest influence on the type of expansion strategy used by the firm.
(Mosey and Wright, 2007)	How do differences in the human capital derive from the entrepreneurial experience of academic entrepreneurs influence their ability to develop social capital?	Human capital and social capital	Longitudinal study of 24 academic entrepreneurs (6 nascent, 12 novice and 6 habitual)	Case study investigation	Academic entrepreneurs with prior business ownership experience have broader social networks and are more effective in developing network ties. This gives them greater opportunity recognition possibilities than nascent entrepreneurs. Less experienced entrepreneurs value their research colleagues as potential role models, while experienced entrepreneurs look at them as potential sources of technological opportunities. Greater business ownership experience is positive related to gaining equity finance and management knowledge from external networks.
(Murray, 2004)	To what extent does an academic scientist contribute not only human but social capital to a firm and how does this social capital contribute to the embeddedness of the entrepreneurial firm?	Human capital, social capital	25 semi-structured interviews, Patent and publication analysis of 12 firms, and some archival data on firms and inventors.	None	The first finding is that the inventor uses his human capital to develop the firm's strategy. The inventor often transfers this knowledge through joining the firm as CSO. "The second finding is that the inventor exploits his social capital, (that contains of two distinct elements, local laboratory network and cosmopolitan network) to build relationships between members of his social network and the firm."
(O'Gorman et al., 2008)	How do university-based scientists overcome the barriers to appropriating the returns from new knowledge via entrepreneurship; and how can a university-based technology transfer office (TTO), with an incubation facility, assist scientists in the commercialisation process?	The Knowledge Spillover Theory of Entrepreneurship	Case study of two firms from Ireland	Case method	The first finding was that "scientists take account of traditional academic rewards when considering the pay-offs of commercialisation activity. The second finding was that the founder's market-related knowledge is embedded in their research context and is a result of the scientist's external contacts. The third finding was "that individuals or organisations with market knowledge learn of new knowledge developed by scientists, through the deliberate efforts of the scientists to acquire market information; and that intermediaries can help individuals or organisations with resources learn of new knowledge developed by scientists."The last finding was that TTO can help scientists to overcome the barriers of commercialisation.

Reference	Research question	Theoretical framework	Sample and data	Analytical method	Main finding(s)
(Shrader and Siegel, 2007)	Are competitive strategies and financial performance of technology-based new ventures related to the entrepreneurial team characteristics?	Human capital	Longitudinal data from 198 high-tech ventures.	Hierarchical regression analysis	They found a fit between team experience and strategy, and suggested a link between this fit and the long-term performance of technology-based new ventures. Technical experience was found to be the most critical type of experience in terms of its impact on strategy that in the end is linked to performance and it also appeared to be the most important determinant of the success of a differentiation strategy.
(Siegel et al., 1993)	Which characteristics distinguish high-growth from low-growth companies?	None	1600 small firms from Pennsylvania and 105 medium firms in the US.	Longitudinal study from questionnaires	The main findings were: 1. the management need substantial industry experience in order to get high growth. 2. Small firms got high-growth by having a focus on few products and by having a lean strategy. 3. For larger firms were “rapid market growth and the ability to develop close customer contacts identified as discriminating characteristics”
(Thakur, 1999)	Is it possible to develop a typology of firms, based on the relative proportion of influences operating on firm start-up and growth?	Human Resource	50 case studies from North India	Content analysis and tabulation to discern patterns	The main findings indicated that resource access may limit the range of opportunity choice and growth potential. Its shown the managerial capability related to human resources could be more significant than we previously thought.
(West, 2007)	Is there a U-shaped relationship between the new venture performance and the degree of differentiation and integration of strategic constructs within the top management team?	Collective Cognition/Cognitive mapping	22 sets of surveys from intact top management teams	Sociocognitive Grid	It was found that “two structural characteristics of collective cognition (differentiation and integration) were strongly related to firm performance”, and that a inverted U-shaped relationship exist between differentiation and integration.
(Wright et al., 2007b)	What role do the human capital characteristics of individuals and teams play in the complex process of technological entrepreneurship?	Human capital theory, agency theory, cognition theory, and social capital theory	Cross-sectional and longitudinal data collections from previous literature	Literature review	The findings showed a positive link between combining science and technology with business management programs and that a technology-based start-up does not possess both the technology and business know-how required to successfully manage high growth.

Reference	Research question	Theoretical framework	Sample and data	Analytical method	Main finding(s)
(Wright et al., 2009)	Seek to identify and understand the challenges to business schools contributing to the transfer of knowledge to enable academic entrepreneurship.	RBT, Institutional theory	42 interviews from 8 UK universities.	Case based method	Findings from the articles showed that cooperate between an academic school and a business school is hindered by: “the strategies of the university and the business school; links between business schools, TTOs and scientists; and process issues relating to differences in language and codes, goal differences, incentives and rewards, expertise differences and the content of interactions.”
(Zhao et al., 2013)	How some capabilities from the founding team is linked with the venture performance.	Resource-based literature	Interview with 6 founders, and data collection from the "Dun & Bradstreet Corporation database"	Path Model Analysis, making a mediating model.	They found out that marketing capabilities had no impact on new ventures' efforts to create protect ability; however results showed that these capabilities played a key role, for new ventures, when it came to create scalability and financial performance.

The effect and dynamics of the champion's human capital throughout the development of the university spin-off: An empirical study

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Abstract

Commercialization of research results from academic institutions through the establishment of university spin-offs has gained increased attention from scholars and policy makers lately. This article focuses on how the human capital of the champion affects the development of a university spin-off. This article builds upon literature research done by Vendrig and Borgevad (2015), categorizing human capital into three main groups: industry-specific human capital, university human capital and entrepreneurial human capital. By performing a comprehensive quantitative study of 120 Norwegian university spin-offs, this article is able to show the changes of the champions human capital throughout the development of the university spin-off and give a greater understanding of the effect human capital of the champion has on the development of a university spin-off. Surprisingly, this article finds a negative and moderately significant effect between management industry-specific human capital of the champion at founding and attracting venture capital. It is believed that this finding is related to the presence of seed funds in the data sample. With regards to changes in the human capital, this article finds a positive increment of industry-specific human capital and entrepreneurial human capital. The results from this article are of interest to entrepreneurs, investors, technology transfer offices and policy makers, as they provide a greater understanding of how human capital is related to the university spin-off development.

1. Introduction

High-tech start-ups have received increasing attention from academics in the last two decades (Mustar et al., 2006). These start-ups offer an important contribution in four key areas of economic activity: new employment creation, innovation, regional development and export sales growth (Rothwell and Zegveld,

1982, Freeman and Soete, 1997). A subset of high-tech start-ups is university spin-offs (USOs), which lately have become very economically powerful and showed a tendency to be more successful than other spin-offs (Shane, 2004). After the US Bayh-Dole act in 1980, many European countries, including Norway, have initiated similar policies (such as the legislative change in Norway in 2003) to stimulate the growth of USOs (Wright et al.,

2007a, Rasmussen et al., 2013), making USOs more common and important in Europe.

Although there is a general agreement about the important role USOs play in a national innovation system (Knockaert et al., 2010), there is confusion about the individual performance of these ventures. Studies have shown that the problems related to the development of USOs are very complex (e.g. Autio, 1997, Carayannis et al., 1998, Clarysse et al., 2005, Druilhe and Garnsey, 2004, Fontes, 2005, Mangematin et al., 2003, Wright et al., 2006). The complexities are stated to be associated with the heterogeneity of USOs in terms of their business models, their resource endowments and their institutional context (Wright et al., 2006). A study by Wright et al. (2006) showed that the most important resource for a USO in order to succeed as a spin-off was venture capital (VC) investments. The first VC investment is an important event for USOs, because it takes the new venture closer to growth, profitability and financial independence. Studies have shown that spin-offs attracting VC outperform other spin-offs when it comes to time to market (Hellman and Puri, 2000), innovative activity (Kortum and Lerner, 2000) and growth (Heirman and Clarysse, 2005).

A key parameter for a new venture to gain credibility is obtaining investments from VC firms (Vohora et al., 2004). Credibility is recognized as a problem for new ventures in general (Birley and Norburn, 1985). However, for USOs the issue of credibility is argued to be more significant compared to other business start-ups (Vohora et al., 2004). The reason for this is (i) most USOs are based primarily on intangible resources, consisting mainly of technological assets and related know-how within a set of licenses or patents. (ii) Due to the nature of USOs, the majority of founders and the surrounding team are typically academics, often with little experience from commercial environments and working with business development. (iii) The commercialization of scientific discoveries is not embedded in the culture and value of the

academic environment, as this is a non-commercial environment (Vohora et al., 2004).

Academic research addressing the development of USOs in relation with early-stage finance has mainly been on investigating the provider of the capital, such as business angels, banks and venture capitalists (i.e. Wright et al., 2004, Wright et al., 2006, Knockaert et al., 2010). There is a gap in the literature seeking to understand how the champion of the USO affects the development in relation with early-stage finance. As USOs generally are small companies with scarce initial resources, human capital of their champion is argued to be one of the venture's main business assets (Shane, 2004, Cooper and Bruno, 1977, Colombo and Piva, 2012). Therefore, the development of USOs is heavily dependent on the human capital attributes of their champion. In parallel with this, the stylized conception of USOs has been that they are spin-offs championed by university employees seeking to commercialize their own inventions (Politis et al., 2012). This means that most of the studies done assume that an academic entrepreneur with only university experience champion the spin-off, which excludes the possibilities of someone else outside the academic environment to champion the USO. A small stream of research has emphasized this and studied the effects an external-entrepreneur might have on the USO (i.e. entrepreneurs who are not the original academic inventor but who, for different reasons, have earned rights to develop the technology) (Radosevich, 1995, Franklin et al., 2001, Dahlstrand, 2008). Their findings show that external entrepreneurs have easier access to risk capital and strategic alliances, due to their extensive industry experience and business knowledge. This makes them less dependent on a support infrastructure for financing and help to the development of the USO (Politis et al., 2012). However, the evidence of such benefits is scarce, and there is a need for more research that explore how entrepreneurs with different human capital

affect the possibilities for a USO to get early-stage finance, and by that earn credibility.

The overall research question driving this study is “*how does the champion’s human capital influence the development and affect the credibility of USOs?*” This research question is motivated by the gap in the entrepreneurial literature on how entrepreneurs with different experience influence the development and performance of ventures initiated in a university setting (Politis et al., 2012, Dahlstrand, 2008). It also looks at the critical factor *credibility*, and by that seek to answer how the champion influence the venture’s possibilities to transit from a discovered opportunity to an operational business.

Building on Criaco et al.’s (2014) division of specific human capital (entrepreneurial, industry and university), throughout the lenses of Becker’s (1975) human capital theory and Vohora et al.’s (2004) phase model, this paper tries to investigate the effect champion’s human capital have on the development of the USO. This is done using a unique sample of 120 Norwegian USOs registered in the “FORNY-program”, which is a database containing consistent and detailed data of the vast majority of USOs created in Norway since 1995 (Borlaug and STEP, 2009). There has been a lack of quantitative empirical testing of conceptual models in the USO literature, and more empirical studies have therefore been called for (Djokovic and Souitaris, 2008). This study has a quantitative approach where descriptive statistics, controlled by t-tests, have been used in order to investigate the changes of human capital throughout the development of the USO. A regression model has been used to find a relation between different initial human capital and the credibility of the USO.

The results show that managerial industry-specific human capital of the champion during the founding, surprisingly, has a negative impact on the USOs development into gaining credibility, while university human capital positively affects this

development. Moreover, management experience of the champion in terms of industry-specific human capital or entrepreneurial human capital is increasing throughout the development of the USO.

This article is structured as follows. First, definitions of central expressions will be given in order to prevent misinterpretations between the reader and the researcher. Second, theoretical framework relevant to answer the research question is outlined. Third, a set of hypotheses related to the research question is presented, based on the findings of Vendrig and Borgevad (2015). Fourth, a detailed description of the quantitative data collection is given, followed by the results from the analyses. Finally, the results are discussed, before the article concludes with limitations and further research.

2. Theory and hypotheses

2.1 Definitions

In this section the definitions and descriptions of key concepts used in this article are presented. This is necessary in order to prevent misinterpretations by the reader and to build a transparent study, which further research can build on. By doing this the authors hope to contribute to the combined academic knowledge regarding university spin-offs.

2.1.1 University spin-offs

There is a lack of consensus among researchers on how to define a university spin-off. Discordant or vague definitions could harm research as they contribute to misinterpretations and increase the likelihood of scholars using the same term to describe different situations and phenomena (Pirnay et al., 2003). Based on work of Vendrig and Borgevad (2015) and Pirnay et al. (2003) the definition of USOs in this paper is:

New firms created to commercially exploit knowledge developed within a university or a public R&D, where the knowledge is transferred directly from the university.

This definition is useful as it do not confine “founder” to only the academic founder, but also includes surrogate entrepreneurs. Only including direct transfer of knowledge excludes firms that are not founded directly after the researchers left the institute of origin. These ventures are excluded since there are various degrees of information available concerning these firms and there are numerous conditions in the years between the employees left the institution and founded the firm, which would be challenging to account for.

2.1.2 Champion of the USO

As the objective of this research is to discover how the champion’s human capital contributes to the USO development, it is necessary to define and understand the role of the venture champion. A champion is defined as an individual who informally emerges in an organization (Schon, 1963, Tushman and Nadler, 1986) and makes “a decisive contribution to the innovation by actively and enthusiastically promoting its progress through the critical [organizational] stages” (Achilladelis et al., 1971: 14). The role of the champion is often to coordinate and manage the different inputs of resources, skills and entrepreneurial capacity according to the planned development of the venture (Olofsson and Wahlbin, 1984, Klofsten et al., 1988, Vohora et al., 2004).

Earlier studies has shown that the presence of a champion is strongly linked to the success of USOs (Howell and Higgins, 1990). According to Schon (1963), "the new idea either finds a champion or dies.", and Clarysse and Moray (2004) argue that that the role of the champion is absolutely vital for the future development of a project. Some researchers (Zahra and Wiklund, 2000, Heirman and Clarysse, 2004) argue that the entrepreneurial team have great influence on

the development of the USO. However, as argued by Vendrig and Borgevad (2015) the champion is, as the principal decision maker, responsible for the strategic decision making, hiring employees and exercising leadership. Therefore, even though the team itself is important, it can be argued that the venture champion is independently of the entrepreneurial team, and that he/she has a significant impact on the team itself, making it valuable to research the champion separately.

2.2 Conceptual framework

In order to study how the champion’s human capital influence the development and affect the credibility of the USO, this article draw its theoretical framework on Vohora et al.'s (2004) phase model and the findings from Vendrig and Borgevad (2015). The application of Vohora et al.'s (2004) phase model is highly relevant to this research since it points out the most critical barriers and challenges a USO have to go through during their development. This stage-based model also identify the organizational focus within each stage of development and propose the necessary adjustments in the behavior and practices, of champions and the entrepreneurial team, for the business to progress to the next stage (Wright et al., 2007a). Moreover, this stage-based model is developed based on a case study of nine British USOs and it can therefore be argued that the USOs used in this article's sample have a similar development path as the USOs used in Vohora et al.'s (2004) article.

The model presented by Vohora et al. (2004) is a non-linear stage model that consist of phases and junctures. The phases are different periods in the development where the USO focuses on accomplishing certain goals in order to overcome a critical juncture and proceed to the next phase (Wright et al., 2007a). Each critical juncture is the distinction between each phase where the resources and capabilities change (Vohora et al., 2004). The model consists of five phases and four critical junctures, although this study will only focus on three phases and three critical junctures. As

argued by Vendrig and Borgevad (2015), the first phase, called the *research phase*, does not involve any business development and the first juncture, called *opportunity recognition*, are merely the outset for the business development of the USO. These parts of the development will therefore not be focused on in this study. The other phase which will not be focused on in this study is the last phase of Vohora et al.'s (2004) model, called the *sustainable returns phase*. The reason for excluding this phase is that when the USO reach this phase, they have overcome the significant challenges in this model distinctive to USOs and become a functioning business (Wright et al., 2007a). Thus, the challenges of the further development are similar to other types of ventures, losing the USO distinctiveness. This leaves the *opportunity-framing*, *pre-organization*, and *reorientation phases*. The critical junctures left are the *entrepreneurial commitment*, *threshold of credibility* and *sustainable returns junctures*.

According to Vohora et al. (2004), the opportunity-framing phase is where the USO analyzes different application areas to find the best commercial potential and creates a strategy for how to fulfill the potential. The USO crosses the entrepreneurial commitment juncture when someone is confident enough, in the strategy and commercial potential, to commit their time to it. The next phase is the pre-organization phase where the USO experiences difficulties in acquiring the necessary resources due to the lack of credibility. This phase terminates in the threshold of credibility where the USO has gained credibility of the surrounding key players, enabling it to acquire the necessary resources. The last phase of this study is the reorganization phase where the USO has to continuously reorganize its resources as new information emerges in order to overcome the last critical juncture and attain sustainable returns. Figure 1 show how the phases and junctures used in this paper is related to each other and points out the most critical barriers the USO face in each stage.

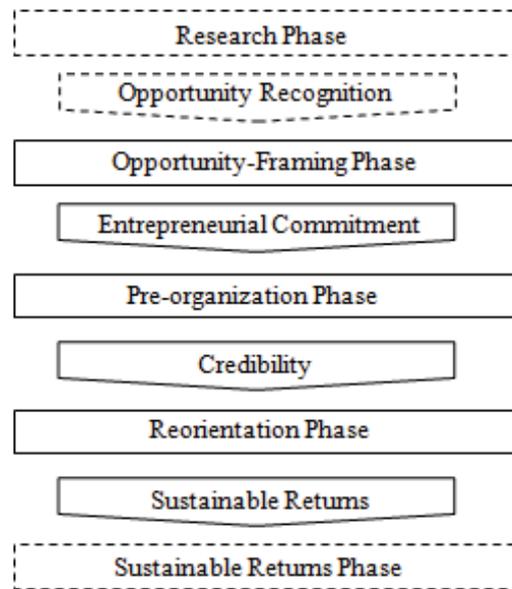


Figure 1: Vohora et al.'s (2004) stage model

To find out how the champion's human capital affects the USO in the aforementioned phases and junctures, this article combine Vohora et al.'s (2004) phase model with the framework of Vendrig and Borgevad (2015), using human capital theory and knowledge based theory. There is consensus in the human capital research that general and specific human capital have a positive effect on USO performance (Criaco et al., 2014). General human capital refers to the general knowledge attributes: professional experience, education and age, measured by number of years (Gimeno et al., 1997). Specific human capital refers to the capabilities and skills gained from education and professional experience (Gimeno et al., 1997). This article do not include USO champions' general human capital as there has not been found to be a distinctive characteristic among the champions, since it is believed that most of them have a similar and high level of general education and experience (Criaco et al., 2014, Colombo et al., 2004). Moreover, overcoming the different critical junctures involves being able to execute a set of functions—such as raising venture capital—that require certain

skill sets. Since specific human capital refers to the skills and capabilities that are acquired through different types of experience, this article will focus only on the specific human capital. This enables the study to relate the champion's background to overcoming the critical junctures.

From Vendrig and Borgevad (2015) it can be seen that the three main dimensions of specific human capital that have received the most attention in the literature on academic entrepreneurship are entrepreneurial, industry-specific and university human capital. Criaco et al. (2014), who also used these three dimensions, argued that these human capital components jointly concur to uniquely characterize USOs as a sub sample of NTBFs. This study will therefore focus on these three dimensions. *Industry-specific human capital (IHC)* refers to experience and knowledge gained from professional experience in the same industry as the USO operates. *University human capital (UHC)* is the experience and knowledge acquired from working with research and teaching at a university-level. The last dimension is *entrepreneurial human capital (EHC)*, which is the knowledge obtained from working in an entrepreneurial venture.

Specific human capital can be divided into skills and capabilities, which mainly refer to different knowledge that the champion has access to that enables him/her to execute different tasks. A framework that describes knowledge and its dynamics is *knowledge-based theory* (Widding, 2005), which will be used in this study to describe the different attributes of the chosen specific human capital. Business knowledge describe the knowledge necessary for the firm to develop into a sustainable business (Chrisman, 1999, Premaratne, 2001) and is described by Widding (2005) in four constituents; product, market, organizational and finance knowledge. *Product knowledge* is knowledge about a technology, production or service. *Market knowledge* is knowledge about the commercial aspect of the business, such as sales and

marketing. *Organizational knowledge* refers to internal management of the venture, such as company structure, routines and management. *Finance knowledge* refers to funding, internal finance management and tax planning.

When it comes to knowledge reservoirs, Widding's (2005) framework consist of three dimensions; internal, semi-internal, and external knowledge reservoirs. Knowledge reservoirs are sources of knowledge, and refer to where the organization accesses it. This study will include internal and external knowledge reservoir, since semi-internal consist of actors such as owners and board members, which is not the focus of this study. Internal knowledge reservoirs contain employees such as the champion, while external knowledge reservoirs consist of people in the network of the USO that is not a part of, or has no interest in the USO itself. Internal knowledge reservoirs is most likely the type that is accessed most frequently by the USO, since it is within the entrepreneurial team and easily accessible, and therefore arguably the most important reservoir (Buckman, 1998, Amit and Belcourt, 1999).

2.4 Hypotheses

Based on Vendrig and Borgevad (2015) and Vohora et al. (2004) a framework is developed using human capital theory and knowledge-based theory. This framework will be used to study the champion's role on the development of the USO. The hypotheses of this study are presented in this section.

As argued by Wright et al. (2007a), funding is often considered to be the key resource that the USO has to attain in order to acquire other resources necessary to overcome the threshold of credibility juncture, and is therefore considered as an operationalization to overcoming the threshold of credibility. Getting funding will therefore be used to operationalize overcoming the credibility juncture.

2.4.1 The effect of the champion's human capital in the opportunity-framing phase

Argued by previous research (Aspelund et al., 2005, Vendrig and Borgevad, 2015), early phase management of the USO is key to later development of the USO due to path dependency. As the principal decision maker, the entrepreneurial champion is central in these decisions. In the early phases, such as the opportunity-framing phase, the champion often operates alone or with a limited entrepreneurial team. Therefore, the decisions and efforts made by the champion initially are crucial to the success of the USO later in its development and might affect the ability of the firm to overcome the later critical junctures. This might also be true concerning the USO's ability to attract venture capital in the credibility phase and overcome the threshold of credibility. Shane (2004) claimed that venture capitalists favored start-ups that pursued a market with a significant commercial potential. According to Vohora et al. (2004) the USO analyzes and makes strategic decisions about what markets to pursue in the opportunity phase, forming the basis of the commercial potential of the USO. As the principal decision maker, the champion's ability to choose the market with the biggest commercial potential therefore sets the direction concerning the USO's ability to attract venture capital in the credibility phase. If the USO is not able to find a market, or a commercial strategy that utilizes the technology in a way that yields significant commercial value, venture capitalists will less likely be interested in investing in it.

When it comes to human capital Vendrig and Borgevad (2015) reasoned that in the opportunity-framing phase university human capital contribute with an internal and external product knowledge reservoir. This knowledge can help the team to find out if the technology is applicable to, or can be altered to fit, an application area that seems promising. On the other hand, as Criaco et al. (2014)

reasoned, the university human capital does not contribute with any significant amounts of business knowledge, besides product knowledge. This makes it challenging for someone with UHC to contribute in the strategic process of choosing what market to pursue and create a strategy for the commercialization which ensures that the USO realizes the highest potential value for their technology. This might inhibit the USO's ability to attain venture capital in the pre-organization phase and therefore inhibit the USO from overcoming the threshold of credibility.

As discussed in Vendrig and Borgevad (2015), industry-specific human capital provides significant internal and external reservoirs of different business knowledge. But this knowledge is industry-specific, which makes it less applicable in other industries than where it is attained. The USO is unlikely to have decided on what industry to pursue when operating in the opportunity-framing phase, but is analyzing the commercial potential of the technology in different industries. Since the business knowledge from IHC is not applicable to other industries, it is challenging for the champion to evaluate the commercial potential in other industries than where he/she has prior experience. This might result in the USO not pursuing the industry with the highest commercial potential, but rather the one the champion is most experienced with since the analysis of other industries becomes insufficient. In addition, it is challenging for someone to form a strategy of execution for an industry with which they are unfamiliar. Therefore, having an IHC champion in the opportunity-framing phase, before the USO has decided upon which market to pursue, might inhibit the USO from obtaining venture capital in the pre-organization phase.

Entrepreneurial human capital provides the USO with the knowledge necessary for the opportunity-framing to yield the best analysis and strategy to pursue the market where the technology has the biggest commercial potential (Delmar and Shane,

2006). Vendrig and Borgevad (2015) argued that EHC provide a significant network of external business knowledge reservoirs spanning several industries that are built from interacting with the entrepreneurial community. The EHC champion most likely also possesses the capabilities required to gather the necessary knowledge for the opportunity-framing phase efficiently (Delmar and Shane, 2006). The external knowledge and internal capabilities provide a solid basis for the USO to do a thorough analysis of the commercial potential in the different industries and create a strategy to succeed with the commercialization. This article therefore aims to test the following hypothesis:

Hypothesis 1: A USO with a champion that possesses entrepreneurial human capital in the opportunity-framing phase is more likely to create a venture which is better equipped to acquire VC and overcome the threshold of credibility juncture, than a USO where the champion possesses university or industrial human capital or none of the aforementioned, with all else equal.

2.4.2 The impact of the champion on attracting venture capital

When the USO has reached the credibility juncture, they have chosen which industry they will pursue and are working to create credibility among the other industry actors and external partners in order to acquire the necessary resources to develop further.

The preferences in different markets concerning how a business should market might vary, and so it can be challenging for actors from outside the industry to succeed in these markets. Both the internal and external market knowledge reservoirs specific to the industry that the IHC champion possesses might contribute to their knowing of how to market the USO and its technology to the industry in such a way that it seems compelling to the key players in that specific industry. For example, the IHC champion can know about different industry-specific additional needs that

the USO ought to meet in order for the potential customers to be compelled to buy the product. The ability to market the USO well might help the USO to look credible to other industry key players, such as venture capitalists.

Another contribution of the IHC to the USO gaining credibility is the external intersecting knowledge reservoirs between the USO and industry key players, described in Vendrig and Borgevad (2015). This can cause the industry key players, such as suppliers and customers, being familiar with the USO, which increases the USO's credibility when reaching out to them, making the key players more inclined to cooperate. This might make it easier for the USO to get actors such as suppliers and distributors to commit to forming a functional value chain. Having a functional value chain ready, may reduce the perceived risk of investing for different VC firms, helping the USO to raise venture capital.

Since the researchers often are the inventors of the technology, it is reasonable to believe that a majority of the USOs have a champion with UHC during the opportunity-framing phase. However, the IHC champion, as argued in this section, will provide the knowledge reservoirs necessary to create the credibility needed to acquire VC and overcoming the threshold of credibility. Therefore, this study argues that champions with IHC will, to a greater extent, be represented in USOs when acquiring VC, than they were in the opportunity-framing phase. The following hypothesis is therefore put forward:

Hypothesis 2a: The proportion of USO having a champion with industry-specific human capital is higher immediately prior to receiving venture capital than at founding.

University human capital has by several studies been found not to directly contribute to obtaining venture capital due to insignificant business knowledge, except product knowledge, that UHC provide to the USO

(Gimmon and Levie, 2010, Hsu, 2007). However, according to Vendrig and Borgevad (2015), having the significant internal and external product knowledge reservoir that an UHC champion at the PhD or professor level has, might give the VC a verification of the technology's viability. This may reduce the VC's perceived risk of investing in the USO, making him/her more inclined to provide the necessary funds. Although, it is not necessary for someone with UHC to be champion in order to provide the product knowledge and being responsible for product development. Considering the lack of market, finance and organizational knowledge, it might be better that the UHC contributor is a part of the entrepreneurial team, but not as the champion.

Based on the argument made previously, it is reasonable to believe that the USO initially had an UHC champion. Due to the lack of ability to develop the USO into a credible business case to the VC, it is likely to believe that of those that receive VC, the UHC champion has been replaced as a champion by someone more capable. The following hypothesis is therefore proposed:

Hypothesis 2b: The proportion of USOs having a champion with university human capital is less immediately prior to receiving venture capital than at founding.

A person with previous entrepreneurial experience, so-called serial entrepreneur, has often interacted with the entrepreneurial community in previous ventures. By doing so, such a champion has built an internal and external knowledge reservoir that can benefit the USO when struggling to overcome the credibility juncture. Since the majority of this network likely consists of people in the entrepreneurial community with knowledge of how to attract venture capital, the USO can access this knowledge and create a strategy to attract venture capital. It can also be assumed that a EHC champion creates credibility for the USO based on the argument in Vendrig and Borgevad (2015) about intersecting external

knowledge reservoirs, also referred to above for IHC. Since VC firms interact with the entrepreneurial environment, the chances of intersecting external knowledge reservoirs between a VC firm and a USO with an EHC champion is high, resulting in the VC firm getting information about the USO. Since the VC firm is likely to be familiar with the USO, and has background information about it in addition to the third-party validation, the credibility of the USO towards the VC firm is likely strong. Additionally, the EHC champion might already know different VC investors personally, thus giving the VC firm better knowledge of the USO and an increased basis to evaluate it, potentially reducing the perceived risk of investing.

The internal business knowledge that the EHC champion provides concerning developing a business, acquired from previous venture experience, might prove to the venture capitalists interested in investing in the USO that the champion really is capable of creating a functioning business (Vendrig and Borgevad, 2015).

As already argued, it is reasonable to believe that the USO initially had an UHC champion. However, the EHC champion is more equipped with both developing the USO into a credible business case and attracting venture capital. As such, the authors consider it likely that there are more EHC champions in the pre-organization phase, among the USOs that received VC, than in the opportunity-framing phase. The following hypothesis is therefore proposed:

Hypothesis 2c: The proportion of USOs having a champion with entrepreneurial human capital is higher immediately prior to receiving venture capital than at founding.

2.4.3 The preferred champion from the VC's point of view

The purpose of the acquisition of funding that the USO is experiencing in the pre-organization phase, is to enable the USO to

develop into a sustainable business (Vohora et al., 2004). It is assumed that the venture capitalists objective of investing comply with the USO's purpose. Therefore it can be argued that if the venture capitalist sees it necessary to change the champion of the USO, the choice of successor will be based on what attributes that enable him/her to develop the USO into a sustainable business. This section will therefore focus on how the different human capital can contribute to sustainable returns in order to predict what human capital that the venture capitalist are inclined to prefer after investing.

As argued in West (2007) and Vendrig and Borgevad (2015), IHC champions provide the USO with external industry knowledge reservoirs by interacting with other actors in their industry-specific network. The knowledge that the USO accesses through this external reservoir might enable it to acquire necessary information to the development through the reorientation phase more efficiently. This will enable the USO to perform the necessary changes in order to develop into a functioning business. This knowledge also enables the USO to acquire information about unexploited opportunities in the market, enabling it to utilize them and grow into a sustainable business.

Strategic viability is often dependent on the context in which the strategic work is performed. Industry-specific human capital provides the champion with knowledge about which strategies are viable in the industry in which the USO operates (Vendrig and Borgevad, 2015). In the reorganization phase, the USO continuously has to restructure its resources and evolve its business strategy as new information and knowledge emerge. The industry-specific strategic knowledge that the IHC champion possesses makes them more capable of forming effective strategies efficiently in order to cope with changes and constantly progress towards becoming a functioning business.

Another tactic to creating a sustainable business is to make the USO work more

efficiently. In order to do so, routines and tools are implemented. The professional experience from working in other companies in the industry provides the IHC champions with organizational knowledge about such tools and routines (Vendrig and Borgevad, 2015). This internal knowledge helps the USO to improve its efficiency, cutting its cost and increasing its potential for sustainable returns.

As argued above, the industrial human capital has a significant positive effect on the USO's ability to become a business generating sustainable returns. It is therefore likely that if the champion of the USO is changed after investing, the preferred champion to replace the previous is likely to be an IHC champion. This result in the following hypothesis:

Hypothesis 3a: After a venture capitalist has invested in a USO, the number of champions with industry-specific human capital will increase.

As argued previously, the main knowledge contribution to the USO from university human capital is the significant product knowledge. As an internal knowledge reservoir, a contributor of product knowledge makes the USO more dynamic by enabling it to find solutions to challenges that arise with emerging information more efficiently. However, this problem solving is not a part of the strategic work that the USO is dependent on its champion to provide in order for it to develop into a functioning business. It is therefore plausible that the UHC contributors who are champions of the USO before passing the threshold of credibility, become more focused on the product development after passing this threshold, succeeded as champion by someone with a more significant business knowledge contribution. The following hypothesis is therefore proposed:

Hypothesis 3b: After a venture capitalist has invested in a USO the number of champions with university human capital will decrease.

As mentioned earlier, reaching sustainable returns is an iterative process, where the firm continually has to reconfigure its resources as new knowledge is obtained and conditions change. This requires the USO to constantly keep innovating. These innovative processes need proper management in order to be efficient and productive (Oakey, 2003, Aspelund et al., 2005, Newbert et al., 2007). Someone with EHC will most likely have organizational knowledge concerning managing a start-up company. This involves innovation management, which makes an EHC champion equipped with tools to manage a constantly changing organization efficiently, making the organization more adaptive to change as new information emerges. The ability to create an organization capable of innovating its product and services, in accordance with feedback from its customers and market in general, helps the firm increase the ability to generate sustainable returns.

In addition to this, as argued earlier in this article and in Vendrig and Borgevad (2015), EHC champions provide a great contribution in different aspect of business knowledge, making them key contributors in strategic formation with the focus of developing the USO into a sustainable business. It is therefore reasonable to believe that someone with entrepreneurial human capital is a preferred successor as the champion of the USO if the venture capitalist finds such a change necessary for its development. The following hypothesis is therefore presented:

Hypothesis 3c: After a venture capitalist has invested in a USO, the number of champions with entrepreneurial human capital will increase.

3. Method

This paper will look at how the initial HC of the champion can contribute to overcome the critical juncture called *threshold of credibility*

for a USO, and how the HC of the champion develops as the USO evolves towards sustainable returns. Receiving VC is used as an operationalization parameter to determining when a USO has surpassed the threshold of credibility juncture. According to Vohora et al. (2004), credibility is the key issue in obtaining the finance needed to establish the venture. In other words, when a USO manages to attract VC, the venture has proven its credibility, and so has passed the threshold of credibility juncture. CEO is used as an operationalization of champion, as the role of the champion is often to coordinate and manage the different inputs of resources, skills and entrepreneurial capacity according to the planned development of the venture, which largely corresponds to the duties of a CEO in small ventures.

In hypothesis 1, the authors investigate how the human capital of the USO's champion in the opportunity-framing phase affects the probability to overcome the threshold of credibility juncture. Since most of the independent variables (IV) and the dependent variable (DV) are operationalized to be binary, they fit into a binary logistic regression model. The IVs have been selected based on past literature and the hypothesis conducted in this paper, indicating the use of hierarchical regression, instead of stepwise regression. A logistic regression creates a statistical model explaining how the IVs affect the outcome, thus enabling an examination to find if hypothesis 1 is supported. Using an event history analysis or a t-test has been considered as an applicable method. However, as this paper does not focus on timing or duration until an event occurs, an event history analysis would not be within the methodological scope of this paper. A t-test would have some limitations, since it do not consider covariance between the IVs, and from the Pearson correlation matrix in section 4.1 it can be seen that some of the IVs covariate significantly.

The binary logistic regression is based on the human capital of the CEO at founding since the knowledge and skills embedded at the birth of the firm impact how the venture

evolves (Cooper et al., 1994). Research from Boeker (1989) shows that characteristics at founding can affect the firm's strategy and hence influence its subsequent development. Results from other studies (Aspelund et al., 2005, Criaco et al., 2014, Delmar and Shane, 2006, Geroski et al., 2010, Gimeno et al., 1997) also show that the pre-entry knowledge and experience of the entrepreneurs at founding is linked to the venture's performance in the long-run. Being in the opportunity-framing phase is operationalized as the founding of the USO, as founding year of the USOs in this study is the year the USO received support from the FORNY-program¹. The reason for this is that when the USO enters the FORNY-programme, it has decided to explore the commercial opportunity of the technology. This is, by Vohora et al. (2004) and Vendrig and Borgevad (2015), described as the opportunity recognition which initiates the opportunity-framing phase. Due to this, it can be argued that the spin-offs getting support from FORNY have passed the opportunity recognition juncture and entered the opportunity-framing phase.

In hypotheses 2 and 3, the human capital of the champion through different stages is analyzed. The HC development is shown using a bar graph. To test whether the statistical means between the stages are significantly different, two t-tests have been conducted. Since this paper only looks at the mean between two different groups, a t-test was considered to be a good statistical hypothesis test. An *analysis of variance model* (ANOVA) was also considered, but since this model is particularly useful for comparing three or more means, and this paper only considers the difference between two means,

¹ The FORNY-program is a program created to contribute to innovation and value creation in the Norwegian industry, by enhancing the ability to commercialize research-based business ideas that arise from in Norwegian universities (BOLKESJØ, T., VAREIDE, K. 2004).

this was not regarded as a necessity.

For hypothesis 2, investigating changes in HC from founding to right before the USO receive VC, an independent-means t-test was conducted since the sample size was different between the two reference points. The sample of hypothesis 3 included the same ventures and had the same size in both stages, thus a dependent-means t-test was conducted.

The events this study looks at are; (i) founding and (ii) before and (iii) after the USO received VC. At founding, the sample included the HC of 120 CEOs. Of the 120 ventures, 51 of the USOs managed to attract VC. The HC of the CEO right before the investment was registered for the 51 USOs attracting VC. 15 of the 51 USOs that got VC changed CEO within two years; HC of the new CEO was also collected. Whether or not the USO had obtained VC was collected from the FORNY database. As this variable was only coded per year the authors did not know at what time during the year the USO received VC. Therefore, a CEO change within a maximum span of two years was chosen to ensure that every firm in the sample had 1 year before the CEO had to be changed to be included as a VC motivated change. The reason for choosing 1 year as an interval is that a recruitment process can take a significant amount of time.

3.1 Sample

The database used in order to get the data sample for this study of 120 USOs is based on the Norwegian FORNY-programme. The FORNY-programme, established in 1995 by the Norwegian Council of Research, is a governmentally funded research support program. The main objective of this program is to trigger the value creation potential of research based business ideas from publicly financed research institutions. The firms involved in this programme are pre-start-up academic spin-offs, which are either in their research or opportunity-framing phase. Since the start in year 1995 until 2012, the FORNY-programme has generated 417 ventures and 424 licensing agreements (Rasmussen et al.,

2013). It is estimated that the accumulated value creation of the ventures will surpass NOK 15 billion in 2017 (Rasmussen et al., 2013). More than one billion NOK has been invested through the FORNY-program since 1995 (Rasmussen et al., 2012).

In 2003, Norway introduced a legislative change that granted the intellectual property rights to research, that previously belonged to the researcher, to the university that it originated from. Due to this change, new technology transfer offices (TTOs) got established in Norway's largest research institutions. Their object was to act as commercialization agents for the inventions created at the universities and help establishing new spin-off companies (Gulbrandsen and Rasmussen, 2012, Borlaug and STEP, 2009). As the legislative change and the following establishment of TTOs was introduced some years after the FORNY-programme got established, it is reason to believe that this program includes the majority of Norwegian USOs after 2003.

The content in the FORNY register is an outstanding dataset when conducting studies about USOs in Norway. The reason for this is the scope of the programme. As written earlier, the FORNY-programme is believed to include the vast majority of Norwegian USOs since 2003 (Rasmussen et al., 2013). The register contains ventures within a wide range of high technology research sectors, located from several geographical locations in Norway (Rasmussen et al., 2013). Due to the large scope of the programme and the great variety, studies can control for numerous of external factors such as economical, cultural and environmental variables. The dataset also contains start-ups that have ceased to exist, preventing a survivor bias in the study.

3.2 Data collection

The data collection of the 120 USOs in our sample was performed in two steps. In the first step, data was collected on firm-level, whereas the second step consisted of collecting data about the CEO of the firm on the individual

level. Each step of the data collection will be explained in the next sections.

3.2.1 Firm-level data collection process

The sample of 120 USOs was selected based on their academic origin. Of the 417 USOs in the FORNY-programme, 129 firms was chosen that had an academic connection with one of the four biggest universities in Norway, *Norwegian University of Science and Technology* (NTNU), *University of Bergen* (UiB), *University of Tromsø* (UiT) or *University of Oslo* (UiO). This limitation was chosen in order to narrow down the differences between external factors, such as university size and support systems, that might blur the model and to make the sample as coherent as possible. This limitation is strength of this study and makes it easier for future research to duplicate this study. Nine of the 129 USOs had been transformed, meaning that the business had merged with an associated company or that the business had transferred its activity into a subsidiary or associated company. After such a transformation the original venture either moves its activity into another legal entity or gets deleted from the registry, making the information trail inconsistent post transformation. Due to the inconsistent information, these nine USOs were not included in the analysis, leaving a sample of 120 start-ups. Table 1 displays the academic origin of the selected 120 USOs.

A general template of the coding sheet, which is presented in figure 4 in appendix, was made, for each USO to gather all relevant information needed. Most of the business level information was extracted from the FORNY database. To extract the relevant information needed in this study from the FORNY database a macro was made. The macro copied the relevant information from the FORNY database and pasted it into the coding sheet of each USO. Table 7 in appendix display the variables gathered from the FORNY-programme and how the variables were characterized. The USOs in our sample were

founded between 2001 and 2011, with an average age of 8.7 years. 51 of the ventures had received VC and 33 were marked as failures. The ownership structure of the USO, registered in its Annual Report, has been used in order to check if the USO received VC. A venture was marked failure if the activities of the USO, connected to the FORNY program, were unsuccessful. Whether or not the venture was deleted from the national business register was not used as a failure parameter since several firms use their legal entity for other purposes after failing with their original activity.

Origin of the USO	Number of USOs
NTNU	57
UiO	30
UiB	18
UiT	15

Table 1: Academic origin of the USOs

3.2.2 Individual level data collection

The second step of the data collection was a gathering of the relevant human capital of the CEOs in each USO. This information was collected in the 120 templates made in the previous phase. First a list of all the CEOs for each venture was gathered. This information was collected using the national business register (www.brreg.no), where all ventures are obliged to inform about changes of the CEO. Then all CEOs that were leading the venture at founding, before and after receiving VC were further investigated. The work experience of these CEOs were tracked and measured. Each variable was coded as *yes*, *no* or *unknown*, giving us an overview of the human capital of the CEO. The depth of the CEO's human capital, in terms of over how many years the human capital had evolved or the level of the human capital, was not registered. The limitations of this approach are discussed in section 3.4. Data about the CEOs was mainly collected using LinkedIn. To control check the information on LinkedIn and find information that was not available through this webpage,

the authors also used the USO's web pages, the webpage "www.bloomberg.com" and the initial business plan of the venture² as a source.

3.3 Variables

The analyses of this study both use micro level and meso level variables. This is due to the hypothesis that looks at how the human capital of the CEO in a USO (individual level variables) affects the USO's development (firm-level variable). The independent variables that characterize the human capital of the CEO are all individual level variables, while the dependent variable, whether or not the USO has received venture capital, is a firm-level variable. The mix of both micro and meso level variables is a common practice in human capital research and are used by many researchers (Gimeno et al., 1997, Shane and Stuart, 2002, Grilli, 2010, Criaco et al., 2014).

In the following section the different variables used in this study model analyzes are present. How the variables were operationalized and the given criteria for each variable are also explained in this section. First the dependent variable is presented, followed by the independent variables and control variable.

3.3.1 Dependent variable

The VC variable is marked as 1 if a VC or a seed funding firm is found in the ownership structure, 0 if not. This study have only recorded the initial VC funding of the venture. The size of the invested capital or differentiations between VC ventures is also not taken into consideration. These are limitations in the analysis that will be discussed further in section 3.4. 42.5% of the USOs in our sample received VC funding.

3.3.2 Independent variables

The independent variables are a measurement of the human capital provided by the CEO of the USO at different events. In total the HC of

² The first business plan of all the ventures was available through the FORNY database

145 CEOs in the sample of the 120 USOs were registered.

Entrepreneurial human capital (EHC) was coded as 1 if the CEO had previously launched or led a start-up, 0 if not. Research by Smith and Ho (2006) showed that an average start-up use 10 years to accelerate the rate of growth. During this phase procedures and routines are often implemented, reducing the influence of the employee's entrepreneurial human capital development. Due to this, a firm age of 10 years was chosen as the upper age limit of a start-up. Also, experience from consulting firms in the form of sole proprietorships was not registered as EHC, even if the CEO was the founder of the firm. This is due to the nature of a consultant company where the "product" being sold is only the knowledge of the consultant. Since it often is less need to obtain and plan how to use resources or build an organizational structure in a sole proprietorship consulting firm, it was decided not to categorize this experience as entrepreneurial experience.

University human capital (UHC) measures knowledge the CEO has achieved through past working experience at a university. If the CEO has been employed at the university, either as a professor or as a researcher, the UHC was coded as 1, if not the UHC was coded as 0. If the CEO held a technical PhD, the CEO was coded with UHC as it was assumed that research was conducted in order to achieve the PhD degree. Students at the university, taking a master or bachelor degree are not coded with UHC since this is not considered as professional experience due to the low level of research work included in attaining the degree. This definition is similar to those of Colombo and Grilli (2010) and Criaco et al. (2014).

Industry human capital (IHC) measures if the CEO has gained industry-specific skills and knowledge through past professional experience in private companies. When looking at the background of the CEOs it was found that the work experience could both be technical or management related. One

can argue that a CEO with a technical experience provides a good technical insight, but lacks management and commercial experience, while the opposite would be true for a CEO with management experience. Due to this, it was decided to divide IHC into two sub groups, *technical industry human capital* (TIHC) and *management industry human capital* (MIHC). If the CEO had previous technical working experience in the same industry as the current USO the TIHC was coded as 1. The TIHC was also coded as 1 if the CEO had taken part in a R&D cooperation contract with industrial firm(s); otherwise the variable was coded 0. This definition is similarly to Criaco et al. (2014). MIHC was coded as 1 if the CEO previously had a management position in a firm in the same industry as the current USO, or if the CEO had been working as a consultant.

3.3.3 Control variables

Every variable included in a regression model acts as a control to the other. Thus, control variables have been used in the regression analysis to improve the reliability of the independent variables. In order to improve the reliability, only variables believed to be relevant with the dependent variable are chosen.

The student control variable is marked as 1 if the USO is primarily initiated by students. In the cases where students are a part of the USO, but other founders, related to the originated university, is the champion, the variable is marked as 0. In the sample of this study, 18% of the USOs are student start-ups. Whether or not the USO is a student start-up is chosen as a control variable since the study of Pirnay et al. (2003) has shown that student start-ups often have inadequate credibility towards external partners, and that their ventures are "rarely grounded on extensive research activities" (Pirnay et al., 2003). This gives reasons to believe that this variable is going to have an exp(B) value below one and a negative correlation with the dependent variable, venture capital.

USOs based on specific technology are believed to have higher financial needs and material needs than USOs based on general scientific knowledge. This is because specific technology based ventures typically develop a product, while general scientific knowledge more often become service oriented. Due to this, one can argue that a spin-off based on specific technology strive more to get VC funding than a spin-off developed from general scientific knowledge. Accordingly, it is expected that this variable is positively correlated with VC funding related to spin-offs based on specific technology. Whether or not the spin-off is based on specific technology or general scientific knowledge is therefore used as a control variable. It was challenging to find information about 24 of the USOs in the sample confirming if it was based on specific technology or general knowledge. However, those spin-offs based on specific technology in most cases stated that the spin-off was based upon technology from the parent institution. It is therefore assumed that all spin-offs marked as unknown is based on general knowledge. This assumption is a limitation in this study. The sample of this study consists of 57% spin-offs based on specific technology and 43% spin-offs based on general scientific knowledge.

The spin-offs in the data sample were founded between 2000 and 2011, giving it a span of 11 years. It is assumed that the financial environment has changed during this period, especially after the dot-com bubble burst in 2000 and the subprime mortgage crises in 2007. Changes in the financial environment might affect the willingness for venture capitalists to finance start-ups. Thus, it is controlled for the year of founding. In the first test founding year was used as a scale variable, this affected the constant DFBeta value considerably. To reduce these oscillating constant DFBeta values in the regression model, founding year was coded as years since founding as an ordinal variable. The USOs founded in year 2000 got the value of 15, decreasing for younger ventures. Due to this

change, the correlation and exp(B) values for the founding year variable are inversed.

Using time from founding to receiving VC as a control variable, in terms of USO age, has also been considered. A USO established in 2010 has had far less time to raise VC than a USO established in 2000. Thus, the USO founded in 2000 might have bigger chance of receiving VC. However, further inspection of the VC variable showed that the average time to first VC was 1.90 years. The measurement of the DV stopped in 2014 and the youngest USO in the sample was founded in 2011, meaning that all USOs have had minimum 3 years to receive their first VC, which is fairly above the average. Due to this it was decided to not include USO age as a control variable.

3.3.4 Variables not included in the analyses

The ratio between number of independent variables and sample size need to be taking into consideration when dealing with a relative small sample as done in this paper. Studies suggests a minimum of 10-15 cases per individual variable (Field, 2009) in order to not lose the reliability of the predictors and the model (Green, 1991). Thus, the selection of control variables has been carefully reviewed, as it is preferable to exclude variables with small predictive power.

Education was excluded as control variables since earlier research show that HC gained from formal education has a nonlinear and inconsistent effect on the development and exploitation of opportunities (Avermaete et al., 2004, Bosma et al., 2004, Davidsson and Honig, 2003, Haber and Reichel, 2007, Mayer-Haug et al., 2013, Stuart and Abetti, 1990). The positive effects of education is argued to originate from the status and signaling effect obtained through the education rather than the experience and skills it gives the individual (Dore, 1976). Education is also believed to have a strong effect and high correlation with work experience, which is measured directly in this study.

The university the USO originates from has also been excluded as a control variable. Including this factor would result in a considerable set of extra dummy variables, as this variable is nominal. It can also be argued that Norway is a relatively small and homogeneous country, and the quality of the universities chosen in our sample are relatively even.

The analyses only focus on the champion of the USO, which is arguably the most influential person in the entire USO. However, it is been argued that most new ventures are started by teams, and that these teams make decisions together (Klotz et al., 2014), thus, making the team and not only the champion an integral part of the development of the USO. Therefore, not including the entrepreneurial team as a control variable is a limitation in this study. However, it is believed that the champion of the USO will reflect the whole team to some degree. Another reason for why this variable was not included in the analysis is that the definition around the boundaries of the entrepreneurial team is blur, and the information about the entire team was not available to the authors.

A factor that might have affected the results in the analysis is that not every new venture wants or need venture capital. However, as this information was not available to the authors, and as it can be argued that most USOs need external funding, as their development often requires a lot of resources, this variable was not included.

3.4 Methodological limitations

Research design

The lack of a longitudinal approach is an important limitation of this study. It can be argued that all CEOs of a USO previous to an event are to some extent affecting the outcome of the event, not just the one CEO at the time of the event. Following this argument the human capital of all CEOs previous to an event, such as receiving venture capital, should be included when investigating how the human capital of the CEO affect the result of the

event. Figure 2 and 3 gives an overview of the human capital of the CEO before and after the USO receives VC, which might give an indication of how the significance of the human capital change at this point. However, this graph is inadequate to predict what type of HC that correlates with VC funding. Secondly, by not having a longitudinal approach exclude the HC gain of the champion learning from performing as the CEO of the USO. Some of the CEOs in the sample have held their position since the founding of the USO, and it would be of interest to explore how this affects the USO.

LinkedIn

LinkedIn was used as the main information concerning the HC of the different CEOs. The quality and the incompleteness of the information that the different CEOs provide on this web page might vary. First, the personal content on the web page is provided by the users, and since LinkedIn often is used as a platform to attract job offers and search for business opportunities, the information might be biased as the person most likely show mainly positive experience. During the data collection it was noticed that several of the CEOs involved in a failed USO excluded this from their LinkedIn page. Another limitation with LinkedIn is the lack of content. In several cases there were not any descriptions of the previously held positions, and assumptions had to be made whether the work experience was related to the industry of the current USO. To limit the consequences of these limitations information was cross checked and supplemented through the initial business plan of the USO and other web pages like the homepage of the university that it originated from, www.bloomberg.com and a variety of web searches. However, using LinkedIn is seemed as strength in this analysis as the option would be to make a survey. A survey would most likely lower the sample size as many CEOs would not reply and it would have higher chance of containing false information, since the information would only be seen by

the authors. LinkedIn on the other hand, which is public open for everyone with a premium membership, as the authors had, provide consequences to publishing incorrect information, as it will be lying publicly, and thereby can be disapproved by others.

Not weighting work experience

Most of the variables used in the analyses were binary variables and none of them were weighted, which provide some limitations. The work experience of the CEO could be weighted with the number of years they held one position. Work experience should be weighted since it is gained and evolved over time. It would be natural to assume that a person working in one position over several years would gain more experience and knowledge than a person working in the same position only for one year.

VC as a binary variable

The VC variable is a binary variable, which not differentiate between the investment size and the quality of the firm providing the funding. There are great differences between the institutions funding the different USOs in our sample. Some of the investors (e.g. Sintef Venture AS and Sparebank 1 SMN Invest) only make seed investments and have a tendency to be co-funded by the government. These firms often have alternative motivations, besides return on investment, to invest in a USO, such as promoting innovation in certain industrial sectors, removing profit as the main objective. Another limitation is that the study only looks at the first VC and not the subsequent investors. As many of the first investments are seed investments, later and larger investments might be of more importance for the USO, and it would be interesting to look at the development of the champion between the investments.

Management experience

Management experience in general is not included in the analysis as only specific EHC, UHC and IHC is looked at. The reason for this is that both IHC and EHC often include

management experience in different regards, and it can therefore be argued that management experience is a sub dimension of IHC and EHC. However, it is a limitation in this study, as a CEO with many years of work experience in a management position is marked with zero human capital if the position was in a different industry.

4. Results

In this section the results from the analyses of the study are outlined. For hypothesis 1, the dependent variable *venture capital* is analyzed using a binary logistic regression. For hypotheses 1 and 2, a bar graph, based on measurements of the champion's human capital at the different stages, was made to show the development of HC through different phases. Two t-tests were also done in order to find out if the means between the stages are significantly different.

4.1 Correlation matrix results

Table 2 presents a Pearson correlation matrix reflecting the variables that are believed to be connected with acquiring VC. The matrix is arranged in two blocks, control variables and HC variables. The matrix gives an estimate to the degree of association between the variables, and makes no a priori assumption as to whether or not one variable is dependent on others. A value of +/-0.1 represent a small effect, +/-0.3 is a medium effect and +/-0.5 is a large effect (Field, 2009).

From the table it can be seen that both the management IHC (5) and University HC (7) variables correlate negatively with the Student start-up (4) variable with a medium to large effect of -0.234 and -0.311. This correlation is not surprising as it is expected that most students lack work experience. University HC (7) and technical IHC (8) is also significant correlated with a medium positive effect of 0.267. As most of the CEOs in our sample have gained their UHC through

	1	2	3	4	5	6	7	8
Venture Capital (1)	1							
Control variables	Founding year (2)	.201*	1					
	Product-oriented (3)	-.065	-.023	1				
	Student start-up (4)	-.041	.017	.004	1			
Human Capital	management IHC (5)	.171	.011	.157	-.234*	1		
	technical IHC (6)	-.075	-.026	.142	-.034	.160	1	
	University HC (7)	-.109	.104	.052	-.311**	-.026	.267**	1
	Entrepreneurial HC (8)	.077	-.101	-.014	-.070	.132	-.088	-.127

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table 2: Correlation matrix

relevant technical research at an university, they sit on knowledge valuable for a technical position at a privately owned firm. Due to this, one would expect that many people with UHC also could have held a technical position at a private firm.

4.2 Regression analysis

Table 3 presents an overview of the hierarchical linear regression model. The variables were divided into two models. Model 1 contains the control variables, and model 2 contains the HC of the CEOs at founding.

Founding year has the highest significant value (0.037) in model 1. The exp(B)-value of 1.129 indicates that the variable has a positive influence on the odds of receiving venture capital. The founding year variable is coded as years since incorporation, due to this the positive value applies to firm age. Whether or not the USO is product oriented have the largest exp(B)-value of 1,376, but is not significant. The student start-

up variable had a exp(B)-value of 1.225, indicating a positive effect on the odds of receiving venture capital. From earlier literature and theory, one would expect this odds ratio to be below one, due to the inadequate credibility and moderate research knowledge of a student (Pirnay et al., 2003). Further inspection of the student start-ups show that 24% of the CEOs had entrepreneurial education, while only 6% of the CEOs in other USOs had this education. Entrepreneurial education gives students theoretical knowledge relevant to starting a business and might also give the students a greater entrepreneurial network through the community surrounding the education. However, the sig-value of the variable is too high (0.689) to have any significance, therefore nothing conclusive can be said.

Model 2 demonstrate no support for hypothesis 1, stating that EHC in the opportunity-framing phase have a bigger positive impact on attracting VC than IHC and UHC, as the odds ratio of EHC (0.757) is below 1 and lower than TIHC and UHC, and none of the variables are significant. MIHC stands out with the lowest exp(B)-value of 0.454, and are the only variable approaching significance. Both TICH and UHC had a positive odds ratio, were the latter had the highest value of 1.804.

4.2.1 Control and verification of the regression model

In order to draw conclusions about a population based on a logistic regression

At founding	Model 1		Model 2	
	Sig.	Exp(B)	Sig.	Exp(B)
Control variables				
Founding year	0.027**	1.129	0.016**	1.149
Product oriented	.409	1.376	.337	1.476
Student start-up	.689	1.225	.696	1.246
Human capital				
Management IHC			0.100*	.454
Technical IHC			.624	1.294
UHC			.202	1.804
EHC			.699	.757
Chi-square	5.974		5.991	
Chi sig.	.113		.200	
"-2 Log likelihood"	153.123 ^a		147.133 ^a	
Hosmer&Lemeshow sig.	.871		.332	
Cox & Snell R Square	.050		.097	
Nagelkerke R Square	.067		.131	

**p is significant at the 0.05 level (2-tailed)

*p is significant at the 0.1 level (2-tailed)

Table 3: Regression analysis

analysis from the sample of this study, several multicollinearity tests has been taken. This was done to check if there are correlations between the predictor variables that can affect the model. From the table 2 it can be seen that the predictors with highest correlation were UHC and student start-up with a correlation of -0.311, which is beneath the absolute critical value of 0.8 (Field, 2009). The values in the *variance inflation factor* (VIF) test, which gives an indicator if there is a significant correlation between the independent variables, did not exceed the critical limit of 10. The results from the VIF-test can be seen in appendix table 8.

A set of residuals were examined to see how well the regression model fits the observed data. The *standardized residuals* were examined to detect outliers. None of the absolute values were above 2.5 and less than 5% of the cases had absolute value above 2. This indicates that there are no outliers (Field, 2009). To check if any cases exert undue influence over the parameters of the model, *Cook's distance* and the *DFBeta* values were calculated. None of the values of Cook's distance or absolute values of DFBeta were greater than 1, indicating that no particular cases influence the regression model (Field, 2009). The standardized residuals, Cook's distance and DFBeta values can be found in appendix; figure 5, 6 and 7.

As a *Goodness-of-fit* evaluation, the *Hosmer & Lemeshow test* was used. The Hosmer & Lemeshow statistics notify if the given data are significantly different from the predicted values in the model. The test was non-significant throughout the analysis, indicating that the model is predicting the real-world data well (Field, 2009).

The *2 log-likelihood statistic* show how much unexplained information there is after the model has been fitted (Field, 2009). In this analysis it is decreasing from model 1 to model 2, indicating an improvement of the model. However, the *Chi-square block* sig-value, which represent the improvement of the

predictive power of the model since last block (Field, 2009), is increasing from model 1 to 2, with a significance above 0.05. This mean that it cannot be concluded that, overall, the model is predicting whether a USO receive venture capital or not significantly better in model 1 than model 2.

4.3 Human capital development from founding to right before receiving VC

Figure 2 displays the human capital held by the CEO of the USO at two different events; (i) founding and (ii) right before the USO receive their first VC. In the first stage the HC of 120 CEOs were collected. For the second stage HC from 49 CEOs were collected, since the number of companies receiving VC was 49 compared to 120 companies founded. As seen in figure 2 the changes in these variables are trending to increase, with the exception of UHC. The largest relative increase is in the MIHC and EHC.

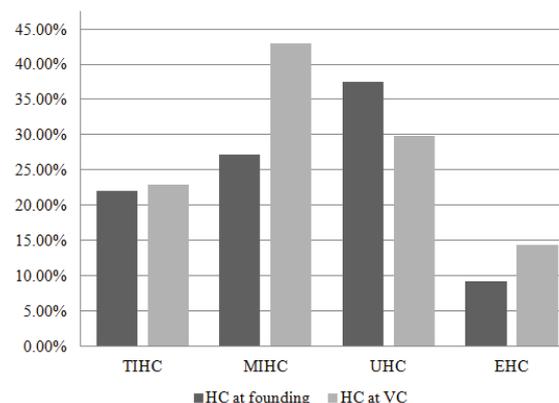


Figure 2: Change in human capital from founding to right before receiving VC

To test if the differences in HC between the two events are random, a t-test has been conducted. Table 4 displays the independent t-test between HC at founding and VC. For TIHC and EHC the *Levene's test* is non-significant (i.e. $p > 0.05$), indicating that there is not sufficient evidence to assume a difference between the variances equal to zero (Field, 2009). Due to this the test statistics in the row labeled *Equal variances not assumed* is used, as the results indicate that the difference

		Levene's test		t-test for Equality of Means			Group Statistics		
		F	Sig.	t	df	Sig. (2-tailed)	Mean (M)	Std. Error Mean (SE)	
TIHC	Equal variances assumed	9.948	0.002	-2.002	0.165	0.047	Founding	.27	.04
	Equal variances not assumed			-1.910	81.387	0.060	VC	.43	.07
MIHC	Equal variances assumed	0.060	0.807	-0.123	0.164	0.902	Founding	.22	.04
	Equal variances not assumed			-0.122	85.644	0.903	VC	.23	.06
UHC	Equal variances assumed	4.218	0.042	0.935	0.165	0.351	Founding	.38	.04
	Equal variances not assumed			0.955	88.095	0.342	VC	.30	.07
EHC	Equal variances assumed	3.670	0.057	-0.976	0.167	0.331	Founding	.09	.03
	Equal variances not assumed			-0.898	75.647	0.372	VC	.14	.05

Table 4: Independent t-test describing the difference in human capital at founding and at VC

between the variables is not zero. The Levene's test is significant (i.e. $p < 0.05$) for MIHC and UHC, indicating that the difference between the variances is zero. Thus, the statistics from *Equal variances assumed* is used.

On average, the MIHC of the CEO was greater right before the USO received VC ($M=0.43$, $SE=0.07$) than at founding ($M=0.27$, $SE=0.04$). This difference was significant ($p=.05$); and the variable represented a large-sized effect ($r=.98$). The TIHC of the CEO was slightly greater right before the USO received VC ($M=0.23$, $SE=0.06$) than at founding ($M=0.22$, $SE=0.04$). This difference was not significant ($p=.90$); and the variable did not represent a noticeable effect ($r=.01$). Thus, hypothesis 2a, stating an increase of IHC right before VC, is partially supported, as MIHC shows significance and TIHC shows no significance.

The UHC of the CEO was generally lower right before the USO received VC ($M=0.30$, $SE=0.07$) than at founding ($M=0.38$, $SE=0.04$). This difference was not significant ($p=.35$); however, it did represent a large-sized effect ($r=.92$). Thus, hypothesis 2b, which propose a decrease of UHC between founding and VC, is weakly supported as the variable showed no significance, but showed a large-sized effect.

Hypothesis 2c, stating an increase of EHC, is not statistically supported as the difference was not significant ($p=.37$); and the variable did only represent a small-sized effect ($r=.10$). However, the EHC of the CEO was

overall greater right before the USO received VC ($M=0.14$, $SE=0.05$) than at founding ($M=0.09$, $SE=0.03$).

4.4 Development of the human capital before and after obtaining VC

Of the 51 USOs receiving VC, only 15 (29%) changed their CEO within 2 years. Figure 3 shows the change of HC within the CEO of these 15 USOs. It is chosen to look at the 15 USOs since this paper is interested in which HC the VC firms prefer to change to when they replace the CEO of the USO. EHC showed the largest change with an increment of 33%, while UHC showed no change at all.

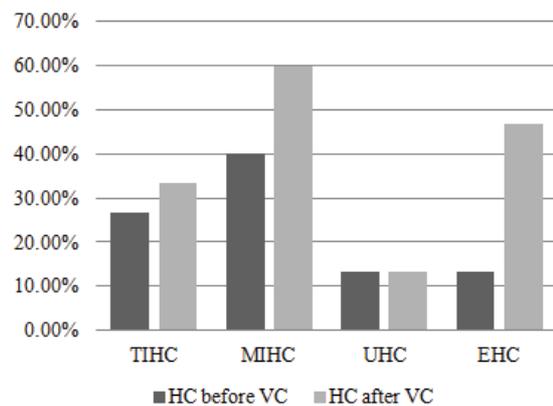


Figure 3: Human capital development from before and after receiving VC

It can be seen from the dependent t-test that the MIHC of the CEO was greater after the CEO change ($M=0.60$, $SE=0.13$) than before ($M=0.40$, $SE=0.13$). This difference was not significant ($p=.19$); however, it did represent a medium-sized effect ($r=.35$). TIHC of the CEO was significantly correlated before and after

		Std.Error		Correlation		t	df	Sig. (2-tailed)
		Mean (M)	Mean (SE)	Correlation	Sig.			
TIHC	Before VC	.27	.12	.53	.04	-0.56	14	0.58
	After VC	.33	.13					
MIHC	Before VC	.40	.13	.39	.15	-1.38	14	0.19
	After VC	.60	.13					
UHC	Before VC	.13	.09	-.15	.58	0.00	14	1.00
	After VC	.13	.09					
EHC	Before VC	.13	.09	.42	.12	-2.65	14	0.02
	After VC	.47	.13					

Table 5: Dependent t-test describing the difference in human capital before and after receiving VC.

receiving VC ($r=.53$, $p=.04$). This indicates a positive relationship between TIHC before and after receiving VC. The TIHC was generally greater after the CEO change ($M=0.33$, $SE=0.13$) than before ($M=0.27$, $SE=0.12$). This difference was not significant ($p=.58$); and the variable did not represent a noticeable effect ($r=.02$), thus hypothesis 3a, which propose an increase of IHC, is weakly supported as the variables showed no significance, but the MIHC showed a medium-sized effect. The UHC mean of the CEO before and after receiving VC was the same ($M=0.13$, $SE=0.09$). This similarity was not significant

($p = 1.00$); and the variable did not represent a noticeable effect ($r=.00$), thus hypothesis 3b is not supported. On average, the EHC of the CEO was greater after the CEO change ($M=0.47$, $SE=0.13$) than before ($M=0.13$, $SE=0.09$). This difference was significant ($p=.02$) and it did represent a large-sized effect ($r=.58$), thus hypothesis 3c is supported. Although there is no minimum sample size for a t-test to be valid, the small size causes that only large effects will be statistically significant. Due to this, it was expected to get few significant results.

Corroboration of hypotheses

H1: <i>A USO with a champion that possesses entrepreneurial human capital in the opportunity-framing phase is more likely to create a venture which is better equipped to acquire VC and overcome the threshold of credibility juncture, than a USO where the champion possesses university or industrial human capital or none of the aforementioned, with all else equal.</i>	Not supported
H2a: <i>The proportion of USO having a champion with industry-specific human capital is higher immediately prior to receiving venture capital than at founding.</i>	Partially supported
H2b: <i>The proportion of USOs having a champion with university human capital is less immediately prior to receiving venture capital than at founding.</i>	Weakly supported
H2c: <i>The proportion of USOs having a champion with entrepreneurial human capital is higher immediately prior to receiving venture capital than at founding.</i>	Not supported
H3a: <i>After a venture capitalist has invested in a USO, the number of champions with industry-specific human capital will increase.</i>	Weakly supported
H3b: <i>After a venture capitalist has invested in a USO the number of champions with university human capital will decrease.</i>	Not supported
H3c: <i>After a venture capitalist has invested in a USO, the number of champions with entrepreneurial human capital will increase.</i>	Supported

Table 6: Corroboration of hypotheses

5. Discussion

This chapter will discuss the results from the analyses. By using Vohora et al.'s (2004) phase model as a framework, this study investigates the development of the champion's HC from opportunity phase to the reorientation phase and how the human capital of the USO's champion influences the venture's possibilities of gaining credibility. In order to do so, three aspects had to be operationalized into variables. The USO passing the credibility juncture is operationalized as obtaining VC, being in the opportunity-framing phase is operationalized as founding of the USO, and the champion is operationalized as the CEO.

First, the champion's role in the opportunity phase and their effect on obtaining credibility for the USO will be investigated. Secondly, the role of the champion in the pre-organization phase is discussed. Thirdly, this paper moves on to consider the champion's role in the reorganization phase. Finally, the changes of the champion's HC throughout the development of the USO will be discussed.

5.1 The champion's role in the opportunity phase of the USO

It can be seen from the results section that a champion with EHC in the opportunity phase of the USO is negatively related to attracting VC. Getting finance is according to Vohora et al. (2004) the key resource enabling the USO to transit from a pre-organization phase to the reorganization phase where the spin-off becomes an operational business. Thus, the results indicate that EHC in the opportunity phase is negatively linked to the transformation of the USO into an operational business. This result is a contradiction to the literature presented in chapter 2 of this study, where a positive effect was expected. The presence of seed funding VCs supported by the government in the sample might be a reason for this discovery. Government supported funding is granted to support innovation, not for the sole purpose of generating a profit,

unlike with privately owned VCs. Due to this it can be argued that innovating research plays a more important role than market potential and firm strategy in attracting this type of funding. A champion with EHC often does not contribute to performing innovating research, due to his/her typical low initial product knowledge reservoir, which might help explain this negative value. Another explanation for this negative relation may be that second time entrepreneurs might become overconfident and re-use strategies that have succeeded in the past (Santarelli and Tran, 2013). Since USOs often operate in dynamic and fast changing environments (Unger et al., 2011), customized strategies should be prepared for each individual USO, as the challenges experienced by their previous start-up are likely to differ from those of their current venture. Thus, serial entrepreneurs re-using old strategies might negatively influence the USO. Another possible explanation might be related to the *Einstellung effect*, which is the negative effect of previous experience when solving new problems (Luchins, 1942). Since many serial entrepreneurs are unsuccessful, this effect might make them take their unsuccessful strategy forward to the new venture (Aspelund et al., 2005).

Some VC investments are created to support innovating research, which could explain the positive effect UHC and TIHC have on attracting funding as an academic and technical entrepreneur often has a focus on innovation-based differentiation (Shrader and Siegel, 2007, Criaco et al., 2014, Politis et al., 2012). Furthermore, these seed funds often have a link with research institutions, creating a connection between the fund and university employees. This relation will favor the champion with UHC, and might explain the fact that champions with UHC had a higher positive effect on attracting VC than champions with TIHC. Capital from seed funds is also often given at a very early phase. Financing acquired so early is generally needed to support initial product development and to explore the market (Politis et al., 2012).

Having a champion with technical HC at the founding stage will increase the focus on product development, and by that strengthen the firm's possibilities in getting the early-stage financing. The model made in this study cannot be used to find support for these assumptions, as it does not differentiate between the different types of VCs. If further investigated, a deeper analysis distinguishing the VCs firms and the financial needs of the USO is recommended.

MIHC of the champion at the opportunity phase was negatively related to attracting VC. This might be because the venture still is in a very early phase, where the most important task is to verify the technology. The entrepreneurial team is also most likely very small at such an early-stage. Due to this, the need of organizational knowledge, coordination and management experience is most likely low. Hence, the initial organization knowledge of the champion with IHC is not necessary at this stage.

The fact that both UHC and TIHC showed a positive relation to attract VC, while EHC and MIHC showed a negative relation illustrates the importance of technical HC in the opportunity phase of the USO. This result matches the findings from Vohora et al. (2004), which state that a key process in the opportunity phase is to evaluate whether the technology works outside the laboratory.

5.2 The champion's role in the pre-organization phase

Differences of the champion's HC in the opportunity phase and the pre-organization phase will be examined in this section. This paper differentiates between two subtypes of IHC, namely MIHC and TIHC. The results showed a large increase (16%) of the champion's MIHC between these two phases, while TIHC increased only by a negligible amount (1%). The significant difference between the change in MIHC and TIHC indicates that it is important to distinguish between these two subgroups, as the results imply that MIHC is the preferred IHC of the

champion as the USO develops from the opportunity phase to the pre-organization phase. The small increment of TIHC may be explained by the already considerable technical understanding and knowledge within most of the USOs, as UHC is the most common HC of the champion at founding. It can be argued that the HC needed within the venture in the pre-organization phase is more management and organizational related than technical related, as a champion with UHC can be assumed to already have abundant technical knowledge. Thus, a HC change towards more managerial and organizational expertise is logical. The need for management and organizational experience in the pre-organization phase is in accordance with Vohora et al.'s (2004) findings, which showed that one of the main tasks to be performed during the pre-organization phase is to decide which resources and capabilities to develop and acquire, and when and how to do so.

The data shows a decrease of UHC (-8%), which is in accordance with the literature examined in this paper. A study by Cressy and Olofsson (1997) found that private equity partners were not preferred by academic champions, in fear that VC involvement would lead to loss of independence and control of their venture. External entrepreneurial champions, on the other hand, had a positive view of VC, seeing it as a driver for venture development and a mechanism for creating a spin-off as effective and competitive as possible (Politis et al., 2012). As a result, external entrepreneurs tend to make a business-oriented strategy, where VC is part of the plan for future development of the USO, while academic champions try to avoid this. As academic champions is related to UHC and external-entrepreneur champions related to IHC and EHC, the results from the analysis, showing an increase of IHC and EHC and a decrease of UHC, correspond with the mindset of the entrepreneur. Thus, one can argue that a champion with EHC or IHC is more likely to develop the USO into an interesting investment venture, than a champion with UHC. Such a

development also makes the USO better equipped to overcome the credibility juncture, as acquiring financial backing is the key factor for the venture to transit from the pre-organization phase to the reorientation phase.

The increase of EHC (5%) is in accordance with earlier literature, stating that a network and previous start-up experience is highly valuable for VC firms (Colombo and Grilli, 2005, Hsu, 2007, Mosey et al., 2006, Shane, 2004). However, the increase is lower than the increase of MIHC (16%). The lower opportunity cost for a champion with EHC than MIHC would indicate a higher increase of EHC than MIHC, especially when the venture still is in its pre-organization phase, where the resources are scarce.

5.3 The champion's role in the reorientation phase

This section discusses the differences of the champions' HC between the pre-organization phase and the reorientation phase. The results showed that only 29% of the USOs that received VC changed champion within 2 years of acquiring VC. A higher turnover rate was expected, as studies (e.g., Cooper and Daily, 1996, Roure and Keeley, 1990, Cyr et al., 2000) have shown that investors traditionally recruit a professional CEO with industry experience to replace the founder. This result might be explained by the fact that the percentage of champions with UHC was relatively low (30%) before the USO received VC, and that many of the champions in the USOs already had IHC before receiving VC.

Of the ventures that changed champion, the results showed a remarkable increase of champions with EHC (34%), notably more so than the increase in TIHC (6%), MIHC (20%) and UHC (0%). There are several factors that might explain this large EHC increase. First, most VC firms have a great network in the entrepreneurial community, and through their network they can find available entrepreneurs that have the right profile and knowledge to match the USOs in which they have invested. Another factor

that implies a high increment in EHC is that most USOs operate in an uncertain and dynamic environment. In such a setting it is important for the champion to continually adapt to the environment in order to sustain the USO's competitive advantage. This is in accordance with the findings from Vohora et al. (2004) stating that the main challenges the USO meets in the reorientation phase is "to continuously identify, acquire and integrate resources and then subsequently reconfigure them". A champion with EHC has previous experience from another spin-off or new venture, probably including experience working in and developing a dynamic environment.

To generate the information and knowledge needed to meet all of the challenges in the reorientation phase stated by Vohora et al. (2004), interaction with customers, competitors and suppliers is central. As a champion with IHC most likely has a great network towards key industry partners, such as competitors and suppliers, the champion can transfer this network into the USO. This will increase the external knowledge reservoirs of the venture and increase its ability to collect the information and knowledge it needs in order to handle many of the challenges it will meet in the reorientation phase.

Some of the investors marked as VCs in the sample of this study are government sponsored seed funds. Even if government sponsored seed funds often take higher risks and are not concerned solely about financial returns (Wright et al., 2007a), they expect some return and an organizational structure that correspond with their investment. This means a board of directors will be formed which will expect growth or an exit-oriented strategy (Wright et al., 2007a). As such, one can argue that the investor(s) would emphasize a champion with the knowledge to create significant growth and an exit-oriented strategy. This might explain the low or non-existent increase of UHC and TIHC and high increase of MIHC and EHC, as champions with MIHC and EHC tends to focus more on

growth than champions with UHC and TIHC, which mainly focus on technology development.

5.4 Changes in the human capital of the champion throughout the development of the USO

In this section the evolution of the champions' HC throughout the development of the USO will be discussed. A very interesting result is that the average HC of the champion increases throughout the phases. This might be related to the age of the CEOs. A correlation test between the age of the CEO at the different phases and their HC has not been performed due to lack of data, and would be an interesting topic for further study. However, it is also believed that the total increase of HC is caused by a higher focus on growth. As the USO evolves the access to resources expand and the internal team grows. This might cause a higher pressure of growth on the USO from the internal team and the investors. The increase of HC is therefore in line with the human capital theory stating that the outcome the firm can expect is linked with the HC investments, meaning that the higher your expectation on return in form of e.g. growth, the more you have to invest in the HC of the champion.

Another interesting result is the low percentage of champions with EHC throughout the development of the USO, compared with the other HCs. The high percentage of UHC is easily explained with the USOs being closely linked with universities and the fact that the founder of the spin-off typically is the inventor. However, due to the high opportunity cost for champions with IHC, one would believe that champions with EHC were more represented in a USO than MIHC and TIHC, especially in the phase before the USO has received VC. An explanation might be that only 2% of the entrepreneurs in the new firms created in Norway 2001 were serial entrepreneurs (Fjærli et al., 2013), which indicates that people with EHC are in a minority in Norway. However, the share of serial entrepreneurs in Norway is trending

upwards, which might result in a higher percentage of EHC in Norwegian USOs in the future.

When looking at the overall HC development of the champion in the USO, it can be seen that product knowledge in terms of UHC and TIHC is strongly represented in the early phase of the USO. As the USO develops the trend goes towards a champion with more market and organizational knowledge in terms of MIHC and EHC. At the very early phase the USO as an organization is often very small. Due to this small venture size the need for organizational knowledge is limited and a champion with an internal organizational knowledge reservoir is not critical. As the USO develops, the team surrounding and involved in the USO expands. At this stage the USO will need a champion with organizational knowledge in order to become a dynamic and effective venture. The USO will also need a champion that is fully committed to the venture. According to Shane (2004) academic entrepreneurs are more likely to work with their spin-off only part-time. This is because the academic entrepreneur's career goals and university conflict of interest policies often limit the possibilities on how to interact with the USO (Shane, 2004). Due to this, it is believed that the academic entrepreneur will step down for the champion role and enter a more technical position in the venture. This article corroborates this view, showing a decrease of champions with UHC.

As the USO enters the reorientation phase it can be seen that most of the ventures (71%) did not change their champion. As the champion on this stage might have moved through several critical junctures as the USO develops, this will have created opportunities for learning and feedback for the champion (Clarysse and Moray, 2004, Vohora et al., 2004, Politis et al., 2012). As part of this experience the champion might have developed the skills and capacities needed to run the venture. A study from Clarysse and Moray (2004) has argued that it might be more efficient to "coach" an inexperienced

champion of a start-up instead of hiring an experienced CEO. This learning effect might also explain the positive relation student start-ups and champions with UHC had with gaining VC. The champion of the student start-up, with no specific human capital at the offset, might have learned the skills and gained the knowledge necessary to run the venture and make it investment ready. The same applies to the champion with UHC, who might have gained knowledge about management and business development through the role as a champion.

6. Conclusion

This paper has examined how the champion's specific human capital has impacted the USO development. By using founding as an operationalization for being in the opportunity phase, and VC investment as a operationalization parameter of getting credibility, this study investigated the HC development of the champion and the relationship between the champion's HC and the critical transit of the USO from a pre-organization to an operational business. Explaining how USOs develop is an increasingly interesting topic of study and is valuable as it helps to understand how one can create better performing spin-offs.

This research adds to the literature in several ways. First, this research contributes to the understanding of entrepreneurial dynamics regarding the existence of different types of specific human capital and its effect on USO development. By classifying different types of specific human capital, this paper provides a contribution to understanding the particular effect of the champion's human capital on the USO development, in answer to Unger et al.'s (2011) call for more research investigating the impacts of specific human capital. Second, several studies argue that American USOs experience significantly different conditions than Western-European USOs (Colyvas et al., 2002, Shane and Stuart, 2002). Wright et al.

(2007a) argue that this is due to the limited resources that Western-European USOs have access to and the relative new and underdeveloped environment of high-tech entrepreneurship at universities in Europe. As the sample of this paper consists of Norwegian USOs, it contributes to explore these differences. Additionally, being based on consistent and comprehensive information of all the USOs developed at the four biggest technical related universities in Norway, it is arguably an outstanding and reliable data sample. As the database contains data on both successful and failed USOs, studying representative samples of both of these categories prevents survivor bias of this research.

The findings of this paper offer different practical implications for the parties involved in the development of the USO. In the following section the practical implication for the entrepreneurial team, technology transfer offices and policy makers will be outlined.

Entrepreneurial teams

Technical knowledge and experience of the USO champion at founding had a positive effect on building up the credibility of the USO. This paper suggests that the champion should focus on technical development in the early-stage to build up technical credibility. Then, when the time is ripe to evolve into an operational business, the USO should hire a champion with entrepreneurial or management expertise and knowledge, as this seems to be the preferred HC by the VC firms.

Technology transfer offices

As USOs seem to have difficulties finding a champion with EHC, technology transfer offices could use their network in the entrepreneurial environment to link entrepreneurs with the USO when the USO is ready to evolve into an operational business.

Policy makers

For most universities, creating USOs based on their research results requires radical changes,

as a university's main purpose has traditionally been only to increase and enhance human knowledge (Pirnay et al., 2003). It requires for the university to handle issues such as intellectual property rights, management and incubator facilities, which is unfamiliar to many universities (Ndonzuau et al., 2002). However, these issues are of less importance for student-spinoffs, since students are not as strongly tied to their university compared to academics (Pirnay et al., 2003). As the results from this paper indicate a positive relation between student start-ups and attracting VC, this paper recommends putting more emphasis on entrepreneurial education and encouraging students to start their own business. Supporting the creation of student spin-offs can be achieved through traditional educational courses in entrepreneurship, and does not require a specific organizational structure from the university.

7. Limitations & further research

The FORNY database provide consistent list of CEOs concerning the firms included in this study, but since this study focused on three events the data was only collected at three different stages, at founding, before attracting VC and after obtaining VC. Further research could create a longitudinal study, which could assess how the change of the champion affects the development of the USO at any given time span, and not be limited by different events.

Some of the champions in the sample had a combination of several human capitals. The interaction effects on these different combinations were not tracked in this study, but would be an interesting area for further research. Various papers have looked at the combination of different experience (Wright et al., 2007b, Ganotakis, 2012, Colombo and Grilli, 2005), and by also considering the interaction between different HC categories this study could have contributed to that body of research. Looking at different human capital combinations could also have further enriched

the analysis, and enabled the authors to perform a more extensive discussion of the results. The relatively small sample size of this study is the restricting factor behind the choice not to include interaction effects, in order to limit the number of variables to an essential few.

Most of the results from the analysis were not significant, showing no significant correlation one way or another. Such mixed results are usually found in cases when the HC of the champion is considered as a determinant of venture development (Unger et al., 2011). This may derive from the absence of theoretical specification to such a relationship (Criaco et al., 2014). The size of the sample might also be one of the main factors for the many insignificant results. Even if the sample of 120 USOs is big enough to make a logistic regression, the same analysis should be done with a larger sample (e.g. the whole FORNY database) to increase the credibility of the results and look for differentiation between the two studies. Furthermore, this paper is based solely on Norwegian USOs. The authors encourage other researchers to extend and apply this research into other countries, to control for differences.

As mentioned in chapter 3.4 this study does not distinguish between different VC firms or the size of the investments. Lack of data prevented the authors to distinguishing the VCs based on the investment size; however other methods to separate the VCs could have been used. The authors could have looked up all the different VC firms and categorized them into groups (e.g. government funded or not and pure seed fund or not), although this method has a limitation in that some VC firms grant both seed investments and larger investments. The financial needs of the USOs could also have been mapped using one of the models already created by Roberts (1991), Lindstrom and Olofsson (2001) or Politis et al. (2012). However, this would have required a deeper case study of the USOs, which is outside of the scope of this article. Nevertheless, the authors suggest that others researchers take this into

consideration when doing a case study of the development of USOs.

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Appendix

Consulting Company X	
Org. Nr.	*****
FORNY-ID	*****
General information	
	Comments
Founding year	Year founded
University	Name of university
TTO	Were TTO involved yes/no (1/0)
Specific technology	yes/no(1/0)
Student start-up	yes/no(1/0)
Events	
	Year
Failure	
Venture Capital	
-	

	Period	Professional Experience			Additional info		
		Industrial HC	University HC	Entrepreneurial	Comments	LinkedIn-profile	Other information
	from	to	Management Yes/n	Technical Yes/n			
CEOs							

Figure 4: Code sheet

Codebook – Firm Overview

Variable	SPSS Variable Name	Coding instructions	Measure
Firm data			
Fornyid	F_ID	Unique ID from FORNY database	String
Founding year	Year_f	Year of founding	Scale
University	Uni	The university the USO originate from	String
Specific technology	Prod_ori	Binary variable. 1 = based on specific technology	Nominal
Student start-up	Stud	Binary variable. 1 = student start-up	Nominal
Venture capital	VC	Binary variable. 1 = received venture capital	Nominal
Age of firm	Age	Years since USO was incorporated	Scale
Person register			
Industrial HC Management	MIHC	Binary variable. 1 = industry-specific management experience	Nominal
Industrial HC Technical	TIHC	Binary variable. 1 = industry-specific technical experience	Nominal
University HC	UHC	Binary variable. 1 = university experience	Nominal
Entrepreneurial HC	EHC	Binary variable. 1 = entrepreneurial experience	Nominal

Table 7: Codebook

		VIF
	Venture Capital (1)	
Control variables	Founding year (2)	1.03
	Product-oriented (3)	1.04
	Student start-up (4)	1.21
	managment IHC (5)	1.14
Human Capital	technical IHC (6)	1.13
	University HC (7)	1.25
	Entrepreneurial HC (8)	1.04

Table 8: variance inflation factor test

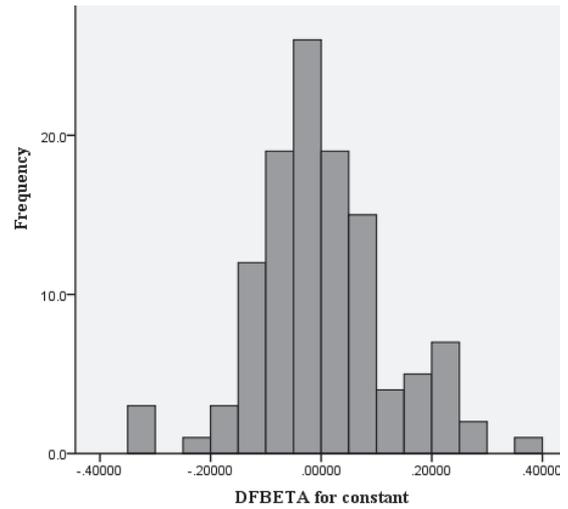


Figure 7: DFBeta constant values for the regression model

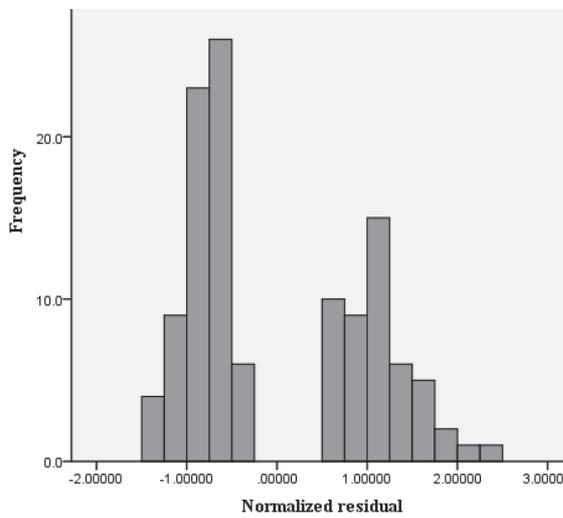


Figure 5: Standardized residuals for the regression model

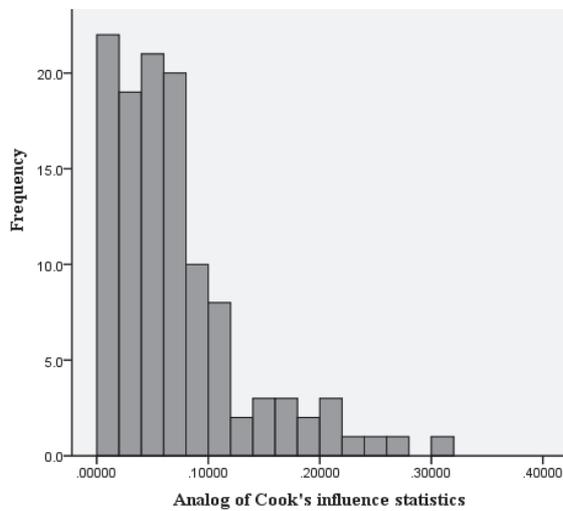


Figure 6: Cook's distance for the regression model