LUND UNIVERSITY
School of Economics and Management

University Spinoffs and the New Venture Creation Process

A Case Study of Lund University Spinoff Model

By: Sally Mansour and Mimoza Maliqi

Master's Program in Entrepreneurship

Supervisor: Caroline Wigren-Kristoferson

Examiner: Diamanto Politis

Abstract

University spinoffs play a significant role in transferring knowledge to society. This research explores and evaluates the creation of a university spinoff within Lund University setting by applying Bhave's new venture creation process with an aim of revealing aspects that lead to spinoff creation that can be related to this specific model. The study reveals that the evolution of university based ventures does follow the three main stages in the venture creation process theory but also reveals unique elements not accounted for in the original process model.

Table of Contents

List of Tables

List of Figures

1. Introduction

1.1 Background

In the last decade academic entrepreneurship has emerged on the initiative by policy-makers encouraging universities to develop a "third mission" as an action towards commercialization of academic knowledge, and research in addition to the traditional roles of education, and research as direct contribution to social, and economic growth (Etzkowitz, 2000; Rothaermel et al., 2007; Perkmann et al., 2013). Universities have been adopting different mechanisms in line with institutional frameworks, and local context specificities with intent to promote and facilitate commercialization in university community (Grimaldi et al., 2011, p. 1048). Initiatives such as "patents, licensing, generation of academic spin-offs, collaborative research, contract research, and consulting" (Grimaldi et al., 2011, p. 1047), as well as "ad-hoc advice and networking with practitioners, teaching, joint publication with industry, and personnel-related learning activities such as staff exchange, and joint student supervision" (Grimaldi et al., 2011, p. 1047) are considered important mechanisms by which academic research results are transferred towards the market place. To organize these mechanisms universities have established technology transfer offices (TTO), business incubators and science parks (Markman et al., 2005, p. 244).

One fundamental aspect in the process of technology transfer is the intellectual property rights (IPR) on research findings (Geuna and Rossi, 2011, p. 1068). Majority of countries follow an institutional ownership model making the university the prime owner of the research findings where the researcher is employed (Geuna and Rossi, 2011, p. 1068). This model has been attributed as a motivator or incentivized model for researchers to pursue technology transfer. Sweden on the other hand follows the invention ownership model (also referred as teacher's exemption) implemented, and maintained since 1949 (Geuna and Rossi, 2011, p. 2070). The government has been actively promoting technology commercialization since the beginning of 1980 (Grimaldi et al., 2011, p. 1047), and has introduced the Higher Education Act in 1997 mandating its universities to "pursue a more active engagement with the rest of society" (Jacob et al., 2003). The most common, and growing technology transfer mechanism is a university spinoff, considered very successful, and an important class of companies (Djokovic and

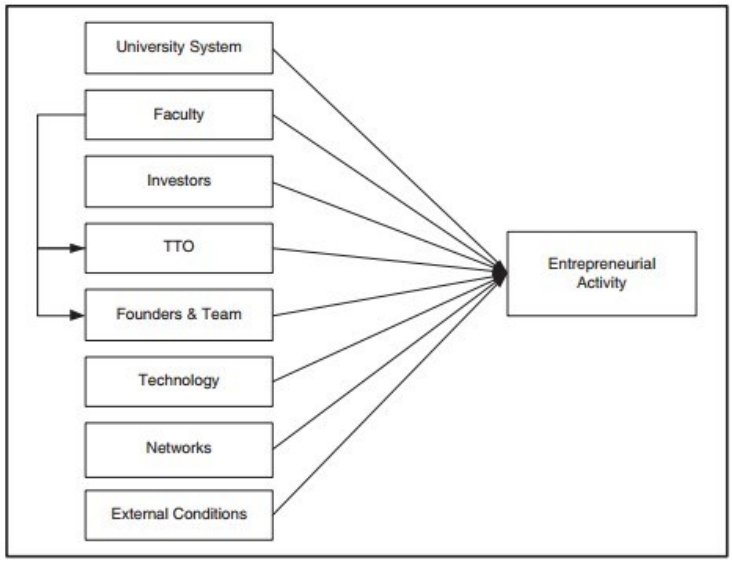
Souitaris, 2006; Shane, 2004) which create more jobs than an average small business (Shane, 2004, p. 21), and enable employment opportunities for highly educated people (Shane, 2004, p. 20). Their importance is not limited only to the adding economic value. Shane (2004) argues that spinoffs are not only routes for commercialization of university technology but also enhance the productivity of academic researchers, increases university's ability to attract talented faculty, and act as facilitators for student training, and in return "providing professors with needed knowledge of the commercial development of the technology" (p. 37) particularly "developing academic entrepreneurship competencies" of a university (Grimaldi et al., 2011, p. 1046).

1.2 University Spinoff Research: What Has Been Done

The rise in significance of university Spinoffs under the umbrella of the academic entrepreneurship phenomenon as demonstrated, has caught the attention of various scholars in recent years. In a comprehensive review of 173 academic articles researching academic entrepreneurship, Rothaermel et al. (2007) point out to the plethora of scholarly articles that have emerged particularly starting the late 1990's onwards. Looking specifically at the creation of new firms the authors in their taxonomy identify a number of themes that have been explored to describe Spinoff creation and have created a useful visualization of this research field as depicted in figure 1. One such group of research looks at the internal components of university spinoffs which include the university policies and strategies governing the process (e.g. Di Gregorio and Shane, 2003; Clarysse et al., 2005 cited in Rothaermel et al., 2007), motivation of academics to move from research into commercialization (e.g. Stuart and Ding, 2006; D'este and Perkmann, 2011), innovation technology (Shane, 2001 cited in Rothaermel et al., 2007), role, and impact of technology transfer offices TTO's (e.g. Algieri et al., 2013), and features and development of founding teams (e.g. Clarysse and Moray, 2004 cited in Rothaermel et al., 2007 ; Knockaert et al.. 2011). On the external front, research has looked at investors and their relationship with university spinoffs (e.g. Wright et al., 2004b cited in Rothaermel et al., 2007; Munari and Toschi, 2011), and at external conditions affecting Spinoff creation such as industry R&D financing, and market receptiveness (e.g. De Coster and Butler, 2005 cited in Rothaermel et al., 2007; Fini et al., 2011). A separate theme also explored is the effect of networks in Spinoff development at different stages (e.g. Walter et al., 2006; Mosey and Wright, 2007).

On a more explanatory level, another research stream has been dedicated to explain the best practices for establishing a spinoff by either looking at the success factors to adopt (e.g. Lockett et al., 2003 cited in Rothaermel et al., 2007; Rasmussen et al., 2011) or the barriers that inhibit a Spinoff's success and thus that should be evaded (e.g. Clarysse et al., 2011 cited in Rothaermel et al., 2007 ; Binkauskas, 2012).

Figure 1: A schematic of new firm creation literature within university entrepreneurship (Rothaermel et al. 2007)



Finally from an impact related perspective, some research has looked at the economic results of university Spinoffs (e.g. Shane, 2004, Guerrero et al., 2015) while others explore the impact Spinoffs have had on universities research performance (e.g. Thursby and Thursby, 2011; Abramo et al., 2012).

1.3 Research Purpose and Objectives: What Will be Done

While it is evident that a comprehensive coverage of the university spinoff phenomenon has taken place as demonstrated in the previous section, what can be seen is a bias towards a more descriptive nature of the research that has been done with less emphasis on establishing a clear correlation between this phenomenon and existing theory (Rothaermel et al., 2007). Some research especially in the last decade has indeed considered a number of important theories such as resource based theory, path dependence theory, process theories through stage-based models (Fernández-Alles et al., 2015, p. 976), multilevel (Rasmussen, 2011, p. 448) and network theory and so "the field clearly appears to be moving towards more theory-driven research" (Rothaermel et al., 2007, p.706). We intend to join in contributing to the maturity of this field by choosing to view university spinoffs within the scope of the process theories more precisely the new venture creation process. Given that university spinoffs by definition involve the creation of a new venture, there is room on one hand to assume that the evolution of university spinoffs would mirror the generalized conception of how new ventures are created as outlined by this process. Yet on the other hand, a university spinoff represents a distinctive form of a new venture given its emergence from academia which gives it "context specific" features such as the availability of resources and capabilities from the university, the intellectual nature of its founding team, and the usually 'long and complex development path" it has to take (Rasmussen, 2011 p. 448). Furthermore, understanding the economic value academic research represents it is vital for universities to develop further knowledge and understanding how this potential can practically be transformed into "genuine commercial projects" (Ndonzuau et al., 2002, p. 282) considering that "universities are generally characterized as having weak capabilities for the development of commercial applications" (Rasmussen and Borch, 2010, p. 604). Such a distinction allows for a challenge to the first assumption and thus to discern an answer we ask this research question: Does the evolution of a university spinoff follow the process as outlined in new venture creation theory, can the various stages and variables of the process be identified, and are there key elements or differences specific to the creation of this type of venture? Employing Bhave's (1994) new venture creation process theory on spinoff development and formation we intend to investigate and explain the challenges of spinoff development, the activities, and dynamic processes, and how the researchers, entrepreneurs, and the academia deal

with this undertaking. Answering this research question allows to uncover possible areas of improvement or hidden opportunities that can be practically employed by the university to further support the emergence of spinoffs (Wigren-Kristoferson et al., 2011).

To fulfill the aim of the research we want to complete a case study analysis of Lund University which is considered an important player in the Spinoff arena in Sweden and a good example to look at. The university has a dedicated entity known as LU Innovation that provides the needed support to researchers to turn their findings into commercially viable products and is considered the university's technology transfer office (TTO) (LU Innovation). It has a productive record of research commercialization with a number of highly successful ventures spinning off from it. Gambro founded in 1946, Tetra Pak in 1951, and Bluetooth market launched in 1998 are famous examples of highly successful businesses that originated from research and innovations created at Lund University throughout history (Lund University, 2014). Thus this active role in the field makes it an attractive source for research. In addition it represents the Swedish context of the phenomenon which as highlighted has a distinctive nature compared to other countries. This research will involve a series of in depth interviews with various actors within the university support system and in different Spinoffs created at the university.

1.4 Thesis Outline

In this section the background has been set for the research question to be answered. Next a theoretical overview will be presented, displaying a conceptual framework of university spinoffs through the previous key literature works that have been produced regarding this specific branch of academic entrepreneurship. Following this is an overview of existing research discussing new venture creation process leading to our choice of one specific process model and how this theoretical framework will be employed as a guide for our methodology. The subsequent sections will involve a thorough explanation of the methodology, a presentation of empirical data, a discussion and analysis of results and finally concluding remarks.

2. Establishing the Theoretical Framework

2.1 A Conceptual Framework of University Spinoffs

University spinoff is one of a few mechanisms of how a university chooses to transfer its knowledge and research findings to the market place (Grimaldi et al., 2011; Rothaermel et al., 2007; Shane, 2004). University spinoff enables the internal party, which are considered the inventor, student, faculty, member, and the external party considered an entrepreneur and investor, to transfer the technology in form of a company (Shane, 2004). Transferred companies can be classified as technology only, technology and people, and people only (Rothaermal et al., 2007, p. 764; Djokovic and Soutaris, 2006, p. 227). Regarding the transfer of people, definitions account for spinoffs which are accompanied by the people from university in role of inventors, founders or those who acquire the rights to commercialize the technology (Djokovic and Soutaris, 2006, p. 277). The creation and development of a university spinoff can be done in a formal or informal way depending on how this is arranged with the university (Shane, 2004; Djokovic and Soutaris, 2006). We are interested in looking into formal university spinoffs which Shane (2004) defines as a "new company founded to exploit a piece of intellectual property created in an academic institution" (p. 4). Many researchers consider a university spinoff created by current and former, students, members or employees of an academic institution (Djokovic and Soutaris, 2006, p. 227; Shane, 2004, p. 4). If we were to look at companies in that sense, we would need to consider a broad range of firms, including those that were created under factors distant from university (Shane, 2004, p. 5). For the purpose of our research, we will consider only firms that are developed by individuals affiliated with the university and in the academic setting (Shane, 2004, p. 5). This understanding directs us into looking only at the development of new companies which exploit university allocated patented inventions, copyrights, know-how, and even trade secrets (Shane, 2004, p. 5). Companies which manifest different business activities such as "consultancy, intellectual property licensing, software, product, and infrastructure creation" (Rothaermel et al., 2007, p. 749), and founded and lead either by entrepreneurs who may come from outside academia or inventors themselves (Shane, 2004).

2.2 The New Venture Creation Process

To describe the new venture creation process we first shed light on an overarching concept which is the entrepreneurial process and how it is interrelated. Defined as the practice "comprising the pursuit of opportunity and the mobilization of resources to deliver value and capture returns", this process is exemplified as new firm creation takes place, hence the correlation (Druilhe & Garnsey, 2004, p.271). Gartner's (1985) conceptual framework for new venture creation is an early example of existing research that reveals this correlation where he centralizes new venture creation within a holistic framework that includes key entrepreneurial elements (the individual, the organization, the process, and the environment) and as such these various entrepreneurial components collectively interact through the emergence of a new venture (p.698). Shane's (2003) work represents a more developed exposition of this correlation where he demonstrates the entrepreneurial process as a model where the individual-opportunity "nexus" is the main driver for the process. Here the individual "discovers" then "exploits" opportunities and this is enabled through the formation of a new a firm while taking into consideration influences of the individual's attributes and the surrounding environment (Shane, 2003).

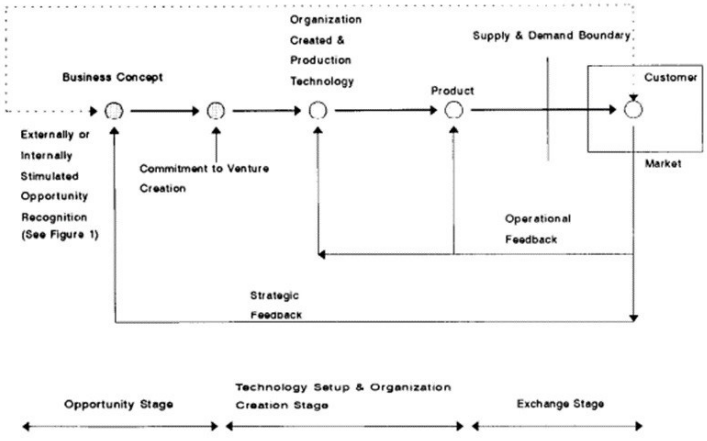
After displaying the correlation between the two concepts we turn our focus to the different sequential events and actions that describe the new venture creation process and from which we extract a guiding framework to detect the evolution of university Spinoffs. Several scholars have demonstrated the venturing process in different manners. When explaining the process dimension in his framework Gartner (1985) refers to six distinct "behaviors" that take place, pointing out they are not necessarily in a sequential order, namely when an entrepreneur recognizes an opportunity, pools resources, engages in marketing activities for the good or service, produces the product, establishes an organization, and interacts with the government and society (p. 699-700). Along a similar line, Delmar and Shane (2002) identify four activities necessary for firm formation which are "planning, legitimacy building, resource transformation and market-related activities" (cited in Liao and Welsch, 2008, p. 105). In an extensive empirical study, Carter et al. (1996) deduced a list of fourteen different activities that take place in the

"gestation" phase of the venture such as business planning, team formation, acquisition of financial resources, setup of facilities, and establishing a legal entity (p.156).

We finally look at the new venture creation model devised by Bhave (1994) which serves as a useful amalgamation of the previously highlighted actions and behaviors in a coherent arrangement. This model represents a comprehensive collection of relevant entrepreneurial concepts including opportunity recognition, entrepreneurial commitment, business concept, resource acquisition, organization creation, and market interaction. In addition these concepts are organized in a clear life-cycle framework with distinct identifiable stages that are linked with points of transition to illustrate how and when the venture moves across the stages. Third it recognizes and reflects important sub-processes and considers the possibility of iterations in each phase reflecting a realistic view of venture creation. And finally the model has an empirical basis coming from a qualitative interview based research carried out with entrepreneurs of 27 different ventures (Bhave, 1994). As such, we see it as an appropriate model (demonstrated in figure 2) that can be utilized as a guiding framework for our research to examine the university Spinoff practice and deduce the correlations to the new venture creation process.

The new venture creation process model is described in three main stages. The first stage is the "the opportunity stage", followed by the "technology set-up and organization stage" and finally 'the exchange stage" (Bhave 1994, p.223). The following sub sections further explain each stage, their underlying variables, and how they are correlated, from the author's perspective but also further elaboration is provided by reviewing related literature works.

Figure 2: Process model of entrepreneurial venture creation (Bhave 1994).



2.2.1 The Opportunity Stage

To define, an opportunity is "the chance to meet a market need (or interest or want) through a creative combination of resources to deliver superior value" (Schumpeter, 1934; Kirzner, 1973; Casson, 1982 cited in Ardichvili et al., 2003, p.108). Bhave (1994) draws out two separate routes for opportunity recognition as the first incident that takes place in this stage. When the decision to initiate a venture comes before an opportunity is recognized, this is labelled as "an externally stimulated opportunity recognition" path where the entrepreneur seeks out for opportunities that he/she comes across, makes a selection of an appropriate opportunity based on previous knowledge, expertise, as well as market conditions, "refines" the opportunity, and ultimately formulates a business concept (Bhave, 1994, p.228-229). In an "internally stimulated opportunity recognition" path, an opportunity is first recognized when the entrepreneur seeks to create solutions to a need that is relevant to him/her and when the potential business value is recognized, a decision to create a venture is then made which would then also lead to a "refinement" of the opportunity, and then business concept development (Bhave, 1994, p.230). Alvarez and Barney's (2007) comparison of the discovery and creation theories also seek to explain those two divergent routes. Within the discovery theory, entrepreneurs are constantly scanning the environment for opportunities that come into existence as a result of external changes, and these opportunities are waiting to be uncovered as Kirzner (as cited in Alvarez and Barney, 2007, p.14) explains by those "alert" entrepreneurs. On the other hand, creation theory asserts that an opportunity is intrinsically related to the entrepreneur who is "exploring new ways to produce new products and services" and is then followed by a series of actions interacting with the market (Alvarez and Barney, 2007, p.15).

Exploring the role of an entrepreneur's characteristics (the "individual" element) and that of his/her surroundings (the "environment" element) in driving opportunity recognition has been the subject of various studies and it is a good point now to shed some light on these investigations. On the individual level; entrepreneurial alertness, prior knowledge or human capital (basic and specific), the learning mode when acquiring and transforming new information, and an inherent belief in the viability of the venture and one's own ability (jointly termed "opportunity confidence") are key characteristics identified that collectively contribute to

the likelihood of opportunity recognition (Baron, 2006; Corbett, 2007; Dimov, 2010). Environmentally, a key factor identified by Ardichvili et al. (2003) is social networks in which an entrepreneur's relationships and interaction with different actors in his/her close and distant social circles plays an active role in enabling opportunity recognition.

Following the incidence of the opportunity recognition, a business concept (the core variable in this stage to be further discussed in the fourth sub-section) is developed where a match between the concept recognized and the corresponding market need is attempted (Bhave, 1994). This involves a development of the idea from its basic form to a more complex one explicitly describing what the product/service is, to whom it will be delivered and how it will be delivered (Ardichvili et al., 2003). This business concept development can be further explained by understanding the "relevance" factor in the idea evaluation construct developed by Dean et al. (2006). An idea or opportunity is deemed relevant if it directly corresponds to the problem or need i.e. is "applicable", and if it successfully (at least potentially) solves this problem i.e. is "effective" (Dean et al., 2006, p.661-662).

In the case of concepts that are highly novel and thus no prior customer information is available, feedback from the market is essential to be able to obtain the fit between the business idea and the market need and complete this phase (Bhave, 1994). This is evident in Rasmussen's (2011) research study which aimed to display the evolution of university Spinoffs in the early stage (before reaching the market phase) from the perspective of four general process theories one of which was the life cycle theory. The study points out that a necessary step taken is the production of "a prototype to validate the viability of the technology for commercial use" (Rasmussen, 2011, p.456).

The final part in this stage is the "entrepreneurial commitment" and which is also a critical transition that leads to the next stage and which is explained as the deliberate decision to allocate resources to translate the business concept into a product (Bhave, 1994). This commitment is more than just a "state of mind" but rather a series of binding actions which would lead to the next stage where a physical setup of the technology and organization takes place (Vohora et al., 2004, p.160).

2.2.2 The Technology Set-up and Organization Stage

Resources including knowledge and expertise, financial means, physical space are brought together to create the organization and production technology (Bhave, 1994). Production technology is the core variable in this stage (as will be further discussed in sub-section 4) since different business concepts would require varying degrees of technology to be developed ranging from standard to complex (Bhave, 1994). The organization is also developed in this stage where the structure and processes are put in place (Bhave, 1994). Based on his findings, Bhave (1994) asserts that this stage is considered procedural rather than a strategic one yet this does not undermine its importance and the effort required to complete it where a "rise to an entire business, not just a product" takes place (Pavia, 1991 cited in Ardichvili et al., 2003, p.109). One key enabler for the allocation of resources (particularly financial) in this stage is the existence of networks that can be utilized for this purpose. Vohora et al. (2004) described this when mapping out the "critical junctures" that a new Spinoff needs to overcome to transfer between different evolutions stages. Entrepreneurs are able to secure needed resources through credibility that is derived from existing relationships and networks and as such as are able to overcome the "credibility threshold" and move to the next phase (Vohora et al., 2004, p.164).

This stage culminates with the production of the product, which inherently involves product development particularly for highly innovative products. At the point where customers start interacting with the product and consequently become involved in the product development, the venture enters the next stage of exchange (Bhave, 1994).

2.2.3 The Exchange Stage

It is in this phase where a so called official interchange happens between the venture and customers in the market when the sale of its first product takes place. This cross over between the supply and demand side is perhaps where the greatest focus on communicating with the customers (marketing efforts) and obtaining their feedback takes place and where it becomes the main source of product development and re-development (Bhave 1994). And so the product in this stage is the core variable. Customer feedback in this stage can have a strategic or operational effect on the venture based on which variable receives a request or recommendation to be altered

(Bhave, 1994). A strategic effect would be one where the business concept receives a negative customer response as the foundation of the business itself is in question (Bhave, 1994). Customer feedback that relates to either the production technology or the product would be operational as the changes require a change in the later stages of the venture keeping a distance from the "validity of the business concept" (Bhave, 1994, p.235).

2.2.4 The Core Variables and the Novelty Factor

A core variable exists in each of the three stages mediating the novelty factor within the new venture creation process. As Eckhardt and Shane (2003) explain novelty can be employed at various points in the value chain and not just in the product or service produced. As such in the opportunity stage novelty can be applied in the business concept where a market need is satisfied in a new way, it can be applied in the technology and organization setup stage where a different production technology is used to produce a product or a superior combination of resources is implemented using the specific knowledge and finally in the exchange stage where the product offered to the market consists of new features (Bhave, 1994).

2.2.5 The Common Theme: An Iterative Non Liner Approach

A vital theme that consistently runs through the entire process is the concept of iterations. In theory the new venture creation process may seem linear whereas in realistic terms, the process moves back and forth with reformulations of the different variables taking place (Bhave, 1994). For example when in the case where a business concept is novel and no pre-existing market information can be found, preliminary customer feedback is likely to take place and which in return would lead to changes in the business concept. This can also be the case during the setup of the organization and technology where resource constraints can be a driver for iterations in the physical setup (Bhave, 1994).

This model will be used as a guide for our empirical research where we aim to find out if the three main stages (opportunity recognition, production technology and organization setup, and exchange) can be identified. Within those stages we will look at how each distinct variable is defined and incorporated with the evolution of the Spinoff and if additional context dependent

variables also exist. We also look at the extent to which the novelty and iteration factors act as defining features for spinoff evolution.

3.0 Methodology

3.1 Research Approach

The research approach used in this study is qualitative and the form that has been applied to acquire information is case study. We chose this strategy considering that our purpose is to test the new venture creation process on the process of university spinoff creation and obtain an overview of it by assessing the 'how' and 'why' a university spinoff transits through different stages of venture evolution. We assume that university spinoffs may follow the venture creation process theory and the qualitative approach enables an in depth recognition of a series of interrelated events within each unit of analysis that could reflect to this process if applicable (Davidssson P., 2007).

3.2. Research Design

To confirm, dismiss or advance theoretical concepts of venture creation, we used a multiple-case design, allowing for a 'replication' logic of our findings (Yin, 2014). The study design involves eight cases divided into three sectors existing within the ecosystem of Lund University considering that university is the realm of this study. To increase generalizability, two cases cover the university's innovation support structure, three cases cover the life sciences industry spinoffs, and three cover technology industry spinoffs. The reason in choosing university support organizations as one sector was to gain the perspective of this sector as an overseer of the process and also due to its importance as an enabler with the support mechanisms it offers. Informants of the university's support structure interviewed were individuals involved in decision making for the forms of support provided. Four individuals with differing responsibilities represent Lund University Innovation (LU Innovation) as one case with one

representing LU Innovation AB as a secondary sub case. A representative from Ideon Innovation incubator was included as the second case within this sector. The choice of life sciences and technology sectors was initially based on the common knowledge that these are the two main fields spinning off ventures. This was confirmed by a review of LU Innovation's investment portfolio where out of forty two companies displayed on the organization's website, twenty companies are under the Life Sciences category and fourteen companies are under the Technology category (LU Innovation). Both sectors were included in the study to acquire a heterogeneous representation of university Spinoff types that may differ in their development based on their domain. To qualify, companies needed to be based on research that originated in the university. To oversee the venture creation process, spinoffs had to be established companies with a developed prototype, patent or product. Our interviews with spinoffs were carried with individuals responsible for the process of venture creation who could accurately recall the events over time that led to spinoff creation. Informants included founders or co-founders of the Spinoffs as the researchers or the entrepreneurs, and in some cases the informant represented both roles.

We employed purposeful sampling. First we reached out to LU Innovation and Ideon Innovation through the contact list available on its website choosing a diversity of members to represent the different support areas (business development, patenting, investment, incubation support). Emails were sent to seven potential candidates out of which five were successfully recruited. The informants then recommended several company names and in addition we used the LU Support System's websites for additional potential spinoffs and in combination we reached out to twelve companies through emails and telephone calling, out of which six spinoffs were successfully recruited for the study, three in each field.

3.3 Data Collection

Two methods were employed: 1) primary data collection through in-depth and face to face interviews and 2) secondary data collection through web sites and other marketing materials. There were 12 interviews of individual respondents, conducted over one month between March and April 2016, with 45-60 minutes in length. In every meeting, we would present the purpose of the research followed by the questions. There were two interview guides, one targeting spinoff

informants and the other innovation support structure informants (See Appendix A). The interview guide targeting spinoff companies was a list of open-ended questions, divided into three sections. This covered background information about the Spinoff, a review of the business evolution based on the stages in the new venture creation process and a final section on reflections allowing for further thoughts and impressions that may have been missed in the previous sections. The interview guide targeting informants of the innovation support structure followed the same chronological order of questions on venture creation with an emphasis on their support and experience in the process. The interviewer had flexibility to ask further questions to probe on noteworthy replies (Bryman and Bell, 2011). This semi structure interviewing method enabled in depth answers from the informants but also ensured a structure of answers to allow for "cross case comparability" (Bryman and Bell, 2011, p. 473). All interviews were openly recorded and later fully transcribed.

3.4 Data Analysis

Following a multi-case strategy, it necessitated that we develop individual case studies and then compare these with each other in order to arrive at common variables and possibly generalize (Eisenhardt, 1989). For every case we carried transcript analysis and used tabular displays of events in sequences (Eisenhardt, 1989) that lead the spinoff creation. In the tabular displays the information is organized in variables highlighting important sequential events in spinoff creation process supported by relevant quotes from the informants (See Appendix B). Overall, to analyze the data we used a combination of pattern matching (Yin, 2014; Eisenhardt, 1989), chronological sequences (Yin, 2014) and construct development (Eisenhardt, 1989) techniques for within-case and cross-case analysis. Our focus on within-case analysis was on pattern matching and describing and explaining "presumed causal events" (Yin, 2014) as experienced and perceived by actors responsible for the spinoff creation. This enabled us to uncover applicable variables in the existing venture creation process and new dependent variables (Yin, 2014) that emerged outside the venture creation theory framework and consequently develop a set of variables for spinoffs for later cross-case analysis (Eisenhardt, 1989). In addition, considering that Lund University is the case of study, a contextual dimension is treated specifically reviewing the effect of the teacher's exemption policy and the ecosystem found at the university. Generally, the

analysis followed an iterative process and after each case was built up and analyzed a cross-case analysis was applied. During this process industry specific variables were being examined alongside with university's support structure themes and emergent variables for a final holistic analysis of spinoff creation in relationship to venture creation process theory. This led to insights applied on generalization of new venture creation process on spinoff creation or how spinoffs form and consequently develop.

3.5 Validity and reliability

The credibility of this research is established based on several aspects. First, clear definitions of the key concepts in the research are set out were used as a basis for the questions raised during the interview process and later used as cornerstones in the analysis and discussion of results (Yin, 2014). Next, the use of multiple sources of data referred to as "triangulation" contributes to the acceptability of research insights and conclusions (Bryman and Bell, 2011, p.396). Dependability stems from the ease with which a research can be replicated and this is ensured since a careful documentation of procedures has been implemented such as email correspondences with interviewees, audio recordings of the interviews, and the interview guide (Bryman and Bell, 2011). Finally, confirmability has been observed in this study with the researcher's primary aim is putting through the reflections captured during data collection as the core source for insights and conclusions (Bryman and Bell, 2011).

Limitations of this research are two-fold. One is the fact that a cross-sectional analysis takes place with the cases being studied instead of a longitudinal design which is the recommended design when approaching process theory (Davidsson, 2007). Yet this research can be used as an offset for future longitudinal studies that want to examine the same context of this research. Second given the time limitations a relatively small number of cases are represented within each sector while a larger number would provide stronger ground for pattern recognition and generalization. Yet this is compensated by the heterogeneity of the sectors included.

4.0 Empirical Findings

We begin this section with background information on each case and interviewees as presented in Table 1. Findings are then displayed by demonstrating the different variables that represent the sequential events in the venture creation process as well as the additional variables disclosed within each of the sectors interviewed: the support organizations the life sciences field, and the technology field. These variables are displayed in the tabulation of findings in Appendix B and summarized in Table 2 below.

Table 1: Cases and Interviewees per Case

Case	**Sector**	**Description of Activity**	**Number of interviewees**	**Role**
LU Innovation	Support Organization	"LU Innovation is the hub for innovation and commercialization at Lund University.... Our goal and mission is to contribute to increased growth in Sweden by ensuring knowledge and research from Lund University benefit society. By supporting and developing research findings with researchers and students we work to lead more ideas to company formations and/or licensing deals." *LU Innovation Website*	4: **a.** Sven Olsson **b.** Fredrik Edman **c.** Johanna Asklin **d.** Anders Boman	**a.** Business Development Manager (social innovations, electrical and biomedical engineering) **b.** Patent Advisor **c.** Innovation Manager (Cancer) **d.** Senior Advisor - LU Innovation AB
Ideon Innovation Incubator	Support Organization	"Ideon Innovation's mission is to contribute to more innovative ideas to develop into viable businesses with high growth potential." *Ideon Innovation Website*	1: Per Garvell	Business Developer
ApoGlyX AB	University Spinoff - Life Science	"ApoGlyx is a company that's in a preclinical stage of drug development [for] type 2 diabetes patients to control their blood sugar...[specifically] for patients that also have problems with their kidneys" Martina Kvist Reimer	2: a. Martina Kvist Reimer b. Prof. Michael Rützler	a. CEO b. Co-Founder and Researcher

Nattaro Labs AB	University Spinoff - Life Science	"We are a research-based company that develops and offers services and products that prevent, identify and effectively treat bed bug infestations." *Nattaro Labs Website*	1: Christine Dahlman Jacobsen	Co-founder and CMO
SARomics Biostructures AB	University Spinoff - Life Science	"SARomics Biostructures is a research-intensive company...[that] was founded in 2006 and quickly established itself as the No 1 provider of protein 3D structure determination and structure-based drug discovery services in Scandinavia. Currently the company provides premium structural biology services worldwide" *SARomics Biostructures Webstie*	1: Prof. Mikael Akke	Co-founder and Director NMR Services
Efficax Energy AB	University Spinoff – Technology	"Efficax Energy AB offers unique energy-efficient solutions based on research at the Lund Institute of Technology" *Efficax Energy Website*	1: Erik Andersson	CEO
Cognibotics AB	University Spinoff – Technology	"Cognibotics specializes in methods and services for high-performing and cost-effective determination of robot properties such as backlash, friction, and non-linear compliance" *Cognbotics Website*	1: Klas Nilsson	Co-Founder and CEO
Bioprocess Control AB	University Spinoff – Technology	"The mission is to bring to market innovative advanced instrumentation and control technologies that allow for more efficient biogas research and an improved operation of biogas plants and processes" *Bioprocess Control Website*	1: Dr. Jing Liu	Founder and CEO

Table 2: List of variables tested and identified in spinoff creation process across 3 sectors

Opportunity Stage
Opportunity Recognition (Internal Vs. External)
Business Concept Development
Commitment to Venture Creation
Technology Setup & Organization Stage
Production technology & Organization creation
Product
Exchange Stage
Customer Feedback/Interaction with Market
Process Features
Novelty
Iteration
Additional Variables or Facilitators (found at the various stages)
LU Support
Validation
Patent Support
Team Formation
Credibility
External (other than university) support
Networks
Context Factors
Teacher's exemption in Sweden
Lund's Ecosystem

4.1 University Spinoff Support Organizations

4.1.1 Role of LU Support Organizations

A support system for university Spinoffs is present within Lund University spearheaded by LU Innovation, considered "the hub for innovation and commercialization at Lund University" (LU Innovation). These support services are evident throughout the three stages of venture creation sometimes playing an influential role in moving the Spinoff from one stage to the other.

LU Innovation primarily provides business support services to researchers and financial resources or "soft money" used for verification purposes. This is explained by Sven Olsson (S.O) who describes himself as “their coach and advisor” facilitating the various support services for free for researchers and students. The researcher/entrepreneur utilizes these within the opportunity stage when verifying the opportunity recognized and developing the business concept.

Investment capital is also provided through the holding company LU Innovation AB which acts as an early stage investor for a number of the companies formed. They work in close collaboration with LU Innovation’s business developers joining in when the venture is becoming physically established and owners are seeking investment. As such the support here comes at the point of commitment to the venture creation enabling the setup of production technology if needed by the Spinoff. Anders Boman (A.B) explains:

> Because [the research is] so early and unproven it is so difficult to find commercial capital to finance a venture and it’s also too early because you don’t have a product to sell to the market. So, our job is to help them to the point where the market can support them … we help them mature their business to the point where [they] can attract commercial investors, or... find the first customer or commercial collaboration project.

The support system also includes incubators in Ideon Science Park. Companies obtain access to business development coaches, office space and to a network of financers and other relevant resources in the innovation system as in the case of Ideon Innovation incubator (Ideon Innovation). As emphasized by Per Gavell (P.G), the main focus is ensuring that business operations are in place enabling the company’s organization setup and operation in the market to reach customers.

Grouped together these support entities oversee the evolution of a university Spinoff, assisting in its development and accordingly provide their reflections.

4.1.2 The Venture Process

Opportunity Recognition

The process is initiated when the researcher contacts LU Innovation to present their research findings and in return there is an evaluation of the existence of a need in the market as well as an investigation into the IP situation and providing *patent support* if required. As Johanna Asklin (J.A) elaborates there has to be a verification from "a technical point of view and a market point of view" and which may differ in length based on the specialization, where in the life sciences for example it is quite a long process. This typical and moreover required *validation* procedure or variable as pointed out by all four members of LU innovation interviewed highlights an internally stimulated opportunity recognition approach. Yet there may be exceptions as in one Spinoff mentioned by A.B which involved an externally stimulated opportunity recognition path recognizing a need first and then creating a solution. The case is described as follows:

In the case of Fieldly …they made a very easy to use system, that was tailored to … all the construction workers out in the field, because [they] like to hold hammers and not make paper reports and sit in an office, all previous systems they have to report, using enterprise systems, for what they are doing. [Using Fieldly], they can just use an app.

Business Concept Development

In the business concept development phase, a competitive advantage for the business idea is distinguished and a position for the business in the value chain is defined, a phase which is acknowledged by all interviewees in LU Innovation (Bhave 1994). S.O explains it:

It's an incremental process. You start with good ideas, investigating the need and then building on that. Build the business model ...[where] you have to consider ...the competitors, the industrial environment, the suppliers of value chain and all this. So, it's incremental.

Novelty

All interviewees confirmed the existence of a degree of novelty in the university Spinoffs they have come across. The novelty spectrum ranges from a business concept that is patentable hence involving a high degree of innovation to one where there would be one aspect of the business

that is new to the market, for example "the way you are charging for it, or producing it or [its] business model" as P.G puts it. In the case where the business concept has a high novelty factor, the potential university Spinoff goes through the additional step of testing the idea by creating prototypes to receive customer and industry feedback. These testing would be funded using soft money accessed by LU Innovation. Fredrick Edman (F.E) explains:

So if we see, OK, we need to develop this prototype for us to go out and speak to the companies to show the product and get them interested then that part is the verification of the business and then we [LU Innovation] can pay for that or part of it.

Commitment to Venture Creation

University Spinoffs registering as a limited liability company (Aktiebolag in Sweden abbreviated as AB) would move into the physical state of the venture (Bhave, 1994, p. 233). Showing this commitment, would enable investment from LU Innovation AB or an acceptance to the incubator of Ideon Innovation which would further contribute to the establishment of the company.

There was an alignment among the interviewees that the decision to create a company is a collaborative one between the researcher/entrepreneur and business advisors agreeing that registration is the next reasonable step in the process, yet the final decision is naturally made by the researcher/entrepreneur. This is evident in S.O's description:

We don't ... make those decisions [to create the company]... The decision is up to the entrepreneur, the champion, to do that. But, if we have done our job well, they rely a lot on what we think and we work together on this.

Production Technology & Organization Creation

During the setup of the organization and the production technology, different forms of support to assemble the needed resources are provided happening in parallel or simultaneously, as the firm develops and grows (Bhave, 1994). LU Innovation provides support in "administrative" areas as F.E puts it such as "place[ing] board members, [and] help[ing] [to] assemble the team". This is enabled through the large network it possess comprising of individuals such as entrepreneurs and investors that would be suitable to join as team members or sharing their expertise as board members. It was viewed by all members interviewed that a combination of science based skills (from the researcher) and business skills (from an external for example) within a team was the optimal organization arrangement. Moreover, it was specifically stated that as the team takes

form and the Spinoff develops with both a researcher and a partner who comes in with business skills (who they refer to as the entrepreneur setting this characteristic separately from the researcher), the entrepreneur gradually becomes the "champion". S.O reflects:

> It's very rare that the inventor, the academic is the entrepreneur. It happens sometimes, but more often, in the successful cases, it's a team, it's an external entrepreneur…In the beginning the researcher is the champion, but somewhere in this journey, the entrepreneur is the champion, [who] comes in as a CEO of the company.

To enable organization setup and production technology securing capital is vital. LU Innovation AB undertakes an early investment role if the Spinoff fits a criteria that shows growth potential as specified by A.B. In addition it also aids in the search and acquisition of other investors to increase the amount of capital that can be invested. Putting the "organizational processes" in place is a large focus area for Ideon Innovation as P.G explains by giving an example of a sales training program that they provide to the incubates.

The Product

The development of a product to sell to the market did not mean that the product sold to the customers was a finalized one. In some cases there is a "first version" of the product sold, or a product is sold to customers first before completing one aspect in the business model such as the delivery mechanism for example.

Customer/Market Interaction

Upon the supply of the product to the market, the majority of interviewees highlighted that the "exchange" with customers provides a commercial validation for the research since someone is willing to pay for the product offered. An additional facilitator highlighted by S.O was regarding the *credibility* given to the Spinoffs by being associated with the University:

> The most important resource for a start-up is the name of Lund University. Imagine a small start-up with a great idea, the credibility is always an issue, so if you go like to professional companies they will want to know who are you. Even if the idea and the product is great they cannot rely on a small player, so what Lund University provides is credibility which I say is the most important thing that we give to the products.

Iteration

It was agreed among all interviewees that iterations in the Spinoff process do take place in various forms. It was viewed that this can happen in any aspect of the business, including the

business idea and the business model, the venture requiring higher capital than estimated, processes taking longer than initially planned for and finally conceptually as A.B puts it "a mindset shift in the entrepreneur [because] it's a road of discovery".

4.1.3 The Context of Lund University

Teacher's Exemption Model

With the emergence of the Spinoffs from Lund University, one situational factor highlighted teacher's exemption model for research that exists in Sweden. Some interviewees believed that they are able to work well with this system enabling Spinoffs to evolve and that the university eventually can share ownership. S.O clarifies this:

> The researcher most commonly he or she wants to remain a researcher that means she cannot go 100% into the business. She could, but the common desire for such persons is that they want to remain in the academy. So how would they do then? Then they need to start a team, they need to get other people in, they need to get investors, they need a lot of those support to make this happen, so that's why we come in.

This was not a shared conception with other interviewees who saw that researchers could be unwilling to share their research with other business partners and hence affect the success rate of university Spinoffs. Citing the UK as one example which adopts the institution ownership model, the rate of research commercialization is considerably higher.

Lund's Ecosystem

Looking at the ecosystem existing in Lund, all interviewees perceived a supportive system aiding in various forms such as organizations providing small loans or grants (e.g. AlMI and Vinnova), a wide range of incubators catering to different types of Spinoffs, and a network of business angels.

4.2 University Spinoffs in the Life Sciences Sector

The three companies interviewed in the life sciences sector operate in two different categories: one in biotechnology and two in pharmaceutical. Biotechnology company Nattaro Labs (pest control products) founded in 2011 with the first product launched in 2013 was represented by its

chief marketing officer Christine Jacobsen (C. J.), pharmaceutical service business SARomics Biostructures (contract research organization) founded in 2006 with first services launched the same year was represented by researcher Michael Akke (M. A.), and pharmaceutical company Apoglyx (preclinical drug development company) founded in 2015 was represented by CEO Martina Kvistreimer (M. K.) and researcher Michael Rutzler (M. R.).

4.2.1 The Venture Process

Opportunity Recognition

Ventures were initiated by researchers based on university research projects following different processes in all three cases. The inventor behind Nattaro Labs had been researching for seven years the development of a unique mapping of bed bugs before realizing the commercial potential of her research. The researcher behind Apoglyx was pursuing research with the objective of potential development of a drug. M. H. explains his research:

> There was already some knowledge in the lab and we thought there is opportunity to also develop a drug, … it was also sort of from the beginning a goal on the side to see if there was an opportunity for some more biotic like a side project.

The academic knowledge and research were the prerequisite for opportunity recognition behind SARomics Biostructures. Their knowledge and expertise were utilized as service.

After this initial stage *team formation* was the next step and an important determinant in beginning of venture creation (commercialization process). In case of Apoglyx team formation was facilitated by LU Innovation brought in Red Glead Discovery as a strategic partner responsible for co-management of the commercialization of research. The team behind Apoglyx from this point are the researchers, LU Innovation, and Red Glead Discovery. Team formation for Nattaro Labs was initiated when the researcher contacted LU Innovation to request C. J. as a consultant on her project. C. J. recommended to add more competence to the project and accordingly brought in the team that she was already part of. This lead the formation of the team present today behind Nattaro. SARomic Biostructures team formation was a natural basis for the business between academic researchers and the industry experts from Biotech Active. M. A. explains:

> The research was already going on, that's our bread and butter academically to do this, day in, day out. So we have the competence, academically, we know how to do this fast and so it's a merger of ideas… and basically this was the catalyst…

The *validation* of the research, product, and services was carried differently for each of the companies. Apoglyx validation phase was supported by LUI providing the researchers with financial resources and their expertise to judge the commercial potential of the research and demand for a patent. Initial assumption on Apoglyx's research is that the application of it will be a new medication for diabetes. This might change as present scientific proof is insufficient to ultimately put a definitive value or as M. R. explains "this is very difficult for us to say, because… we are lacking too much on the scientific part to actually know exactly what our application will be at the end".

Nattaro Labs carried their validation with Sweden Migration Board who invited the company to test their product in their refugee camps due to issues with bed bugs. C. J. illustrates their process of validation:

So, we said, let's try out and make a pilot or a field study, …. thanks to the migration board, we got this opportunity to try it out in the field and validate it, exactly, so we had been validating it in the lab but that's not really the same thing so now we could validate it in the field so we know it's a success.

SARomics Biostructures relied on inside industry information on the changing approach of pharmaceutical companies from doing projects in-house to outsourcing. This change had become apparent with the rise of contract research organizations in the US and Germany.

Novelty

Two companies are characterized by high degree of novelty. Nattaro Labs first product holds a double patent for innovation which C. J. illustrates "we came out with a completely new product, in a completely new market". Apoglyx's invention is considered highly novel but dependant on development of further scientific proof that should support the establishment of a therapeutic concept in an existing market of diabetes drugs targeting a niche group of patients not covered by available diabetes types of treatment drugs. SARomics Biostructures is characterized by low concept novelty which is standard for service businesses considering that services provided are competence based, dependent entirely on knowledge and expertise of the responsible providers.

Business Concept Development

Business concept development for two of the life sciences companies has its fundamentals in research ideas characterized by high degree of novelty requiring great deal of resources in

finance, time, and people. Nattaro Labs and Apoglyx business concept development consumed considerable financial resources with Apoglyx continuing this process to date. Nattaro Labs began their process with a goal of developing a trap which in and out of laboratory testing turned out challenging to develop due to high novelty. Continuous testing involved working with properties in the laboratory and introducing them to the customers in order to receive feedback and further develop the concept. Throughout this process they arrived at a second idea which became their primary concept as a demonstrated fit with customer needs meanwhile postponing the development of the first idea. C. J. summarizes this process:

> So I spend a lot of time working with pest control technicians in the field and to see how do they work today, how do they deal with bed bugs and that's how we came up with our idea, the product and that was not really from the research but on the other hand if we would not have had the research and the knowledge about the bed bugs we wouldn't have been able to formulate such a good product and a business concept.

Apoglyx started off their business concept development process with an assumption that a novel mechanism they had discovered can be applicable for treating type 2 diabetes patients. However, the high degree of novelty of this research in actuality puts the initial assumption under question. The researcher estimates that the current concept might still not be at a stage where it can be evaluated as a certain product, even less what the value of it could be, considering that their research needs to be complemented with more research in order to develop further scientific proof to support the assumption.

The contract research organization business concept formation was a product of the latest directions the pharmaceutical industry was taking (Bhave, 1994, p. 231). Pharmaceutical companies known for doing everything in-house began outsourcing their projects and acquiring other promising projects as a way to reduce the risk of competition of new entrants. The researchers in the past were frequently inquired by pharmaceutical companies for complementary services based on their expertise, therefore, initiating their venture was a very natural step in their careers as researchers.

Commitment to Venture Creation

To proceed beyond business concept formation (Bhave, 1994, p. 232), researchers required physical, financial, and human resources. The commitment to venture creation was discussed as

a stage coming after business concept identification had been established and steps to incorporate the business were taken. M. K. illustrates the decision to register the business:

I think it was a joint decision a year ago, approximately, we had said that now we have everything that is needed in order to start a company in terms of research and development data, but now to be able to address investors we need to do that, so that's what we did.

All ventures were registered as AB companies. Nattaro Labs defined a shareholder agreement between the team responsible to establish the company in the market in parallel with the registration.

Production Technology & Organization Creation

After companies had legally formalized their ventures they all proceeded with the production technology set-up and organization creation. Companies varied in resources needs necessary to carry the venture through this stage with an emphasis on start-up financial capital. Nattaro Labs and Apoglyx in this respect were supported by LU Innovation meanwhile SARomics Biostructures got a bank loan. Other resources included facilities needed to carry research or business and legal and accounting commitments. Nattaro Labs initiated an agreement with a supplier in Sweden whereas SARomics Biostructures established a contract with the University for the use of Maxx Lab facilities needed to offer the services to the clients. M. A. explains the benefits of this agreement:

We needed to have a contract with Maxx Lab, that we can use their facilities and be embedded there, but then again, this was kind of a win-win situation, because they needed someone to run the lab, but the university wasn't going to put money to pay for that position and the academic groups really couldn't afford that either.

Organization creation coincided with technology set-up. Apoglyx and SARomics Biostructures defined roles, responsibilities and communication processes between the management and the researchers. Nattaro Labs company organization on the other hand was characterized by what C. J. described as "wearing many hats".

Product

Product development process was challenging for two companies with high novelty concepts. It consumed more resources in terms of finance and time and in one case further delayed the product. The research necessary for product development was carried in the laboratories. Nattaro Labs complemented this research with field testing and additionally connected with bed bugs global research community with an intent of bringing more knowledge to the process which

coincided with the discovery of a new concept that became the primary marketable product. On the other hand, Apoglyx's continue to develop new research continually necessary to either confirm the current assumption or redirect to different application fields. They are expected to arrive to a final of this process in next two to three years. M. H. explains that finally "we are looking for is to generate a package of knowledge and IP that we can sell". SARomics Biostructures developed their scope of services based on the knowledge and expertise of the team responsible for providing the services.

Customer Feedback/Interaction with Market

The customer exchange stage is a final event in the venture creation process where the company links its product with the market and further evaluates the viability of its offering (Bhave, 1994, p. 234). Nattaro Labs and SARomics Biostructure had customers lined up for their products and services early in the process enabling the companies an easier introduction to the market. Nattaro Labs C. J. illustrates the creation of agreements with potential customers:

... we also signed a co-operation agreement with potential customers, before we had a product in the market and they were saying if we get this product out we are very interested in buying it, so we got kind of support from customers as well.

For Sairomics Biostructures clients willing to outsource their projects with them was the prompt for starting the business. They had assured contracts for a minimum of one year foreseen by the partners with industry experience and networks. Apoglyx with its research still in progress ideally will sell or license the IP of its invention to a large pharmaceutical company with the capacity to develop the drug commercially.

Iteration

New venture creation theory suggests an iterative, conceptual process of venture creation (Bhave, 1994, p. 236) confirmed by every spinoff interviewed. However, Apoglyx and Sairomics Biostructures assert that although new knowledge was acquired in the process the core idea remained the same. M. H. explains:

Overall, we haven't really changed the basic idea so far, but of course we have some new knowledge... Research sort of goes wrong all the time and then you figure out that it was actually not how you thought then you find out something new. It would have to be a pretty big concept change.

Meanwhile for Nattaro Labs iteration resulted into a new product.

LU Support

All spinoffs have received support by Lund University Innovation Systems. Most notable support has been offered to Apoglyx where LUI was involved from the very beginning with securing necessary financial resources, managing the validation of the research, taking responsibility for team formation, and bringing in another party Red Glead Discovery as strategic partner, helping establish contacts with industry, and dedicating a business developer official who became board member in the process. M. K. illustrates the involvement of LUI in the validation phase:

"They had a very reactive role and trying to drive the project towards commercialization… It was within the validation phase then so I would say that they would took an active role in driving the validation in order to see if there is potential for commercialization."

Nattaro Labs reached out to LUI one year after they had incorporated their business and received financial support worth 300,000 SEK which they invested to set up their production technology. The contract research organization had LUI join as an investor with one board member.

4.2.2 The Context of Lund University

Teacher's Exemption

The teacher's exemption model which gives researchers the right of ownership of their research results was in all cases perceived as a motivating model to work under and even in one case described as a key factor for successful spinoffs. M. A. explains:

I think it's extremely important in our business... that's the kind of a driving force for me to be involved, that I can, my idea is my competence, I can try to shape it into a product in some way... if you have your own company, it's up to you, to make it happen and to bring in, make sure that your competence, all your smartness actually bares fruit.

Lund's Ecosystem

The support system for university spinoffs within Lund University in all three cases is perceived positively, particularly in one case highlighting LU Innovation's role as a "must" in terms of complementing the researcher primarily with entrepreneurial and business skills.

4.3 University Spinoffs in the Technology Sector

The three companies interviewed in the technology field operate in different sectors: solar-thermal energy, biogas, and robotics (see Table 1). BioProcess Control represented by Jing Lui (J.L) has been operating in the market for the past 10 years. Efficax Energy represented by Erik Andersson (E.A) established in 2011 and launched their product in the market last year (2015). Cognibotics represented by Klass Nilsson (K.N) was established in 2013 and are planning to introduce their final product version to the market within this year (2016).

4.3.1 The Venture Process

Opportunity Recognition

The initiation of the ventures was based on university research projects for two Spinoffs, Cognibotics and Efficax Energy, where researchers found technical solutions to specific problems in their respective industry. Since the research was owned by the researchers they were able to commercialize their findings after recognizing the business opportunity and thus both experienced an internally stimulated opportunity recognition. E.A shares the story of his partners:

> The research started because there was a need from the market from the solar thermal community, solar energy was too expensive so they wanted to lower the costs, [so] we need to do some research to solve this technical problem ... And then when the technical solution was found, then the PHD students/researchers saw an opportunity to start the business because they owned the results themselves.

On the other hand, the experience of J.L with BioProcess Control was slightly different as he attempted to use his research study to fully "optimize the whole biogas plan" but then realized it was too early to introduce his innovation (based on his research findings) as planned and as he points out "we had to step back and see what is missing" and decided to pursue an opportunity in one aspect of the market only. This can be still viewed as an internally stimulated opportunity but where the initial interaction with the market resulted in a strategic change in the business.

In validating the existence of the need in the market, both J.L and K.N who had previous work experience in their respective industries knew there was a market need based on this previous knowledge while E.A explained that they were in contact with industry representatives such as

the installers and carried out market research to obtain a better understanding of the market. In addition to the need verification, market testing was an additional step. Two of the three businesses described the creation of prototypes of their products. For Efficax Energy, they produced three prototypes before reaching a final product version. For Cognibotics, prototyping was used to educate customers about their product as "most customers thought about it as impossible… so we had to go there and prove that" in K.N's words. Overall, these validations were necessary to complete the opportunity recognition step.

Novelty

Two Spinoffs scored high on the novelty scale. Cognibotics currently owns two patents for their processes solutions and Bioprocess Control chose a niche in the biogas industry where they have established market leadership with competitors following after. For Efficax Energy the solution is an "incremental improvement" to the current options in the market "improve[ing] it by 30 or 40 per cent."

Business Concept Development

When developing the business concept, all three companies started off with one business model which was then revised or completely changed based on feedback from the market highlighting the iterative nature of this variable. J.L explained that his idea for BioProcess Control initially was to reconstruct the entire biogas value chain but realizing this was too advanced for the market he chose to focus on one aspect where they have launched their flagship product. For Cognibotics with the high novelty of the product offered they needed to add a consultancy service to their business model to educate their customers about how to integrate it with their current systems. E.A explains the journey for Efficax Energy with different business models here:

First we thought that we are going to sell it to installers because they are the ones the customers contact...The problem with that we had no credibility among them because we are unknown company and brand... Then we tried [selling] directly to end customers. That might work...but then ... it costs alot of money to do sales in a business to consumer market. Also … manufacturing was … quite expensive to do ourselves. Because we have small volumes. So this is why we landed in a business model where we actually are partnering up with some bigger actor already in the market in the heating sector ...[who] can manufacture cheaply and they have all the brand awareness, credibility in the market. We dont have signed deals but that is the plan to license the technology.

Commitment to Venture Creation

Starting the actual business by registering it as an AB was a defined point in the process recognized by all three founders. For one founder K.L this decision was a transforming one since he had initially not planned to become a business owner when he first contacted LU Innovation. It was during his discussions with the business advisors that he became more attracted to the business idea until he finally decided to commit to creating Cognibotics. K.L describes making this milestone decision with his co-founders:

> That was about three years ago and it was me thinking a lot, … let's say the day after I retired thinking back I might see that everyone is using this method but I didn't exploit it myself, then I would feel so bad and I don't want to do that so then I decided...And then I talked with my research colleagues, the four, ... although the basic idea was mine but we all contributed [and] then they also invested their private money.

Production Technology & Organization Creation

In all three cases, the technology set-up and organization creation followed after the registration of the business. The primary resource highlighted by all was financial. BioProcess Control and Efficax Energy primarily generated funds through external investments including LU Innovation AB whereas Cognibotics major investment was made by the co-founders along with some investment from LU Innovation AB and as K.L highlights "I did not want venture capitalists in, I was very afraid of [them]". Starting up the business involved resource leveraging for all three businesses where certain tasks such as legal, accounting and sales were outsourced on a need basis and needed facilities such as laboratories were co-owned with other entities.

Another vital aspect of organization setup was *team formation*. In all three Spinoffs, the researcher(s) that originally initiated the business idea sought to add another member to the core team who had relevant business background. This was facilitated through the *network* (an additional facilitator identified) either possessed by LU Innovation or the own researcher. For Efficax Energy E.A joined the team of two researchers and brought in the business expertise which the two researchers did not possess. For BioProcess Control, although J.L possessed the sales expertise he also partnered with another team member who was more focused on the marketing aspects of the business. K.N was able to access a business partner through his own social network, a friend who brought product management experience. LU Innovation also contributed by board members representing LU Innovation AB in all three businesses. Two of

the three Spinoffs specifically mentioned that they were able to access further team members through Academia, employing post graduate students with relevant study backgrounds. Given the limited size of the teams ranging from four to ten, members typically had several roles and as J.L explains it:

We are a rather flat organization, one of the reason, each individual has multiple roles. I am the manager, people are reporting to me, so it's rather a simple communication. Which we like, because the communication is easier... But that's our current stage, the business grows, then people will increase, of course you will need to create a bit more complicated procedures, the structures, but no intention to go for big ones, that's their efficiency.

Product

All spinoffs share their start of product development in their research which aimed to propose an improvement of current market conditions of respective industries either by improving performance of processes or reducing costs. For one of the spinoffs [Bioprocess Control] developing the research into a marketable business concept and product was a natural continuous process which enabled the merger of his inventions and assumptions. Going from research to market required researchers in two other cases to develop prototypes in order to test and prove their hypothesis. The feedback allowed both spinoffs to continue to develop their prototypes towards a better market fit which would eventually qualify the prototype for production. E. A. explains the process of product development:

We installed the prototype and we learned a lot, and it didn't work very well for a long time, did another prototype and tested again and then another prototype and now they are working. "[The successful product has] ... been running around half a year the most so it's too early to draw conclusions , but so far they have worked more or less.

Customer Feedback/Interaction with Market

Venture creation process for all spinoffs was highly characterized by customer interaction. Efficax Energy describes their customer interaction process with their customers, starting with someone they knew, as a trial and error procedure to validate their product until reaching the current version in the market. For BioProcess Control who has been operating in the market the longest, J.L describes their customer interaction through meetings with clients mostly at events where they discuss how products are serving the needs of their clients. Otherwise, "the product sells itself", implying a general understanding and need for this type of product, predominantly designed based on the judgment of the researcher with customer feedback coming in after the product is utilized by the clients. For Cognibotics who is not operational in the market yet K.N

described interaction that involved education of the potential clients who they were able to reach through his network in the industry known to be highly conservative. The process involved demonstrating and testing the prototype and finally returning for further development of the product.

Iteration

The conceptual process of venture creation dictated by iterations (Bhave, 1994, p. 236) was confirmed by all spinoffs. The iterative process helped spinoffs re-define their business models with basic ideas remaining the same throughout the process visibly for two spinoffs [Cognibotics and Efficax Energy]. Whereas in the other case [BioProcess Control] the final marketable product changed focusing on one aspect of the value chain but with the ultimate goal to "work on a full scale system" with other products in the pipeline, as such the business idea has not changed from a long term perspective. E. A. illustrates the iterative, conceptual process:

The business model has changed a few times. But the basic idea is still the same, we haven't pivoted any major thing technologically. The product is still the same, the business side has changed. You try out, you have an hypothesis and then you try out and then it doesn't work, so you do something else and you learn.

LU Support

All spinoffs received support from LU Innovation from the time they had contacted the organization. The support came in form of grants for concept verification, patent applications assisting them in the opportunity stage. Also through their networks the Spinoffs gained access to cofounders and project leaders contributing to the organization setup stage. For one Spinoff, Cognibotics, LU support was vital as K.L explained "they were assisting me in getting Vinova verification grant so that was very good, without that, I don't know if we actually would make it".

4.3.2 The Context of Lund University

Teacher's Exemption Model

All response on the teacher's exemption policy was positive. The impression is that the policy enables the researcher the opportunity to pursue the establishment of their own company as a way to operationalize their own research and become of service to the society by participating in

the private sector and thus plays an important role in motivating researchers to start their ventures. An exception came from E.A pointing out that while the Swedish system is valuable for researchers who are and ambitious, there is a greater motivation when research is university co-owned as in the case of the US since in Sweden there is still common belief that "science shouldn't do business". On the contrary, K.L describes a different experience:

"First, Sweden with this teacher's exemption, it is wonderful. Although people don't use it very much... When I talk to my German colleagues they typically have a 1/3 of the patent ownership with the university … And the hassle they have to go through. How can university staff put a value on the patent? It's too much trouble. I don't think I would have started if it was like in Germany. There is still so much risk. … and I don't want to have these unclear vague legal issues there."

Lund's Ecosystem

General impressions on the Lund University support systems were positive, acknowledging the value of available expertise, grants and recognition present in the processes of setting up their ventures. Some reservations against the system pointed out to the inefficiency caused by the large number of organizations and sometimes that the grants system might steer Spinoffs in a certain direction that may not be optimal.

5.0 Analysis and Discussion

This research study has demonstrated the evolution of university Spinoffs from three perspectives. Findings within the two industry sectors (Life Sciences and Technology) represent practical experiences. On the other hand, findings from the sector of support organizations (TTO unit, investment arm and incubator) principally represent a collective view of Spinoffs that they have interfaced with combined with an ideal or theoretical perspective. Utilizing these perspectives the following is a discussion of how university spinoffs evolved within the framework of the new venture creation process (as defined in the three stages: opportunity recognition, production technology and organization setup, and exchange stage) highlighting deviations or additional variables when applicable.

5.1 The Opportunity Stage

University spinoffs were predominantly initiated following an "internally stimulated recognition of opportunity" driven by a newly found solution or discovery (Bhave, 1994). A much less common but still existing initiator was "external opportunity recognition" where the founders typically had industry affiliation in addition to research background (Bhave, 1994). In an internally stimulated path, the research findings represent the "meta opportunity stage" where the business dimension is not recognized yet but researchers are aware that their findings can fulfill a "broader need" for society (Bhave, 1994). This can be further explained by Corbett's (2007) findings signifying that specific human capital (defined as the technical know-how in a certain field) has a significant role in this opportunity stage of the process. Given this awareness a business objective then became more clarified as the researchers moved into the market validation phase which was mandated and often facilitated by the university's TTO that the majority of spinoffs came in contact with at this stage. Another area where financial and technical support is offered by TTO is an investigation into the intellectual property situation. This was an important activity at this point especially for the life sciences field since patenting is a method used to efficiently protect results giving it a lead in the market (Ndonzuau et al., 2002). With this evidently multifaceted procedure of "opportunity refinement" a preliminary business concept was identified (Bhave, 1994). A high degree of novelty was always evident in the business concept variable. Furthermore, within the life sciences, high novelty is natural considering that new discovery is the essence of life sciences research, likely identified as scientific important and in most cases of great commercial relevance (Powell and Owen-Smith, 1998). Meanwhile, from the perspective of the university support organizations novelty was emphasized across all variables (the business concept, production technology set-up, and product) in line theoretically with the model but this can be seen as a reflection of a vision rather than as a representation of real cases.

To complete the business concept development and due to the high novelty of this variable, majority of spinoffs were involved in developing and testing prototypes or furthering lab research necessary to "achieve a good fit between customer needs and perception of those needs" as well as the development of an appropriate business model (Bhave, 1994, p. 231). This two

step progression is well demonstrated in Ndonzuau et al.'s (2002) stage based model of academic spinoff creation where the transformation from the idea into "a genuine entrepreneurial project… involves: (i) technological development, that is, the production of a prototype; and (ii) commercial development, that is, the construction of a business plan" (p.285). University's TTO also played an effective role here enabling prototyping and testing through the provisioning of "verification grants". Business model formation was a highly iterative activity for the ventures as the founders became more knowledgeable of market prospects, needs and resources (Druilhe and Garnsey, 2004 cited in Rasmussen, 2011). In this phase, Bhave (1994) called out for further research to understand if a high entrepreneurial effort takes place when there is a combination of high concept novelty and an internally stimulated opportunity recognition. Seen that university spinoffs fall into this criteria and a considerable amount of effort and time is invested in this stage, the current study can be seen as a demonstration of this. This importance of this stage (and hence the effort exerted) is in line with Vohora et al.'s (2004) proposal that the "capability to combine scientific knowledge with a commercially feasible offering that satisfies an unfulfilled market need" is necessary for researchers to proceed with the commercialization process (p.160).

To proceed beyond business concept formation (Bhave, 1994, p. 232), researchers required financial, human and physical resources. The commitment to venture creation was discussed after business concept identification had been put in place and this commitment was marked by physical creation of the company. Yet this did not practically imply that the business concept development was complete as university spinoffs continued with further testing demonstrating a non-linear dimension in the process. The decision to physically start a business was derived from the researchers/founders readiness and desire to move into commercialization. This is in line with the reflected positive perception of the teachers' exemption model allowing them to maintain control over their research and economically benefit from it thus acting as a motivator. This is supported by Jain et al's (2009) findings that influencers for researchers to move into commercialization were economic as well as a desire to act "as a custodian" for their research and how it will be applied in the industry (p. 926).

Within the opportunity stage the university spinoffs utilized resources that are beyond the researcher's personal resources. This involved university facilities and government sponsored verification money and incubation services, which as Rasmussen (2011) explains "lower[ed] the

initial cost and risk associated with exploring a business idea". These tangible resources provided by the university's TTO is in contrast to what Bhave (1994) points out as a stage where efforts are mostly personal and intangible representing a major point of divergence from process model (p. 322).

5.2 The Technology Set-up and Organization Stage

After the entrepreneurial commitment has been taken and the first act, of incorporating the business has been made, the venture transits into the technology set-up and organization stage, necessary for the business to progress into operational and engaged business transactions (Vohora et al., 2003, p.160). Conform to Bhave (1994) to meet the objectives of this stage and consequently begin to function, spinoffs needed to consolidate an initial stock of resources with the all-important resource considered the financial resource (Vohora, 2003, p. 164). This included investment from the University's support organization and similar to small business and entrepreneurial finance, spinoffs too relied on personal (internal) finance, an ability to assemble an investment by founding members (share holders), bank loans, and even angel investments. Beyond finance, some spinoffs were required to set up technology production necessary for product development and management which included the negotiation of terms with providers. Production technology resource demands are relatively higher for the life science sector. The development of organizational processes, routines, and capabilities to coordinate productive activities (Bhave, 1994; Vohora, 2003) were facilitated by support organizations in form of service or were outsourced by companies themselves. The capabilities and processes common for a pre start-up occurred in parallel with production technology (Bhave, 1994, p. 232-233). Majority of spinoffs considered the establishment of necessary organizational structures (Bhave, 1994, p. 233) costly at this stage describing themselves as linear organizations with each individual part of the spinoff found in multiple roles. However, once the venture was legally established, two distinct teams with defined roles come into existence: the management team and the board of directors (Vanaelst, 2006, p. 262). Furthermore, with the evolution of spinoffs, transiting into later development and growth stages, organizational structures with departmental boundaries and defined roles and responsibilities among staff were seen as conditional. Fundamentally, without the resources and capabilities the spinoffs cannot proceed to the next

phase of development (Vohora, 2003) where the business concept is expected to transform into a marketable product (Bhave, 1994).

Team formation is an important determinant for the spinoff to evolve from one stage to another and consequently form. Within the life sciences category this becomes even more apparent where team formation takes place early, in the opportunity recognition stage when researchers actively begin pursuing the commercialization of their inventions. Meanwhile, for the spinoffs in the technology category team formation develops at a different stage of venture creation process, frequently in the commitment to venture creation stage. Understanding that researchers, inventors, and academics view the decision to start a venture challenging (Vanaelst, 2006, p.249) due to their preference for academia or lack of competence (Rasmussen, 2011, p.458), the involvement of the support organizations early becomes important in the process of the creation of the spinoff in the life sciences category. The researchers can rely on coaches and consultants in the validation phase (Vanaelst, 2006, p. 258) once they reach to support organizations. Together they form a pre founding team (Vanaelst, 2006, p. 258). Once they go pass the validation phase and the commitment to venture creation is made, the leading role is taken by the entrepreneur (Vanaelst, 2006, p. 258) who in case of life sciences ventures is already part of the team. In other cases core team members will be acquired through existing networks primarily coming from the university support organizations but also researchers own networks. Furthermore, in some cases the leading role is taken by the researcher who in the process becomes increasingly committed (Rasmussen, 2011, p. 458) and comfortable. Contrary to Bhave (1994), where the entrepreneur is responsible for carrying the development of the venture through the whole venture creation process, with spinoffs, researchers initiates the process, meanwhile upon team formation the responsibility for driving the venture is either shared with co-founders or handed over to the business oriented person.

Product development was not differentiated from business concept development. As instructed by Bhave (1994) product development is understood as the embodiment of business concept and is viewed in relation to customers and markets “to be changed as dictated by customer needs” (p. 233). Generally, product development was characterized as a lengthy process for all spinoffs and demanded additional financial and human resources to enable the process in order to come to a final and commercial version of the product. The evaluation of business concepts and products in

correlation to consumers (Bhave, 1994, p. 234) was carried on an ongoing basis for the majority of spinoffs in an iterative and a non-linear way (Bhave, 1994) between university laboratories and field work.

5.3 The Exchange Stage

The physical creation of a venture or the final steps in venture creation process is recognized with a customer and their feedback regarding the products or service (Bhave, 1994, p. 234). A few of the spinoffs had customers express interest for their products and services early in the venture creation process. These first customers enabled an easier introduction of ventures in the market although were not a guarantee for future customers (Bhave, 1994, p. 234). Customers provided entrepreneurs with additional feedback for their products and services atop the ongoing iterations. None of the feedback affected the strategic stance of the ventures, their existence or emergence of new market substitutes, (Bhave, 1994, p. 234) as these spinoffs, after all, are based on highly novel concepts. The feedback developed into revisions that contributed to the operational improvements of their products (Bhave, 1994, p. 235). Additionally, all spinoffs accompanied the introduction of their products and services with consumer education programs like trainings and consultancies.

6.0 Conclusions and Implications

Analyzing spinoff development through Bhave's (1994) new venture creation model explained clearly how a spinoff develops and moves from one stage to another, from business concept development, production technology set-up and organization creation stage, and the exchange stage (p. 223). Furthermore, the application of Bhave's process model helped reveal new aspects of university spinoff creation resulting as additional dependant variables interacting in sequential manner in the spinoff venture creation process prompted by the university context. This holistic outline represents a set of insights that enables practitioners to understand how spinoffs are created within an academic setting and how the three actors, the researcher, the entrepreneur and the university interact with each other in developing necessary capabilities that influence the initiation and development of a university spinoff.

Compared to Bhave's theory where the only individual discussed in the process is the entrepreneur our study helped unveil the role of human agency in the spinoff development process (Rasmussen, 2011, p. 464). Future research should address the many actors involved in the different stages of university spinoff development with their objectives and strategies in facilitating the creation of a spinoff. It should seek to analyze how these actors take responsibility in taking the venture from one stage to another and how changes in team composition occur during the process. Actors to examine should include the government, the university, the department, the research group, individual academics, industry partners, investors and support agencies (Rasmussen and Borch, 2010, p. 604).

Understanding that spinoffs have an academic origin, founders have a deficiency in competences related to business management, "experience in competing in industry, and skills in recognizing and exploiting market opportunities" (Fernández-Alles et al., 2015, p. 977). Further research should analyze how spinoffs develop resources and internal capabilities necessary to progress through different phases of development. Moreover, it should address how these resources are integrated into organizational capabilities.

Our study revealed that The Act on the Right to Employee's Inventions or the so-called teacher's exemption in all cases was perceived as a motivating model to work under and in some cases

described even as a key to a successful spinoff development. A possible area of further research would be looking specifically at the extent to which this model acts a motivator for spinoff creation compared to the Western institutional ownership model.

On the practical front, this research has two main implications stemming as bottom up factors (Rasmussen and Borch, 2010, p. 602). As demonstrated the teacher's exemption model acts as a strong incentive for driven researchers to proceed with commercialization. This incentive is amplified with the existence of a strong innovation system providing various forms of support facilitating new venture creation. For more researchers to engage in spinoff creation, aspects of this innovation system need to be clearly communicated and emphasized. Given that the university's TTO unit is the hub of research commercialization, such activity would be part of this domain. Information kits drawing the different stages of spinoff creation (where this study can be used as a basis) along with the various forms of support available from different actors within the ecosystem should be created and be communicated regularly to ensure that this information is effectively disseminated to the potential pool of researchers. Moreover, for further motivation part of this communication should also include prior success stories and role models (Rasmussen and Borch, 2010, p. 607).

The second implication stems from the demonstrated importance of team formation in the evolution of spinoffs where researchers ideally seek to complement their skills set by acquiring team members that have the relevant business competencies. While the current setting primarily depends on the existing networks within the TTO unit and the social circles of the researchers to access their potential co-founding team, further efficiency can be attained if a dedicated bank of contacts or database is created as a way to legitimize human resource exchange. This database would initially use the existing networks' contacts, academics with commercial backgrounds and students interested in entrepreneurship (Rasmussen and Borch, 2010, p. 607) but would be open for "applications" from interested individuals who based on a predefined criteria could be matched with research projects looking for specific competencies that they offer.

The significant role that university spinoffs play in the economic betterment of society and in enabling the university to extend its mission beyond teaching, made it an attractive phenomenon to understand. To accomplish that and in an effort to join in the progression of academic entrepreneurship literature the choice was to investigate if and how spinoff formation can be

mirrored to Bhave's (1994) model of new venture creation. This was done with the awareness of the context represented by the case of Lund University. Our analysis suggests that the evolution of university spinoffs follow the three stages of firm creation (opportunity recognition, production technology and organization setup, and exchange) with all its core variables as instructed in Bhave's (1994) new venture creation model, explaining how the spinoff moves from one stage to another, clearly from opportunity recognition to launch in the market. It also revealed a highly iterative and non linear nature in the evolution of spinoffs reconfirming the importance of this feature within the model. Within the process spinoffs typically take the specific path that combines high concept novelty with an internally stimulated opportunity recognition approach. As such the business concept development stage is highly critical requiring resources that go beyond the researcher and commonly provided by the university support organization, making this is the first major point of divergence from the process model. Moreover in cases where the support provided is pivotal to the evolution of a spinoff, obtaining TTO support rises as an additional variable in the process. The context of the teacher's exemption is evident at the commitment to venture creation stage incentivizing the researchers to move on the following phase. The second point of difference is team formation which not only exists before the organization setup stage for a certain type of spinoffs (life sciences) acting as a critical determiner of the spinoff evolution, but involves a transformation or at least a sharing of the responsibility to drive the venture between the researcher and the co-founding team. This is not foreseen as a possibility within the process model which demonstrates a single driver moving through all stages.

References

Abramo, G., D'Angelo, C.A., Ferretti, M. and Parmentola, A., 2012. An individual-level assessment of the relationship between spin-off activities and research performance in universities. *R&D Management, 42*(3), pp.225-242.

Algieri, B., Aquino, A. and Succurro, M., 2013. Technology transfer offices and academic spin-off creation: the case of Italy. *The Journal of Technology Transfer, 38*(4), pp.382-400.

Alvarez, S.A. and Barney, J.B., 2007. Discovery and creation: Alternative theories of entrepreneurial action. *Strategic entrepreneurship journal, 1*(1-2), pp.11-26.

Andersson, M. and Klepper, S., 2013. Characteristics and performance of new firms and spinoffs in Sweden. *Industrial and Corporate Change, 22*(1), pp.245-280.

Ardichvili, A., Cardozo, R. and Ray, S., 2003. A theory of entrepreneurial opportunity identification and development. *Journal of Business venturing,18*(1), pp.105-123.

Baron, R.A., 2006. Opportunity recognition as pattern recognition: How entrepreneurs "connect the dots" to identify new business opportunities. *The Academy of Management Perspectives, 20*(1), pp.104-119.

Bengtsson, L., 2014. Comparing University-Ownership Technology Transfer Systems With University- Inventor Technology Transfer Systems In Scandinavian Universities–A Question Of Focusing On Licensing Or Spin-Off Business Models? *In 2014 University-Industry Interaction Conference: Challenges and Solutions for Fostering Entrepreneurial Universities and Collaborative Innovation (pp. 339-353).* University Industry Interaction Network.

Bhave, M.P., 1994. A process model of entrepreneurial venture creation. *Journal of business venturing, 9(3)*, pp.223-242.

Binkauskas, G., 2012. Academic entrepreneurship: Barriers and fears versus wishes and opportunities. *International Journal of Technology Management & Sustainable Development, 11*(3), pp.231-244.

Carter, N.M., Gartner, W.B. and Reynolds, P.D., 1996. Exploring start-up event sequences. *Journal of business venturing*, *11*(3), pp.151-166.

Corbett, A.C., 2007. Learning asymmetries and the discovery of entrepreneurial opportunities. *Journal of Business Venturing, 22*(1), pp.97-118.

Davidsson, P. (2007) Researching entrepreneurship. New York: Springer.

Dean, D, Hender, J, Rodgers, T, & Santanen, E 2006, 'Identifying Quality, Novel, and Creative Ideas: Constructs and Scales for Idea Evaluation', *Journal Of The Association For Information Systems, 7, 10,* pp. 646-698

D'este, P. and Perkmann, M., 2011. Why do academics engage with industry? The entrepreneurial university and individual motivations. *The Journal of Technology Transfer, 36*(3), pp.316-339.

Dimov, D., 2010. Nascent entrepreneurs and venture emergence: Opportunity confidence, human capital, and early planning. *Journal of Management Studies, 47*(6), pp.1123-1153.

Djokovic, D. and Souitaris, V., 2008. Spinouts from academic institutions: a literature review with suggestions for further research. *The Journal of Technology Transfer, 33*(3), pp.225-247.

Druilhe, C. and Garnsey, E., 2004. Do academic spin-outs differ and does it matter? *The Journal of technology transfer, 29*(3-4), pp.269-285.

Eckhardt, J, & Shane, S 2003, 'Opportunities and Entrepreneurship', *Journal Of Management, 29, Entrepreneurship: Past Accomplishments and Future Challenges,* pp. 333-349.

Eisenhardt, M. K. 1989. Building Theories from Case Study Research. *The Academy of Management Review, Vol. 14, No. 4*, pp. 532-550.

Eisenhardt, M. K., Graebner, M. E. 2007. Theory Building from Cases: Opportunities and Challenges. *Academy of Management Journal, Vol. 50, No. 1,* pp. 25-32.

Ensley, M.D. and Hmieleski, K.M., 2005. A comparative study of new venture top management team composition, dynamics and performance between university-based and independent start-ups. *Research Policy, 34*(7), pp.1091-1105.

Etzkowitz, H. and Leydesdorff, L., 2000. The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university–industry–government relations. *Research policy, 29*(2), pp.109-123.

Etzkowitz, H., Webster, A., Gebhardt, C. and Terra, B.R.C., 2000. The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm. *Research policy, 29*(2), pp.313-330.

Fernández-Alles, M., Camelo-Ordaz, C. and Franco-Leal, N., 2015. Key resources and actors for the evolution of academic spin-offs. *The Journal of Technology Transfer, 40*(6), pp.976-1002.

Fini, R., Grimaldi, R., Santoni, S. and Sobrero, M., 2011. Complements or substitutes? The role of universities and local context in supporting the creation of academic spin-offs. *Research Policy, 40*(8), pp.1113-1127.

Gartner, W.B., 1985. A conceptual framework for describing the phenomenon of new venture creation. *Academy of management review, 10*(4), pp.696-706.

Geuna, A. and Rossi, F., 2011. Changes to university IPR regulations in Europe and the impact on academic patenting. *Research Policy*, 40(8), pp.1068-1076.

Grimaldi, R., Kenney, M., Siegel, D.S. and Wright, M., 2011. 30 years after Bayh–Dole: Reassessing academic entrepreneurship. *Research Policy, 40*(8), pp.1045-1057.

Guerrero, M., Cunningham, J.A. and Urbano, D., 2015. Economic impact of entrepreneurial universities' activities: *An exploratory study of the United Kingdom*. *Research Policy, 44*(3), pp.748-764.

Ideon Innovation, Om Inkubatorn. Available from http://www.ideoninnovation.se/sv/om-inkubatorn. [26 April 2016].

Jacob, M., Lundqvist, M. and Hellsmark, H., 2003. Entrepreneurial transformations in the Swedish University system: the case of Chalmers University of Technology. *Research Policy, 32*(9), pp.1555-1568.

Jain, S., George, G. and Maltarich, M., 2009. Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity. *Research policy*, *38*(6), pp.922-935.

Knockaert, M., Ucbasaran, D., Wright, M. and Clarysse, B., 2011. The relationship between knowledge transfer, top management team composition, and performance: the case of science-based entrepreneurial firms. *Entrepreneurship Theory and Practice, 35*(4), pp.777-803.

Liao, J.J. and Welsch, H., 2008. Patterns of venture gestation process: Exploring the differences between tech and non-tech nascent entrepreneurs. *The Journal of High Technology Management Research, 19*(2), pp.103-113.

LU Innovation, Creating Growth From Research. Available from http://innovation.lu.se/en/om_oss/verksamheten#.Vv2XxOJ97IU. [31 March 2016]

LU Innovation, Our Portfolio. Available from http://innovation.lu.se/en/portfoljbolag#. [25 April 2016].

Lund University, 2014, Innovations from Lund. Available from http://www.lunduniversity.lu.se/research/innovations-from-lund. [31 March 2016]

Markman, G.D., Phan, P.H., Balkin, D.B. and Gianiodis, P.T., 2005. Entrepreneurship and university-based technology transfer. *Journal of Business Venturing, 20*(2), pp.241-263.

Mosey, S. and Wright, M., 2007. From human capital to social capital: A longitudinal study of technology- based academic entrepreneurs. *Entrepreneurship theory and practice, 31*(6), pp.909-935.

Munari, F. and Toschi, L., 2011. Do venture capitalists have a bias against investment in academic spin- offs? Evidence from the micro-and nanotechnology sector in the UK. *Industrial and Corporate Change, 20*(2), pp.397-432.

Ndonzuau, F.N., Pirnay, F. and Surlemont, B., 2002. A stage model of academic spin-off creation. *Technovation*, *22*(5), pp.281-289.

Powell, W.W. and Owen-Smith, J., 1998. Universities and the market for intellectual property in the life sciences. *Journal of Policy Analysis and Management, 17*(2), pp.253-277.

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A. and Krabel, S., 2013. Academic engagement and commercialisation: A review of the literature on university–industry relations. *Research Policy, 42*(2), pp.423-442.

Rasmussen, E., 2011. Understanding academic entrepreneurship: Exploring the emergence of university spin-off ventures using process theories. *International Small Business Journal, 29*(5), pp.448-471.

Rasmussen, E., Mosey, S. and Wright, M., 2011. The evolution of entrepreneurial competencies: longitudinal study of university spin-off venture emergence. *Journal of Management Studies, 48*(6), pp.1314-1345.

Rasmussen, E. and Borch, O.J., 2010. University capabilities in facilitating entrepreneurship: A longitudinal study of spin-off ventures at mid-range universities. *Research Policy, 39*(5), pp.602-612.

Rothaermel, F.T., Agung, S.D. and Jiang, L., 2007. University entrepreneurship: a taxonomy of the literature. *Industrial and corporate change, 16*(4)*,* pp.691-791.

Shane, S.A., 2003. *A general theory of entrepreneurship: The individual-opportunity nexus.* Edward Elgar Publishing.

Shane, S.A., 2004. *Academic entrepreneurship: University spinoffs and wealth creation*. Edward Elgar Publishing.

Stuart, T.E. and Ding, W.W., 2006. When do scientists become entrepreneurs? The social structural antecedents of commercial activity in the academic life sciences1. *American Journal of Sociology, 112*(1), pp.97-144.

Thursby, J.G. and Thursby, M.C., 2011. Has the Bayh-Dole act compromised basic research?. *Research Policy, 40*(8)*,* pp.1077-1083.

Vanaelst, I., Clarysse, B., Wright, M., Lockett, A., Moray, N. and S'Jegers, R., 2006. Entrepreneurial team development in academic spinouts: An examination of team heterogeneity. *Entrepreneurship Theory and Practice, 30*(2), pp.249-271.

Vohora, A, Wright, M, & Lockett, A 2004. Critical junctures in the development of university high-tech spinout companies. *Research Policy, 33,* pp. 147-175.

Walter, A., Auer, M. and Ritter, T., 2006. The impact of network capabilities and entrepreneurial orientation on university spin-off performance. *Journal of business venturing, 21(4),* pp.541-567.

Wennberg, K., Wiklund, J. and Wright, M., 2011. The effectiveness of university knowledge spillovers: Performance differences between university spinoffs and corporate spinoffs. *Research Policy, 40*(8), pp.1128-1143.

Wigren-Kristoferson, C., Gabrielsson, J. and Kitagawa, F., 2011. Mind the gap and bridge the gap: Research excellence and diffusion of academic knowledge in Sweden. *Science and Public Policy, 38*(6), pp.481-492.

Yin, R.K. (2014) *Case study research: Design and methods*. Sage: Thousands Oak, California.

Appendix A

i) Interview Guide: University Spinoff Version

Question	Stage/Area Covered
Introduction and description of Spinoff	
1) Please introduce yourself, what do you do/what in company X? What does Company X do?	Background information on respondent and company
2) How would you describe LU research and incubation strategy (personal perceptions from direct experience with the organization)? o What are its strengths? o What are its weaknesses? o What else would help the strategy? o What would be your recommendations, based on your experience?	Background information: understanding how contact with academia/LU contributes to the university Spinoff process
3) How does the policy effect / shape the spinoff process? How does policy effect growth potential of the venture?	Background information: understanding university Spinoffs within the Swedish context
The Process	
4) Can you describe the evolution of a spinoff, from research to markets?	Process overview: understanding if a process exists and if it is recalled spontaneously
5) What was the prompt ?How was opportunity recognized?	Opportunity recognition stage Type of opportunity recognition (internally/externally stimulated)
6) How did you validate the idea? Did it involve finding a market need?	
7) How does the Academia (the link with the Academia) affect the evolution / growth of the venture? Who did you contact ? LU only or other?	
8) How would describe the novelty of the idea? Do you see it as a product innovation or something else?	Novelty Factor and Core Variables
9) Can you describe the business concept development phase?	Business Concept Development stage
10) How is the decision to create an actual business (a real presence) made? Is it a joint decision?	Entrepreneurial commitment
11) Are resources purposefully allocated for the creation of a separate entity?	Technology and Organization Setup

12) What do you see as the different resources required? Prompts: Knowledge and expertise/financial means/physical space	
13) To what extent does LU INNOVATION support the technology and organizational setup in a venture?	
14) What are the accesses to expertise and networks? Prompts: • How did your social network play part in the process? How do you perceive its influences on the process of venture formation and development? • What are the implications of networks / network activities with your University relationship?	
15) Can you describe team formation? Did you go into your network to find people? When and how did you start adding people to your venture? Were they volunteers? Were they employed?	
16) Is there a point where customer feedback / market research is somehow mandatory or implemented purposefully by LU INNOVATION / through LU INNOVATION / mandated by LU INNOVATION or is it up to the researcher? Do you think that scientists could contribute with their research without the industry expertise?	Exchange Stage
17) Do you see different stages in market interaction?	
18) Once you reached the market, can you explain the implications of the relationship with the University? The benefits, limitations?	
18) Based on your experience to what extent do iterations in the research take place, and how flexible is LU Innovation in that?	Iterative- Non Linear Approach
Lessons Learnt	
19) Can you summarize points of progress (breakthrough moments / milestones) in your process of spinoff development?	General/Recap
20) What are your biggest lessons from spinoff formation, development, creation (establishment)?	
21) What are the biggest challenges of the spinoff process? Issues?	
22) In your opinion, what mechanisms facilitate the spinoff process? How about the factors, which were the factors that enabled the process and which restrained? Which resources were most beneficial for your performance?	
23) Generally, how does the relationship with Academia affect the success of	

the venture?	
24) How would you describe the role of spinoffs in transforming knowledge to economy? How do you perceive the nature and motivation universities taking such initiatives?	General/Societal Role

ii) Interview Guide: TTO/Incubator Version

Question	**Stage/Area Covered**
Introduction and description of LU Innovation / Incubator	
3) Please introduce yourself, what do you do/what is your role in LU Innovation/Incubator? Do you work within a certain area / industry?	Background information on respondents and entity
4) How would you describe LU Innovation/Incubator mission? Prompts: • What is the role of LU Innovation/Incubator in facilitating the transfer of a university invention into practice? Can you describe your objectives? • What is the contribution (extent of contribution) you make to industrial R&D, society?	Background information: understanding how the entity contributes to the university Spinoff process
5) How do you achieve this mission/these objectives? (implementation strategy?) Prompts: • How does university or industry funding contribute to this activity?	
6) How does the policy effect / shape the spinoff process? How does policy effect growth potential of the venture? Prompts: • For example here in Sweden we have the teacher's exemption. What are the implications of that on the potential of the venture? What are the implications of that on the whole commercialization of research?	Background information: understanding university Spinoffs within the Swedish context
7) What are the University policies that affect the tech transfer / spinoff output?	
8) How do you classify the different university Spinoffs under LU Innovation/Incubator (i.e. basic versus applied research or by industry)?	Background information: understanding the scope of the university Spinoffs supported by the entity
The Process: Opportunity recognition / Organization setup / Supply and demand	
9) How does LU Innovation/Incubator see the evolution of a spinoff? Can you, from your position, describe the evolution of a spinoff, from research to markets? Prompts: • What is the process of formation & development / venture process (from research to market)?	Process overview: understanding if a process exists and if it is recalled spontaneously

• Is there a standard process? • Can you describe different progression phases?	
8) How does university or industry funding contribute to this activity?	Process overview: understanding if funding is seen as a step in the process or a resource provided
9) How do you assess potential spinoff? (assessment criteria categories: tech & commercial potential; level of product innovation; how it satisfies a market sector;)	Opportunity recognition stage
10) Is novelty a factor you look for? Prompt: How do you asses if it exists? Does it have to be related to the product?	Novelty Factor and Core Variables
11) What do you see as the prompt for the venture. Who do you think initiates the venture / business idea. Is it always the researcher or can it come from LU innovation/Incubator? E.g. is it basic research turned into a commercial venture based on LUIS recommendation/efforts. Or is it applied research requested from LUIS in the first place? Or is it a researcher completely initiating the research and then applying for LU Innovation/Incubator support?	Type of opportunity recognition (internally/externally stimulated)
12) When do you decide it's time to turn your technological research into a venture?	
13) Can you describe the business concept development phase?	Business Concept Development stage
14) How is the decision to create an actual business (a real presence) made? Is it a joint decision?	Entrepreneurial commitment
15) To what extent does LUIS support the technology and organizational setup in a venture? Are resources purposefully allocated for the creation of a separate entity?	Technology and Organization Setup
16) What do you see as the different resources required? Prompts: Knowledge and expertise/financial means/physical space	
17) What are the accesses to expertise and networks?	
18) How are entrepreneurial teams formed and how do they evolve?	
19) Is there a point where customer feedback / market research is somehow mandatory or implemented purposefully by LUIS / through LUIS / mandated by LUIS or is it up to the researcher? • Do you think that scientists could contribute with their research without the industry expertise?	Exchange Stage
20) Do you see different stages in market interaction?	
21) Based on your experience to what extent do iterations in the research take place, and how flexible is LUIS in that?	Iterative- Non Linear Approach
Lessons Learnt / Reflections	
22) Can you summarize points of progress (breakthrough moments / milestones) in the process of spinoff development? *What is the most common milestone for a venture that you know will make it?*	General/Recap
23) Based on your experience, can you see reasons (factors) why some Spinoffs are successful and why some fail? Is there a model / success that you would follow? What would you improve in the process?	General/Areas of improvement
24) What are the biggest challenges/barriers of the spinoff process?	General/Recap
25) How would you describe the role of spinoffs in transforming knowledge to economy? How do you perceive the nature and motivation of Lund University in taking such initiatives?	General/Societal Role

26) Why should academia, industry and governments have an interest in tech transfer / spinoffs?	
27) What are your recommendations for the cases to interview? Why? How would you classify them?	Lead to other respondents

Appendix B

i) Table of Analysis: University Support Organizations and New Venture Creation Process

New Venture Creation Process	LU Innovation	LU Innovation AB	Ideon Innovation Incubator
Opportunity stage			
Externally stimulated opportunity	**No**	**Yes** This form of opportunity recognition was identified in one example of the companies LUIS AB has invested in: "In the case of Fieldly, there was nothing really world shatteringly breakthrough with it, but it was just they made a very easy to use system, that was tailored to the building industry for all the construction workers out in the field, because the construction workers like to hold hammers and not make paper reports and sit in an office, so all previous systems, they have to report, using enterprise systems, for what they are doing. This way [using Fieldly], they can just use an app" Anders Boman	**No**
Internally stimulated opportunity	**Yes** "[Some] researchers ...come too early, so they haven't completed their research, they haven't reached the maturity where we can actually start commercializing ... and some come in this optimum time, we do first market analysis, to see is there a market that wants this product or service ... and then parallel to that we do screening of the IP or the intellectual assets that they have. When we have done that, we have an answer with what kind of market we can target" Fredrik Edman "Typically when a researcher would come to us, they would say we have these great results ...	**No**	**Yes** "Usually, they have some idea of doing business on their idea but its not always the best way of doing it. ...We have a company in our environment now they do robots software, so they can fix themselves... And they have a great idea and they have clients that are very interested in this and the business model is ancient. They could do so much better if they did it in another way, so we are working on that to find another business model so they can make a lot more money, grow more, be more efficient" Per Gavell

	and then our focus is OK so what's the need, who has this need. ... what is the problem out there, with the society? How would you approach it? How would you solve that problem? What is the benefit of the solution" Johanna Asklin		
Novelty factor	**Yes** "It has to be novel... Sometimes you can find a drug that has been used for one indication and then the researcher finds it, well if you use it for this disease it works as well, then you have novelty within that area and you can patent that and commercialize. So, that's part of the IP market screening that we do" Johanna Asklin "my experience is that great successes are new business models in very traditional industries and there are loads of examples of that. One of [the] very good secrets of succeeding would be to find an appropriate new business model. So you can do very traditional things with a new business model and succeed" Sven Olsson	**Yes** "generally, we do want the novelty of something that can be protected by patents"	**Yes** "Traditionally there has been a criteria, for novelty, patentable idea. It's not really that strong when you take China into it. They are getting better at it, but i think it's a lot work, a big process and a lot of money in getting your patent, it's worth nothing, until you do the business, so when you start to do the business, then it doesn't matter if you have a patent or not because you are so far ahead... … It's called Ideon Innovation. So it should be some sort of innovative take it on, maybe not a new product, but the way you are charging for it, or producing it or a business model" Per Gavell
Business concept development	**Yes** Well, it's an incremental process. You start with good ideas, investigating the need and then building on that. Build the business model ...[where] you have to consider ...the competitors, the industrial environment, the suppliers of value chain and all this. So, it's incremental." Sven Olsson	**Yes** "So in some cases we have to do a bit of value chain analysis, who has the pain, whose problem are we really solving?... You have an idea, but you have to find what exactly will be your market, who will pay for it, what is the value proposition, sales arguments are important for them, it's a discovery process, it's a bit like lean start-up" Anders Boman	**Yes** "we have six months of trial period when accepted into the incubator… we feel each other, we make sure, they are on the track, so that they have been thinking about sales, marketing, they are thinking about IP, know what the budget is and they know it is important to communicate (e.g. pitching)" Per Gavell
Commitment to venture creation	**Yes** "It's always the entrepreneur. We don't … make those decisions... The decision is up to the entrepreneur, the champion, to do that. But, if we have done our job well, they rely a lot on what we think and we work together on this" Sven Olsson "I think it's more of a natural process, since we want to have early cases, we want to work with them for a long time and then at a certain stage ... you start looking at it from a different	**Yes** "Formally, it's us that make the decision [of investment], but in terms of doing the background check, when it is ready to start a company, start a business, we will do that together... the researcher can start a company whenever they want to, it's only the question whether they want our pre-seed money to go into a running start for the company" Anders Boman	**Yes** "if you want to be part of the incubator process, you need to have a company. We have demands from the government, it should be that kind of company. So that in end, it has to be an AB, if they haven't got that, we help them to start that...You need to have a company, ambition to grow it" Per Gavell

	view, well this is more commercial, more developed than research and then we start thinking of the idea to a spinoff... [but to create a company] is always their decision" Johanna Asklin "This is our core knowledge here, when actually to start a company, what kind of things you should do along the road. Some researchers have done this ...many times before, so they of course know much more, they see when it's time to form the company ... but in most cases, it's we together with the researchers and the team that we build up, that decides when it's time to do things" Fredrick Edmun		
Technology setup & organization creation stage			
Organization creation& production technology	**Yes** "We help with administrative things, ...we can place board members, we can help assemble the team ... buying for instance equipment, paying for prototype development … as long as it is for verifying the business case. …We seldom like purchase a machine that they could use in their company, because that is not for verification, that's investment" Fredrik Edman	**Yes** "There are two different concepts, one is, if we are co-owners and the other is if we are not. If we're not, than we just cheer and come in with good advice... Then we have the companies that we invest in. Then we change responsibilities. I work with projects until the creation of company, then my colleague takes over this process" Sven Olsson " It depends on the funding. There is a lot of effort going into finding money early on for everybody. Basically you try to find as much money as you can, then you have an idea of how much you can achieve, what you can achieve, using that funding, so you can have an even stronger business case, for the next round of funding. That's how you work." Anders Boman	**Yes** "if you take the workload or what you should be doing [the idea] is a very small part, the idea is maybe 2% of the company, the rest is execution and doing stuff and organization and customer relations. the idea is important but not the main thing for the company this is why most big companies they haven't got ht best ideas they got the best business. There are lots of great ideas that could save the world but never lived off because they dont know how to do the business they don't get it they focus on the wrong thing."
Product	**Yes** "we come to a point where we say, OK now we have..produced the first version of the product or ...are in the process of sending out the first bill to someone that has bought something, first customer and so on and that is where we usually leave the company or ... the researcher, because we are mainly for the verification process" Fredrik Edman	**No** An example of a company LU Innovation AB invested in that showing a case where there is no product: "Another one, [where the] research innovation was of very high quality, it's a company called Opti Freeze, so, it's a brilliant idea that you can actually freeze products or food, whether ice crystals don't	**No** "[some companies] they have a great business model, but the product isn't there yet, so we work with the product or with the delivery so there are different parts, that they are strong in and parts they are a bit weaker."

		burst through these walls which means it will keep it structured. So what's the market for that? Enormous. That's one of the companies listed on the stock exchange in three years, so our initial pre-seed investment turned into a lot of money. So that was very successful, but they don't have a product yet, they don't have a customer yet. They haven't sold anything, it's just a lot of promises but the research is obviously fantastic, but then to make it into a product, that we don't know yet." Anders Boman	
Exchange stage			
Customer Feedback/Interaction with Market	**Yes** "I think it's important to get as much feedback from the outside, to be able to have the ideas from the industry, have their feedback, because it might be that something could work very well in an academic setting but it might not work out there and then I think it's important to have that feedback and that comes back to the contact with the industry, they have to come in and we have to go out, to work together." " Johanna Asklin	**Yes** **"**Making the first commercial sale is a very important step, because that is proven, that somebody is ready to pay money for your product" Anders Boman.	**Yes** "The sooner you talk to your potential customers, the better your business will be. We focus on the market, on communication with the potential customers, selling, marketing and structures to get that into the company as a routine."
Iteration factor			
Iteration	**Yes** "Usually it changes a lot from the initial idea... What is nowadays called a lean start-up where you test things and you change it, where you pivot your hypotheses all the time, we have done this a long time" Sven Olsson " We are really flexible. We have a theoretical process on how we see our line of work ...However, in reality, every case is different, so we need to adapt and adjust all the time and the different phases take different amount of time, depending on the researcher and other things" Fredrik Edman	**Yes** "Well, everything takes a lot longer and takes a lot of more money than you think and it's also a mindset shift in the entrepreneur, it's a road of discovery and that's why we can't sort of say you should do this and that... and it can be challenging for researchers to make that transition to entrepreneurial thinking, researchers want 150% proof of everything" Ander Boman	**Yes** "We change all the time. Even in the business idea. That's development. Otherwise we could be like in the 40s. We are very flexible and very open that's really the point, if we are not flexible, how can they be flexible?"
Additional Variables			
LU Support	"I will be their coach and advisor. I have some financial instruments and also some human resource, consultancy persons, lawyer, patent	"Because [the research is] so early and unproven it is so difficult to find commercial capital to finance a venture and it's also too early because you don't	"Focusing on business and building... since 2010, we focus on doing business and people and building teams Because if you fail with the

	experts, market communication resources. And all this is free for researchers and students at the Lund University." Sven Olsson	have a product to sell to the market. So, our job is to help them to the point where the market can support them, both in terms of capital and market for their products. So, we help them mature their business to the point where you can attract commercial investors, or you find the first customer or commercial collaboration, project." Anders Boman	company, that has taken a lot investment and built a product and it failed with that then the money is lost but if you build a team, you don't loose the money, you still have the team"
Validation	"Somewhere we say, OK, we believe in this, let's do some testing. Then we go into the project phase and in the project phase we spend money. Prototyping, interviewing, writing project plans and testing" Sven Olsson "Market validation, that would include IP, [and] need obviously, you have to have [it] verified... your idea from a technical point of view [and] market point of view" Johanna Asklin "So if we see, OK, we need to develop this prototype for us to go out and speak to the companies to show the product and get them interested then that part is the verification of the business and then we can pay for that or part of it" Fredrick Edmun	"the basic criteria for investments is, it needs to have a market. A total market of at least 100 million SEK, it needs to be a growth company... some sort of technology, that can be leveraged into a fast growing company with a decent size market" Ander Boman	Its about timing. We have another company they just moved out. They have been trying for 5-6 years, with their technology that is also connected to IOT, but they were 4-5 years too early, they have a technology and it can make a difference in the world but no one can use it yet. They have been struggling, everyone saying they can use it but its too early, they cant buy it or invest it... they sold their team to a bigger consulting firm, and he has the technology so that he can use it maybe in 2-3 years but now he's putting it on ice.
Team Formation	"In the beginning the researcher is the champion, but somewhere in this journey, the entrepreneur is the champion, [hes/she] comes in as a CEO of the company and sometimes it's the researcher, however, in successful cases it's mostly not" Sven Olsson "That is one of the things that we [are] constantly battling with. In some cases, the researchers are not entrepreneurs, they're not champions, they think they're champions, but they're not and then it will be probably a lengthy process convincing the researcher that we need to bring on an entrepreneur into the group and then we usually use our network to see if there will be someone interested, ...and they come in and they usually bring in some money or some specific expertise into the project" Fredrick Edman	"But the ideal team was that the original founder was an IT guy, very quiet spoken, very, very smart in terms of product development and then we had an entrepreneurship student, graduated [from] industrial economics. They became partners. He was very sales and marketing oriented and together they just took off and grew very quickly. That's an ideal scenario, if you can actually put sort of in business partnerships together, that add different skills, that's the ideal solution" Anders Boman	"When you come from the university, and the focus is technology, research, and producing stuff, it's not natural for them to shift into that, there is a process, or you can team up with other people, that's mostly the case in the successful ones, they team up. If you're a scientist, you don't really want to do that part with markets and so forth so you team up."

Other	**Credibility** "The most important resource for a start-up is the name of Lund University. Imagine a small start-up with a great idea, the credibility is always an issue, so if you go like to professional companies they will want to know who are you. Even if the idea and the product is great they cannot rely on a small player, so what Lund University provides is credibility which I say is the most important thing that we give to the products". Sven Olsson **Patent Support** "we need also maybe to protect something, we have to initialize this patent application process... I can't write patent applications to [the] researcher, even though I worked as a patent consultant for many years, because then I would, since I am employed by the state, then I would be competing with the other companies and that's not allowed. So we need to have money for paying for that service and then I can ensure quality" Fredrick Edman		
The Context			
Sweden's Teacher's Exemption	"You can't compare countries, so you can't take one country for instance like Norway and compare it with Sweden and say OK you have the exemption, you don't… because there are so many other parameters that influences... it doesn't really matter, because if we have the exemption we could work it on in one way and draw back some benefits and if we don't have it, we will draw back again with some other benefits" Fredrick Edman "We have 100% ownership of the researcher and the researcher most commonly he or she wants to remain a researcher, that means she cannot go 100% into the business. She could, but the common desire for such persons is that they want to remain in the academy. So how would they do then? Then they need to start a team, they need to get other people in, they need to get investors, they need a lot of those	"I talk to Oxford University and .... they have a lot more technology licensing deals. And what we do, virtually, all [are] technology spinoffs, companies that we start, very few licensing deals. Because of the researchers who owns the IP" Anders Boman	"[the teacher's exemption] you can look at it into two ways: it could be positive or negative. As we look at it its not all positive. The one that owns the research, maybe it's not that suitable to make the company because many have been doing research for 30 years, this is their baby, they are not inclined to share it with the ones that can build the company. That's kind of a problem. If that would change like in Denmark, or Netherlands, I think they have a shared ownership of the research, that the university can also part of financing the company, that would be a good solution. "

	support to make this happen, so that's why we come in" Sven Olsson		
Lund's Ecosystem	"[There are] a lot of soft money organizations, Connect Skane, Almi, Invest in Skane, Invest in Sweden and things like that" Sven Olsson	"Overall ecosystem is very important and in Lund it's a very good one...rather [I] would say that good advice is cheap because there are so many different groups that offer good advice for free, including us... [And] not just capital but maybe successful entrepreneurs that ... know how to take an early stage company to commercial success, Also, institutional money, that's valuable through Almi, we have the incubators, we have angel investors, the ecosystem is important" Anders Boman	"We started this house [Ideon Agora] in 2010 and we tried to collect all the support you can get in Lund in the same building. If you come here you can get support you need, maybe not from us maybe from Nyfercentrum or Connect..."

ii) Table of Analysis: Life Sciences Spinoffs and New Venture Creation Process

New Venture Creation Process	Apoglyx	Nattaro Labs	SARomics Biostructures
Opportunity stage			
Externally stimulated opportunity	**Yes** [Researcher] ”There was already some knowledge in the lab and we thought there is opportunity to also develop a drug, but the primary was to get some tools for research, to do different research with chemical molecules, but I think it was also sort of from the beginning a goal on the side to see if there was an opportunity for some more biotic like a side project… we could then confirm the concept more and more…”	**No**	**Yes** ”So there’s a niche, especially right now, this is type of thing that fluctuates throughout history, sometimes Big Pharma don’t want to outsource anything, they want to do everything in-house, right now they outsource a lot and they buy, we should say half baked projects. Projects that look very promising, but you don’t really know yet, whether this will be the next big blockbuster drug you know. But they buy these projects, to in a sense, minimize risk for themselves. But for the contract research organization, some colleagues of mine and I, together we realized, that we could start a company that could do this, because, as often times as academics we get approached by pharmaceutical companies asking can you do this, can you help us out with this.”
Internally stimulated opportunity	**No**	**Yes** ”One of my co-founders, she had just left the University, so she had been working for University for 17 years and the last 7 years she had done research on bed bugs at department of biology group called the phermon group. Working with Chemical ecology, she was the first scientist to map the chemical language of bed bugs. Actually, she was the first scientist in the world to start to map the chemical language of bed bugs so it was actually her research, me and my other co-founders who	**No**

		built the company on her idea."	
Novelty factor	**Yes** [CEO] "Researchers they have come up with an idea or concept for novel kind of treatment for helping type 2 diabetes patients to control their blood sugar better and we are focusing our endeavor on specific type of patient, that has very few treatment alternatives and that is patients that also have problems with their kidneys. Kidney function, diabetes patient is compromised and there is a lot of diabetes treatment around but many of those cannot be given to patients with kidney problems."	**Yes** "Completely novel idea. Since we are working preventively and not reactively, all other products in the market they are formulated so you can use them when you have the problem, but we say, use this in advance so you don't get the problem. We didn't make it easy for ourselves, we have come out with a completely new product, in a completely new market."	**No** "It's not hugely, I don't think so, like I mentioned there are other companies existing when we started, there was very timely and it's a, the competence level that's needed to do this, so now I'm mainly talking about my other colleagues who are experts on crystallography, not myself specifically, the level of competence is really high. You can't do this unless you're really an expert. You need to know how to use advanced equipment like this cyncatron, so it's not like any company can come up with this and do this. So even if you're not hugely innovative, I think, there aren't that many people in the world to start doing this."
Business concept development	**Yes** [CEO] "There was a concept, so we have found a novel mechanism which would be good for treating patients… but from there to a business case, it's a really long way and you really have to think about it and I think that we have learned a lot on our way… yes we have a business plan and yes we are still following it in a way of the business plan, it is much more important in this project with all the bits and pieces that you need, also with when you talk with potential buyers in the end and investors especially."	**Yes** "She [Camilla] had this maping of this basic research, how bed bugs communicate with cells, this she had and we had this idea, how to take these phermons and create a trap where you can catch the bed bugs. This is what we would like to do, we have bought the bed bugs and started to try out… because then you use synthesized phermons in order to make it industrial viable product. You need to identify the different components of phermons and that is kind of a science behind it." "So I spend a lot of time working with pest control technicians in the field and to see how do they work today, how do they deal with bed bugs and that's how we came up with our idea, the product and that was not really from the research but on the other hand if we would not have had the research and the knowledge about the bed bugs we wouldn't have been able to formulate such a good	**Yes** "The research was already going on, that's our bread and butter academically to do this, day in, day out. So we have the competence, academically, we know how to do this fast and so it's basically a merger of ideas. We had kind-a thought about this for some time and basically this was the catalyst when the guy said if we started now we have business coming in to that new company for at least a year. So then we knew we can hire one person to take care of it."

		product and a business concept."	
Commitment to venture creation	**Yes** [CEO] "And the project leader from that part is our chairman of the board, so that is the person that has consistently and continuously been working with this project."	**Yes** "That's the decision we took in February when we started to, in February 2011. We took help from PWC to start-up the company. You can do that yourself, but it's easier to go through one of these and since we were part of the entrepreneurship programme we got help from them to set up the company and all this. One thing that is really important when you start-up the company is to define the shareholder agreement, that's really important, because even though you feel like you're really good friends, that's the point when you should get an agreement."	**Yes** "So it was us and I'd say four academic professors and then two people from formerly Active Biotech when they focused on clinical projects they closed down a lot of basic research, they decided to start a company and then they realized that what they were doing, they need this competence, so they said let's start the company together." "They had contracts, they had contracts and realized if we were supposed to deliver on this we really need to sub-contract this particular competence and that's how we kind-a started. We realized now's a good time, let's do it."
Technology setup & organization creation stage			
Production technology & organization creation	**Yes** [CEO] "The goal with this collaboration was to form a company in due time in order to be able to find investors and now we have started the company in order to have the possibility to talk to investors because they wouldn't. Yes, Pharma companies were interested in knowing what we were doing, but they couldn't invest in a project, so, you had to do that at the time."	**Yes** "We have set up the production, we have a supplier here in Sweden so we negotiated the deal with them and that was after we got these 300,000 SEK from LUIS that we could use to set-up the production. We got the graphical profile, the logo, design guide, there we used an external company to help us with the graphical design. Supplier for this, we also used legal advice of course and we got help from PWC to do, to help us learn, I did accounting. We went on a training from them and they provided us with a system for us, and economy system, you can do your accounting so you can pay your taxes and all these details. We also took some legal advice for the shareholder agreement and also legal advice to set up the conditions for when you want to set-up your product."	**Yes** "That was very simple, almost naïve, we didn't, we got the business plan in order of course and I don't actually remember if we started, got a loan from a bank, I know we presented the business model, I guess it was the bank, yeah cause we needed the check credit or line or something like that so there were some professionals looking at this and obviously this should go into, when you have established this, public company, you have to follow all those rules…" "We needed to have a contract with Maxx Lab, that we can use their facilities and be embedded there, but then again, this was kind of a win-win situation, because they needed someone to run the lab, but the university wasn't going to put money to pay for that position and the academic groups really couldn't afford that either."

Product	**Yes** [CEO] "You test many molecules to try and find something and then you have to develop these molecules, as I said you need to make new compounds in order to be able to make the patents, so that is what we did, we wrote a patent application together."	**Yes** "So, we got our idea in the field with the pest control technicians and based on this research on bed bugs we could turn it into a very good product and since we continued to learn more about the bed bug research after the start we have also connected with research community on bed bugs around the world and learned more about new research so we are now taking research from other universities around the world and making use of their results and using them in our ideas. So, that's how we came up with our second idea, this tape. So that was the first product but in parallel we have been continuing to work with this trap but we have been unable to solve all the technical challenges."	**Yes** "They did drug design, computational drug design, helping other companies out and they realized they needed structural information, because it's so much more powerful, they needed a model, I mean look in 3 dimensions, it's almost like this stick model, but you need to have computer graphics to look at it, you need to have that, of the protein with the legen down."
Exchange stage			
Customer	**Desired outcome** [CEO] "Our prioritized outcome would be that we can sell the whole company."	**Yes** "At that point of time we signed also signed a co-operation agreement with potential customers, before we had a product in the market and they were saying if we get this product out we are very interested in buying it, so we got kind of support from customers as well."	**Yes** "All the time, specifically, we are contract research organization so the feedback is really important. Even if you lose a grant or a contract, you always try to find out why and often times people don't want to disclose that."
Iteration factor			
Iteration	**Yes** [Researcher] "Overall, we haven't really changed the basic idea so far, but of course we have some new knowledge and that might happen in some point not so far in the future, that we might find out that our basic idea of how we think our drug works, might change. If that is true it might open up other opportunities in treatment of other diseases. Research sort of goes all the time wrong. You figure out it's not something like you thought and then you figure out something new. But i guess it would have to be a pretty big concept	**Yes** "Extensive testing over and over again. You see the bed bugs how they move, see if they move into the right jar, with the right cocktail in. That is something that we did, but we also decided very early on, to go out in the field, to meet customers and see what they do. So I spend a lot of time working with the pest control technicians in the field and see how do they work today, how do they deal with bed bugs and that's how we came up with our idea, the product and that was not really from	**Yes** "Oh, it's very flexible you know we are adapting to requests all the time and but we also, I don't know if this is really what you're asking and if this is a good answer but we really, we also given our competences and expertise, we can also mold the customer in some sense, we can direct their interest in a way that we think is best for their projects, because they don't have the competence." "No, the core techniques are pretty much

	change. Right now I think there is an alternative hypotheses of what we are seeing, that might be importnat, but I will probably need another year."	the research but on the other hand if we hadn't had the research and the knowledge we wouldn't have been able to formulate such a good product."	the same and then we add other types of biophysical characterization. Yeah, from my perspective, but I am a science geek, from my perspective yes, but I am a science geek, from my perspective we have added 3 or 4 new methods in our tool box you could say. But for the company outside, who come in, look in, to them we are basically just zero with expertise in biophysical characterization and structural biology, that can help them out."
Additional Variables			
LU Innovation Support	[CEO] "They had a very reactive role and trying to drive the project towards commercialization… It was within the validation phase then so I would say that they would took an active role in driving the validation in order to see if there is potential for commercialization."	"Approximately one year after we had started the company, when we had completed the business plan, handed in the patent application, defined what we wanted to do, define the first product, define what kind of process we needed to do in order to define track study."	"So also at the time when we got, brought in those investors, both those investment companies if you want to call LUIS or LU Innovation, but they came in with one board member each, so basically we had four professionals on the board plus me."
Validation	[CEO] "LU Innovation Systems, they have their way of taking care of validation money, VFT (verification for growth funds) and that is a smaller amount of money that it has been administered by Lund University Systems, researchers they send an application to VINNOVA and then they get this money to prove a point, to prove market, that there is market potential, to do some validation, this machine can really work, or customers really needs this, something like that, so here we show that we can make a patent, so that's what we did for them."	"The wife to one of the key procurement officer for border migration, she had read an article about the bed bugs that I have written so she had called me "we have huge problems with the bed bugs, in the refugee camps in Sweden and what should we do?" I said please come down to Lund and visit us and we will talk about bed bugs and that's when we formed the hypothesis to put it on the beds, because the refugee camps are very Spartan, like it's only a bed and a chair, it's not a lot of things for the bed bugs to hide in, they can just be in the beds, so it's easy to protect the beds. So, we said, let's try out and make a pilot or a field study so that's what we did, thanks to the migration board, we got this opportunity to try it out in the field and validate it, exactly, so we had been validating it in the lab but that's not really the same	"It was well known at the time that this was something up and coming, there were some companies in the US and in Germany that started who got a huge donation from the government who are hard to compete with. The need was definitely out there and we knew from contacts in Big Pharma that Big Pharma started to outsource that they needed research organizations to start help them out with this, so we kind of knew that the need was there, so that's obviously the first thing you need to establish and verify but then also of course the fact that my two colleagues coming from biotech knew that they had enough business to run the company within the upcoming, for at least a year or so."

		thing so now we could validate it in the field so we know it's a huge success, but then we could validate it in the field."	
Other	**External support – Red Glead Discovery** [CEO] "When we came into contact first time with LU Innovation they asked us as a service provider if you could help these researchers."		**University facility - Maxx Lab contract** "We needed to have a contract with Maxx Lab, that we can use their facilities and be embedded there, but then again, this was kind of a win-win situation, because they needed someone to run the lab, but the university wasn't going to put money to pay for that position and the academic groups really couldn't afford that either."
Team Formation	[Researcher] "The team today is three researchers, it's Red Glead, the CEO from Red Glead, the business developer from Lund University."	"Camilla [researcher], she asked the HR responsible person if I could help her as a consultant and I looked into her business idea and I said that this is really, really interesting but I don't think I can work with this on a consultancy basis, I think it would take too much time and I also think we need more competences, the guys that I had teamed up. I proposed to Camilla that we need to be all four of us and then we sat down and discussed what type of company and all these issues. So I think it was more of a personal match and that was the real driver why we the four of us should team up."	"Well, you know, we didn't have any business background at all, we are all science geeks, but these guys have worked in industry for a few years, of course, they have some experience and I think they have taken some entrepreneurial courses, business law, business economics and things like that."

iii) Table of Analysis: Technology Spinoffs and New Venture Creation Process

New Venture Creation Process	Bioprocess Control	Efficax Energy	Cognibotics
Opportunity stage			
Externally stimulated opportunity	**No**	**No**	**No**
Internally stimulated opportunity	**Yes** ”Where I originally come from the idea come from that we can optimize the whole biogas plan, there was a supervision control, intelligent and all that stuff. But the industry is not there, is not mature enough to take that decision, then we have to step back, one step back and see what is missing?” ”the overall idea for optimize the process came from research study, but the reality is you are not able to do that, so you have to take a step back and the product has to be very solid, then that would develop to one created starting running the company.	**Yes** "[it started as] a project between Vattenfall and the Swedish Energy agency i think ... around the 90’s ... and then nothing happened. Then the professor that was involved moved to Lund ...he employed the PHD student who is my colleague and during the Phd ...he solved the technical challenge that was present ... And then he and his colleague [who]were working together they decided well we should start to do some business out of this , so they started a company" "I would actually say that the research started because there was a need from the market from the solar thermal community, solar energy was too expensive so they wanted to lower the costs, in this case, ok we need to do some research to solve this technical problem which was identified. And then when the technical solution was found, then the PHD students/researchers saw an opportunity to start the business because they owned the results themselves"	**Yes** "There was a new project actually ... and we were struggling with the precision of robot motions ... there are millimeters of error sometimes and the project was about researching this to decrease these errors. And then I realized the new principle for how to accomplish that and it was after working with robot motions for 30 years ... I turned the problem inside out and saw the solution and i told a couple of the companies in the consortium that I think i know how to do this. I had googled, I have found nothing on the internet doing it this way so it’s maybe something you want to exploit. But they were not interested and later on I understood that they didn’t understand." "So still at that point it was not clear that I wanted to start a company, i could also sell this and continue in the university. But then gradually in the discussions [with LU Innovation] I found it quiet interesting, the business aspect. So I thought well i am over 50 and does it help if i publish a few more papers? No. So my conclusion that the best impact I could have was to start a new business, because I worked in a big company, I worked in research, and I came to kind of the end in both theses.."

Novelty factor	**Yes** ”I think we have in the very short time, have become really the leader. We are very niche, we do not do everything, we operate ’narrowly’, but very, very niche, we actually created the market and then the competitors started to follow.”	**Yes** "we would probably have to call it an incremental innovation, or an incremental improvement its not so radical or disruptive... it doesn’t really change it by factor 10 or something it improves it by 30 or 40 %."	**Yes** "Completely unique, 2 patents granted" "I turned the problem inside out and saw the solution and I told a couple of the companies in the consortium that I think I know how to do this. I had googled, I have found nothing on the internet doing it."
Business concept development	**Yes** ”Again, you have to be flexible, you have to quickly understand what is possible, what is not possible. Sometimes, the target is over there and if you are not able to reach that, then you have to turn that away, then you have to find a middle way, without loosing what your focus. That is what basically we’re doing. When I originally came from the idea, came from that we can optimize the whole biogas plan, there was a supervision control, intelligent and all that stuff. But the industry is not there, is not mature enough to take that decision, then we had to step back and see what is missing? OK we found out, one of fundamental thing, in our work is, for example fistac.”	**Yes** “First we thought that we are going to sell it to installers because they are the ones the customers contact...The problem with that we had no credibility among them because we are unknown company and brand... Then we tried [selling] directly to end customers. That might work...but then you would have the problem it costs alot of money to do sales in a business to consumer market...Also we had the problem that manufacturing was also quite expensive to do ourselves. Because we have small volumes. So this is why we landed in a business model where we actually are partnering up with some bigger actor already in the market in the heating sector ...[who] can manufacture cheaply and they have all the brand awareness, credibility in the market. We dont have signed deals but that is the plan to license the technology."	**Yes** “First, I thought ... we have one or two patents and we can work ... and have some dialogues with the customers and then we can license the use because the patents are methods and systems, then the customers [would] do all the work the integration and everything. ... But then it turned out, well first, they didn’t believe it’s possible and when they did, they didn’t know how to apply it and when they understood how to apply it, they needed assistance with integrating with their existing product line, so then...we are now six employees to assist the customers... We need[ed] to add consultancy.”
Commitment to venture creation	**Yes** ”We registered the business before and then we started running, so the company is registered before.” ”Yes, of course. It’s a step, a decision to make, you never know what will happen, so, you still have to invest a little bit, even though you’re not an investor, so it’s a step and once you’re on that it’s difficult to get out, you have more responsibilities.”	**Yes** "[The two researchers] started a company with a third person, who is very known person in Swedish solar thermal world from the industry side. They also produced a prototype before I came in and then they decided they need help on the business side, I got hired as a consultant at first, then we installed the prototype[s] and we learned alot...In the process, we have brought in more money, as much as soft money that we have been able to find but also 2 investment rounds." "2011 the company was started [registration],	**Yes** “That was about three years ago and it was me thinking a lot, also checking with my wife she said it’s a very, very bad idea ...But still I felt I had to do it because, the bottom line is I did not dare not to do it, because I was thinking, let’s say the day after I retired thinking back I might see that everyone is using this method but I didn’t exploit it myself, then I would feel so bad and I don’t want to do that so then I decided...And then I talked with my research colleagues, the four, ... although the basic idea was mine but we all

		but nothing much happened in the company until 2012 i should say [experimenting with the prototype]."	contributed [and] then they also invested their private money."
Technology setup & organization creation stage			
Production technology & Organization creation	**Yes** "We have been trying to do as a less capital intensive business, so, nothing to be proud of it but also more like running a family business so we need to make sure that the balance sheet is a black not red although it's tough, but by the same time, to grow it, is also very important. So that's why I'm saying, we're proud of, we're running that, but also, the business is how to leverage resources, to grow quicker. So this is something that still needs to be proved." "We are a rather flat organization, one of the reason, each individual has multiple roles. I am the manager, people are reporting to me, so it's rather a simple communication. Which we like, because the communication is easier. It's more transparent for individual performance, you can't hide, it's very easy to see. But that's our current stage, the business grows, the people will increase, of course you will need to create a bit more complicated procedures, the structures, but no intention to go for big ones, that's their efficiency."	**Yes** "You only need 50,000 SEK, this is a development company you start from zero. You don't need much legal and accounting at the beginning" "LU Innovation helped us, actually the first chairman came through their networks."	**Yes** "We have some production but we put that in a factory outside the Vasteras" "[Financials] mainly [me] and my colleagues. I did not want venture capitalists in, I was very afraid of venture capitalists" "At the beginning it was two persons and it's still these two persons involved. So, it's chairman of the board from LU Innovation and then I have an old colleague from ABB Robotics he quit ABB 1-2 years before started the business so worked with other products and he used to be the product manager for ABB"
Product	**Yes** "And based on my research where I was doing my Phd and also senior researcher at Lund University. At that time I had several technology invention and also working very much on the biogas and also instrumentation control field, it came out naturally, to continue to develop instrumentation control automation for the biogas industry. This is how where we start, this is also, how we are being focused in the past 10 years." "We have a product portfolio mainly so far focused on the laboratory instrument for the moment, but we do work on a full scale system,	**Yes** "[The succesful product has] ... been running around half a year the most so it's too early to draw conclusions , but so far they have worked more or less, we have some problems with some of them mostly it's been components that were just bought in components, so not really a big issue. Otherwise, the feedback is that it works, it is good "	**No** "We still only have produced prototype systems...It's borderline, we have now, September is the month when we are supposed to do the final prototypes before production."

	but they are not really commercialized yet, not yet released to the market. So our co-product we are working right now is the laboratory instrument, we call it smart instrument, it's a very specific instrument to be run as a scientific tool, a research tool but also as an engineer tool."		
Exchange stage			
Customer	**Yes** "The customer feedback is not in a formal way, of course we chat, we meet the customer at the event, we talk to them about it, we see the publication and that's kind of natural, it flows back. At the beginning we were very bad at marketing, but it's a learning process. So actually, customer comes to us. The product sells itself, let's put it this way. And then soon, when you reach to a maybe 20% awareness, if you have 100 people and the top 10 of 20% you always have a chance to meet and communicate."	**Yes** "We tried to sell it, that's how we validated it. The first version was sold to someone we knew ... It worked only for three weeks and then it broke down. So then we had to do a new prototype and the next version we sold a few. So selling to customers and testing in that way..."	**No** Customer exchange is not after production but during prototyping "Then to get started with customer tests, it is quiet costly and slow, more costly and slower than I thought, so they were assisting me in getting me Vinova verification grant ...[Used] to go from a wholly prototype to a testable prototype and to do the test because we have to do the testing at the customer's side, in Italy, Germany and England."
Iteration factor			
Iteration	**Yes** "It's learning by licence. Of course, when you have come out, you test it, is that something people are interested, yeah starting people interested, starting purchase and then of course we discover there's a problem, quality issues, need to improve functionality, need to improve and then we find a distributor, but many cases, what attracts people who recognize that "oh, this is a great idea", but not everyone can recognize, maybe 5% top of it, that's what we wanted to target from the beginning, especially, that this is a non existent market." "This decision judgment is based on my expertise and experience, from the very beginning, later on we try to get more open for people input external. Once we have a product, of course we listen to the market response, we also discuss with our staff making improvement. I think, we do not have fundamental change in this procedure, still	**Yes** "The business model has changed a few times. But the basic idea is still the same, we haven't pivoted any major thing technologically. The product is still the same, the business side has changed. You try out, you have an hypothesis and then you try out and then it doesnt work , so you do something else and you learn."	**Yes** "So what I mentioned that we need to do more consultancy but also the way our solution will be used. It's very different if it's the robot manufacturer that uses it in their production or it's something that they support, as part of their product for their customers to use it, or if it's system integrators, installations, or if it's CAD CAM providers that want to provide the support for our method, and all these things, it's rather different / complex... So it took us couple of years to figure it out."

	innovation and idea are driven by my side to put it this way. The difference is the implementation, of course the idea is driven by me, but is implemented by the team."		
Additional Variables			
LU Innovation Support	"We are a spinoff of University... I think they are called LU Innovation Holding something, they still have our share small symbolic shares. This is extremely rare, normally they don't stay that long. It's an exception, we are interesting or something like that. Of course, we got quite good help from LU Innovation at that time, actually, mainly in match making, so I also met my partner, so we two basically set up the system. I was mainly responsible for the business and technology side, he is more from marketing and also business side, of course every start-up needs risk capital like a business angel investment, a grant, later on the capital… this has been done together, LU has helped out. There was not much funding, but there is more like recognition you can say."	"Two of the three founders were researchers at university, PHD students when they started it. They went to LU innovation because they thought they needed help ... to start the business. And this is how I got into the project because i knew some people in LU innovation so they connected us, they needed a project leader. Then they have invested in us, and helped us with some soft grants etc."	"I was amazed what a nice support, I had no idea. Like how do you actually form a company, how is the board setup ... what are the rules the shareholder agreements and all these things and also they put in an investment, and supported and make sure all the book keeping was in place and all these practical things" "And they immediately responded, Mariam Olsson and she said ok we can get you some money to file a patent application" "they were assisting me in getting me Vinova verification grant so that was very good, without that, I don't know if we actually would make it"
Validation	"When you get the feeling, unlike the big company, where you do so called marketing, intelligent search, we don't have that luxury, the people to do that and we have to trust our own adjustments, the lucky part is the domain knowledge which is important, from both research and also industry, so we can get the feeling, OK, this is a bit too far and we have to drop it for the moment and what is now needed... OK let's do like that."	"We did market surveys, we called alot of installers for example and also talked to end customers to get feedback, we also did online research, everything you can find on the market and how it works etc. "	"They [LU Innovation] were more triggering or inspiring me to think about certain questions." "They said ok apart from a patent, we could and should also look at what market opportunities are there... gradually in the discussions I found it quiet interesting, the business aspect." "The need I knew [from past experience and contact with industry], but most customers thought about it as impossible. What we do is considered impossible so we had to go there and prove that."
Other		**Networks** "LU Innovation helped us, actually the first chairman came through their networks. It was good . But we use every channel we can get	**Networks** "[Networks contributed] very much, because automation as such is an extremely conservative business,

		to. Depends on what you need at the moment."	although they use high tech solutions, but the process to get the high tech solutions in the factory with all these routes and certificates and conservative and existing providers and existing processes etc it's very, very hard." "Because most technical or CTOs and even CEOs of robot manufacturers they know me personally. I have a network, a big one, bigger than I realized actually. And this is a big benefit from having background in applied research, working in the companies."
Team Formation	"In Sweden here, we are still quite small company, so we are ten people a consultant and let's say 12, 13 or 14 people, including also we have a counseling, internship programs for students, master students, Phd, but altogether we are not more than 15 people."	"[We are] two researchers and me, the third guy is not a researcher he is from the industry, was active at the beginning but is not so active anymore. We are the operating team...[Others were] on a consultant basis. We had sales people, an engineering firm for development." "my two colleagues were very open to learn the other side [the business side] and let me handle it, but for me that is totally personal dependant. It's definitely not a general case. ... So working with researchers generally it's very challenging, but in this case it hasn't been."	"I have recruited my top students... master students, [in] mechanical, electrical and computer engineering and then one of the staff is the co-founder and studies Phd in robotics and another Phd in robotics graduated a few months ago, all these are from projects I initiated when I was a researcher, so it feels like 10 year effort to get to this stage, because all the staff now has worked with me at university as students or PHD students and on projects that I got funding for, I got the money to it."
The Context			
Sweden's Teacher's Exemption	"I think, I'm not here to judge whether the policy is good or bad, but, as a researcher you have a possibility to develop a company out of it, so from that aspect it's quite good. But I want to say, that developing journey, from idea to research outcome that journey compared to research result to a product and to someone willing to pay, to commercialize, this journey is a much difficult and longer... of course you need a system 'let people try', so from that, maybe [it] is good to have this researcher, have their own idea, to try."	"It would make more sense if the university owned [the research], like in the US and they have TTO and they share ... and also the incentives would be on the university side to do some business out of it, cause now all the incentives are on the personal level of the scientist and most researchers maybe don't want to do business. There is still culturally in Sweden that Science shouldn't do business.... But in many cases it creates opportunity for the researchers who are driven and ambitious."	"First Sweden with this teacher's exemption, it is wonderful. Although people dont use it very much ... When I talk to my German colleagues they typically have a 1/3 of the patent ownership with the university or sometimes ½. And the hassle they have to go through. How can university staff put a value on the patent? Its too much trouble. I dont think I would have started if it was like in Germany. There is still so much risk. I mean I put many hundred of

			thousands of private krona in this, and I don't want to have these unclear vague legal issues there."
Lund Ecosystem	"They can participate in competition, there are not so many, but there is more recognition, that's also supported sometimes directly or indirectly from the government. It's ... difficult to get public funding because it doesn't mean that… registering a company is easy, but, whether you can run a business it doesn't help, so often the public funding are more open to this spinoff after you have revenue, after you have a certain performance, that are showing that you are on the way of becoming mature... what I mean is that the policy from that part, there is nothing wrong, it's a matter of how much, more chance of supporting more."	"There is a lot of grants that you can get or apply for. Sometimes the problem is if you get a grant for specific purpose it might steer your development in a direction you might not otherwise go" "there is far too many organizations in my opinion in the innovation system ....so it is an inefficient system… I would rather see that the money goes directly to the companies. You need some intermediary but not the hundreds ... we have"	"During the last two years I had been in big robotics meetings and a few conferences and globally there are more and more workshops on startup and investment aspects of robotics and i have participated in a number of those. And I have not seen anywhere where the conditions are as good as here.... I think [the ecosystem] is better in Lund than anywhere else, but I also think that the researchers are kind of lazy, in Sweden general or maybe in Northern Europe I dont know." "Like one Chinese said to me once, well you are Europeans you dont have to work hard, you can do it if you want to so to say. But we have a good life anyway, so why add stress?"