THE PROCESS OF NEW VENTURE CREATION IN A UNIVERSITY SETTING

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Abstract

Universities are found to be an important source of new innovations and increasingly seen as a seedbed for new spin-off ventures. Research-based universities are challenged by policy makers to increase the rate of spin-off formation. This paper addresses the university spin-off phenomenon by developing a framework for studying the new venture creation process in a university setting. The emergence and development of the business opportunity are addressed through a longitudinal research design. Empirical data to explore this process perspective is provided through in-depth studying of four spin-off projects at two Norwegian universities. The findings reveal that different sets of resources seem important as the new venture project develops over time. Attention needs to be directed toward the particular dynamics throughout the entire process of development. Implications for both policy makers and academics studying the field are provided.
INTRODUCTION

The Process of New Venture Creation in a University Setting

Introduction

Scholars from several fields such as entrepreneurship, innovation, science policy, regional development, and technology transfer find the creation of new ventures based on university knowledge important. University based spin-offs are found to be very robust, having significantly higher survival rates than other start-ups (AUTM, 2001; Mustar, 1997). For instance, Shane (2004) found that companies founded to exploit MIT inventions was 257 times more likely than average companies to go public (IPO). Policy makers see universities as engines of local economic growth (Candell and Jaffe, 1999). Many countries and universities have undertaken reforms to increase the extent of commercialization of research, both by changes in the academic system and instruments for research funding (Benner and Sandstrom, 2000; Slaughter and Leslie, 1997), and by setting up structures to support such activities (Guston, 1999; Hellström and Jacob, 2003; Mian, 1997). Nevertheless, there seems to be lack of research on how universities deal with and promote the formation of spin-offs (Carayannis et al., 1998; Mowery and Shane, 2002; Nicolaou and Birley, 2003a; Shane, 2004; Steffensen et al., 2000). Shane (2004:2) even state that “scholarly investigation of this phenomenon is virtually non-existent”.

To increase the extent of spin-off formation from universities, a better knowledge of the process by which they are created is necessary. The factors that influence the commercialization of university inventions is, however, poorly understood, and the application of a variety of frameworks and methodologies has resulted in a fragmented set of observations (Mowery & Shane, 2002). This paper aims to give a better explanation of the process leading to the establishment of university spin-offs. A better understanding of the university spin-off process are vital for policy makers, universities, and persons involved in facilitating the emergence of such new ventures. The spin-off phenomena is very complex, hence a constructivist perspective emphasising the entrepreneurial process and development of the business opportunity in this process is emphasised. A spin-off is not a result of a single event or made in a short time, but usually dependent on long and complex development paths. Hence applying a holistic perspective on the process is important in order to achieve insight into how such complex processes works.
Spin-offs are often referred to as a special case of technology transfer (Mowery and Shane, 2002; Pérez and Sánchez, 2003; Samsom and Gurdon, 1993). This logic implies that before academic research results can be commercially applied, the technology or knowledge has to be transferred from the research organization to industrial adopters. This process of university technology transfer can take place through many channels, such as free dissemination of knowledge through teaching and publication; by interaction, cooperation, and licensing to existing companies; and finally by establishing new business entities based on university technology and knowledge, so called university spin-offs. In this article, university spin-offs are seen as a tool for technology transfer where the goal or outcome is to transfer university knowledge into application in society. This is in accordance with the policy of many universities and technology transfer offices (TTOs) (Carlsson and Fridh, 2002).

For the perspective proposed in this article, a university spin-off is defined as a *new venture initiated in a university setting and based on technology from a university*. This definition follows the logic of Shane (2004:4) who define “a university spin-off as a new company founded to exploit a piece of intellectual property created in an academic institution”. Spin-offs often commercialize research results where existing firms show little interest of applying the knowledge (Jensen and Thursby, 2001; Matkin, 1990). The situation might be that the knowledge is of a kind that can not be directly sold in the market due to high uncertainty, tacit nature, and heterogeneous expectations (Dew et al., 2004). Thus, spin-offs are special by the fact that the commercialization process is initiated inside the university organization. From a university perspective those new venture projects that are initiated in the university is of particular interest, compared to other companies that utilize university technology. Such projects are affected by and affect the university operation; they can be stimulated and supported by the university.

The next section use central concepts from recent theorizing in the field of entrepreneurship to review existing literature on university spin-offs, and proposes a framework of the university spin-off process. Next, the data from a longitudinal study of four university spin-off processes are presented and analyzed. Based on existing research on the topic and the four cases critical characteristics of the university spin-off process are discussed. Implications for university policy and further research are given.
An entrepreneurial perspective on the university spin-off process

The entrepreneurial process
Explaining how new ventures emerges is one of the major questions addressed in entrepreneurship research. For instance, Low and MacMillan (1988) defined entrepreneurship as the “creation of new enterprise”. For this paper, which aim is to take a holistic view on the creation of spin-offs, I draw upon definitions of entrepreneurship that focus on the individual(s), the opportunity, the context, and the process over time (Bruyat and Julien, 2001; Stevenson and Jarillo, 1990).

Many have called for more process driven research on entrepreneurship (Van de Ven and Engleman, 2004). For exploring the university spin-off phenomenon this would be a nearly unexplored and promising approach. Process theories are about series of events occurring, rather than about a set of relations among variables. As emphasized by both Langley (1999) and Pentland (1999), events and the patterns among them are the core of process theory.

The outcome of the entrepreneurial process is a new venture which is based on application of a university technology as illustrated in Figure 1.

![Figure 1: The entrepreneurial process of university spin-off creation](image)

The opportunity, the individuals, and the university context are all central for the creation of university spin-off firms. The characteristics of these elements are not static. There is a need
to explore the dynamic elements participating and contributing in a process over time. The most prevailing way of representing the process of new venture formation is by dividing it into different stages of development (Bhave, 1994; Churchill and Lewis, 1983; Hansen, 1998; Kamm and Nurick, 1993; Scott and Bruce, 1987). Stage models have been critiqued for being too rigid (Neergaard, 2003), and the models are often adjusted with feedback loops and overlap between stages (Fayolle, 2003).

Schumpeter (1934) defined entrepreneurship as the carrying out of new combinations. For entrepreneurship to be possible there needs to be entrepreneurial opportunities (Shane and Venkataraman, 2000). According to Ardichvili et. al. (2003) the concept of opportunity recognition encompasses three distinct processes of perception, discovery, and creation. First, the perception of market needs. Second, the discovery of a ‘fit’ between market needs and resources that might fill those needs. Third, the creation of a business concept to utilize the discovered fit between resources and needs. This process is a mental construction, and neither the market need, or the specific resources, or the business concept need to be obvious to other individuals. The business concept might even be perceived as completely unrealistic by most people. Some persons may see more opportunities than others due to their entrepreneurial alertness (Ardichvili et al., 2003; Kirzner, 1973). Shane (2003) claims that the individual-opportunity nexus is the core of entrepreneurship. This view addresses the identification and development of opportunities leading to firm formation and gives the individual a central role (Ardichvili et al., 2003).

A dominant issue in entrepreneurship research has been the individual entrepreneur and the characteristics and traits of entrepreneurs (Erikson, 2002; Kolvereid, 1996; Markman and Baron, 2003; Westhead and Wright, 1998). University spin-offs are often characterized by being team start-ups and by dynamic interaction by different individuals throughout the start-up process (Chiesa and Piccaluga, 2000; Roberts and Malone, 1996). Different individuals may play different roles throughout the process, and as pointed out by Ardichvili et al. (2003), some people excel at invention, others at creating business models, but few at both. Hence, the academic inventor(s) may not lead the entire spin-off process. Some have pointed to the advantage of using external persons, or so called surrogate entrepreneurs (Franklin et al., 2001; Radosevich, 1995) to develop and lead the new venturing process. After all, individuals are a core element in the spin-off process, but they do not alone explain the outcome.
The university spin-off process takes place inside a university organization, which positively and negatively, formally and informally takes part in the spin-off process. The university’s role in the spin-off process is reflected in the variety of university measures aiming to support different phases in the commercialization process (Rasmussen et al., 2005).

**Opportunities and university spin-offs**

Eckhardt and Shane (2003) define entrepreneurial opportunities as situations in which new goods, services, raw materials, markets, and organizing methods can be introduced through the formation of new means, ends, or means-ends relationships. Two differing perspectives in entrepreneurship are whether opportunities are of a Schumpeterian or Kirznerian type (Shane, 2003). Adherents of the Schumpeterian perspective suggest that new information is important for entrepreneurship, and entrepreneurs use new information to recombine resources into more valuable forms (Schumpeter, 1934). In contrast, Kirzner (1997) argues that entrepreneurship is based on differing access to existing information. Both these perspectives may help to explain the existence of entrepreneurial opportunities (Shane and Venkataraman, 2000). A university spin-off venture is, at least partly, relying on the Schumpeterian type as it is established to exploit new research results. There is also a debate whether opportunities are discovered (Shane and Venkataraman, 2000), or if opportunities under many circumstances are enacted (Gartner et al., 2003). The latter view emphasizes that opportunities are not objectively existing and static, but are developed throughout the entrepreneurial process. The opportunity may start out very vague, but be developed into a more articulated business idea, and finally become the core business for the new venture.

Research into innovation processes (Van de Ven et al., 1999) and new venture development (Bhave, 1994) have assessed the transformation and development of business ideas. Some studies point to what kind of opportunities that are common for university spin-offs. The commercial potential seems to differ between fields of research (Bird and Allen, 1989). Chrisman et al. (1995) found that the faculties of Engineering, Medicine, and Sciences where the most productive in technology transfer at University of Calgary, although significant activity took place at other faculties as well. According to Shane (2004), the fields of biotechnology and computer software, are most common for university spin-off creation. Also, a relation between start-up generation and intellectual eminence at universities has been detected (Di Gregorio and Shane, 2003). Shane (2004:136) review factors that makes technologies more likely to become the basis for a spin-off company. He finds that radical,
tacit, early stage and general purpose technologies with significant customer value, major technical advance, and strong intellectual property protection do constitute a better opportunity for creating a spin-off than other technologies.

The protection of IPR, for example by patenting, may in some cases be an important condition for creating business opportunities from university research (Shane, 2001). Shane (2002) found that university inventions are more likely to be licensed when patents are effective, and then generally to non-inventors. When patents are not effective, it is more likely that the inventors themselves commercialize the innovation. Jensen and Thursby (2001:241) found that most licenses from US universities comprise technologies that “…are so embryonic that additional effort in development by the inventor is required for a reasonable chance of commercial success”. Inventions that can be effectively patented might be easier to transfer directly to an external organization or entrepreneur, while no or weak patent protection increase the role to be played by the inventor(s) in the commercialization process. Hence, spin-offs may be particularly feasible for the commercialization of tacit knowledge, as noted by several authors (Chiesa and Piccaluga, 2000; Nicolaou and Birley, 2003b; Pirnay et al., 2003).

Previous research on university spin-offs assert that some fields or characteristics of the research seems to give rise to more entrepreneurial opportunities than other. The involvement of the inventor seems also to be a key element for developing the research result into a business concept with success in the marketplace. Little is known, however, about how the initial research result becomes perceived as an entrepreneurial opportunity and how this opportunity gets developed into a viable business concept. This gap in the knowledge can be addressed by including the opportunity as a unit of analysis in the study of the university spin-off process. Compared to entrepreneurship in general, the opportunity plays an even more central role when exploring the university spin-off phenomenon, as it is the research as a source of entrepreneurial activity that is the distinctive feature of this particular type of new ventures.

**The role of individuals in university spin-off creation**

The identification of entrepreneurial opportunities is a cognitive act, hence it is connected to individuals (Gaglio and Katz, 2001). Thus, individual intentions are found to be the single best predictor of entrepreneurship (Krueger, 2000). The nexus of individuals and
opportunities is at the heart of entrepreneurship (Shane, 2003). It seems like more personal interaction between university researchers and people with market knowledge leads to the identification of new opportunities and subsequently into the development of a business venture (Bird and Allen, 1989). Several studies points to the risk that advanced knowledge based ideas may fade away if the idea is separated from the creator or researcher from who the idea originated (Henrekson and Rosenberg, 2001; Stankiewicz, 1986). Hence, in addition to the discovery of an entrepreneurial opportunity, entrepreneurial commitment (Erikson, 2002) is important. There has to be someone taking the role as entrepreneur or new venture champion (Greene et al., 1999).

Choi and Shephard (2003) found that entrepreneurs were more likely to exploit opportunities when they perceived more knowledge of customer demand for the product, more fully developed enabling technologies, greater managerial capability, and greater stakeholder support. According to Erikson and Nerdrum (2001), the capacity to combine or coordinate resources is crucial for the entrepreneurial endeavor. Before a new venture can be developed, there may be a need for acquiring resources and assets, both tangible and intangible, and including human, social, physical, financial, and organizational capital. Researchers involved in commercialization need to perceive it both as a desirable and a manageable activity (Reitan, 1997). Studies have also found that pull factors such as market opportunities, or a wish to apply research results in practice, motivates the creation of university spin-offs (Chiesa and Piccaluga, 2000; Smilor et al., 1990) Although to a lesser extent, the same studies found push factors such as desire for independence, dissatisfaction in current occupation, or monetary reasons to be a motive as well.

Research shows that entrepreneurship involves a significant component of learning by doing (Carroll and Mosakowski, 1987). Previous entrepreneurial experience is found to correlate with future entrepreneurial behavior (Alsos and Kolvereid, 1998). From studying cases of university spin-offs, Vohora, Wright and Lockett (2004:161) propose that “without developing or accessing the capability to combine scientific knowledge with a commercially feasible offering that satisfies an unfulfilled market need, academic scientists would not be able to proceed towards commercializing their technologies”.

Studies show that knowledge-based new ventures often are developed by teams, rather than by single individuals (Chiesa and Piccaluga, 2000; Clarysse and Moray, 2004; Roberts, 1991).
Further, Etzkowitz (2003) claims that research groups may be as important as individual academics in initiating entrepreneurial actions. Grandi and Grimaldi (2005) found that prior joint experience among the academic founders might be positive for creating successful university spin-offs. Lack of business experience and management skills is recognized as a potential barrier to success for venturing scientists (Radosevich, 1995; Samsom and Gurdon, 1993). Hence, an entrepreneurial team consisting of both the academic inventor and experienced entrepreneurs may be favorable, and this is also common among university spin-offs (Birley, 2002).

The intentions, previous experience, and network of academics seem important for the creation of entrepreneurial opportunities, although none have studied how such opportunities come into existence. Further, the motivation and experience of one or several individuals seems crucial for the further development of the business project. Different involvement from different individuals as the process proceeds seems common, but some involvement by the inventors and the strength of entrepreneurial teams are frequently mentioned. Although the individuals are a central element in the spin-off process, different individuals can act at different times in the process. Hence, applying the opportunity as the main unit of analysis might be appropriate for understanding the university spin-off phenomenon.

The role of context in university spin-off creation

Environmental conditions such as access to venture funding, governmental regulations, and closeness to markets is seen as attributes of the opportunity or business idea. For instance, commercializing a new invention might be easier in an environment (region) with many potential customers. Individuals in other environments may, however, not consider the same invention to be an entrepreneurial opportunity at all. Hence, the external environment affects which opportunities are created and pursued. This article assumes that the university plays an important role in the spin-off process as context for the entrepreneurial process. Hence, environmental conditions that are outside the control of universities are beyond the scope of this article and considered as attributes of the business opportunity.

Smilor et al. (1990) found in their survey that the university played an important or very important role in 56% of the spin-off company formations, a highly more significant role than any other organization. The most important role of the university was as a source of personnel. Academic entrepreneurship is found to be considerably higher in some research
departments than other, even within the same field of science (Louis et al., 1989). Thus, the specific university context is probably playing an important role in the spin-off process. The formal university involvement in spin-offs can vary, and Steffensen et al. (2000) distinguishes between spontaneous and planned spin-offs, the latter including an organized effort from the parent organization. Franklin et al. (2001) found that more successful universities in fostering spin-offs tended to be less skeptical of the role of surrogate entrepreneurs. Di Gregorio and Shane (2003) found evidence that a low inventor’s share of royalties and a willingness to make equity investments in university start-up companies increase start-up activity. Hence, university policies seem to have an effect on the spin-off process.

The academic culture values publishing and disinterested research, while entrepreneurial activity may be a sensitive issue (Ndonzuau et al., 2002). Studies have found that the most significant barriers to the adoption of entrepreneurial friendly policies at universities are cultural and informational (Franklin et al., 2001). Chrisman et al. (1995:277) concluded that “supporting research and sending a message that faculty entrepreneurship will be valued is perhaps more important than the specific programs designed to foster economic development”. Based on their study of professorial entrepreneurship, Kenney and Goe (2004:679) suggests that “being embedded in an academic department and disciplines with cultures that are supportive of entrepreneurial activity can help counteract the disincentives created by a university environment that is not strongly supportive of these activities.” This indicates a complex structure where academics are part of different cultures in their discipline, department, university, and external environment.

Contact between persons with technical and market knowledge may induce identification of entrepreneurial opportunities. Pérez and Sánchez (2003) stress the importance of networks in the early development of university spin-offs. Further, Shane and Stuart (2002) found that founders of university spin-offs having prior relations to venture capitalists are more likely to receive venture funding and less likely to fail. Another way of developing the business concept is through strategic alliances (Carayannis et al., 2000). Chrisman et al. (1995) found that formal university programs can enhance economic development activities such as spin-off formation. Boundary organizations (Hellström and Jacob, 2003) like incubators (Etzkowitz, 2002), technology transfer offices (Guston, 1999), entrepreneurship centers (Dill, 1995), and science parks (Stankiewicz, 1998) does also play a role in university spin-off creation. Mian (1996) found that university technology business incubators added value to
their tenant firms, specifically through university related inputs such as university image, laboratories and equipment, and student employees.

The university and its departments and research groups plays an important role in the creation of spin-off ventures by providing a setting rich on entrepreneurial opportunities, and by stimulating and attracting entrepreneurial individuals who can develop and pursue opportunities. The university setting may also provide valuable resources throughout the process of developing an opportunity into a new business venture. The university’s role seem, however, to differ throughout the spin-off process, but few studies have investigated the process over time when studying universities and spin-off formation. To capture the time dimension, the opportunity needs to be a key variable in the analysis.

The framework

Some studies examine phases or stages in the university spin-off process. Based on interview data from successful university spin-off programs (Ndonzuau et al., 2002) suggest four stages in the university spin-off process (generate business idea, finalize new venture project, launch spin-off firm, and strengthen creation of economic value). By following one university spin-off, (Clarysse and Moray, 2004) also suggests four phases of development (idea, pre start-up, start-up, and post start-up), while (Vohora et al., 2004) suggest five phases based on a study of nine spin-off projects (research, opportunity framing, pre-organization, re-organization, and sustainable returns). In addition to the focus on the opportunity identification, stage models often refer to a phase of opportunity development taking place before the new venture is established. Issues to be addressed in this phase of the spin-off process is the protection and the development of the business idea, including technological- and commercial-development, and funding (Ndonzuau et al., 2002).

This article identifies three important elements in the university spin-off process; the opportunity, the individual(s) involved, and the university context. In Figure 2 the main characteristics of these elements throughout the spin-off process are summarized. The spin-off process is for illustrative reasons presented in four periods of development: the preceding conditions, the opportunity identification, the process of developing the business opportunity, and the emergence of a new venture project. Most existing research is based on variance approaches, investigating only parts of the university spin-off process, or only one of the key elements.
Methodology
The embryonic nature of research into the university spin-off phenomenon makes room for more in-depth and explorative studies. In order to key into the development process of university spin-off creation a longitudinal research design is chosen. This study examines the initiation and establishment of four university based start-up companies in two Norwegian universities.

Research Setting
Universities in Norway receive most of their research funding from public sources and commercializing of research results has not been a high priority at universities until recently. Public policies to stimulate technology transfer have been top-down oriented (Goldfarb & Henrekson, 2002), providing few incentives for academics to involve in entrepreneurial activity. Support structures were first established in the boarder area of many universities, having little direct impact on academic life. This has now changed as the responsibility of new support initiatives are increasingly put at the university level, following a more bottom-up approach (Jacob, Lundqvist, & Hellsmark, 2003). As a part of policy changes in this respect, Norway changed the intellectual property rights (IPR) legislation in 2003, granting the ownership of IPR emanating from public funded research to the universities, while it previously belonged to the individual university employee. Following these changes, and partly inspired by the US model, technology transfer offices (TTO) have been set up at the

![Figure 2: A framework for the university spin-off process](image)

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>Preceding conditions</th>
<th>Opportunity identification</th>
<th>Opportunity development</th>
<th>New venture project</th>
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<td></td>
<td>Research Market need</td>
<td>See fit between market need &amp; resources</td>
<td>Developing a business model</td>
<td>Exploiting the technology</td>
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<td>Individuals/entrepreneur</td>
<td>Intention Experience</td>
<td>Cognitive act</td>
<td>Motivation Experience</td>
<td>Team Network</td>
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<td>University context</td>
<td>Culture Policies History/paths</td>
<td>Setting, time &amp; place</td>
<td>Incentives Resources Networks</td>
<td>Research Personnel</td>
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universities. Thus, the support measures and universities’ formal relation to spin-off processes are about to be formed in Norway. This setting was chosen to reveal the critical issues related to spin-off creation in a university context. This study includes two universities where each represents rather typical segments in the European university system. University A is quite large with a history of more than a hundred years, while university B is a smaller and younger university established primarily with regional intentions.

Case Selection
Spin-off cases were chosen in order to achieve high variation on key variables. Two cases come from a university and research group with traditionally strong ties to industry and from where a number of companies have spun-out throughout the years. University B traditionally had much weaker ties to industry, and fewer examples of spin-off companies. The goal of this study was to follow the process of spin-off company creation in a university setting in real time from research to an independent new venture. To identify projects with a reasonable chance of success, however, I had to look for projects with some track record. First, the development at national policy and university level were followed for about two years. Then, prospective cases were identified in cooperation with well informed persons at each university. The cases had been developed for about one year, but were still in an early phase where neither the product, first customer, or funding were in place. To fit with typical definitions of university spin-off companies, I chose cases where the technological basis for the spin-off was based on university research, the business idea had a high market potential, and the academic researchers played an important role in the initiation and development of the spin-off project. The university has formal ownership in one case at each university, and the cases are also in the industries most commonly associated with university spin-offs; one in life science, and the others in different engineering fields.

Data Collection
Data triangulation including several sources of data was used to map out the situation and critical events prior to and during the development of the spin-off projects. Secondary data from the universities were collected through documentary sources. For each of the firms, archival data, including financial reports, business plans, market analyses, and research documents, were achieved. Primary data from each university was collected through visits, conversations, and personal interviews for a four year period at university A and a two year period at university B. Primary data was collected by 6 to 12 personal interviews at each case.
conducted throughout a nine month period. I interviewed people in various positions including: company founders and entrepreneurial team members, researchers, university managers, people involved in commercialization support. The interviews focused on letting the informant describe his or her involvement in, and knowledge of the spin-off project from its inception up to date, with a minimum of interruption by the interviewer. This was done in order to avoid possible influence of theoretical perspectives of the researcher on data collection. Most interviews were recorded and the transcriptions were done by me as a part of the data analysis process. In addition, relevant written documentation was collected both from the informants and other sources like press articles and the internet. By combining the different sources of information and collecting information over a period of time doing repetitive interviews with central informants, an in-depth description of the research and commercialization process was obtained. For confidentiality reasons the cases are anonymized, and some of the factual information have been slightly adjusted in the case presentation. Confidentiality has resulted in a richer set of data including better access to documentation and more honest statements from the informants.

Data Analysis
The collected data provided both narrative accounts of the process and factual descriptions of context, actors, and events from a large number of sources. From the data I identified critical characteristics and events that influenced on how the spin-off process emerged and developed. In order to derive at theoretical explanations for the processes observed, I identified observations that matched theoretical concepts (Borch & Arthur, 1995). I formed the theoretical concepts to match the empirical data in an interactive process. As the analysis proceeded, the overarching logical frame shifted from exploring data through induction to verifying theory through deduction. For further validation of the results I have aligned the findings from the cases with existing empirical research on the university spin-off phenomenon.

Findings
This chapter presents findings from the cases emphasizing the role of opportunities, individuals, the university context, and the process over time as outlined in the theoretical framework developed above. But first, a short introduction to each case:

Spin-off Case Alpha within University A
Case Alpha is based on the specialized competence of the professors in the founding team, addressing a current need in industry. The unique competence of the team has developed since two of the founders were among the first to combine two engineering fields during their Master and PhD studies. One of them continued at the university and became a well renowned Professor, while the other made a career in industry for about ten years before he became Professor at the university. The research group they are a part of is connected to two departments and is well renowned internationally in their niche, having a substantial academic track record including high volumes of publications, Masters- and PhD-graduates, and industrial relations. Although the knowledge that forms the basis for the spin-off was developed over many years, the initiation of the spin-off happened by coincidence. The professors usually had close relations to industrial partners, through projects or part-time positions, but at the time each of the professors had for different reasons reduced their relation to their main industrial partner and were looking for new activity. During informal conversations and based on their research based competence combined with their industrial knowledge, they decided to explore the possibility to start a new venture. Alpha has successfully developed the product and signed the first contracts with customers.

*Spin-off Case Beta within University B*

The history of case Beta started about ten years ago when a group of researchers almost by chance discovered a medical effect. The researchers obtained funding from a pharmaceutical company that for several years gave substantial funding for research at the university. A research group was build up, which provided good scientific results, several PhDs, and promising results from an industrial viewpoint. Just as the research activity was about to give the basis for more development work, the pharmaceutical company made a general decision to pull out of such projects due to economic difficulties. This caused great uncertainty about the future for both the research group and the project, and triggered the two research managers to continue the commercialization of the technology on their own. The process of taking over the project and the related patents from the pharmaceutical company was long and cumbersome. With considerable financial and administrative support from the university the two professors were able to retain ownership of the technology. The university then became a major shareholder, and the two professors constitute the entrepreneurial team in the company Beta which is established to commercialize the technology. Beta has built a professional team, obtained the first round on funding, and have started to commercialize the technology.
Spin-off Case Gamma within University A

Although the university plays a central role in the Gamma case, this is formally a spin-off from another company that spun out of the same research group 8 years earlier. This first spin-off, let us call it TechBase, was by the researchers seen as an entity for applied projects, and established as a continuation of a cooperation with an industrial partner which had resulted in the development of the core technology. TechBase maintained close relation with the research group at the university and acted as a development company for a technology base which the research group specialized in. This technology has several applications, and a new opportunity emerged after a process where the university, TechBase, and a large company in this area discussed the commercial opportunities. The university has now decided to build competence and laboratory facilities in this area, and Gamma was established to commercialize the TechBase technology for application in the same area. To lead this project, the CEO of the industrial partner who initially led to the establishment of TechBase is now hired as CEO and entrepreneur of Gamma. The university TTO will negotiate an owner share in Gamma depending on how much resources the university contributes with in the commercialization process. Gamma is now planning the prototype project.

Spin-off Case Delta within University A and B

For more than 30 years a professor at university A renown for being innovative and his group have conducted research and actively commercialized many of the results. One of the first PhD graduates has during the last 20 years founded or managed several companies based on university research from this and other research groups. Patents and technology with a commercial potential from the professor’s research are managed by a company where the professor together with both industrial partners and the entrepreneurial graduate have been owners. This professor was also the source of the current idea, and the idea were developed through student thesis and finally in a PhD project from 1996 to 2000. The idea was attempted sold to the Norwegian industry, with little success. In about the same period another of the Professor’s Master’s graduates took his PhD and had a position at university B. He had family background among the users of the technology, and when he occasionally heard about the research project he saw the potential and made contact. As the technology lacked an entrepreneur this request were highly welcomed, and the technology owners are now supporting him to commercialize the technology. Public support measures connected to university B are also supporting Delta which is now is testing a prototype.
The opportunity development

The development of a well working research group and conditions for doing fundamental research seems to have been an important basis. All cases initially developed from creative or experimental behavior among university academics. The innovative combination of two engineering fields by two PhD students created the knowledge base on which Alpha is based on. The medical effect exploited by Beta was initially discovered by a group of young and curiosity driven researchers. The technology which forms the basis for Gamma is a result of both academic and applied research activity for about a decade, and Delta have a similar story going even longer back in time. Hence, academic freedom and curiosity driven research seems to be important in creating radically new knowledge that have been the basis for these spin-off ventures. The role of a strong technological basis and accumulation of knowledge over many years is strongly emphasized by most informants.

The process can be illustrated by the Alpha where the founders discussed the possibility of starting a company, and they where enthusiastic about such an option. “All four of us professors were actually looking for some new industrial projects, and then this idea came up, and it was very good” (Founder Alpha). Although the professors saw an opportunity to start a new venture, the business concept was not clear from the start. “The idea was not fully cultivated to begin with, and it took some time before we saw the commercial value” (Founder Alpha). The motivation of the researchers might affect the focus of opportunity development. According to consultants involved with Beta, the researchers seemed motivated by obtaining funds for doing more research, and the commercial aspects were less clear. Also the precursor for Gamma, the spin-off TechBase “was not based on any particular idea, but rather on prospects for a future technology” (Professor Gamma).

The initiation of the opportunity is in all cases dependent on someone seeing the connection between the technology at hand and some market need. Hence, in addition to the academic research, contacts with industry and possible users of the new technology were crucial for the opportunity to emerge. In case Alpha the industry experience of one of the founders played a central role in deciding on and developing the idea. In case Beta the idea was developed in cooperation with and industrial company. Gamma emerged as a result of discussions with researchers and industrial partners. Case Delta seemed difficult to obtain interest from industry, but the previous user-experience of the founder made him see a commercial opportunity in the technology.
The individuals involved

Committed individuals seem crucial for driving the projects forward. The entrepreneurs of Alpha and Beta which are the two projects having the fastest progress get very good references from the other informants. “The team is working very well, and is very well compounded when it comes to being both creative and structured” (Consultant Alpha). “I believe in the entrepreneurs, they are though boys” (Professor/Consultant Beta).

The motivations for starting the new ventures are diverse. Some are very explicit about their role as professors. “I support smaller companies in Norway with technology” (Professor Gamma). “To create jobs and building industry is plenty motivation for me” (Founder Alpha). Other motivations were mentioned, such as: “It was fun that the four of us could work together” (Founder Alpha). The process of establishing Beta came as a response to a crisis in the research project. “That we have become entrepreneurs just came to us, we have not been dreaming or planning about that” (Founder Beta). The entrepreneurs are clear on the advantage of working in a team. “An important point is that it is much easier to be two. Thing goes in waves, and sometimes it is difficult when fighting with others and try to make things happen. We have worked together for 10 years and know each other well. Our motivation now is that we both really want to see that this project becomes something. We know there is a great risk. We are used to the scientific risk” (Founder Beta).

Links to the commercial environment may prove critical for receiving the impulses for adaptation to the commercial setting. Industry interaction was critical both in forming the business concept and in developing personal competencies, network, and experience among the founders that have been of critical value for the spin-off project. In case Alpha the professor with industrial background has a key role. According to one of the other founders, “Professor X got the market contact, without him this project would have been impossible. He is a previous ‘customer’ and he think like a customer” (Founder Alpha). Traditionally, professors within Nordic universities rarely have strong links to industry as part of their career. “I think the founders of Beta are atypical as researchers because they have worked for an industrial partner for many years, so they probably have other attitudes than the average researcher” (Consultant Beta).
The university context

At both universities the culture is clearly changing towards a more positive attitude in the university system towards spin-off creation. “As the issue of commercialization of research has become a more public issue at the university, there is a process going on where creating spin-off companies is getting more accepted” (Founder Beta). “The attitude has changed radically … there is now an infrastructure or environment for commercialization” (Technology owner Delta). The university environment is considered to be a good place for such creative spin-off processes, and one of the Alpha founders made this general comment: “The universities does not have any business to secure, and therefore are in a unique position to commercialize new technologies. The professors have their security through their salary, and with the new infrastructure such as the incubator and TTO, I see a large potential for more commercialization”. The relation to the university is seen as important and a source of valuable resources. The academics generally want to retain their relation to the university.

The access to PhD- and Master-students is a valuable resource for the spin-offs. Students can do thesis and smaller projects, be a source for future employees, and former students constitute a valuable network in industry. One challenge is to establish clear routines and guidelines in the relation between students and the spin-off company, “we need to make an agreement with the university that legitimizes use of these resources” (Team member Alpha). Former students constitute an extensive network: “I know a lot of people in domestic and international industry. There is a strength being a professor. You only work with the best people in your field, some of them you learn to know very well” (Founder Alpha). The network seemed to be an important asset when hiring people. “To pick very competent people which the professors know is a quite unique opportunity, with the result that new employees get very fast into operation, and can deliver from day one” (Team member Alpha). “I make sure that the best graduates get employed in spin-offs and other companies we cooperate with” (Professor Gamma).

Opportunities for taking leave and sabbaticals make it possible for the professors to be involved in commercialization projects without leaving their position at the university. One of the founders of Alpha said that “I was asked 10 years ago if it could be viable to start a new venture, but at that time I considered this to be impossible. The prevailing attitude was that it would be a personal defeat to fail and little credit to gain from trying. There where no incentives to leave a safe position at the university“. In recent years “the students started to
gain interest in starting new ventures and writing business plans”, and “the issue of forming new ventures became a topic at the university and signals from the central university management were that they looked favorable on such initiatives”. “Also the tremendous success of the company X which spun-off from another university department made a great impression”.

A common theme which has caused some worry at all cases is the regulation of the relation towards the university department, especially when it comes to use of university infrastructure. It seems that the universities centrally are positive to support the creation of spin-offs, while the situation might be more mixed at department level that experience strain on resources. “The departments get paid for use of the facilities, regulated through agreements. Hopefully, this will be perceived positively by the departments. As this is the first case at the university, it takes some time to work out agreements” (University manager Beta). “It has been a though process, because the university do not have any experience. This is the first company the university formally establishes, which means that we had to make many new roads as we moved along. There are many rounds to go to make agreements with the university. The university, however, have done all what they could do to help in this process, but lack experience” (Founder Beta). In other cases the relation with the university seems more ambiguous: “I experience that we now are mapping things that needs to be arranged, but it will take time to get these things in place” (CEO Gamma).

The importance of having a clear and unambiguous relation to the university was often pointed out. “The university is updated on what we do. We have put all facts on the table from the beginning” (Founder Alpha). “The relation to the university was a little ambiguous in the beginning, but as we became an incubator company we do now have a clear and good relation to the university” (Founder Alpha). “It is an advantage to be located at the university; it gives us credibility and help us in the relation towards industry” (Founder Alpha). The founders acknowledge the importance of the university context, although a lack of experience and organizing has posed constraints on the process. “We are in a very good position here at the university, and have good access to expert knowledge in many fields” (Founder Alpha). “I am strong because I got a group around me” (Professor/team member Gamma).
The process over time

The business ideas, the individuals involved, and the relation with the university context have gone through radical changes in all the cases. For instance in case Delta, the commercialization process stopped until the business opportunity was discovered by an external entrepreneur located at another university. The prior history leading to each business opportunity was also long. For instance, the history leading to Gamma shows that the previous spin-off TechBase has for years been in an almost symbiotic relation to the university department.

In case Alpha the academic entrepreneurs were very aware of the need for external resources, and in addition to the diversified competence among the professors, two external persons were included in the start-up team. The team worked on external relations and business concept development the first year, before doing technical work where they knew they possessed the competence. In case Beta the academic entrepreneurs have gradually changed the company focus (e.g. board composition) from being targeted to gain internal support and use the competence at the university, to a focus on connections to external resources important for business development when the internal support and legitimacy in the university was established. The university seemed to have actively used the latent contacts of persons in the organization to access competence when needed. “I think it is very important that entrepreneurs get support as they work, maybe in the beginning it can be the university, but more specialized competence is needed later on” (Consultant Beta). The commercialization unit connected to the university seemed to be able to play only a modest role compared to the latent networks of the academics and their ability to engage specialist competence.

The availability of public funding seems to be crucial in the start-up process of university spin-offs in the Norwegian setting. All cases have got start-up grants for entrepreneurs, and all except Delta have received substantial research grants from public sources. All cases except Delta have also been accepted as tenants in the incubators recently established at each university. Delta and the entrepreneur have no longer a formal relation to the university, but still use knowledge and networks at the university in developing the project.

Discussion

University spin-offs are created on the basis of business opportunities emerging from university research. These can be characterized as entrepreneurial opportunities based on new
information, or of the Schumpeterian type. The research based opportunities in these cases are based on many years of research effort and the transition from being research activity to become an entrepreneurial project is often overlapping and ambiguous. The research base plays an important role for leading to the entrepreneurial opportunity, but also as a resource in the business development process and as a competitive advantage for the new venture.

The findings suggest that the researchers’ network, experience, and knowledge of industrial application is crucial for being able to see entrepreneurial opportunities by connecting research findings to potential areas of application. The decision to pursue such entrepreneurial opportunities seems to be a result of supportive elements in the persons’ environment combined with events creating a new situation where starting an entrepreneurial action is perceived as a viable option. The motivation for devoting time and resources to such projects includes: a desire to create something new, to see the invention in use, to get rich, and to create new industry and work positions for graduates. Difficulties in getting existing industry to take new technology into application seem to create both opportunities and a desire for the researchers to start the process of pursuing the opportunities themselves. No university spin-off can be created without the entrepreneurs who pursue and develop the opportunity. In case Delta there has been a huge time span from idea to commercialization due to a lack of industrial partners or entrepreneurs to pursue the project. Delta was seen as a business opportunity by the researchers, but the project did not proceed until someone could take the role as entrepreneur.

In all the cases the opportunities do not seem to exist independently of the individuals and the specific context, especially when seeing the development over time. A cross-sectional study might identify a specific business opportunity at one point in time, but in all these four cases it was the broader set of knowledge combined with the individuals involved who determine how the business idea of the new venture are formed. The initial opportunity seems often to need substantial revision over time, as in case Alpha which started with a strong competence base and a desire to start something, while the idea has been revised and concretized several times before the current business model was found. The availability of resources also constrains and shapes the opportunity to be pursued. The founders of Beta had to narrow down the initial focus considerably to adapt to what seems to be a realistic business model to get funded and developed in the current context. The most tangible opportunity is Beta where the business is built on exploiting a medical effect discovered by the researchers. Beta is also the company
which is most dependent on good patent protection to succeed. Alpha and Gamma are also relying on patents, but these are one part in a broader strategy to protect the business concept.

The overall culture and attitudes at the university also seems important. The academic entrepreneurs have to break some ties to be able to go on with their idea, which is difficult within a university where job security is high. Signals from policy makers and university management that spin-offs had their support were important both for the decision to start the process, and for the further development. Pursuing an entrepreneurial opportunity in the university setting had to be perceived as a viable behavior by the individuals involved. The university can contribute with resources such as available time, equipment, business consulting, and office space, which lowers the initial cost and risk associated with exploring a business idea. The entrepreneurs are generally very eager to maintain a good relation to the research group, and an important way to develop further the technology which is being commercialized is to initiate cooperative research projects involving public funding. Hence, in later phases of development, the university seems important as a research partner and source for recruiting highly skilled graduates to the new venture.

The university contributes with different resources early in the process, compared to later in the development of spin-off ventures. It is, however, difficult to connect specific resources to distinct phases or stages of development in a way that can be verified across the cases. The initial resources available and the need for new resources and bundling of resources are unique in each case. The development paths of each case are also unique, making it difficult to apply stage or phase models to analyze the university spin-off process. Still, the cases share some common characteristics. A critical condition in order to start and to pursue the spin-off process is to make the coupling between technological knowledge and a perceived market need. This is referred to as opportunity recognition or development. Further, the spin-off process is dependent on entrepreneurial individuals to pursue the business opportunity. The process is also dependent on the context for injection of physical, technological, financial, human, and organizational resources for developing the product or service and to increase the value of the business concept. The university setting can play an important role in providing many critical resources in order to make the spin-off process succeed.
Conclusion

Researchers in the field of entrepreneurship often define entrepreneurship as a process, and points at the need to develop theories that take into account the dynamics of complex processes. The creation of a university spin-off venture is indeed such a complex process where many actors are involved and many routes can lead to the same goal. Apparently, a large number of factors influence this process, but not only of the efficient cause kind and in a linear fashion as described by variance theories. Although, looking for causal relations to explain the emergence and development of university spin-offs might yield fruitful results, it seems unlikely that a university spin-off is a causal result of some necessary and sufficient conditions. Alternatively, the process leading to a new spin-off venture can reveal factors that are necessary, although not sufficient, for spin-off creation, and patterns of probability for spin-off creation. Hence, in order to explain how university spin-offs emerge and develop, it is likely that taking a process theory perspective will be rewarding.

For university spin-offs, an important ingredient of the business opportunity is obviously research and scientific knowledge. Thus, knowledge about why, when, and how the action of university researchers leads to creation of opportunities are vital in order to understand how the university spin-off process is initiated. If policy makers and universities seek to promote the creation of new spin-off ventures as a tool for university technology transfer and economic development, the factors that facilitate and inhibit the new venture gestation process in a university setting needs to be addressed. The university spin-off process is not static; hence attention needs to be directed toward the particular dynamics emerging throughout the entire process of development. The university spin-off process is likely to succeed only by assuring the presence of opportunities that may form viable business concepts, individuals that may take the role as entrepreneurs through the different phases of a venture development, and a munificent context in the university. The perspective and findings presented in this article may inform initiatives to support the creation of spin-offs at universities, and for implementing measures at weak points in the process. Such mechanisms should focus on facilitating the entrepreneurial action. This might be done by paying attention to the opportunity, the individuals, and the university capability to support the process. All three elements have to be present prior to and through the entire entrepreneurial action of creating a new spin-off venture.
University spin-off is of particular interest for academic inquiry for several reasons. First, it shows how the mechanism of entrepreneurship can be used for university technology transfer. Second, it may be seen as a special case of entrepreneurship, thus models describing the university spin-off process may be useful for understanding entrepreneurial processes in other contexts as well, such as community entrepreneurship or regional entrepreneurship. By applying a process perspective, a new avenue of research opportunities is opened. Longitudinal case studies following real spin-off projects as they evolve may be particularly suited to develop a more precise model of the entrepreneurial process in a university setting, and to develop hypotheses about the critical elements throughout the process. Real-time studies are preferable because retrospective approaches tend to be flawed by memory decay, rationalization after the fact, and hindsight bias. This study has started this endeavor, but more research is needed in order to develop better explanations of the university spin-off process.

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