



Universiteit Utrecht

Influence of Utrecht University spin-off support institutions on patent based academic spin-off performance

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Abstract

In the past decade, valorization through entrepreneurship has received increasing attention from both academics and university executives. These developments have led to substantial growth in university initiated entrepreneurial activities, like the start up of academic spin-offs. This study focuses on Utrecht University affiliated patent-based academic spin-offs and the supporting institutions of Utrecht University: UtrechtInc, Utrecht Valorization Center and Utrecht Holdings. Based on the resource based view, several capital types are identified that potentially influence venture performance. This thesis provide additional insights in the supporting activities of Utrecht University support institutions and the influence of a broad variety of resources on spin-off performance. A patent analysis is employed in order to identify academic spin-offs that (have) utilize(d) intellectual property generated at Utrecht University. From the 230 discovered UU related patents, 15 relevant academic spin-offs are identified. Four of these companies were willing to cooperate in this study. By means of structured interviews a cross-case analysis is performed. Pattern matching is employed in order to compare theoretical patterns (proposed hypotheses) with empirical patterns. From the four investigated academic spin-offs, only one company has received formal help from Utrecht Holdings and UtrechtInc. The results show that the external acquisition of management team experience is preferred over the internal availability of diverse experience. This indicates that high performance academic spin-offs acquire management team experience when their business environment raises this demand. Additionally, a inverted-U relationship between amount of patents applied for and venture performance is uncovered, which indicated that spin-offs should find a correct balance between R&D activities and business performance. Also, a mix of largely external private investor funding and a small proportion of governmental funding is employed by the high performance firms. Additionally growth of the amount of collaboration partners results in improved venture performance. The low performance of the company that received assistance from Utrecht University support institutions indicates that independently developed companies are more successful in acquiring essential resources to improve venture performance. Also, companies prefer to contact faculties or departments directly when looking for collaboration partners for research projects, instead of contacting the TTO or incubator. This raises the question whether Utrecht University affiliated TTO and incubator is supporting low potential technologies and spin-offs that aren't able to acquire demanded resources independently.

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2) Introduction

2.1) Background

According to Furman et al., (2002), technological innovation plays a central role in the process of long-run economic growth. This statement is underlined by the European Union, which states that it is essential to generate breakthrough technologies and translate them into new products, processes and services in order to boost future productivity and growth. (European Commission, 2011) Generation of knowledge and adequate management of information flows are seen as one of the main drivers of technological innovation. Furman et al., (2002) argue that the stock of technological knowledge is important for the development and commercialization of new ideas. The availability of technological knowledge is essential in order to optimize innovative capacity.

2.2) Relevance

Universities are perceived as primary sources of technological knowledge and thus technological innovation, as the two main mission goals of universities are education and research. Over time, knowledge valorization has been introduced as a third mission goal of universities in the US and Europe (Rothaermel et al., 2007). Awareness of the amount and value of internal knowledge creation and the newly adopted mission of knowledge valorization has led to the identification of various business opportunities. Commercialization of academically generated knowledge has received increasing attention from both policy makers and researchers (Rothaermel et al., 2007). This process of valorization can best be described as: “the process of value creation out of knowledge, by making knowledge available for economic and social utilization and to translate this into competing products, services, processes and novel business activity.” (Rathenau Instituut, 2011)

Having adopted knowledge valorization through entrepreneurship as a method, universities devote significant amounts of resources (both human and financial) to these activities. For example, as stated by Utrecht University in its Strategic Plan 2012-2016: “*The social and economic capitalization of scientific knowledge – knowledge transfer, or valorization – is the third core task of each university*”(Utrecht University, 2012). University entrepreneurship is also a popular topic in the academic literature, especially since the late 1990s. Growing demand from the industry for technological innovation and the goal of universities to valorize their knowledge through entrepreneurial activities are largely responsible for these developments (Rothaermel et al., 2007; Looy et al., 2011).

These ‘recent’ developments have led to a substantial growth in university initiated entrepreneurial activities, such as patenting, licensing, research joint ventures with private companies and the start up of academic spin-offs. To manage these processes, some universities utilize a Technology Transfer Office (TTO). According to Siegel (2007) almost all research universities in the USA and Europe have established TTOs to commercialize their intellectual property. TTOs facilitate the knowledge transfer between university scientists and industry stakeholders like firms, entrepreneurs and venture capitalists (Siegel, 2007).

Transfer of knowledge towards the industry should occur in a pre-specified, routinized fashion. Whenever an employee/researcher that works at the university has discovered an invention that could possibly be commercialized, he/she should inform the TTO about this specific invention. The TTO will look at the possibilities to commercialize this invention either through out-licensing or the creation of an academic spin off. After a patent is disclosed to the TTO, it could be developed in several types of organizations. If an invention proves to be unfavorable for commercial activities the patent application will be withdrawn. If it does prove to be commercially favorable, it could be utilized internally, licensed out, transferred to a larger company/multinational or used as a basis to start a new business (Fini et al. 2010; Rothaermel et al. 2007). The trajectory outlined above is described by Fini et al (2010) as processes performed within the university IP-System. Unfortunately, this trajectory isn't always utilized by researchers/employees of universities. According to Fini et al. (2010), approximately 2/3 of all businesses started by academics are not based on inventions disclosed to and patented by TTOs. This statement implies that 1) some businesses are started on knowledge/technologies, which proved not to be patentable, or 2) inventions aren't disclosed to the TTO and the formal trajectory as described above isn't utilized. By these shortcomings, universities miss out on potential additional revenues, which could further bolster/strengthen their valorization program in order to reach the targets described in their mission statement.

Successful valorization activities could also enhance a university's scientific reputation as their expertise and intellectual property get transferred to the industry. This helps them in attracting additional contract research, high profile scientists and students/researchers, which are interested in the entrepreneurial realm. These preferred outcomes are in line with the essence of valorization - in terms of economic and social development - as described by the Rathenau Institute (2011). The academic focus towards valorization has resulted in a stronger relation with the industry via entrepreneurs, firms, venture capitalists etc. This development is beneficial for both the academic world and the industry. Firms can be supported by university-based institutions, network connections and very specific knowledge and expertise. With more attention for university-industry relations, more funds come available for the facilitating processes (O'Shea et al., 2008; Gras et al., 2008). Additionally, valorization through entrepreneurial activities will result in employment creation and 'local' economic growth. Subsequently, all firms within the region may benefit from the increased possibility, for instance, to attract additional risk capital.

Creating spin-offs based on academic knowledge or research has proven to be an important task for policy makers and universities (Mustar et al., 2008). Universities increasingly utilize the creation of academic spin-offs as a mechanism for commercialization (Wright et al., 2007; Siegel et al., 2007). These spin-offs are brought to life based on scientific knowledge generated at the university. The primary goal of academic spin-offs is to commercialize scientific knowledge and technological know-how accumulated within the university (Shane, 2004). Besides exploitation of academic knowledge, an academic start-up is also responsible for employment creation, economic growth and the overall level of innovation within a region. This makes academic spin-offs an interesting subject of research, as it focuses on the essence of valorization, namely value

creation out of knowledge in the light of economic and social development on a local, regional and national level (Gerry et al., 2009; Mets, 2009).

Being the starting point of an academic spin-off, unique knowledge is seen as an important resource, which one would like to protect in an attempt to reach competitive advantage. As competitors of a spin-off may have a broader and more sophisticated research base, they could transform the knowledge faster and more efficient into product or process innovations. In order for academic knowledge to be valorized, it is the university's task to prevent competing firms to benefit from its knowledge via imitation or reverse engineering. Patenting strategies are considered the most common technique to prevent competitors from imitation.

As all academic spin-offs start in a fast changing environment facing lots of competitors of different sizes with their own sets of unique resources, it is important to manage their own limited set of resources adequately (Gras et al., 2008). Literature shows that spin-offs evolve and mature through several development phases, being: 1) research, 2) opportunity framing, 3) pre-organization and 4) re-orientation and sustainability (O'Shea et al., 2008; Vahora et al., 2004). The first phase mainly entails the development phase of an idea through research. Consequently, in phase two, this idea/invention is investigated for further commercialization; the potential market needs to be examined to identify possible business opportunities. Phase three consists of the marketing of a product, the construction of a distribution system, (large scale) production etc. In this phase, the organization is described and built, which is needed for market penetration. This entails The final phase explains the reaction of the firm to reactions of the environment to the service/product launch. In order to attain long-term durability, re-orientation of the market and adaptation to the changed business environment is essential. Service/product alterations could be made and novel business opportunities may arise that demand for organizational change. (Vahora et al., 2004) These different phases in the development of a spin-off ask for an adjusted set of resources. External acquisition and internal management of these resources are essential. When these resources cannot be generated internally, external opportunities need to be embraced/exploited to complete the set of resources.

This is where support institutions could prove their value. Adequate assistance on the acquisition of required resources of academic spin-offs is necessary to catalyze the described valorization process. In order to do this, the academic spin-offs that develop technologies with potential commercial value needs to be identified. Participation in an elaborate research project made it possible to identify these academic spin-offs.

This research is part of an overarching research (named RIS & IP-based entrepreneurship) initiated by OctrooicentrumNL the Dutch patent office in Rijswijk. Along with 11 other universities in the Netherlands, this RIS & IP-based entrepreneurship study attempts to uncover all companies that utilize patented knowledge generated at universities. Based on inventor names and employee records of each university, these companies could be identified. Additional information on this research and the used methodology are presented in appendix A. Participation of Utrecht university in this research has led to a

detailed overview of which companies and institutions benefit from IP generated at Utrecht University. This research will limit itself to patent based academic spin-offs that utilize(d) intellectual property generated at Utrecht University and the assisting role of Utrecht University support institutions: Utrecht Holdings, Utrecht Valorization Center and UtrechtInc.

Supporting institutions that solely focus on starting firms are called business incubators. For Utrecht University, this incubator is UtrechtInc. Additionally, the TTO structure of Utrecht University entails combined activities of the Utrecht Holdings and the Utrecht Valorization Centre.

An incubator is able to support academic spin-offs on various business levels. Because an incubator possesses a lot of experience with starting enterprises, it is able to identify possible bottlenecks in the development process of the company. By offering managerial advice or utilizing their extensive network to contact influential stakeholders, these problems could be resolved. Additionally an incubator is able to offer facilities and/or equipment demanded by academic spin-offs that operate in diverse business environments.

Clarysse et al. (2005) has identified three different approaches of the way business incubators support academic spin-offs, being the low selective, supportive or incubator approach. The low selective approach maximizes the number of created spin-offs; the supportive approach focuses on generating revenue from spin-offs; the incubator approach focuses on financial gain at the point of exit. Studies from O'Shea et al (2005) and DiGregorio and Shane (2003) have shown that the availability of incubators decreases the development costs of novel technologies due to subsidies and shared administration costs. This cost benefits haven't lead to increased start-up rates. Whether or not the availability of incubators influence spin-off success isn't discussed by DiGregorio and Shane (2003).

TTOs facilitate the knowledge transfer between university scientists and industry stakeholders like firms, entrepreneurs and venture capitalists (Siegel, 2007). TTOs can help starting companies to accumulate abundant necessary resources. The relation between the entrepreneurial university, its TTO, related novel academic spin-offs and their fast changing environment can best be illustrated by the model of Rothaermel et al. (2007).

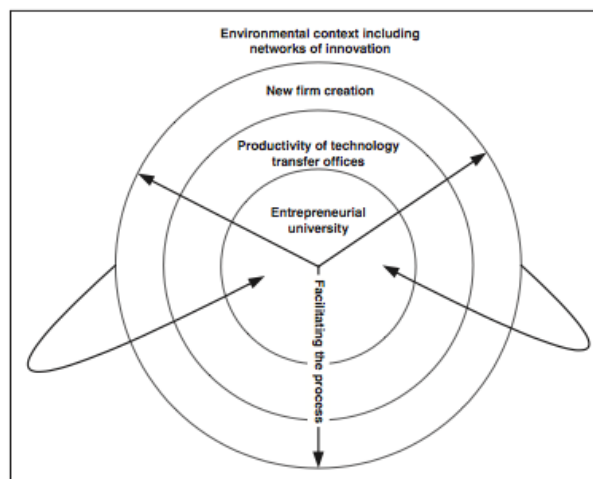


Fig1: Conceptual framework of University entrepreneurship (Rothaermel et al., 2007)

As it is a TTO's task to facilitate the technology transfer process and support start-ups in the acquisition of adequate resources and capabilities, it is possible that these firms get accustomed to (or even dependent on) these supporting activities (Johansson, et al., 2005).

For example, DiGregorio and Shane (2003) state that the level of university venture capital funds doesn't affect university spin-off creation rates on a large scale. This implies that university entrepreneurs are also able to form relations with, amongst others, external fund providers and convince them to invest. By doing this, university entrepreneurs are able to acquire desired external risk capital (Gras et al., 2008). By attracting external risk capital, a newly founded university related firm becomes increasingly independent from university funding as a supporting activity. This could suggest that firms with relatively high levels of university funding are less stimulated to develop relationships with external fund providers and in turn become more dependent on university supporting activities. The inability to attract sufficient external risk capital raises questions about the involvement of universities in these lagging, underperforming academic spin-offs.

By examining the supporting activities and the level of dependence on an incubator and/or TTO, it is possible to identify possible good and bad practices by looking at spin-off performance. On the other hand, "independent" spin-offs could have developed a whole different set of capabilities influencing their performance. This independence forces them to rely on external factors and to be more creative in acquiring the required resources. The identification of these resources and the influence they have on spin-off performance could prove to be valuable for university, incubator and TTO policy makers. Utrecht University affiliates TTO and Incubator could offer specific assistance to academic spin-offs, while the managers of these spin-offs are able to distribute their resources into fields that increase venture performance.

Therefore, the main research question and related subquestions are formulated in the next section.

2.3) Research question

This paper is focused on answering the following research question and subquestions.

How do university spin-off support activities influence their academic spin-offs performance?

Subquestions:

SQ1) Which resources benefit academic spin-off performance?

SQ2) Which resources hamper academic spin-off performance?

SQ3) Which supporting activities increase the beneficial resources of a firm.

At this moment, the degree and nature of assistance from TTO and incubator of Utrecht University are identified. Their assisting activities should result in the

acquisition of resources, required by an academic spin off to perform in its business environment. However, by offering these supporting activities, it isn't guaranteed that spin-off performance will improve. Academic spin-offs might demand additional support for the acquisition of specific types of resources. Furthermore, academic spin-offs may receive unwanted/unfavored assistance from the TTO or incubator of Utrecht University. These activities may drive their attention away from other –possibly more important/urgent – operations. Besides the degree and nature of assistance, the appreciation of these activities is investigated. The following subquestion is composed in order to provide additional insights in academic spin-off assistance for Utrecht University's TTO and incubator.

SQ4) How are University Utrecht support activities appreciated by affiliated academic spin-offs?

In order to answer these questions, a theoretical framework and corresponding hypotheses are derived in section 3. Additionally, section 4 describes the methodology used and empirical case description of this research. Section 5 presents an overview of the results. Consequently, section six provides an overview of the implication of the findings of this research, as well as the limitations of this research design and an attempt is made to identify areas for future research.

3) Theoretical framework

3.1) Theoretical background

If an academic spin-off is started on the basis of unique knowledge, the researchers, who are responsible for the generation of this knowledge, are usually involved in the start-up process, because they hold the largest amount of technological knowledge and expertise on the research subject (Gras et al., 2008; O'Shea et al., 2008). The different mental set-up, experience, capabilities etc. of researchers lead to a knowledge asymmetry within a specific research area.

This knowledge asymmetry - if managed adequately - could be the basis for the competitive advantage of a firm, because it is a hard to imitate such a unique resource that offers business opportunities (Burt, 1992). However, merely having unique knowledge doesn't guarantee successful commercialization of that knowledge. Small starting companies have only limited resources (financial, human, organizational etc.). Furthermore, they face also several restrictions brought forward by their small initial size, financial resources, entrepreneurial expertise and numerous other factors (O'Shea et al., 2008). Literature has shown that academic spin-off development occurs through four distinct successive development phases, being: 1) research, 2) opportunity framing, 3) pre-organization and 4) re-orientation and sustainability (O'Shea et al., 2008; Vahora et al., 2004).

In order to adequately introduce technological knowledge into an industry a specific set of capabilities is needed for each of these development phases (O'Shea et al., 2008). To create a competitive advantage, a firm's resources should be rare, imperfectly imitable and strategically unique, which creates resource heterogeneity amongst firms (Teece et al., 1997; Penrose, 1959; Barney, 1991). Firm specific resource management, accumulation, processing and utilization/exploitation is key in order to sustain a competitive advantage. To withstand pressures from the ever changing environment, companies should constantly alter and develop their resource base to preserve their hard to imitate resources. In order to reach a long-term competitive advantage, both the resource base as well as the companies' capabilities should be constantly developed and adjusted. Being a flexible organization that is able to accumulate and develop rare/unique resources (both tangible and intangible) and create routines to guide and manage these resources is of utmost importance when operating in a changing business environment. (Penrose, 1959; Barney, 1991; Teece et al., 1997; Makadok, 2001)

3.2) Conceptualization

In the literature, various theoretical strands are applied in order to examine the performance of academic spin-offs. Particularly the resource-based view is widely used in the academic literature to conceptualize spin-off performance (Rothaermel et al., 2007; Gras et al., 2008; Powers and McDougall, 2005). Other theories that are used to explore this research area are social capital theory (Trott et al., 2008; Nahapiet & Ghosal, 1998), the science based design approach (van Burg et al., 2008) and some others.

According to Siegel et al. (2007), academic spin-offs originate from unique knowledge generated at the university and the choice to commercialize this knowledge. As academic spin-offs can be conceived as bundles of unique resources to be utilized in order to create competitive advantage, the Research Based View is an appropriate theoretical foundation to study this problem area (Gruber et al, 2010;).

According to the Resource-Based View, companies consist of a set of tangible and intangible resources that need to be managed properly. In the long term, adaptation to internal and external changes and the capability to develop and adjust firm resources to these changes is seen as a primary source of competitive advantage (Roberts & Malone, 1996; Teece et al., 1997). Here, the theory of dynamic capabilities is employed as an extension of the resource-based view to explain the need to adapt a firm's resource base to each specific development phase or other environmental changes.

The broadly defined concepts of resources and capabilities leave scholars and researchers with a lot of room for interpretation. For this reason, there exist several variations in classifications of resources and capabilities. Brush (2001) studied this problem and has identified some categories of resources and capabilities that influence the development of new and small companies. Brush (2001) has categorized several important resources into six different classes, being: technological, human, social, financial, physical and organizational capital. Other models do not (entirely) take these six types of resources into account and fail to generate a complete overview of the factors that determine spin-off performance (de Castro et al., 2003; Bueno & Salmador, 2002; Shane et al, 2004; Siegel et al., 2007).

In this study, organizational capital is combined with human capital, because the internal organization of a start-up company largely overlaps with the concept of human capital, which describes the attributes of the founding- and management team and the firm's personnel. The external aspect of organizational capital of academic spin-offs contain the Utrecht University TTO and incubator. These institutions are created to support the development process of academic spin-offs in areas where they lack resources.

The other resource categories are social capital, (i.e. networks and external relationships of the company and its personnel), technological capital, (i.e. firm specific products and technology) financial capital, (the amount and type of funding attracted by an academic spin-off) and physical capital (the availability of tangible resources like scientific research equipment and facilities). According to the model described by Brush et al. (2001), academic spin-off performance is determined by its tangible (financial capital, physical capital) and intangible resources (organizational capital, human capital, technological capital, social capital). How these assets are related to academic spin-off performance is illustrated in fig2.

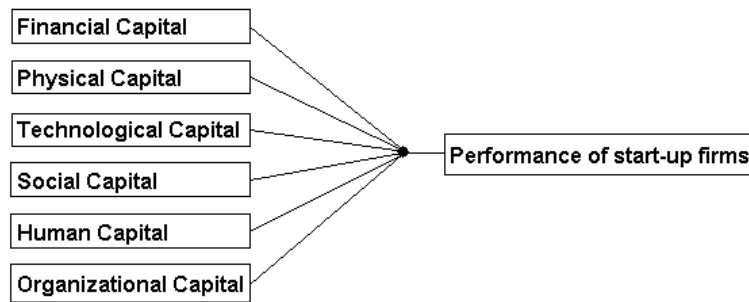


Fig2: The role of various types of capital according to Brush et al. (2001)

In the next section, the different types of capital, i.e. internal organizational- and human capital, technological capital, social capital, financial capital and physical capital, will be discussed in further detail for academic spin-offs. This will be done after the dependent and independent variables have been clarified in this study.

3.3 Variables.

3.3.1) Dependent Variable: Venture performance.

In order to assess the influence of the capital types mentioned above on venture performance, venture performance must be measured. This can be done in various ways. The most common indicators to measure venture performance are level of turnover, profitability and employment creation (Robinson, 1999; Murphy et al., 1996; Gras et al., 2008).

The amount of generated revenues partially reflects market demand satisfied by the spin-off's product/service. The firm's turnover or is an indicator of how successful they are in commercializing their product, service or technology. Revenue growth illustrates that a company is able to attract additional funds from their client-base, external investors or both. This shows that a company has succeeded in marketing their product, or to display the potential of their product in such a way that external parties are willing to invest.

Amongst other performance measures, it is important for starting ventures to become profitable (Terjesen et al., 2010). Profitability demonstrates the current potential of the technology, service or technology, which is important for possible future take-overs, public offerings and venture capitalist investments. Additionally, it illustrates that the company has adjusted their product/service to customer' demand, who are willing to pay a premium price. Profitability growth illustrates the future potential of the product/service adjusted to realistic customer demand when the market isn't saturated yet.

Employment creation is another performance measure used in various studies (Gras et al., 2008; Luke et al., 2007). Employment creation illustrates that firms have acquired sufficient resources to hire additional personnel and that their business is expanding. By hiring additional employees, a new venture attempts to acquire additional human resources and capabilities suitable for specific development phases. For instance, marketing of a product demands an entirely different set of human capabilities than researching the potential of a technology. By attracting new employees with various backgrounds and experiences the spin-off firm is able to properly interact with the changing business

environment, due to passing through to the next development phase(Vahora et al., 2004).

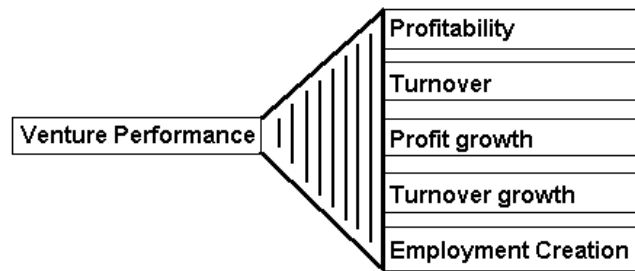


fig 3: components of venture performance

3.3.2) Independent variable: internal organizational capital:

As stated in the previous section, the external aspect of organizational capital will be examined in depth in this study. Especially its relationships with the identified intermediary variables: Organizational/Human capital, Technological capital, Financial/Physical capital and Social capital, is studied.

External organizational incentives that could possibly support academic spin-offs are business incubators and technology transfer offices (O'Shea et al., 2008). The purpose of these institutions is to support academic spin-offs in the acquisition of required resources. Adequate utilization of these facilities could improve spin-off performance within a region (O'Shea et al., 2008; Gras et al., 2008). Three different supporting institutions are identified in this study, which are responsible for the supporting role of Utrecht University with regard to valorization through entrepreneurship: Utrecht Inc., Utrecht Holdings and Utrecht Valorization Centre.

First of all, the incubator role of UtrechtInc. should be closely examined. Gras et al. (2008) has uncovered that the availability of technological incubators positively influence venture performance. Based on interviews with an UtrechtInc. executive, the assisting activities this incubator performs are examined. Based on this interview it can be observed what degree and nature of assistance is offered to academic spin-offs. According to the conducted interviews, UtrechtInc specifically offer assistance on physical, social and internal organizational / human capital.

Secondly the supporting role of the Technology Transfer Office (Utrecht holdings and Utrecht Valorization Centre) is explored. The TTO role can be further specified into four core tasks, namely: assistance in patent application, venture capital acquisition, network partners and/or management advice(Gras et al., 2008; O'Shea et al., 2005; Roberts and Malone, 1996). Employment opportunities for university researchers as well as local economic and technological spillovers could be seen as favorable outputs of an adequately operating TTO (Siegel, 2007). These tasks of Utrecht University affiliated support organizations are discussed specifically per capital type in the following section.

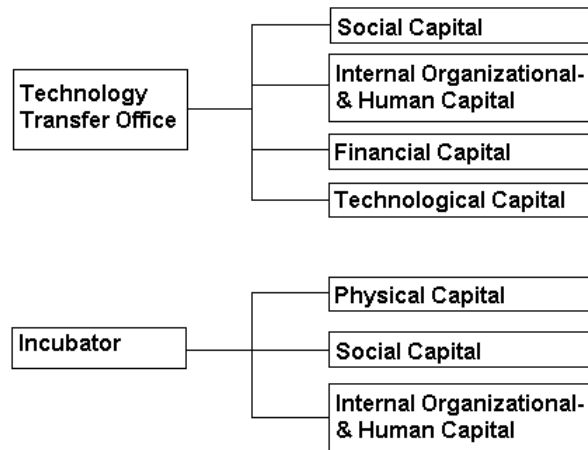


fig 4. TTO and incubator roles

3.3.3) Intermediary capital variables

3.3.3.1) Internal organizational- and Human capital:

As stated earlier, starting companies evolve during different consecutive development phases. Most of these starting spin-offs do not have the capacity and internal resources to pass through these development phases without problems (Vahora et al., 2004). Additionally, Vahora et al. (2004) found that companies face critical junctures in the process of passing from one development phase to the next (O'Shea et al., 2008). In order to withstand the possible hampering effects of these critical junctures, it is essential for an academic spin-off to identify these critical junctures and to adjust and develop new routines to overcome them. Firms should modify, refine and develop their business model to adapt the organization to the changed environment (Druilhe & Garnsey, 2004).

With regards to the management team, three characteristics determine the proper generation of information/resources: size, diversity and experience (Eisenhardt & Schoonhoven, 1996; Bekkers et al., 2006). The size of the management team often results in a more extensive network, which could be utilized to attract the required external resources. The diversity of a management team supports the spin-off with a more sophisticated and complete set of capabilities, which makes it easier to move through different development phases (Ucbasaran et al., 2003). Amongst literature there exist a discussion whether or not previous entrepreneurial experience within the management team is beneficial or not (Ucbasaran et al., 2003). In order to obtain the required set of resources, it is favorable for a management team to consist of multiple team-member originating from various disciplines. This diversity is needed to overcome critical junctures, brought forward by the progression of an academic spin-off via different development phases (Vahora et al., 2004; Cooper et al., 1994; Vyakarnam & Handelman, 2005).

Furthermore, O'Shea et al. (2008) state that older, experienced researchers get more easily involved in entrepreneurship activities. Researchers with a high reputation and/or researchers working at high reputation faculties have less difficulty with acquiring the right set of resources to start a new firm, because they are perceived as more credible (Zucker et al., 1998; Gras et al., 2008; Powers & McDoughall, 2005).

Utrecht University affiliated TTO and incubator could help to attract management team members needed to overcome these previously described critical junctures. As these supporting institutions are continuously working with numerous starting firms, they have become rather experienced in identifying critical junctures and assisting/educate spin-offs on how to minimize the negative influences of these junctures on the development of the company. Additionally, the above described characteristics – reputation of the involved university scientist, size, diversity and experience of the management team members- are believed to increase the probability to acquire and develop the correct set of other resources and thereby improving venture performance(Zucker et al., 1998; Eisenhardt & Schoonhoven, 1996; Gras et al., 2008). These statements lead to the following hypotheses.

H1a: The Utrecht University affiliated TTO positively influences the management team size.

H1b: The Utrecht University affiliated incubator positively influences the management team size.

H1c: The Utrecht University affiliated TTO positively influences the management team diversity.

H1d: The Utrecht University affiliated incubator positively influences the management team diversity.

H1e: The Utrecht University affiliated TTO positively influences the management team experience.

H1f: The Utrecht University affiliated incubator positively influences the management team experience.

H2a: The reputation of the university scientist involved in founding of an academic spin-off positively influences Venture Performance.

H2b: Management team size positively influences Venture Performance.

H2c: Management team experience positively influences Venture Performance.

H2d: Management team diversity positively influences Venture Performance.

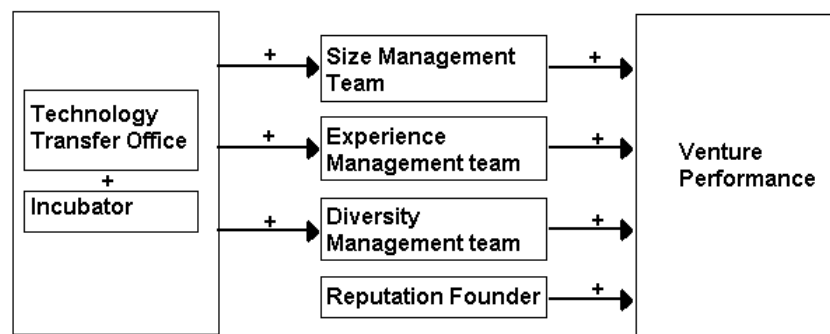


fig 5. The role of Internal Organizational- and Human capital

3.3.3.2) Technological Capital:

The basis of technological capital is intellectual property, indicated by the number of patents filed/applied for, because it is the starting point of the research and development phase of any patent based academic spin-off. In order to benefit from the generated knowledge, starting companies should embrace an adequate patent strategy, as patents are considered the basis of technological innovation (Zahra, 1996). Levin et al., (1987) argues that patenting is the most

widely used strategy for starting ventures to protect their unique knowledge. Also, being a relatively small company with a few employees, an academic spin-off should manage their resources efficiently(Gras et al., 2008; O'Shea et al., 2008). Every product or service, which forms the basis of an academic spin-off is different and demands its own distinctive set of resources. As resources are relatively limited for start-ups, the allocation of personnel as well as budget to R&D activities indicates its dedication to develop their technology/product/service on their own. The amount of personnel and finance that is devoted to R&D activities influences the performance of the academic spin-off, for it supports the development of new products and helps sustaining adequate R&D personnel(Zahra, 1996). If internal R&D activities are utilized, a company is better able to protect their generated technological (and tacit) knowledge. By doing this, a company is able to build up lead-time and ultimately create a first mover advantage over their competitors.

When these resources are insufficient to benefit optimally from the business opportunities provided by their unique knowledge, the acquisition of external resources to supplement their R&D activities could be seen as an outcome. External parties, like Utrecht Holding, could assist spin-offs by providing advice regarding patent strategy, supervising and monitoring the patent portfolio, investment in R&D activities like prototyping, product development etc. The involvement of an external party such as a TTO may have an effect on the distribution of the property rights of patent applications. In exchange for support, the TTO may negotiate a certain share of property rights. The larger this share is, the less likely firms will be eager to commercialize this technology and extract revenues and profits from the marketing of their product/service(Bekkers et al., 2006).

The following hypotheses follow from the statements made above.

H3a: The Utrecht University affiliated TTO positively influences the share of property rights appropriated by the TTO in patent applications of academic spin-offs.

H3b: The Utrecht University affiliated TTO positively influences the amount of employees of UU spin-offs devoted to R&D activities of UU spin-offs.

H3c: The Utrecht University affiliated TTO positively influences the amount of funding devoted to R&D activities.

H3d: The Utrecht University affiliated TTO positively influences the amount of patents applied for by an academic spin-off.

H4a: The share of property rights acquired by the TTO negatively influences venture performance.

H4b: The amount of employees devoted to R&D activities positively influence venture performance.

H4c: The amount of funding devoted to R&D activities positively influence venture performance.

H4d: The amount of patents applied for positively influence venture performance.

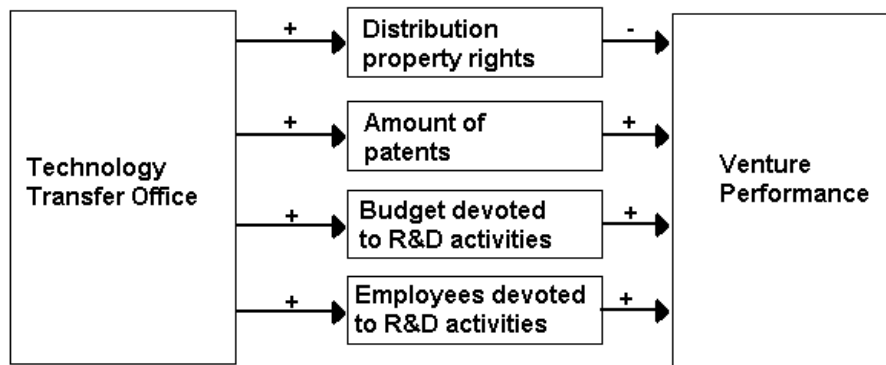


fig 6. The role of Technological capital

3.3.3.3) Financial capital:

In order to create high-technology firms and to increase their probability to become successful organizations, proper access to and availability of venture capital is vital to survive in a fast changing, highly competitive environment (Florida & Kenney, 1988). The ability to attract nearby external capital should be one of the focus points of an academic spin-off (Rothaermel et al. 2007; Powers & McDougall, 2005).

Venture funding may be obtained from four different sources: Internal funding, University funding, Government funding and external private funding. Internal funding consists of the amount of funding brought in by the founding team at the moment of founding and the management team members in a later stage. University funding could vary between funded research and direct investment by the Holding or formal TTO structure. Government funding could best be described as subsidies of any sort a company is able to apply for. External private funding indicates that a firm is able to translate the potential of their technology/service into business opportunities in which external parties are willing to invest in. Therefore, the amount of external parties that invest in a company doesn't solely influence venture performance, it also reflects the potential of the utilized technology. If a venture capitalist is willing to invest in a starting venture or in the development of a technology specifically, this indicates that the business environment acknowledges the commercial potential of the generated knowledge. By having external parties investing in the development of an invention, these parties recognize the economic benefits that could be derived from it. These external investors consist of domestic and foreign venture capitalists, banks etc. This research measures the distribution of acquired funding from these sources of funding in order to get a complete overview. Differences between funding distribution could influence venture performance significantly. University support institutions, particularly the affiliated TTO, can also assist firms in attracting additional capital by direct investment, fundraising, introduction to well-known external private investors etc. By opening up their own elaborate business network, the TTO is able to steer companies towards interesting external investors and vice versa. This assistance could enhance both the amount of external investors and the amount of acquired external investor funding of an academic spin-off.

As stated above, an important goal of academic spin-offs is to attract external risk capital. According to Siegel et al., (2007), high levels of spin-off activity within a certain region result in favorable economic and technological

spillovers(O'Shea et al, 2008). High rates of start-up companies attract venture capitalists looking for business opportunities to invest in. Also, being closely related, there exists a higher risk of knowledge spillovers (wanted and unwanted) between starting companies. Knowledge spillover supplements each company's resource base with valuable technological knowledge that can be applied in their products or services.

However, Cumming and Macintosh (2006) have found in their study, that public venture capital financing negatively influences the availability of external private venture capital within the region. In this case, tax subsidies make public funds operate at larger profit margins than private funds, thereby outbidding them. The study of Cumming and Macintosh (2006) shows that the availability of public funds actually has crowded out other types of external funding. External risk capital declines, because firms are more willing to attract public funding. Therefore, it is interesting to observe what types of external funds are acquired by starting enterprises and to what degree these funds influence each other and affect spin-off performance.

H5a: The Utrecht University affiliated TTO positively influences the number of external investors of academic spin-offs.

H5b: The Utrecht University affiliated TTO positively influences the amount of public university funding acquired by an academic spin-off.

H5c: The Utrecht University affiliated TTO positively influences the amount of public governmental funding/subsidy acquired by an academic spin-off.

H5d: The Utrecht University affiliated TTO positively influences the amount of external private investor funding acquired by an academic spin-off.

H6a: Internal funding positively influences venture performance.

H6b: Public university funding positively influences venture performance.

H6c: Public government funding/subsidy positively influences venture performance.

H6d: External private investor funding positively influences venture performance.

H7a: Public funding negatively influences external private funding of academic spin-offs.

H7b: Public funding negatively influences the amount of external investors of academic spin-offs.

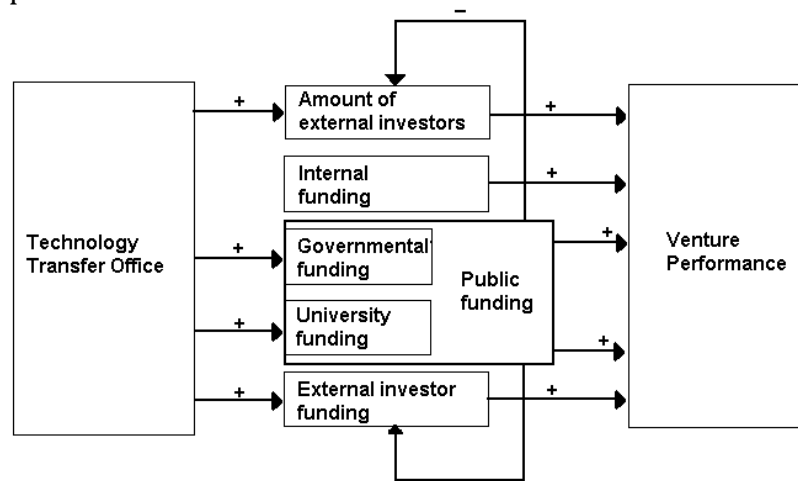


fig 7. The role of Financial capital

3.3.3.4) Physical capital:

Another tangible asset of an academic spin-off that may influence its performance is physical capital (Gras et al., 2008). This consists of facilities such as laboratories, research equipment, office space etc. As financial resources are limited and these facilities are relatively expensive, it is interesting to investigate if and how these facilities are acquired by starting firms. University spin-off support institutions like UtrechtInc. could contribute by offering cheaper office space; equipment and laboratories for Utrecht University affiliated spin-offs. When this proves to be impossible, these institutions could direct starting firms to external options and give advice on negotiation strategies. The availability of low-cost R&D facilities offer the opportunity to conduct R&D activities internally, instead of spending significant amounts of funding on outsourcing these activities. This will increase venture performance on both short- and long term. Accordingly, the following hypotheses are formulated.

H8: The Utrecht University affiliated incubator positively influences the utilization of R&D facilities by academic spin-offs.

H9: The utilization of R&D facilities by academic spin-offs positively influences venture performance.

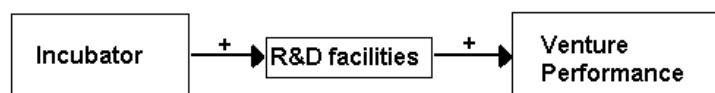


fig 8. The role of Physical capital

3.3.3.5) Social capital:

At the moment of founding, an academic spin-off's external relations and network coincides with the personal networks of the founding team. Over time this network will expand and develop when moving from one development phase to the other. Eventually, the firm will acquire its own sophisticated network with specific alliance partners for specific development phases. Because of the limited availability of resources, spin-offs are more likely to form collaborations with other parties to acquire these resources (Ahuja, 2000). Social networks are said to influence the type of spin-off created and spin-off performance (Rothaermel et al. (2007). Previous experiences with network partners and alliances have a positive effect on the creation of subsequent alliances (Gulati, 1999). Fruitful collaborations with external parties increase the chance of fruitful future collaborative activities and possibly additional network partners. The amount of network partners and the development of the network are essential in order to acquire a beneficial network position within the industry. External supporting institutions could improve this network position by introducing management team members to adequate collaboration partners.

H10a: The Utrecht University affiliated TTO positively influences the amount of collaborations/alliances of an academic spin-off.

H10b: The Utrecht University affiliated incubator positively influences the amount of collaborations/alliances of an academic spin-off.

H10c: The Utrecht University affiliated TTO positively influences the network position of an UU spin-off.

- H10d: The Utrecht University affiliated incubator positively influences the network position of an academic spin-off.
- H11: The amount of collaborations/alliances of an academic spin-off positively influences venture performance.
- H12: The network position of an academic spin-off positively influences venture performance.

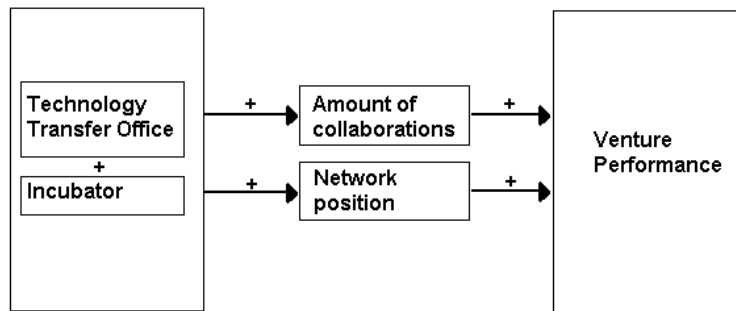


fig 9. The role of Social capital

3.4) Control variables

Besides the identified capitals, other characteristics of academic spin-offs could also influence venture performance. In this study, the effects of the causal variables on Venture Performance are controlled for the effects of spin-off size, spin-off age and industry type. These control variables are widely used in other studies on academic spin-off performance (DiGregorio and Shane, 2003; Cooper et al., 1999).

Spin-off size might influence spin-off performance independently from the intermediary variables and independent variable. Spin-off size partly determines the degree of employment creation, turnover and profitability of an academic spin-off.

The age of an academic spin-off might influence spin-off performance, because the organization has developed over time and has become more experienced. Established academic spin-off have more experience with dealing with their specific industry competitors etc.

Also, it can be argued that the industry in which an academic spin-off functions, determines its performance. For instance, it might be easier to develop a potential highly profitable pharmaceutical spin-off than a consumer electronics spin-off. In this sense, academic spin-offs with a pharmaceutical focus might consequently outperform ICT oriented academic spin-offs.

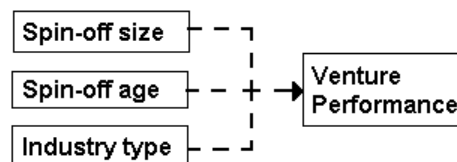


fig 10. The role of Control variables

These control variables are added to the conceptual framework, which illustrates the different types of capitals and their influence on venture performance. Also, the relation between Utrecht University support institutions and the generation of resources and capabilities of an academic spin-off is shown in fig.11.

3.5) Conceptual framework:

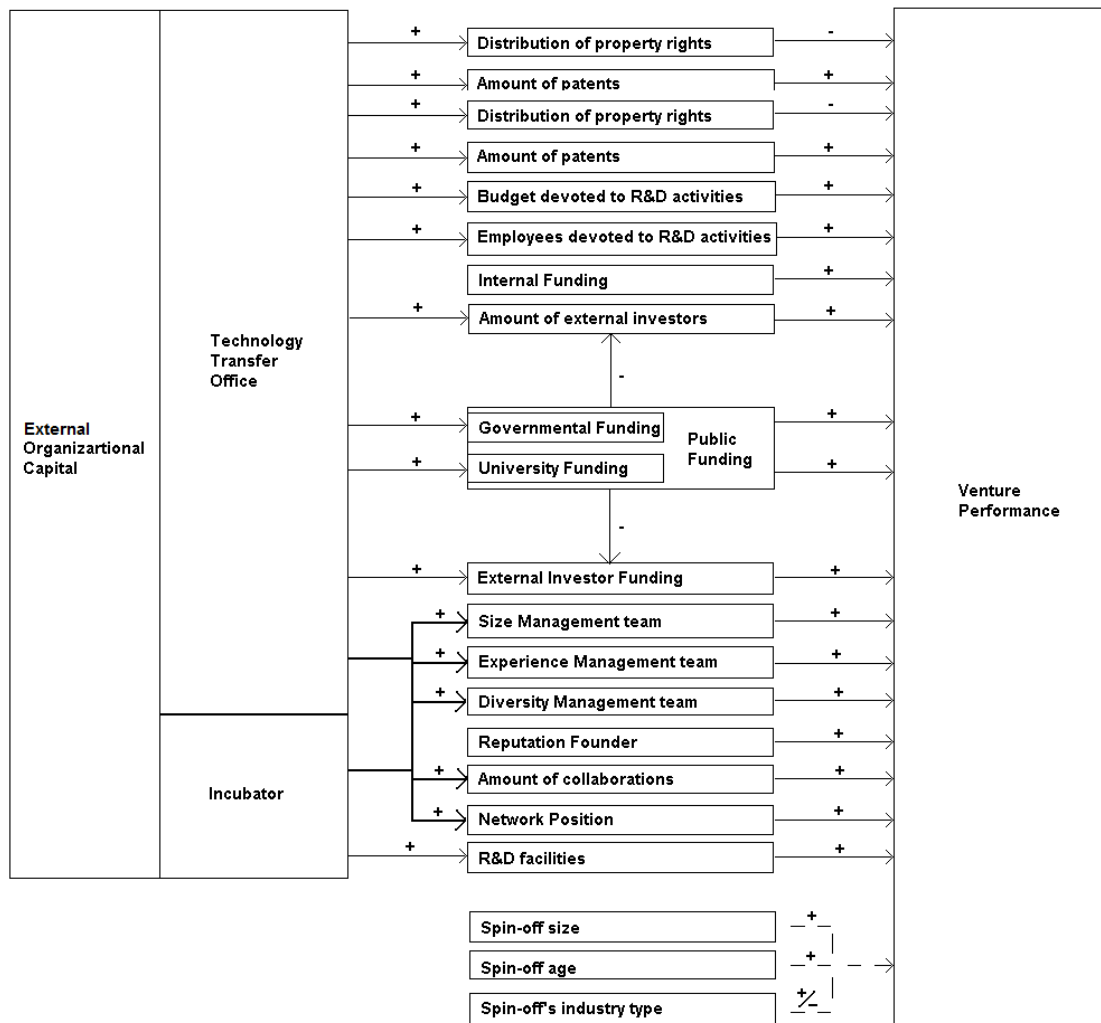


Fig 11. Conceptual framework

3.3.6) Overview:

According to the theoretical framework, five types of resources that influence the dependent variable - venture performance - are identified, being: internal organizational/human capital, technological capital, financial capital, physical capital and social capital. These categories of resources are related to a set of measurable indicators acting as intermediary variables. Besides the dependent variable and intermediary variables, the independent variable is also split up in measurable indicators with causal effects. Consequently the control variables supplement the overview of indicators that influence venture performance.

An elaboration on the variables are illustrated in the model below:

Dependent Variable	Venture Performance	Economic	Profitability	
		Socio-economic	Turnover	
			Employment creation	
Independent Variable	External Organizational Capital (Incubator, TTO)	Incubator role	Role of incubator	
		TTO role	Share in Academic spin-off	
			Reward system researchers	
			Size TTO (FTE)	
			Resources devoted to TTO activities	
Intermediate Variables	Internal Organizational / Human Capital	Management Team	Size management team	
			Diversity management team	
			Entrepreneurial experience	
			Academic experience	
			Managerial experience	
			Scientific (R&D) experience	
			Financial experience	
			Reputation university scientist	
	Technological Capital	Patents	Amount of patents	
			Property Right distribution	
	Financial capital	R&D capabilities	Employees R&D	
			Budget allocated to R&D activities	
	Financial capital	Venture Funding	Internal investments	
			University funding	
			Government funding / subsidy	
Venture capital			Amount of external	

				investors
				Amount of external risk capital
	Physical capital	R&D facilities	Utilization of R&D facilities	
	Social Capital	Network	Network Partners	
Network Position				
Control variables			Firm size Firm age Industry type	

Fig 12: Overview of variables and indicators

In the subsequent section the research design is engineered, which is necessary to test the influence of the independent and intermediary variables on the dependent variable. Additionally, the identified variables and corresponding indicators are operationalized.

4) Methodology

4.1) Research design:

This research attempts to examine which assets and capabilities utilized by academic spin-offs might hamper or increase their performance. Additionally, this research attempts to clarify the supporting role of the university support activities performed by TTO structures. This research is explanatory, because it tries to assess the effects of different types of assets and capabilities on venture performance. This study doesn't observe this phenomenon over time. Data collection takes a snapshot at one moment in time in order to answer the research question of this study. Since we are dealing with a rather small population, the identified academic spin-offs are interviewed in a structured way. So, a comparative case study design is employed in order to explore the validity of hypotheses among Utrecht University affiliated, patent based academic spin-offs at one moment in time.

4.2) Data Collection:

This specific research is part of a larger research, initiated by OctrooicentrumNL i.e. the Dutch Patent Office. In an attempt to create a complete overview for the Dutch situation regarding valorization through entrepreneurial activities, the Dutch Patent Office targets each Dutch university specifically. This research will contribute to the generation of this complete overview, by examining the case of Utrecht University in depth.

As Utrecht University doesn't operate through a formal TTO, all its supporting activities must be investigated in order to assess whether they are executed efficiently. Fini et al. (2010) has shown that approximately 2/3 of all academic spin-offs aren't based on patented inventions disclosed to a TTO (Fini et al., 2010). In order to generate a complete overview of Utrecht University activities concerning the valorization of academic knowledge through academic spin-offs, information gathered through contact with the TTO of a University will not suffice as this only addresses the within the UU IP-system started academic ventures. For this reason companies started on patented inventions outside the Utrecht University IP system and companies started on academic knowledge, which proved not to be patentable, should also be identified.

For this research, the Utrecht University employee register and the European patent office database and register (called Espacenet and Epoline respectively) are consulted. The European Patent databases provide patent information, like applicant name, inventor name, application date, publication date etc. By checking the Utrecht University employees' names with the patent database, all possible Utrecht University inventor names could be filtered out. By checking the inventors' names with their corresponding appointment date and field description provided by the UU employee register, the chance of generating invalid cases is minimized. By having identified all patents based on Utrecht University generated knowledge, the corresponding academic spin-offs can be identified from the European (or domestic) Patent Register. This technique helps to identify all patent based academic spin-offs from Utrecht University, within and outside its formal IP-system, as described by Fini et al., (2010).

The patent analysis, as described in the appendix, yielded 37.225 possible matches between the Utrecht University employee register and the European

Patent databases. Validation of these matches on period and faculty of employment has resulted in 780 matches. Of these 780 matches, 230 distinctive inventions were found, where UU employees were mentioned as inventors on patent applications. 30 of these inventions still hold a slight risk of uncertainty. From these 230 patent applications 70 were applied by 24 academic spin-off companies, independently or in collaboration with research institutions, universities, multinationals etc. After these 24 companies were contacted, correction of the research population was necessary. One company had ceased to exist, six didn't fit the proposed constraints to be part of the research population where one was taken over by a larger company. Eventually 16 academic spin-offs remained to be examined. Unfortunately, a statistical methods cannot be applied to a research population of such a small size. Additionally, the identified academic start-ups are invited to co-operate in this research. Interview invitations are sent to the 16 identified spin-offs in an attempt to assess the hypothesized relations proposed earlier. Within a week after the interview invitations are sent, these specific companies are contacted by phone to make an appointment for an interview. Ultimately, only four of these 16 identified companies were willing to cooperate in this research. An overview of the company types that have applied for the identified 230 patents is shown in. The figures in table 1 don't add up to 230, because some patents are applied for by multiple types of companies. An elaborate overview of table 1 is given in appendix C.

Table 1: distribution of applicants over identified unique inventions

Amount of individual inventions	Spin-off is applicant	Multinational is applicant	Public Research Org, is applicant	Utrecht University is applicant
230	70	123	47	34

Besides interviews with the identified companies, this research also attempts to explore the supporting institution's view on their offered assistance. To get a complete impression of the situation and to possibly check the offered answers on TTO involvement, interviews with managers of the Utrecht Valorizations Centre and Utrecht Holdings are conducted to provide additional information on the supporting role of the Utrecht University. Questions referring to UtrechtInc. were also answered by the manager of the UVC, as UtrechtInc. was his former employer. Hopefully, this information will be valuable when explaining the degree of influence and appreciation of specific supporting activities.

4.3) Measurement:

In order to measure the indicators described in section 3.3, several question techniques are applied.

Closed questions: Questions that do not require additional explaining or elaborative structuring, could best be asked in a closed fashion. This makes the indicator related to this type of question easier to compare between academic spin-offs.

Open questions: In order to explore the effect of a certain phenomenon on a small population, significant value could be extracted from the explanation or

elaboration of an answer to a question. Open questions could sketch a more elaborated picture of a specific situation than could be done with multiple closed questions.

Ordinal scale: In an attempt to measure the degree of influence and the degree of appreciation of a specific assisting activity, an ordinal scale is employed. In this study, each respondent is asked to assess the influence and perceived appreciation on a 10-point scale.

In the following sections, it is described how specific indicators are operationalized and what type of questions are utilized to collect valuable data for this research. In appendix B, a complete overview is shown of the interview structure. The light blue shaded questions are part of the overarching research of OctrooicentrumNL. Each proposed interview question is indicated, so it matches the questions depicted in appendix B.

4.3.1) Operationalization dependent variable

In this research profitability and profit growth are measured in percentages at the moment of founding and the current situation. This gives insight in the profit generated and the profit growth over the total examined period between the moment of founding (1998) until November 2013. This shows whether or not a company has succeeded to adjust their product or service to realistic customer demand. Turnover is measured in absolute numbers, based on the estimate of the respondent, for he/she might not know the exact figures. Employment creation is questioned in a similar fashion as profitability; absolute figures at the moment of founding and the current situation.

Table 2: operationalization dependent variable

Dimensions	Indicator	Operationalization	Value
Venture Performance	Profitability	Q24) What is your current turnover and profitability (%)and at the moment of founding?	Profitability in percentages.
	Profit growth		
	Turnover	Intro) How many employees (FTE) did your company have at spin-off founding and currently?	Turnover in 8 categories ranging from 0-10.000.000 euro
	Turnover growth		Numbers
	Employment creation		

4.3.2) Operationalization independent and intermediary variables

4.3.2.1) External Organizational Capital

Incubator role:

Based on the incubator activities identified by the UVC respondent, the UU incubator model is determined. These activities are checked by interviews with incubator executives.

Table 3: operationalization incubator role

Dimension	Indicator	Operationalization	
Incubator role	Incubator role	Q17) To which degree does the University-affiliated incubator perform activities for your firm?	Nominal: three identified activities: strategic advice, networking, monitoring. Per category ordinal scale from one to ten.

Share in academic spin-off:

The share of the University in the academic spin-off could be a decisive factor for spin-off performance. The respondent is asked straightforward how large the university share in their company is.

Reward system researchers:

The researcher reward system of the university for an invention and the possible valorization of academic knowledge could both affect the researcher's drive to perform entrepreneurial activities and thereby the spin-off performance. First, the type of reward system is questioned, giving three predetermined categories. Secondly the importance of this reward system is questioned.

Table 4: operationalization holding role

Dimensions	Indicator	Operationalization	Value
Holding role	Share in academic spin-off	Q18) To which degree is the University shareholder in the company?	10 Categories: 0-9%...89-100%
	Reward system researchers (Value and Appreciation)	Q19) What type of reward system for researchers (you) does the university employ?	Nominal: per category on a scale from one to ten.

Size of TTO:

Additional research has shown that the amount of employees working at a university's TTO positively influences the number of start-ups from that university (O'Shea et al., 2005; Roberts and Malone, 1996). After interviewing the TTO executive(s), the history and current amount of employees working at the TTO is determined.

Resources devoted to TTO-activities:

Gras et al. (2008) suggest that certain stocks of assets and capabilities of a TTO, like for instance their number of employees could be a determinant of spin-off performance. These relations are explored by interviewing 'TTO-managers' at the Utrecht University.

Table 5: operationalization TTO role

Dimensions	Indicator	Operationalization
TTO role	Size TTO Resources devoted to TTO activities	Interview with Technology Transfer managers at Utrecht Holdings, Utrecht Valorization Centre and Utrecht Incubator

4.3.2.2) Internal Organizational and Human capital

Internal organization:

For the internal organization of an academic spin-off it is essential to identify possible critical junctures and to adjust and develop new routines to overcome these junctures. Each respondent is asked to point out the critical changes that its company has experienced and to what degree the junctures have hindered the development process of the company. Because this research attempts to examine factors that influence the development and ultimately the performance of an academic spin-off, this question is added to identify what kind of problems are encountered in the development process. Additionally, by questioning how these junctures have influences the development of the academic spin-off, the eventual results can be placed into context.

Table 6: Operationalization internal organizational capital

Dimension	Indicator	Operationalization	Value
Internal organizational capital	Identification of critical junctures	Q16) What kind of critical changes in the development process did your company face and to what degree did they hinder the development process of the company?	Ordinal scale: to identify the impact on venture development. Open: elaboration on the way this juncture hampered spin-off development
	Activities to overcome critical junctures		

Management team:

As indicated in the theory section, management team size, diversity and experience has a positive effect on venture performance. The management team size is measured in FTE, because this is relatively easy to estimate by our respondents, knowing that employee numbers are small in start-ups. This study examines the effect of diversity, entrepreneurial experience, scientific experience and previous experience with applied science in entrepreneurial organizations through a combined question. For each management team member, it should be possible to answer the proposed questions. Finally, the degree of involvement of UU support institutions to form and alter the management team of a spin-off is questioned, as well as the level of appreciation of these activities by academic spin-offs.

Table 7: Operationalization management team

Dimension	Indicator	Operationalization	Value
Management team	Size management team	Q13) How many members does your management team have currently and at the moment of founding?	Numbers
	Diversity management team	Q14) In how many previous starting companies have the management team members been involved before the founding moment of your company? For how many years? What is the scientific background of the founding team members?	Absolute figures are given for the amount of previous started companies; previous experience in all subsequent fields are measured on a nominal scale (amount of years of experience)
	Entrepreneurial experience		
	Scientific experience		
Previous entrepreneurial			

	l incentives Reputation university scientist		Open question on reputation involved scientist
	Value and Appreciation	Q15) Which UU support institution has assisted you in forming/altering of the management team (searching and recommending adequate personnel), how large was this influence and how much was this appreciated?	Ordinal: Per external support organization: level of influence(1-10) and level of appreciation (1-10)

4.3.2.3) Technological Capital

Patents:

The number of patents applied for can be questioned in absolute figures, because these figures are well-known. Property right distribution is questioned by an ordinal scale, which describes the property rights of the patent.

Table 8: Operationalization Patents

Dimension	Indicator	Operationalization	Value
Patents	Amount of patents	Q1) How many patent applications has your company filed?	Number
	Property Right Distribution	Q4) How are the intellectual property rights distributed between University and spin-off?	Ordinal: full ownership of spin-off, spin-off owns more than 50%, University owns more than 50%, Full ownership of University
	Value and Appreciation	Q3) When applying for patent(s), which UU support institution has assisted you in these activities?, How large was this influence? and How much was this appreciated?	Ordinal: Per external support organization: level of influence(1-10) and level of appreciation (1-10)

R&D Capabilities:

The amount of resources devoted to R&D activities is measured as the number of full time equivalents (FTE's) an academic spin-off devotes to R&D activities and the utilization of its R&D facilities. For R&D activities, the contribution of UU support institutions and the appreciation by the spin-offs they support are questioned.

Table 9: Operationalization R&D capabilities

Dimension	Indicator	Operationalization	Value
R&D capabilities	Employees R&D	Q5) How many FTE does your company devote to R&D activities?	Number
	Budget allocation to	Q6) Which percentage of your total budget do you	Number

R&D activities	spend on R&D activities at moment of founding and currently?	
Value and Appreciation	Q7) Which UU support institution has assisted you with R&D activities (product development, prototyping, etc)?, How large was this influence? and How much was this appreciated?	Ordinal: Per external support organization: level of influence(1-10) and level of appreciation (1-10)

4.3.2.4) Financial Capital

Venture Funding:

Venture funding can be subdivided into four different sources, being internal funding, University funding, Government funding and external private funding. This study measures the distribution of the budget available over these sources to get a complete overview of the funding sources and their magnitudes. Consequently, the number of different external private investors is questioned. Finally, the degree of influence of UU support activities and the level of appreciation by spin-offs for these activities are questioned.

Table 10: Operationalization Venture funding

Dimension	Indicator	Operationalization
Venture Funding	Internal investments	
	University funding	
	Government funding (subsidy)	Q10) How is your funding distributed over various sources, currently and at the moment of founding?
	Amount of venture capital	
	Origin of venture capital	
	Value and Appreciation	Q11) Which UU support institution has assisted you in accessing additional (external) investors/funds?, How large was this influence? and How much was this appreciated?
	Amount of external investors	How many external private investors invest in your company?

4.3.2.5) Physical capital

R&D facilities: For the utilization of R&D facilities the contribution of UU support institutions and the appreciation by the spin-offs they support are questioned in the following manner.

Table 11: Operationalization R&D facilities

Dimension	Indicator	Operationalization
R&D facilities	R&D facilities + Value and Appreciation	Q8) Which UU support institution has assisted you in accessing and utilizing R&D facilities (laboratories, test facilities, construction facilities etc.)?, How large was this influence? and How much was this appreciated? Ordinal: Per external support organization: level of influence(1-10) and level of appreciation (1-10)

4.3.2.6) Social Capital

Network:

Finally, the supporting role of UU support institutions in terms of network partners and collaborations is examined using the following questions.

Table 12: Operationalization Network

Dimensions	Indicator	Operationalization
Network	Network position	Q20) How many collaborations with partners did your company have at the founding moment? And currently? Numbers
	Value and Appreciation	Q21) Which UU support institution has assisted you in attracting adequate partners for collaboration since the founding moment until now?, For what percentage of total network partners? and How much was this appreciated? Ordinal: Per external support organization: level of influence(1-10) and level of appreciation (1-10)
	Value and Appreciation	Q23) Which UU support institution has assisted you in creating and maintaining long term alliances?, What was the magnitude of this influence? and In which way do you perceive this supporting activity as beneficial? Ordinal: Per external support organization: level of influence(1-10) and level of appreciation (1-10)

4.3.3) interview set-up:

The interview set-up can be found in the appendix B. All light-blue questions are questions constructed in collaboration with AgentschapNL Octrooicentrum. These questions are part of their overarching research. In order to measure their set of indicators, these questions are included in the interviews with UU related academic spin-offs.

4.4) Reliability and Validity:

Before the interview invitation is sent to all 16 identified academic spin-offs, two pilot interviews are set up to eradicate all possible ambiguities. So, the interview questions can be answered without large difficulties. When potential ambiguities have risen during these pilot interviews, indicators have been added or adaptations have been made to the operationalization of initial indicators.

The internal validity of this research is supposed to be high, because all predicted relationships are empirically tested and confirmed by other researchers. Furthermore, the model of Brush (2001) uses a combination of tangible and intangible assets that is in line with the Resource Based View.

The theoretical framework and derived hypothesis guide the process of data collection and analysis during this research (Bryman, 2008). This data will be used to indicate and examine causal relationships between the identified variables. As this research focuses on Utrecht University, multiple Utrecht University academic spin-offs are targeted. As the variables and hypotheses suggest relationships for universities in general, this research design could be applied to academic spin-offs related to other universities/regions.

The external validity of the results of this study is unknown, because the sample isn't selected randomly and the sample is too small to derive generic statements about academic spin-offs. How representative the examined spin-offs are for the entire population and other universities therefore remains unknown. Also, academic spin-offs which do not (yet) have applied for a patent, or utilize non-patentable knowledge could be interviewed in a similar manner. This could be valuable for internal research at TTO's or incubators. The research design is created in such a way that it can be applied to other university-affiliated spin-offs or non-patent based spin-offs too. When the research focus is expanded to these areas, the external validity could be enhanced.

The construct validity of this research is high, because all indicators are successfully utilized in prior empirical research.

The reliability of the data is high because reproduction of this research is possible and the research design can be applied to other academic spin-off populations.

4.5) Data analysis:

The interview structure used in this study contains questions that measure indicators, which could have a direct or indirect influence on venture performance at different moments in the development phase of an academic spin-off.

Several questions demand information on the founding moment situation, for example the number of network partners at the founding moment. These questions are meant to explore the initial start-up phase of an academic spin-off. In order to generate statements on the degree of assistance they've received and how this relates to venture performance, the starting position of that company should be investigated. This could show in which areas spin-off companies truly need assistance and in which areas their resource base suffices.

Additionally, questions are set-up to examine the current resources of an academic spin-off. These resources are related to current venture performance

in order to explore which additional resources have been appropriated and how this has influenced venture performance. This is a direct approach to identify (sets of) resources that help the development process of an academic spin-off. Consequently, intermediate factors that occur throughout the development path of an academic spin-off are examined. These questions entail the level and appreciation of the received assistance from the Utrecht University support institutions in particular. These assisting activities are investigated, because they are considered to influence venture performance indirectly by enhancing the resource base of an academic spin-off.

The structured interview covers all proposed hypotheses in order to answer the research question(s) of this study.

The introductory questions, as well as questions 4, 10, 13, 14, 18, 20 and 24 question the respondent on factors that occur at founding moment. These factors solely influence (or don't influence) venture performance at founding moment.

Additionally, two distinctive factors exist that influence current venture performance, being intermediary factors and final factors. First of all the intermediate factors occur throughout the entire development process of an academic spin-off. These factors influence the long term development of the firm, reflected by the performance of the company on November 2012. The intermediate factors are covered by questions 2, 3, 7, 8, 11, 15, 16, 17, 19, 21 and 23.

Secondly, the final factors relate to venture performance on November 2012 solely. Their relation to the resource base and performance level of the academic spin-off is only measured on November 2012 to create an overview of the current situation. These topics are covered by questions 1, 5, 10, 12, 13, 14, 20, 22 and 24.

5) Results and analysis:

Because the number of cases examined by this research is rather limited, it is difficult to generate solid statements about the relation between variables. Based on data provided by one or two cases, it is impossible to confirm or reject proposed hypotheses. A more careful technique of labeling and coding is employed, in order to interpret the answers and obtain sophisticated data (Charmaz, 2006).

This research is designed to question the respondents in a structured way, which makes it easier to apply the method of labeling. The respondent's answers could all be categorized per type of capital and even per proposed hypothesis. Consequently, pattern matching is employed, in order to analyze the data (Yin, 2003). This approach attempts to compare the patterns described in the theory section with the patterns observed in the data. Specific characteristics of one or more companies could be examined for differences and similarities. Elaborations on these differences and similarities can be made, based on additional information obtained from the structured interviews. In the following section, a short overview of the companies is presented in the form of narratives. Consequently, the offered information is combined with additional interview information, so that each hypothesis can be investigated.

5.1) Narratives:

5.1.1) Company A:

In early 2005, company A was founded and introduced to the pharmaceutical industry. The initial goal of this novel drug development company was to discover a solution for severe inflammatory disorders, like rheumatoid arthritis and cancer. Three members who also formed the management team founded the company. One of them had a formal function and was on the payroll whereas the other two weren't on payroll and performed informal tasks. Two management team members had previous experience with starting enterprises. Additionally, academic, managerial, scientific and financial experience was present amongst the founding members. The founding members generated the required start-up capital and approximately 75% of it was allocated to R&D activities. Outsourcing of research activities was utilized in a later stage of the development process of company A in order to acquire additional external knowledge. The bulk of research and development processes were executed at their internally organized R&D facilities. During the start-up phase, company A didn't collaborate with external partners. No profits and revenues were generated during the year of founding.

Between 2005 and November 2012, company A was able to apply for 5 patents, entirely owned by the company itself. These patents are partially based on collaborative activities with Utrecht University, and some are based on internally generated knowledge. Even though the company has applied for both university- and internally generated patents, they didn't perceive any differences in the application process. Besides the fact that Utrecht Holdings has a 15-20 percent share in the company, company A didn't receive any assistance from the Utrecht University affiliated TTO or incubator. The only external support company A has

received in this timeframe was based on research collaborations. Being a small drug development company, Company A has outsourced and collaborated in specific research projects with other small enterprises and public research organizations. In every phase of the development process, company A has experienced difficulties, which resulted in delays. The experience gained in the development of their premium drug/product (pharmaceutical, pre-clinical, clinical), has led their attention to the design of novel promising therapeutics. The company has grown from three to five employees, from which three FTEs are devoted to R&D activities. The amount of funding is currently distributed differently than at the moment of founding. 5% still represents internal funding whereas the other 95% are provided by two specific external investors. Over time, the management team of company A hasn't changed in composition. They did in fact started to expand their network by collaborating with three relatively small partners, of which two are based on contract research. These developments have resulted in an increased turnover of approximately 200.000 – 500.00 euros. Still, in November 2012, no profits were generated.

5.1.2) Company B:

Two individual researchers from the Dienst Landbouwkundig Onderzoek (DLO) were experiencing increasing internal friction and signals of reorganization from their employer. In 1998 they decided to start their own company to continue their research activities. At this moment, the concept of a spin-off was rather new and the DLO institute had minimal knowledge of how to manage, organize and assist this new company. Besides the utilization of greenhouse facilities by company B, Wageningen University offered them R&D facilities and donated equipment. Also, the DLO institute didn't negotiate any share in the company or intellectual property, which makes company B highly independent in theory. At company B's moment of founding (1998), their core business was the discovery of markers for diagnostics and development of tools for genetic modification. The founding members had a significant amount of scientific and academic experience in the field of diagnostics. These areas were the only areas of experience of the management team at the moment of founding. The capital required to form company B was generated internally, no external investors or public research organizations contributed financially. The network contacts build up at the DLO institute resulted in three collaborations with partner agents at the moment of founding. Without generating any profits, company B succeeded in generating a turnover between 0-50.000 euros.

Over the years, company B's focus has shifted and extended from diagnostics towards the determination of markers and the practical application and development of tools for genomic breeding and sustainable biotechnology. The growing amount of information on biological markers and the growth of genetic and gene expression databases made the development of advanced data storage, data analysis and data visualization software necessary. In order to protect this potentially valuable information, ten patents applications were filed. Only one of them was developed in collaboration with a university whereas the other nine were internally developed. Collaboration with universities was primarily initiated because company B could then apply for additional university and government funding. For this reason they have worked on 5 – 6 projects in

collaboration with Utrecht University and Groningen University. Universities were mostly interested in the PhD trajectories of their students, thereby minimizing the amount of time devoted to the project of company B. These projects didn't yield desirable results, due to the difference in approaches and targets between both universities and company B. In 2003, company B has moved to the Wageningen University affiliated incubator, due to persistent reorganizations at the DLO institute. This incubator assisted company B with the acquisition of adequate facilities and network partners. In 2006 they noticed that the amount of available public funding was declining and they had to find more creative ways to access external risk capital. Due to assisting activities of their shareholders, Wageningen University, and Utrecht University the network of company B is expanded and additional collaboration partners were attracted. This has eventually resulted in an expanded pool of 10 collaboration partners, which in turn have a very broad network of themselves. Besides the company's network-base, also the number of employees and management team members has increased. In November 2012 Company B has 18 employees, of which 15 are busy with R&D activities. The amount of received funding is unevenly distributed between governmental funding and external private investors (three parties), with 10% and 90% respectively. 25% of the received amount of external funding has been provided by banks. As stated earlier, the management team of company B has expanded from two to six members. Where financial and entrepreneurial experience is lacking and management experience is only marginally available, academic and scientific experience is widely present in the management team. In November 2012, company B wasn't able to generate any profits. It was, however, able to generate a turnover between 2.000.000 and 4.000.000 euros.

5.1.3) Company C:

In 1999, five founding members started company C as a center for clinical and scientific research. Three founding members took positions in the management team of the corporation with only academic experience. Despite of being a starting enterprise, company C was already able to attract external private investors and two collaboration partners at the start of operations. External investors provided 40% of all available funding, while 10% was acquired via the university and 50% was provided by internal funding. Utrecht University didn't have any share in the company (and its intellectual property). At the founding moment, company C wasn't able to generate any profits. It did however generate a turnover of 200.000-500.000 euros. Initially, Company C started by building a software system that was meant for personalized medicine in the healthcare sector and on the labor market. This system was designed to support patients in their medicine use and monitor the drug-use behavior and effects of the patient automatically.

Approximately around the year 2004, this project was separated from company C and a new route was chosen. Due to financial issues, company C went on as a contract research organization focusing on clinical drug research and research for the pharmaceutical industry . The focus of the company had shifted from an artificial intelligence system to research of female sexual dis-functioning and several drugs that could potentially resolve or minimize this phenomenon. Their operations have led to seven patent applications, of which one was developed in

collaboration with Utrecht University and six were developed internally. Company C hasn't received any assistance from the Utrecht University affiliated support organizations during the development of their company. When applying for patents however, they received assistance from De Verenigde, a patent bureau in Amersfoort that takes care of the entire patent application and maintenance process. Collaborations with Utrecht University consists of common projects and outsourcing of research tasks to acquire external knowledge. Besides these parties, company C states that their network has helped a lot to come in contact with adequate research partners, investors, network connections etc.

This has resulted in a vast expansion of their business. In November 2012, company C has 25 employees, of which 15 are devoted to R&D activities. Their management team has expanded from 3 to 5 individuals, increasing their experience in managerial and financial fields. As stated earlier, utilization of the company's network has resulted in additional benefits. In this manner, the amount of collaboration partners has increased from 2 to 30 and they were able to attract 160 external private investors. In turn this has resulted in a funding distribution of 80% external private investors and 20% governmental subsidies. Although these activities and especially the utilization of their network position hasn't led to profits, their turnover has increased to between 4.000.000 – 10.000.000 euros in November 2012.

5.1.4) Company D:

Ever since their founding in 2005, company D has held strong ties with Utrecht University and its supporting environment. Just like company A and C, this enterprise operates in the field of drug discovery and development and especially in misfolded protein diseases. Misfolded proteins stick together and form so called protein oligomers, which ultimately lead to diseases like Alzheimer's disease, Parkinson's disease and diabetes mellitus II. Company D has discovered a technology that is able to identify compounds that specifically target protein oligomers, thereby minimizing the chance to get the diseases mentioned above. From the five employees company D had on payroll, three of them formed the management team, devoting a total of 0.6 FTE to these activities. Common knowledge of entrepreneurial, academic, managerial scientific and financial fields is present, for at least one management team member has previous experience in these areas. The internal capital acquired from the founding team members reflects 20% of total venture funding. 15% of this 20% are investments by Utrecht Holdings. The remainder of total funding (80%) is acquired from external private investors. At the start-up moment, company D had already established collaborations with ten network partners. In 2005 the company's profit was 0% and they generated a total turnover of approximately 0-50.000 euro.

Over the years, company D has applied for 17 patents, eight being developed in collaboration with Utrecht University and the remainder being developed internally. Besides assistance from Utrecht holdings, company D has received assistance from De Verenigde in Amersfoort in a similar manner like company C. The collaboration with an intellectual property strategist at De Verenigde has supported the application procedure and strategic application of all 17 patents.

Company D has underlined the importance of this individual for the development of their organization and has contracted him later on. For their other R&D activities, company D has collaborated with Utrecht University affiliated research groups and the Utrecht Medical Centre. University researchers contributed to corporate research projects and vice versa. These research projects consisted mostly of the acquisition of additional information on specific patent applications, which enhances the strategic position of the company. Company D also received assistance from the ABC expressiefaciliteit and ABC hybridoma. From 2005 until mid-2008, all lab facilities, equipment and office space were made available by the UMC. After that, UtrechtInc has assisted them in the search for alternative locations on the Uithof in Utrecht (Utrecht Science Park). Utrecht Holdings supported company D in altering the management team formation, by recognizing and communicating the need for a diverse management team, by pointing out management team positions that were lacking or abundant. Utrecht Holdings was able to do this, as they have a 24-29% share in company D and could influence the development of the company at shareholder meetings.

In November 2012 this influence on the management team formation has, amongst other causes, resulted in a total of 1.0 FTE devoted to management team tasks, divided over four employees. The alterations made by company D have resulted in a broadly oriented management team, which hold knowledge on all potential business areas. Company D also argues that all management team members have several years of experience with patents. Besides this management team of four individuals, the company has three additional employees on payroll. Between the moment of founding and November 2012 the number of employees has risen from 5 to 12 and ultimately decreased to the current number of seven. These seven employees devote approximately 80% of their time i.e. 5.6 FTE to R&D activities. The available funding could be ascribed for 60% to external private investors (divided over 6 external investors) and for 40% to governmental subsidies. The amount of collaboration partners has grown slightly without receiving additional support in finding the right collaboration- or network partners. These network partners are believed to have approximately 10 other collaboration partners on average. In terms of venture performance, company D wasn't able to generate profits and their turnover numbers in November 2012 still lie between 0 and 50.000 euro's.

5.2) Analysis:

5.2.1) Venture performance:

Because no company is able to generate any profits, the percentage of profitability is considered as a non-discriminating variable in this research. No comparison could be made between the examined academic spin-offs based on their ability to generate profits. On the contrary, the turnover and employee numbers differ significantly amongst the studied firms and are illustrated in table 13.

Table 13: Venture performance

	Company A	Company B	Company C	Company D
Employees founding moment	3	2	5	5
Employees November 2012	5	18	25	7
Turnover Founding moment	0	0-50.000	200.000-500.000	0-50.000
Turnover November 2012	200-500.000	2.000.000-4.000.000	4.000.000-10.000.000	0-50.000

Table 13 shows a large employment growth at company B and C. From the moment of founding, their employee numbers have increased with 16 and 20 FTEs respectively. Also, their eventual turnover figures lie in a different category than those of company A and D. Company B is able to generate approximately 2.000.000-4.000.000 euros, where company C even outperforms company B by generating approximately 4.000.000-10.000.000 euros.

Company A and D have experienced a much less growth of employee- and turnover numbers. Both companies have succeeded to incorporate two additional employees in their organization. Where company D isn't able to realize turnover growth, company A has increased its turnover with approximately 200.000-500.000 euros.

These figures suggest that since the moment of founding company B and C have outperformed company A and D, in terms of employment creation and economic growth. In the following section, all variables that could have influenced venture performance are discussed extensively.

5.2.2) External Organizational capital:

In this research, the influence of Utrecht University affiliated incubator+TTO structure on academic spin-offs is studied. Based on interviews with executives from these institutions, the supporting role of Utrecht University could be clearly examined.

Currently, UtrechtInc. operates with five employees performing management tasks, while two additional employees solely perform facilitating tasks.

In terms of technological resources, UtrechtInc doesn't perform formal assisting activities. It does however, participate in a pre-seed fund together with Utrecht Holdings and the Rabobank. Assistance in human capital is offered by advising academic spin-offs with acquiring additional competencies within the management team. Consequently, UtrechtInc. offers starting ventures facilities, like office space and laboratory, and advise companies regarding potential suitable R&D locations. In terms of the networking role of UtrechtInc., no formal activities are executed. Informally, Utrechtinc. steers academic spin-offs to potential suitable collaboration partners or investors whenever these parties are

encountered/recognized. The network value provided by UtrechtInc. is highly appreciated by academic spin-offs after the moment of exiting the incubator, for:

“Spin-offs die al langer weg zijn, die zeggen dat een van de grootste toegevoegde waarden van business ondersteuning zit hem niet in huisvesting of financiering, maar zit hem juist in het netwerk. Dat wil niet per se zeggen dat iedereen altijd een business partner of co-develop partner heeft gevonden, maar het algemeen schakelen met andere start-ups het schakelen met investeerders het schakelen met wie dan ook”

The Utrecht affiliated TTO structure consists of Utrecht Holdings and Utrecht Valorization Center. Utrecht Holding is performing all formal tasks, where UVC is mainly a facilitator between spin-off, holding and incubator. UVC is established in 2008-2009 in order to supplement the Valorization Program of Utrecht University. In 2000, the TTO structure of Utrecht University consisted of three people, of which 2.5 FTE was devoted to managerial tasks. Since 2005 the concept of valorization through entrepreneurship became increasingly important for Utrecht University executives, which has resulted in the availability of additional subsidy and ultimately the appointment of three additional employees. At the end of 2010 the Utrecht University TTO structure consisted of six employees. Currently (November 2012), this amount is doubled, with 12 employees working at the TTO, of which two don't perform formal management tasks.

The reward system handled by Utrecht Holdings is different from that of the majority of Dutch universities. Where other researchers maintain a 33%-33%-33% arrangement, Utrecht University distributes patent revenues 25%-25%-50%. In this distribution, 25% goes to the individual researcher, 25% goes to the Holding and 50% goes to the research groups (or faculty-members) responsible for the invention.

In terms of Technological capital, Utrecht Holdings assist companies with patent applications. As the discovered technology or invention is formally owned by Utrecht University, inventors need to negotiate with Utrecht Holdings over property rights if they want to commercialize the invention through an academic spin-off. Financial assistance of the Utrecht University TTO consists of the search for syndicates with existing seed or venture capitalists or informal investors that they know who could be interested in the specific type of academic spin-off to invest in. Utrecht Holdings prefers to invest in companies that also have been able to acquire external investor funds, for:

“ Vanuit de gedachte dat als de Holding investeert en ze doen het alleen, dan is er in principe hoger risico dan dat een marktpartij bereid is mee te investeren. Je deelt het financiële risico, en twee omdat je een toets hebt van een marktpartij die een brede ervaring heeft met dat type investeringen, is het voor de Holdings ook makkelijker om te zeggen: ok als de marktpartij hier ook in vertrouwt, dan is dat voor ons een extra toets een extra zekerheid, nou ja niet echt zekerheid, maar een extra vertrouwen dat het een goede investering is. “

Additionally, Utrecht holdings influences the formation of the management team by looking for suitable entrepreneurs (executive or CEO level) to commercialize discovered inventions or technologies. Similar to UtrechtInc. Utrecht Holdings doesn't perform formal networking activities, i.e. they don't actively search for suitable collaboration partners for affiliated academic spin-offs.

5.2.3) Internal organizational- and human capital:

Between the examined companies in this study, there exist noticeable differences and similarities in management team formation.

At the founding moment, the size of the management teams of the examined companies was relatively similar, ranging from two to three members. Apart from company A, the management teams have developed over time. Additional management team members were attracted to appropriate knowledge in areas where this was lacking. In comparison to company A, Company B has experienced the largest increase in management team size, by expanding their management team from two individuals at the founding moment, to six in November 2012. Company D explicitly mentioned their management team does not execute their tasks on a full time basis. From the four individuals that form the management team only 1FTE is devoted to management team tasks. This suggest that either their management team members operate by means of a part time agreement, or they combine their management team function with other – most likely research – activities. In this manner company D is able to acquire the desired amount of experience and diversity, without paying a premium price.

The reputation of involved university scientists is determined by their scientific degree, level of academic experience at Utrecht University and uncommon achievements that are worthy of mentioning. As all involved scientists and founding members of all investigated companies have a PhD degree in the field their academic spin-off operates in, this indicator becomes non-discriminating amongst firms. The amount of previous academic experience during their period of employment at Utrecht University is not enough to generate statements on the reputation of involved scientists.

In terms of management team diversity and experience a clear difference can be discerned between company A&D and company B&C. Even though the management team size of company A is relatively limited compared to the other companies, they did succeed in acquiring experience in all identified fields of practice. Company D has the most diverse and experienced management team of all examined companies, with 30 years of entrepreneurial experience, 39 years of academic experience, 41 years of managerial experience, 31 years of scientific (R&D) experience and at least seven years of financial experience. Additionally they underline the importance of experience with patenting and state that their management team has a combined patent experience of 40 years. On the contrary, company B and C didn't have management team members with previous entrepreneurial experience. Each company has hired an individual with experience in specific fields to acquire additional beneficial capabilities within the management team. For company B this has resulted in five years of managerial experience, where company C has acquired 20 years of managerial- and 30 years of financial experience. An illustration of the manager team size, diversity and experience per company is illustrated in table 2. CompanyA1 and CompanyA3 represents company A's first-third management team member.

Similar labels are used for company B,C and D's management team members' information. The management team members that were acquired externally are marked red in table 14.

Table 14: management team formation per company

	Starting ventures	Entrepreneurial exp.	Academic exp.	Managerial exp.	Scientific exp. (R&D)	Financial exp
CompanyA-1	Yes, -	10-20	10	10	10	10-20
CompanyA-2	Yes, -	10-20	0	10	0	10-20
CompanyA-3	-	-	-	-	-	-
CompanyB-1	0	0	4	0	(4)	0
CompanyB-2	0	0	15	0	(15)	0
CompanyB-3	0	0	8	0	(8)	0
CompanyB-4	0	0	8	0	(8)	0
CompanyB-5	0	0	7	0	(7)	0
CompanyB-6	0	0	12	5	(12)	0
CompanyC-1	0	0	15	0	0	0
CompanyC-2	0	0	2	0	0	0
CompanyC-3	0	0	1	0	0	0
CompanyC-4	-	-	0	20	0	30
CompanyC-5	0	0	0	0	0	0
CompanyD-1	0	0	10	2	(10)	0.5
CompanyD-2	0	0	15	7	(15)	0.5
CompanyD-3	3	20	4	20	1	?
CompanyD-4	?	10	10	12	5	6

In terms of University support, only company D has mentioned the influence of Utrecht holding (TTO) on the management team formation. For the other companies TTO and incubator assistance in the alteration of the management team isn't observed. As Utrecht Holdings is shareholder in company D, it could influence the development of the company by communicating their observations/concerns. At shareholder meetings, Utrecht Holdings pointed out which specific capabilities or experiences were missing in the management team in order to enhance venture performance. This procedure is explained in detail by the interviewee of company D.

“Holdings hielp met het onderkennen en signaleren van het belang van verandering binnen het management team. in de rol als aandeelhouder hebben ze bij aandeelhoudersvergaderingen een input gehad op basis van het reilen en zeilen van het bedrijf. We hadden toen geen raad van commissarissen dus toen was er een sterke interactie tussen het management team en de aandeelhouders en daarin zijn dit soort zaken besproken en ook besproken hoe dit anders of beter moet. Combinatie van competenties, hoe dit anders moet worden ingezet of uitgebreid. Er kwamen dus duidelijk andere competenties binnen.”

The supporting role of Utrecht holdings in possible improvements in management team formation is in line with the mission goals of Utrecht's TTO-structure, as explained by a TTO executive:

"Ja, waarbij de Holdings wat meer op het niveau zitten van: " we hebben een hele goede onderzoeker, maar hebben daar een goede ondernemer voor nodig, om die op executive en CEO level te zoeken. Bij UtrechtInc... dat zijn vaak niet per se onderzoekers, dus dat zijn vaak mensen die met een iets andere aanvliegroute een bedrijf gaan beginnen. Daar zit het vaak niet in het gebrek aan ondernemerschap, maar meer in het aanvullen van competenties. Hoe stel je een goed team samen. En daar zoeken we bij een hardcore techneut, zoeken we iemand die veel meer op de zakelijk kant zit. Het is altijd een faciliterende rol, het is nooit "je moet en zal nu met deze en deze samen gaan werken" want dat werkt in de praktijk niet. "

These statements suggest that the following hypotheses are plausible, but could not be confirmed, based on data limitations. Additional research, with a larger sample is necessary in order to generate more valid statements on TTO influence on management team formation. It is unwarrantable to confirm, nor reject the proposed hypotheses H1a t/m H1f:

H1a: The Utrecht University affiliated TTO positively influences the management team size.

H1b: The Utrecht University affiliated incubator positively influences the management team size.

H1c: The Utrecht University affiliated TTO positively influences the management team diversity.

H1d: The Utrecht University affiliated incubator positively influences the management team diversity.

H1e: The Utrecht University affiliated TTO positively influences the management team experience.

H1f: The Utrecht University affiliated incubator positively influences the management team experience.

As mentioned in the previous section, a clear difference in management team formation could be identified between company A&D and B&C. The management teams of company B&C consist of six and five management team members respectively. In comparison, company A has three management team members and company D has four, of which one FTE is devoted to management team tasks. This implies that companies that are able to generate larger employee and turnover numbers, organize their operations through larger management teams. On the other hand, the level of diversity within the management team in company B&C is rather limited, compared to company A&D. Company B&C were able to acquire a large management team with a focus on academic and scientific experience. The companies with the most diversified management teams (A&D) performed suboptimal, compared to company B&C. This is in contradiction with the literature, which argues that a more diversified management team results in a broad set of competencies that are necessary to increase venture performance.

Where company A didn't succeed in acquiring additional experience, company D has increased their management team by one individual, devoting an extra 0.4FTE to management team activities. Compared to company B&C this could be seen as a marginal change in management team formation. This suggests that with regard to venture performance, external acquisition of experience is more important than the internal availability of diverse experience.

Additionally, entrepreneurial experience is lacking at companies B&C, because no management team member has had previous experience with starting companies. These companies have focused more on academic and scientific experience in order to elaborate their technology-specific knowledge base. Company A&D have previous experience with starting enterprises, which could have led to the understanding that a diverse management team is beneficial in the entrepreneurial environment. This did not result in larger venture performance, compared to company B&C. This study suggests that previous entrepreneurial experience doesn't necessarily have a positive effect on venture performance. Especially in high technology firms where research and development accounts for a large part of a spin-off's operations, academic and scientific knowledge could prove to be more valuable. Where hypothesis H2b could not be discarded, the following statements replaced hypotheses H2c and H2D.

H2C) Previous entrepreneurial experience is no necessity for venture performance.

H2D) External acquisition of experienced management team members positively influence venture performance.

5.2.4) Technological Capital:

The technological capital of a company consists of its patent portfolio, how the intellectual property rights are distributed and the amount of resources that is devoted to R&D activities.

Between companies, a clear difference exists in patenting behavior. Company D is considered the most active when it comes to patenting behavior. Because company D was founded in 2005, it is considered the youngest company together with company A. When these two companies are compared based on the number of patents they applied for, a clear difference is observed. Where company A has applied for five patents, company D was able to apply for 17 patents in approximately the same period of time. Company B&C, both founded before 2000, have respectively applied for ten and seven patents.

Table 15: amount of patent applications

Company A	Company B	Company C	Company D
5	10 (1 uni, 9 intern)	7 (1 uni, 6 intern)	17(8 uni, 9 intern)

Apart from company D, none of the studied companies has received any form of assistance from the Utrecht University affiliated TTO when applying for a patent. Company D argues that the involvement of Utrecht Holding was essential for their business, for:

“Zonder deze partij is het onmogelijk om iets in te dienen aangezien de gegenereerde kennis officieel eigendom is van de UU.”

Additionally, company C and D both mention the involvement of another external party, whose assistance was appreciated more than the involvement of the Utrecht University affiliated TTO. “De Verenigde” in Amersfoort is a patent office, which handles the patent application, - maintenance and strategic utilization. Company C describes the involvement like:

“ Ze gaan heel erg doorvragen op het idee, waar er nog meer opportunities zouden zijn voor de patenten, om het zo sterk mogelijk te maken, of er misschien zelfs nieuwe uitvindingen in kunnen zitten. Ze helpen heel erg met een patent opschrijven die heel sterk en breed is en ook met nieuwe uitvindingen verzinnen, als er bijvoorbeeld een wetenschappelijk artikel de deur uit gaat kijken zij er eerst naar om te kijken of daar nog eventueel nieuwe uitvindingen in kunnen zitten. En zodra het is gefiled bij verschillende landen, waarbij zij ook weer adviseren wat verstandig is om waar te filen, dan houden zij ook de hele patentprocedure bij. Als er een respons moet worden geschreven naar een land dan stellen zij een conceptantwoord op en dan vragen ze ga je hiermee akkoord en als er een lastige situatie is ga je om tafel om zitten en dat bespreken en ze houden de timelines, alles houden zij bij”

Company D’s patent portfolio was handled by a patent strategist of “De Verenigde” specifically. This collaboration was appreciated on such a high level that company D eventually contracted this individual and made him part of their management team.

This study shows that applying for patents has an inverted U-relationship with venture performance. An major focus, as well as a minor focus on the application of patents, results in a suboptimal effect on venture performance. Company D has applied for the largest amount of patents in the shortest period of time, but wasn’t able to generate additional turnover while their contribution to the creation of employment was limited. Also, company A has applied for the smallest amount of patents without increasing the performance of their venture. As stated earlier, this suggests an inverted U-relationship of patent applications on venture performance.

Based on this information, the following statements replace hypotheses H3d and H4d.

H3d) External assistance in the application of patents is largely appreciated by academic spin-offs.

H4d) The amount of patents applied for has a inverted U-relationship with venture performance.

The distribution of property rights is considered non discriminating amongst the firms, because three companies argue that the intellectual property is owned completely by the firms, and company C didn’t knew exactly which party held (a

share of) the property rights. For this reason it is impossible to generate statements on which factors influence the distribution of property rights and how this in turn influence venture performance. Hypotheses seem irrelevant among the investigated spin-offs.

In section 5.1.1-5.1.4 the amount of FTE devoted to R&D activities is mentioned per company. Company B&C stands out with 15FTE devoted to R&D activities, where company A and D devote only three and 5.6 FTEs to R&D activities. This difference could largely be attributed to the difference in company size, with regard to the number of employees. For this reason, the amount of FTE devoted to R&D is given in percentages. Additionally, the amount of budget devoted to R&D activities is questioned. How these numbers relate is illustrated in table 4.

Table 16: Employees and budget devoted to R&D activities

	Company A	Company B	Company C	Company D
Amount of FTE currently	3	15	15	5.6
% of total employees currently	60%	83.33%	60%	80%
% of total budget at founding moment	75%	-	80%	55%
% of total budget currently	75%	-	80%	55%

None of these companies has received direct assistance with their R&D activities from the Utrecht University affiliated TTO or incubator, but they all mention external help from other parties. Company A underlines the importance of external help during the research and development phase, for:

“je moet soms dingen outsourcen hè, dus ja er zijn zeker wel samenwerkingen geweest met andere bedrijven. Ook geneesmiddel ontwikkeling bedrijven en PRO’s”

The other companies have had a different connection with Utrecht University, because they all have collaborated with specific faculties and departments of the university. University assistance could be specified as outsourcing of research tasks, common research projects, and PhD projects. Both company B and D mention the common research projects specifically and have encountered similar problems with this type of collaboration/assistance. Both companies argue that these projects didn’t yield the desired results, because both parties have different motivations and targets. In all cases, the collaboration is initiated/requested by the company itself. A company desires the acquisition of specific external knowledge and looks for a suitable collaboration/research partner. Universities offer an efficient solution, being able to offer this external knowledge in return for possible PhD places, low costs due to subsidies etc.

“Universiteiten hebben een andere doelstelling dan bedrijven. Daar moeten mensen promoveren en die hebben een onderzoekslijn en die willen die

onderzoekslijn vasthouden. Die zitten niet te wachten op een bedrijfje wat bijvoorbeeld een kenmerk van een plant wil onderzoeken.” (Company B)

“Waarbij hun doel was om te publiceren en voor het bedrijf het doel was om voor octrooien die ingediend waren om daar relevante onderbouwing voor te verkrijgen. “(Company D)

Based on the arguments made by all companies, it is fair to say that external parties definitely influence R&D activities of an academic spin-off, for a small company is not able to develop all knowledge internally. Outsourcing to external partners and collaboration with faculties and university departments does contribute to the R&D activities of a starting firm. The following statements replace hypotheses H3b and H3c

H3b) External parties positively influence R&D activities of academic spin-offs and vice versa.

H3c) Direct contact with faculties and departments by academic spin-offs is preferred over contact with the TTO, with regard to research projects.

How increased R&D activity is related to venture performance is the next step in this analysis. For company B&C, the absolute number of employees devoted to R&D activities is significantly higher than for company A&D. This implies that when more employees are devoted to R&D activities, the firm has more employees and a larger turnover. When looking at the percentages of employees devoted to R&D activities with regard to the total amount of employees, company B and D score higher with 83.33% and 80% respectively. Company B initially collaborated with universities in order to acquire additional subsidies. When these subsidies decreased over time, company B shifted to the attraction of external private investors to complement their balance. Collaboration with universities decreased, while corporate research partners substituted this demand. This has led to an increased venture performance compared to company D, which still utilized Utrecht University research groups in order to accumulate additional information to structure/reinforce their patents. Based on the gathered information, the following hypothesis is confirmed:

H4b: The amount of employees devoted to R&D activities positively influence venture performance.

The amount of budget devoted to R&D activities hasn't changed over time for all investigated companies. Company C devotes the largest amount of their budget to R&D activities. The following section will show that company C has by far the largest number of external private investors. Additionally, their turnover in November 2012 is significantly higher than of the other investigated companies. This indicates that company C devotes the largest amount of budget to R&D activities, relative to the other investigated companies. Based on this information, no statements could be generated, because no clear pattern exists. H4c could not be discarded, for it holds a high level of plausibility.

H4c: The amount of funding devoted to R&D activities positively influence venture performance.

5.2.5) Financial Capital:

According to the proposed hypotheses it is presumed that Utrecht University TTO positively influence the amount of acquired external funding, originated from both public and private sources. The conducted interviews show that none of the studied companies received any form of assistance from external parties in attracting additional funding. Company D is the only firm, which has received start-up capital from Utrecht Holdings in exchange for a share in the company. This isn't considered an assisting activity, because Utrecht Holdings didn't contribute to the acquisition of additional external sources. As no company has received any form of assistance from Utrecht University related institutions, hypotheses H5a t/m H5d are rejected.

At the moment of founding, the founding members assembled the start-up capital of company A and B, without assistance from external parties. Company C and D both attracted external investors at the moment of founding to increase their external risk capital. In November 2012, all companies were able to attract external investors that were willing to invest in their company. 95% of company A's funding originates from external investors, where for company B, C and D these percentages lie at 90%, 80% and 60% respectively. The total overview of funding distribution per company is shown in table 5

Table 17: financial capital

Founding	Company A	Company B	Company C	Company D
Internal	100%	100%	50%	20%
Governmental			10%	
University				
External			40%	80%
2012				
Internal	5%			
Governmental		10%	20%	40%
University				
External	95%	90%	80%	60%
Amount of external investors	2	3	160	6

With respect to venture performance, similarities between company B and C could be observed based on the figures above and the conducted interviews. Table 17 shows that company C is extremely successful in the acquisition of external investors, by having 160 parties investing in their operation.

“Je begint met een relatief klein groepje mensen en inmiddels heb je om en nabij 160 aandeelhouders en de meeste is via-via gegaan, maar een deel is ook via een paar van die bedrijfjes die financieringen probeert te organiseren een beetje facilitair.”

Due to declining subsidies, company B needed to attract external investors in order to provide funding for their operations. A shift is made from collaboration with universities in order to qualify for subsidies, towards the attraction of external private sources to supplement their budget.

“Eerst veel subsidies gehad, in 2006 kwamen we erachter dat subsidies niet voldeden en dat ze op zoek moesten naar aandeelhouders. Hier kwam een kritiek punt omdat toen de subsidies duidelijk af gingen nemen en we toen externe klanten binnen moesten halen.”

Both company B&C have focused on the attraction of external risk capital largely through external investors and to a lesser degree by public governmental subsidy. A specific focus on external investors, while still harvesting the benefits from available public funds has increased their venture performance. Hypotheses H6a t/m H6d are replaced by the following statements.

H6a) Internal funding is essential in order to start an academic spin-off.

H6b t/m H6d) A funding distribution in which external investors account for the majority of funding, supplemented by governmental funding, positively influence venture performance.

Until 2006, company B didn't feel the need to focus on external investors to supplement their budget. Public subsidies were utilized to cover the expenses brought forward by research projects. The option of external investors was overlooked, because public funding was widely available. This is in line with statements of Cummings and McIntosh (2006), that public funding crowds out venture capital funding. For this reason hypothesis H7a and H7b could not be discarded.

H7a: Public funding negatively influences external private funding of academic spin-offs.

H7b: Public funding negatively influences the amount of external investors of academic spin-offs.

5.2.6) Physical Capital

In order to operate optimally, all investigated companies require office space, specific research equipment and research facilities, like a laboratory for example. Company A and C have organized this internally, without assistance of Utrecht University TTO / incubator or other external parties. Company B received significant 'assistance' from Wageningen University. Besides their own internal laboratory, company B also utilized the greenhouse facilities of Wageningen

University. When company B moved to another location, they were able to acquire specific research equipment that didn't belong to them.

“We hebben gebruik gemaakt van kasfaciliteit van de Uni Wageningen. We hebben ook een deel van de apparatuur meegekregen op dat moment omdat mijn collega zei, “ja dit is apparatuur die ik heb binnengehaald en jullie mogen dit onderzoek straks toch niet meer doen, dus kunnen jullie het beter aan ons doneren.””

Company D received assistance from Utrecht Medical Centre in terms of offering available laboratory space, specific research equipment and office space. Until mid-2008 company D has been located at UMC Utrecht and when a new location was required, both UMC Utrecht and UtrechtInc. have assisted in the search for alternative locations.

“... zijn uiteindelijk in het Kruytgebouw gekomen. We hadden geen lab, UtrechtInc had dat niet in de aanbieding. Wij hadden het wel nodig. De Holdings zat vol. Hulp vanuit UtrechtInc? Ze hebben mee gedacht naar alternatieven op de Uithof.”

These supporting activities were highly appreciated by the studied companies. In these cases, the supporting role of universities has led to the acquisition of required R&D facilities. Company A&C have acquired their R&D facilities without help of external parties. They did identify the need for their own laboratory and equipment in order to be operational.

As the level of assistance of the Utrecht University affiliated incubator for the utilization of external R&D facilities is rather limited, the following statement replaces hypothesis H8 and H9:

- 1) External assistance in the search for adequate R&D facilities positively influences the utilization of R&D facilities by academic spin-offs.
- 2) Availability of R&D facilities (internal and external) is essential for an academic spin-off to perform R&D activities.

5.2.7) Social Capital:

The business network of a company is extremely important in every phase of the development process. It is clear to see that company B and C were able to develop their network over time, by attracting numerous collaboration partners. Company A has attracted three collaboration partners, of which two are contract research partners. Company D hasn't expanded their pool of collaboration partners, but has substituted partners over time. At both moments, they had 10 collaboration partners.

Just like company C, Company B also succeeded to increase their amount of collaboration partners from the moment of founding from three to 10 partners. Especially the shareholders have assisted in searching adequate collaboration partners, which is highly appreciated by company B. Additionally, research projects with Wageningen University and the faculties of genetics and biology of

Utrecht University have brought company B in contact with interesting collaboration partners.

“Ja, universiteit wageningen: we doen nog projecten met de uni en daar zitten ook andere bedrijven bij, wat je netwerk vergroot.
Ook Universiteit Utrecht, voorheen de afdeling genetica, biologie via XXXXX XXX
XXXXXXX”

Especially company C has indicated that their network has helped the company to come in contact with universities, researchers, research organizations, investors etc. Especially the shareholders in company C helped them to attract additional investors and collaboration partners. Additionally, the faculties of pharmacology and methods&statistics at Utrecht University are mentioned as parties that contributed to the hunt for potential new collaboration partners. Based on this assistance, company C was able to increase their amount of collaboration partners from two partners at the moment of founding to 30 partners in November 2012. Besides collaboration partners, company C has been able to attract 160 external private investors by utilizing their network position. For all companies an overview of their collaboration partners is given in table 6.

Table 18: Collaborations with network partners

	Company A	Company B	Company C	Company D
Founding	0	3	2	10
November 2012	3	10	30	10

Based on this information, hypotheses H10a t/m H10d are discarded, for none of the investigated companies have received assistance from the Utrecht University affiliated TTO or incubator. It has been found that companies operate through a more direct form of contact with universities instead of contacting a TTO or incubator. The examined companies prefer direct contact with faculties, which hold the largest amount of technological knowledge and expertise.

Companies B and C has experienced the largest growth in the amount of collaboration partners. This indicates that these companies underline the importance of business networks and are willing to devote time and money to enhance their network position. For the development of these firms, close contact with their shareholders has proven beneficial for the attraction of additional investors and collaboration partners. These relationships directly influence the performance of a firm. Hypothesis H11 is replaced by the statement below, while hypothesis H12 is confirmed.

H11) Growth in the amount of collaboration partners positively influences venture performance

H12: The network position of an academic spin-off positively influences venture performance.

5.2.8) Control variables:

This study has employed three control variables, being firm size, age and industry type. Company B and C outperformed company A and D in terms of venture performance. However, these companies were both founded in 1998 and 1999 respectively, where companies A and D were founded six years later, in 2005. Company B and C have increased in employee numbers over the years, which makes them able to devote more FTE to management team tasks and R&D activities. However, company D has also increased their employee numbers from five to 12, but ultimately decreased their capacity to seven employees. All examined companies operate in industries where high levels of R&D activity are demanded. Company A, C and D operate in the field of drug discovery and development whereas company B's core business lies in the genomic breeding and bioinformatics. Due to the small sample size, no definite statement could be generated on the influence of the control variables on the results. However it is possible to raise questions on the relation between venture size and age and venture performance. Besides being the older companies, company B&C operate with a larger number of employees. It is impossible to state that firm size has influenced venture performance, for it might be the other way around. Research on the development process of these specific companies is required in order to generate valid statements on this subject. According to the retrieved data, company age does influence venture performance. Whether this uncovered pattern still holds within a larger sample is yet to be seen. The industry type didn't affect venture performance. This might be due to the fact that the studied firms operate in related technological fields, i.e. biotechnology.

5.3) Summary of the results

In this section, an overview of the discovered patterns of the data is offered. Because of the limited sample size, it wasn't always possible to confirm or discard all proposed hypotheses. For these cases, the hypotheses were replaced by statements that describe the identified patterns specifically.

Table 19: Overview theoretical and empirical patterns

Hypothesis (theoretical patterns)	Data (empirical patterns)
H1a: The Utrecht University affiliated TTO positively influences the management team size.	Sample size is too small to either confirm or reject H1a t/m H1f:
H1b: The Utrecht University affiliated incubator positively influences the management team size.	Additional research with larger sample size is needed in order to generate solid statements on the supporting role of Utrecht University on management team formation.

H1c: The Utrecht University affiliated TTO positively influences the management team diversity.	
H1d: The Utrecht University affiliated incubator positively influences the management team diversity.	
H1e: The Utrecht University affiliated TTO positively influences the management team experience.	
H1f: The Utrecht University affiliated incubator positively influences the management team experience.	
H2a: The reputation of the university scientist involved in founding of an academic spin-off positively influences Venture Performance.	No solid statements could be generated, for part of the indicators were non-discriminating amongst the investigated companies.
H2b: Management team size positively influences Venture Performance.	Confirmed
H2c: Management team experience positively influences Venture Performance.	Reformulation: Previous entrepreneurial experience in the founding team is no necessity for venture performance.
H2d: Management team diversity positively influences Venture Performance.	Reformulation: External acquisition of experienced management team members during venture development positively influence venture performance.
H3a: The Utrecht University affiliated TTO positively influences the share of property rights appropriated by the TTO in patent applications of academic spin-offs.	Non discriminating amongst firms, hypothesis could neither be confirmed or rejected
H3b: The Utrecht University affiliated TTO positively influences the amount of employees of UU spin-offs devoted to R&D activities of UU	Reformulation: External assistance in the application of patents is largely appreciated by

spin-offs.	academic spin-offs.
H3c: The Utrecht University affiliated TTO positively influences the amount of funding devoted to R&D activities.	External parties positively influence R&D activities of academic spin-offs and vice versa. Direct contact with faculties and departments by academic spin-offs is preferred over contact with the TTO, with regard to research projects.
H3d: The Utrecht University affiliated TTO positively influences the amount of patents applied for by an academic spin-off.	
H4a: The share of property rights appropriated by the TTO negatively influences venture performance.	Rejected: Non discriminating amongst firms, hypothesis could neither be confirmed or discarded
H4b: The amount of employees devoted to R&D activities positively influence venture performance.	Confirmed
H4c: The amount of funding devoted to R&D activities positively influence venture performance.	Sample size is too small to either confirm or reject H4c
H4d: The amount of patents applied for positively influence venture performance.	Reformulation: The amount of patents applied for has an inverted U-relationship with venture performance.
H5a: The Utrecht University affiliated TTO positively influences the amount of external investors of academic spin-offs.	
H5b: The Utrecht University affiliated TTO positively influences the amount of public university funding acquired by an academic spin-off.	Rejected, no company has received external assistance from Utrecht University affiliated TTO. Additional research with an expanded sample is required.
H5c: The Utrecht University affiliated TTO positively influences the amount of public governmental funding/subsidy acquired by an academic spin-off.	
H5d: The Utrecht University affiliated TTO positively influences the amount of external investor	

funding acquired by an academic spin-off.	
H6a: Internal funding positively influences venture performance.	Reformulation: Internal funding is essential in order to start an academic spin-off.
H6b: Public university funding positively influences venture performance.	Rejected: Non-discriminating amongst firms. No patterns could be observed, besides the fact no company has acquired governmental funding.
H6c: Public government funding/subsidy positively influences venture performance.	A funding distribution in which external investors account for the majority of funding, supplemented by governmental funding, positively influence venture performance.
H6d: External investor funding positively influences venture performance.	
H7a: Public funding negatively influences external private funding of academic spin-offs.	Confirmed
H7b: Public funding negatively influences the amount of external investors of academic spin-offs.	
H8: The Utrecht University affiliated incubator positively influences the utilization of R&D facilities by academic spin-offs.	Reformulation: External assistance in the search for adequate R&D facilities positively influences the utilization of R&D facilities by academic spin-offs.
H9: The utilization of R&D facilities by academic spin-offs positively influences venture performance.	Reformulation: Availability of R&D facilities (internal and external) is essential for an academic spin-off to perform R&D activities.
H10a: The Utrecht University affiliated TTO positively influences the amount of collaborations/alliances of an academic spin-off.	Rejected: Non-discriminating amongst firms. No company has received external assistance from Utrecht university affiliated TTO or incubator.
H10b: The Utrecht University affiliated incubator positively influences the amount of collaborations/alliances of an academic spin-off.	

H10c: The Utrecht University affiliated TTO positively influences the network position of an UU spin-off.	
H10d: The Utrecht University affiliated incubator positively influences the network position of an academic spin-off.	
H11: The amount of collaborations/alliances of an academic spin-off positively influences venture performance.	Growth in the amount of collaboration partners positively influences venture performance
H12: The network position of an academic spin-off positively influences venture performance.	Confirmed

The overview above illustrates per hypotheses whether it is confirmed, rejected or reformulated. Hypotheses H1a t/m H1f are non-discriminating amongst firms, as only one single company has received assistance with management team alterations. Besides the fact that this assistance was highly appreciated by the company, no solid statements could be generated based on one case. Utrecht University support organizations have also assisted company D in patent applications and research facilities. The other investigated companies haven't received any form of assistance from Utrecht University affiliated TTO or incubator. Also, relatively to the other investigated companies, company D performed below par in terms of employment creation and economic growth. This gives rise to the question whether or not the companies that receive TTO or incubator support attempt to commercialize low-potential patents, inventions or technologies. Additional research is required in order to generate valid statements on TTO and incubator assistance. In the discussion section extra attention will be given to this finding.

In terms of venture performance, some hypotheses are confirmed, where others required a reformulation, based on the retrieved results. Firstly, external acquisition of experience is preferred over internal availability of diverse management team experience. The management team size did positively influence venture performance. In terms of technological capital it appears to be beneficial for both patent behavior and R&D activity to contact external parties like patent agencies or public research organizations. Also, companies that search for collaboration partners for research projects favor direct connection with faculties or departments. The results have also uncovered an inverted-U relationship between the amount of patents applied for by an academic spin-off and venture performance. In terms of financial capital, this study has found that internal capital is a requirement in order to start an academic spin-off. Additionally, a mix consisting of mostly external private investor funding and a

small proportion of government funding was observed at companies that performed best. This research has also confirmed the presentiment that public funding has a negative effect on the availability of external investor funding. Either companies depend on easily accessible public funding to cover their expenses, or prefer the benefits of public capital over the more restricted external capital provided by investors. Either way it has resulted in a decreased availability of external private venture funding. As could be observed in the results, R&D facilities are essential for an academic spin-off to perform R&D-activities. Assistance from either Utrecht University affiliated support institutions or other external parties is highly appreciated by firms. Finally the network of academic spin-offs has influenced venture performance significantly. Growth in collaboration partners during the development of the company and the utilization of the corporate network position has positively influenced venture performance.

This study has employed three control variables, being firm size, age and industry type. Venture age is the only factor that could potentially influence venture performance. Additional research with a larger sample is required in order to thoroughly test this finding.

6: DISCUSSION

6.1) Theoretical implications

This study contributes to the existing theoretical and academic literature in several ways.

Firstly, various researches have indicated that patents are the most widely used mean to protect technological knowledge from being imitated by their competitors. Gras et al. (2008), Levin et al. (1987), Zahra (1996) and O'Shea et al. (2008) underline the importance of patent applications for a new venture in order to perform in a competitive business environment. This study argues that the higher the level of protection, i.e. the larger the number of patents applied for, positively influences venture performance. However, the results have shown that there exists an inverted U-relationship between the amount of patent applications and venture performance. This implies that when a company focusses too much on generating technological knowledge instead of business performance, they will be outperformed by their competitors. This study has revealed supplementary information on the influence of patent behavior of starting enterprises. Castells (2012) has found that the patent behavior of academic spin-offs is influenced by venture capitalists. Because venture capitalists finance the development of inventions, at first the amount of patents applied for will increase. He discovered that patent activity increases the first two years after venture capitalists become involved in the company. After this period the focus shifts towards the development of sales, which results in a decrease of patent applications. This influence of venture capitalists could be an explanation for the discovered-U relationship between the amount of patent application and venture performance. Because there exists a risk of firms neglecting as well as over concentrating on the application of patents, venture capitalists utilize their business experience and financial influence to offer an efficient balance between technology development and sales development.

Besides protection of intellectual property, Gras et al. (2008), O'Shea et al. (2005), Rothaermel et al., 2007, Cooper et al. (1994) and Powers & McDoughall (2005) have studied the financial capital of academic spin-offs in detail. They argue that the attraction of external risk capital should be one of the focus points of an academic spin-off. Especially the attraction of additional funding through external private investors and venture capitalists could catalyze the development of technological knowledge to an invention and ultimately to a product (Castells, 2012; Samila and Sorenson, 2011). This process leads to increased growth rates and innovative activity of the company (Engel & Keibach, 2007). Consequently Cummings and McIntosh (2006) argue that public funding sources crowd out private sources of external funding, for they are able to work with reduced risks and larger margins. This study shows that academic spin-offs that are able to acquire a mix of funding that largely consist out of external private investor funding and for a minor part out of governmental funding, are able to outperform their peers. While these companies exploit the benefits of offered governmental funding, they do not become dependent on this type of funding by attracting external investors to increase their budget. These results underline the phenomenon of crowding out as proposed by Cummings and

McIntosh(2006) and show empirical examples how funding could optimally be distributed amongst various sources.

Additionally, previous research has shown that the size, diversity and experience of the management team of academic spin-offs could help in acquiring demanded resources(Zucker et al., 1998; Eisenhardt & Schoonhoven, 1996). This study has investigated the development of management teams amongst four cases from the moment of founding to November 2012. Results have shown that previous entrepreneurial experience of the founding members is not a requirement for an academic spin-off to establish venture performance. This goes against previous research of Vohora et al. (2004), Ucbasaran et al. 2003a & 2003b and Bekkers et al. (2006), who indicate that previous entrepreneurial experience increases the human capital of a starting venture. This study indicates that external acquisition of experienced management team members during venture development also positively influences venture performance. In academic literature, a make-or-buy dilemma could be identified between researchers that vow for internal development of capabilities versus researchers that advocate for external acquisition (Lepak&Scott, 1999; Snow et al., 1992). This research contributes to the everlasting discussion on this topic, by arguing that for Utrecht University affiliated patent based academic spin-offs, external acquisition of management team members during venture development positively influences venture performance.

In terms of networking activities, literature shows that the network of starting companies is important in order to appropriate required resources and capabilities (O'Shea et al., 2008; Gras et al., 2008). Ahuja (2000) states that shortages in different types of resources are a motivation for companies to utilize their network and form alliances. Also, Powell et al. (1996) argue that in the biotechnology sector and other sectors where intellectual developments are rapidly expanding, there exists a liability of unconnectedness. Long term collaborations are preferred in order to develop their set of resources and capabilities (Powell et al., 1996). This research has shown that growth in the amount of collaboration partners occurs at companies that achieve relative high performance levels. These companies have identified the need to devote time and money to enhance their network position and ultimately increase their resource base.

Further research is required in order to generate statements on the influence of growth in the amount of collaboration partners and venture performance. This research has shown a positive relation between these two variables, which implies academic spin-offs should expand their network and optimize their network position. However, an excessive focus on the attraction of adequate collaboration partners could leads to a reduced focus on business development, which ultimately lead to a decreased venture performance. Additional research is required in order to examine the relation between growth in collaboration partners and venture performance.

Furthermore, results show that the majority of investigated companies don't contact the Utrecht University TTO, but prefers to contact the designated faculty directly in an attempt to work on common research projects. Companies contact these faculties directly, because they believe they hold the best technological knowledge and expertise. Generated knowledge, which isn't picked up by stating or larger companies, could indicate the relative small potential of valorization of

this knowledge. These are the areas where the potential of a technology, the market demand and academic demand is discussed and research projects are established. This step lies prior to an invention and invention disclosure to the TTO. It could indicate that the research projects that didn't meet the discussed market- and academic demand are considered low-potential technologies and that the TTO misses out on the economic and social benefits of valorization. Where low potential spin-offs fail to acquire demanded resources, assistance from the TTO or incubator is needed in order to survive. These signals indicate that the TTO and incubator might only be supporting the low potential, spin-offs, where the spin-offs with high valorization potential develop independently in their business environment.

Finally, this research has combined numerous studies and literature reviews in order to create a framework that is able to measure academic spin-off performance. This framework can be applied to a broader population than only patent based academic spin-offs, for example non-patent based academic spin-offs or even independent spin-offs. Additional research in these specific areas could prove to be beneficial for both starting ventures and university related support institutions, like the TTO and incubator. By applying this research design to a broader population or a larger sample, more solid statements can be generated on the influence of TTO and incubator assistance and the influence of specific types of capital on venture performance. Beneficial support executed by external parties could be identified. Consequently, similar supporting activities can also be employed by the TTO or incubator in order to improve venture performance of their affiliated academic spin-offs, when these fail to seize these opportunities independently.

Additionally, by expanding the research to other industries, types of capital that increase venture performance could be identified for each industry specifically. After identification of these differences between industries, novel theoretical frameworks could be developed that target specific types of academic spin-offs. For example, the business environment of pharmaceutical companies might demand for a different development of resources than for an online insurance provider.

6.2) Managerial implications

With respect to management implications, this study has offered new insights in the amount and nature of assistance acquired by academic spin-offs. For instance, external assistance in patent application is highly appreciated by academic spin-offs, but not offered on the demanded level by the Utrecht University affiliated TTO or incubator. This information can be used by managers of both starting enterprises and TTO / incubator structures, because it identifies the demand of an academic spin-off and the opportunity for a supporting organization to meet this demand. As the majority of investigated companies have developed without assistance from Utrecht University support institutions, it is interesting to see that these companies have coped with this lack of assistance by developing their own business network.

More specifically, company C was able to attract 160 external private investors, where the other companies had six external private investors at most. According to company C, the utilization of their network (position) was largely responsible

for this increase in external private investors. They started with a private network consisting of a relatively small group of individuals. This group expanded through social networking and other forms of interaction. By exploiting one's network, companies are able to reach numerous individuals and organizations that share common interests and value the company's potential.

In a similar way, company B has held close contacts with their shareholders. As their shareholders are partial owners of the company, their success depends on the performance of the company. The shared goal of maximizing performance have helped company B in attracting external private investors and collaboration partners.

In both cases, the utilization of the company's business network has resulted in additional funding and business opportunities, two factors that highly influence business performance. Managers of academic spin-offs should create a feeling of mutual dependence between themselves and their shareholders. Company B and C both succeeded to improve their network position without assistance from Utrecht university affiliated TTO or incubator, by utilizing the business network of their investors and shareholders. Utrecht University affiliated TTO and incubator doesn't formally perform tasks to steer academic spin-offs to suitable collaboration partners. Based on the results of this research, this type of assistance is not required for independent spin-offs, because they are able to develop and increase their network position by themselves. Whether this is also the case for academic spin-offs with strong connections to the TTO or incubator of Utrecht University, needs to be examined in future research. Independently developed spin-offs have no supporting structure to fall back on, which forces them to enhance their network position, in order to survive.

As stated earlier, Utrecht University affiliated TTO and incubator doesn't formally support academic spin-offs to attract suitable collaboration partners. However, the results have shown that companies that are able to increase the numbers of collaboration partners over time, are able to increase venture performance. Besides the notion that independently developed spin-offs are able to increase the amount of collaboration partners over time, this is an area where Utrecht University support organizations could prove their value. First of all, managers from university affiliated support institutions could enhance their own business network in order to find suitable business partners for each development phase of different types of academic spin-off.

Additionally, the Utrecht University affiliated support organization should open up their elaborate business network to academic spin-offs, in order to improve the network size and position of affiliated academic spin-offs. Also, independent organizations that offer supporting services could be recommended to other academic spin-offs. Starting companies could benefit from previous experiences of similar companies. By steering academic spin-offs towards suitable collaboration partners, their network position improves and reduces the dependence on the TTO and incubator of Utrecht University.

Similarly, this procedure could be repeated for external private investors in order to steer academic spin-offs towards sources of external risk capital. The results show that besides the attraction of external private investors, a proper distribution of funding between external private investors and governmental funding may result in venture growth. Adequate advice of the TTO and incubator on the funding distribution of academic spin-offs could increase venture

performance. This research has shown that independently developed spin-offs are able to attract sufficient external private funding to perform in their business environment, without any help from Utrecht University support organizations. For example, experiences in the development process of company B have shifted their focus from subsidies towards external private investors. This indicates that the business environment itself raises the demand for external private investor funding. Whether or not academic spin-offs that are supported by Utrecht University TTO or incubator are able to identify this need independently, needs to be investigated.

Besides the optimization of the network position and funding distribution, academic spin-offs should not blindly strive for high diversity within their management team. Company B and C mainly perform research tasks in order to develop unique knowledge internally, or to execute orders from their clients on a contract research base. Their management teams consisted of individuals who had high levels of academic and scientific experience. Managerial experience or financial experience was subordinate to technological expertise. Drug development companies and contract research organizations largely perform operations in the R&D stage of the development process. As the development of drugs takes several years to pass through the research and clinical stages, contract research organizations almost never get to the point of product launch or marketing. For this reason, precise technological knowledge could be perceived as more important than for instance financial knowledge. Managers from TTO's and incubators should take this information into account when consulting starting academic spin-offs.

Consequently, the results have shown that external acquisition of this specific experience in the management team is more beneficial than the internal availability of this managerial and financial experience. The external acquisition of additional knowledge and experience is more in line with the needs of an academic spin-off at a specific moment in a specific industry. The business environment of contract research organizations might, however, not raise the need for financial or marketing experts, as research projects are appropriated through the experience and reputation of their researchers. Where company B was able to attract managerial and a limited amount of financial experience, company C didn't face the need to attract these specific types of experience. Nevertheless, these companies were able to perform well in their business environments. Whether or not the degree and nature of assistance in this field is beneficial for spin-off development is to be questioned. Results have shown that unassisted academic spin-offs are capable of acquiring the right amount and type of experience in their management teams. This indicates that whenever a need for specific experience is identified, the spin-off is able to react by attracting the demanded experience. Assistance in management team formation might be superfluous, as companies are able to identify the need for specific experience provided by their business environment.

From a more technological perspective, the results have shown that there exist an inverted-U relation between the amount of patent applications and venture performance. This could be ascribed to the balance between theory and practice, i.e. research focus and the application of appropriated knowledge. A small technological basis, as well as an excessive technological basis doesn't result in business development. Excessive attention to R&D activities could result in the

neglect of commercialization of that technology and the identification and seizing of business opportunities. On the other hand, limited attention for R&D seems to be associated with more attention for business development, ultimately leading to limited availability of resources for necessary R&D activities.

6.3) Policy implications

The supporting role of the Utrecht University for academic spin-offs has received increased attention over the past years. As mentioned in previous sections, the Utrecht University TTO structure is expanded significantly from three employees in 2000 to 12 employees on November 2012. This expansion was mainly possible through subsidies from the Utrecht Valorization Program, in which Utrecht Valorization Center also participates. These developments underline the theoretical pattern of increased attention for valorization through entrepreneurship. In the following years it is to be seen if these developments have been able to improve employment and regional economic growth, the main focus of the valorization program of Utrecht University.

The results show that direct contact with the designated faculty is preferred by academic spin-offs in order to negotiate on possible common research projects. TTO's and incubators should be more involved in discussions between faculties and corporate organizations or public and private research organizations. Otherwise they will only be able to commercialize these patents through academic spin-offs that hold limited valorization opportunities. In order to gain access to the high potential technologies/research projects, Utrecht Holdings (and incubator) should monitor the direct interaction between faculties and companies and become involved when necessary. The TTO could offer cheap research opportunities for faculties and spin-offs in exchange for additional contract research or a share of the generated intellectual property rights.

6.4) Limitations

As mentioned earlier, the research design of this study can be applied to a broader research area than Utrecht University affiliated patent-based academic spin-offs. For this study employs a rather specific research scope, it holds no surprise that the amount of cases examined in this research is rather limited. By expanding the research population to for instance academic spin-offs affiliated to other universities, additional respondents could provide extra data and new insights. When the contacting strategy of respondents is maintained, a similar response rate of 25% might be expected. The expansion of sample size will result in an increase of respondents, which makes it possible to apply statistical methods. In this manner, more solid statements on relations between proposed variables could be generated.

Furthermore, by increasing the sample size, specific patterns can be identified per technological field the academic spin-offs operate in. This research has investigated four companies that operate in similar industries, i.e. biotechnology. The biotechnological industry is heavily dependent on the execution of R&D activities. Besides the need for specific technological knowledge and experience, additional research projects are appropriated based on the reputation and

technological competencies of the academic spin-off researchers. This indicates that spin-offs operating in different industries utilize different business models, which require different sets of resources. As this research has solely investigated the development and performance of biotechnology firms, no statements could be generated on firms that operate in other industries. In this manner, potential supporting activities or resources that influence venture performance could be overlooked.

6.5) Further research

As mentioned earlier, a broader research population or larger sample size could provide interesting results in future research, on which solid statements could be generated.

By expanding the research population to non-patent based spin-offs derived from Utrecht University, especially the supporting role of the TTO and incubator could be better explored in depth. Also, by expanding the research area even further to all patent based and/or non-patent based academic spin-offs in the Netherlands, or for example all university affiliated spin-offs, the dataset will expand significantly. This makes it possible to generate statements on the differences between industries. In this manner, beneficial strategies of resource utilization could be explored per type of academic spin-off. Whether or not contract research organizations demand a different set of resources than a product manufacturer could be explored in depth with the research design of this study.

Additionally, by comparing companies of similar founding years, it is easier to make comparisons between the development processes of academic spin-offs, when all companies follow a similar timeframe. For example, all academic spin-offs that were founded in 2000 could be compared with each other or with similar datasets from companies that were founded in 2005 or 2010. By comparing multiple companies with similar founding years, more solid statements on venture development and venture performance could be formulated, without the need for the control variables proposed in the research design of this study.

As valorization through entrepreneurship receives more attention and priority from Utrecht University's executive level, the amount of manpower and resources devoted to valorization activities (i.e. Utrecht Holdings, UtrechtInc. and Utrecht Valorization Center) is likely to increase in the near future. For the coming years it is extremely interesting to see how these developments influence venture performance and the degree and nature of received assistance of Utrecht University affiliated spin-offs.

6.6) Conclusions

In the previous section the research findings were translated into theoretical, policy and managerial implications. Concluding, the identified empirical patterns are used to answer the proposed research question and its corresponding subquestions.

SQ1) Which resources benefit academic spin-off performance?

Particularly resources categorized within internal organizational / human capital, technological capital, financial capital and social capital improve academic spin-off performance. The results of this research show that external acquisition of required management team experience and management team size positively influence venture performance. Additionally, the amount of FTE devoted to R&D activities as well as a proper balance between research focus and business development is found to benefit academic spin-off performance. Furthermore, the acquisition of a mix of mainly external private investor funding and small amounts of governmental funding benefits academic spin-off performance. In terms of social capital, utilization of the network position of an academic spin-off as well as the growth of the amount of collaboration partners shows positive relationships with venture performance.

SQ2) Which resources hamper academic spin-off performance?

This study hasn't uncovered any resources that are believed to hamper academic spin-off performance directly. Indirectly, the phenomenon of crowding out of external private funding by sources of public funding is identified. However public funding doesn't directly hamper spin-off performance, it does influence venture performance indirectly by reducing the amount of external private investors and investor funding.

SQ3) Which supporting activities increase the beneficial resources of a firm.

According to the identified empirical patterns, external assistance in the application of patents is largely appreciated by academic spin-offs. Additionally, external organizations positively influence the R&D activities undertaken by an academic spin-off. These specific support activities increase the technological capital of an academic spin-off. Furthermore assistance in the search for adequate R&D facilities, which are essential for patent-based academic spin-offs to perform R&D activities is highly appreciated by the investigated companies.

SQ4) How are Utrecht University support activities appreciated by affiliated academic spin-offs?

Besides the above described assistance in the search of adequate R&D facilities, Utrecht Holdings performs a supporting role in the application of patents, for Utrecht Holdings is formal owner of all intellectual property generated at Utrecht University. Researchers that desire to commercialize their discovery, need to negotiate with Utrecht Holdings on the conditions. As only one of the investigated companies has received formal support from the Utrecht University affiliated TTO and incubator, no solid statements could be generated.

By answering SQ4, the main research question is answered in a similar fashion, as this question also attempts to explore the Utrecht University support activities:

How do university spin-off support activities influence their academic spin-offs performance?

Additional research with an expanded sample size is required in order to generate solid statements on the degree of influence of Utrecht University support activities on academic spin off performance and the appreciation of these support activities by academic spin-offs.

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Appendix

Appendix A: methodology patent analysis

1) patent analysis

Firstly the Utrecht University employees list is compared with the EPO World Wide Statistical Database PATSTAT. This database contains information on 69.693.282 patent applications. For this research, only patent application after 1999 could prove to be valuable, so all applications before the year 2000 are neglected. This leaves 2.072.070 patent applications that fall within the predetermined scope of research. Additionally, these patent data are limited to application in which the inventor's land of domicile is mentioned as the Netherlands (NL). This leaves a specific selection of 295.371 patent applications after 1 January 2000, invented by someone, which is indwelling in the Netherlands.

Consequently the names from the Utrecht University employees' database are shortened, so they can be used as a search term within the patent database. This will most likely result in an amount of exact matches that exceeds the amount of inventions that could eventually be appointed to specific universities. The risk of losing valuable data when exactly matching full names from one database with another database is one to be reckoned with. Especially because spelling mistakes are not unknown in patent databases. For this reason the amount of 'false positives' is large and should be validated later in order to generate a complete and valid dataset.

2) manual filtering

For the Utrecht University employees' list (containing of 8.903 different surnames, last names, initials etc.) a grand total of 37.225 matches were found within the prepared patent data. This means that 37.225 inventor names as stated on the patent application could resemble the possible 8.903 names from the Utrecht university employees' file. This number indeed indicates that we suffer from the phenomenon of false positives. Therefore, the list of 37.225 hits should be manually checked for possible exact matches, in order to reduce the problem of false positives and validate the data.

This first validation has resulted in 780 matches that have the highest possibility of being an exact match with the name and initials mentioned in the Utrecht university employees' file. From these 780 matches, 170 different employee names and corresponding employee numbers are identified. In order to make this data more workable, another validation process is needed.

3) second validation

The second validation of the dataset is handled in collaboration with the Human Resource Department of Utrecht University. For the 170 specific employee names, their period of employment and related faculty is added as extra information. Based on these additional data, a second validation procedure is

started to narrow down the original dataset and to improve the validity of the dataset.

For each original hit, the invention subject is checked whether or not it falls inside the realm of expertise of the identified faculty. This should indicate whether or not a Utrecht university' employee is capable of inventing a specific technology or application as described on the patent application. For example; it is highly unlikely an employee related to the literature faculty is capable of inventing an artificial kidney.

Also, the first publication date/priority date is checked with the period of employment of the identified employee. When this date falls inside the period of employment of the Utrecht University' employee and its faculty could have offered him the knowledge/capabilities of inventing that specific technology or application, this match is included in the final dataset. When the first publication date/priority date is prior to the period of employment of the Utrecht University' employee, the invention is not based on University generated knowledge and thus excluded in the final dataset.

For University Utrecht 230 different patent applications are identified, which are completely or partially invented by a Utrecht University' employee. 30 of these inventions still contain a level of uncertainty about the inventor.

Appendix B: interview structure:

Introductory questions:

Date:	
Name Respondent:	
Name Spin-off:	
Address:	
Founding year:	
Amount of employees at spin-off founding(FTE):	
Amount of current employees(FTE):	
Amount of employees on 01-01-2011	

Technological Capital:

- 1) How many patent applications has your company filed?
.....
- 2) Do you perceive any differences between this 'university' developed patent and specific 'company patents'? Which differences exactly?
.....
- 3) When applying for patent(s); which UU support institution has assisted you in these activities, how large was this influence and how much was

this appreciated on a scale from 0 – 10 (0=not important/appreciated, 10= very important/appreciated)?

O	Utrecht Holdings	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Utrecht Valorization Centre	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Utrecht Inc.	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Other:	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Other non-UU related organizations:	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	None											

4) How are the intellectual property rights distributed between University and spin-off?

Full ownership of spin-off	Spin-off owns more than 50%	University owns more that 50%	Full ownership of University (licence)

5) How many FTE does your company devote to R&D activities?

.....

6) What percentage of total budget does your company devote to R&D activities at moment of founding and currently?

Founding moment	Currently

7) Which UU support institution has assisted you in R&D activities (product development, prototyping, etc), how large was this influence and how much was this appreciated?

O	Utrecht Holdings	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Utrecht Valorization Centre	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Utrecht Inc.	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Other:	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Other non-UU related	Importance	1	2	3	4	5	6	7	8	9	10

	organizations:	Appreciation	1	2	3	4	5	6	7	8	9	10
<input type="radio"/>	None											

- 8) Which UU support institution has assisted you in accessing and utilizing R&D facilities (laboratories, test facilities, construction facilities etc.), how large was this influence and how much was this appreciated?

<input type="radio"/>	Utrecht Holdings	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
<input type="radio"/>	Utrecht Valorization Centre	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
<input type="radio"/>	Utrecht Inc.	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
<input type="radio"/>	Other:	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
<input type="radio"/>	Other non-UU related organizations:	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
<input type="radio"/>	None											
<input type="radio"/>	I don't make use of any R&D facilities											

- 9) Explicitly per patent applications we identified; Voor (octrooinummer, publicatie datum en titel) willen we weten of u deze uitvinding (heeft) gebruikt, hoeveel mensen eraan hebben gewerkt en of de exploitatie van het octrooi heeft geleid tot substantiële inkomsten

	Yes	No	Amount of Time devoted To activities (1-12 & total) in FTE	Income of patent exploitation in euro or % turnover
1. om op te nemen in bestaande octrooiportefeuille	0	0		
2. als onderdeel van contractonderzoek met de universiteit	0	0		
3. om een product te kunnen ontwikkelen	0	0		
4. idem, een proces	0	0		
5. om een (niche-) markt te ontwikkelen	0	0		
6. om deze markt kon monopoliseren	0	0		
7. om aan derden een octrooi (sub-) licentie te verlenen (zo ja, hoeveel)	0	0		
8. om financiering te verwerven	0	0		
9. om aan te geven hoe innovatief uw bedrijf is	0	0		
10. als onderdeel van een octrooiportefeuille en voor evt. onderhandelingen in kruislicenties	0	0		

11. om te voorkomen dat anderen u beletten toe te treden tot een (niche-) markt	0	0		
12. om anderen te beletten octrooi aan te vragen voor deze uitvinding	0	0		
Total				

Financial Capital:

10) How is your funding distributed amongst various sources, currently and at the founding moment?

Source	Percentage of total budget at founding moment	Percentage of total funding at current situation
Founding team (internal funding)		
Government funding (subsidies)		
University funding		
External investors domestic		
External investors foreign		

11) Which UU support institution has assisted you in accessing additional (external) investors/funds, how large was this influence and how much was this appreciated?

O	Utrecht Holdings	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Utrecht Valorization Centre	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Utrecht Inc.	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Other:	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Other non-UU related organizations:	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	None											

12) How many external entities invest in your company?

.....

Human Capital

- 13) How many members does your management team consist of currently and at the founding moment (FTE)?

Founding moment	Currently

- 14) In how many previous starting companies were the management team members involved at the founding moment of your company, for how many years and what is the scientific background of the founding team members?

Founding team employee	Amount of previous starting companies	Years of entrepreneurial experience	Years of academic experience	Years of managerial experience	Years of scientific (R&D) experience	Years of financial experience
1						
2						
3						
4						

- 15) Which UU support institution has assisted you in forming/altering of the management team (searching and recommending adequate personnel), how large was this influence and how much was this appreciated?

O	Utrecht Holdings	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Utrecht Valorization Centre	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Utrecht Inc.	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Other:	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Other non-UU related organizations:	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	None											

Organizational Capital

- 16) Spin-offs usually develop through different development phases, which all demand for a different set of routines/activities or even a change in business model.

What kind of critical changes in the development process did your company face and to what degree did they hinder the development process of the company

Critical changes	Degree of influence

	Not at all	Not really	Fairly	Very	Extremely
Change of business model					
R&D → product/process development					
Product/process development → production					
Production → marketing					
Marketing → market growth					

17) To which degree does the University-affiliated incubator perform activities, described below, for your firm?

0	Strategic advice	1	2	3	4	5	6	7	8	9	10
0	Networking	1	2	3	4	5	6	7	8	9	10
0	Monitoring	1	2	3	4	5	6	7	8	9	10
0	Other	1	2	3	4	5	6	7	8	9	10
0	None										

18) To which degree is the University shareholder in the company?

0-9%	10-19%	20-29%	30-39%	40-49%	50-59%	60-69%	70-79%	80-89%	90-100%
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19) What type of reward system for researchers (you) does the university employ; what is its magnitude and how important do you think this reward system is for spin-off creation/performance?

Percentage of profit	Magnitude	1	2	3	4	5	6	7	8	9	10
	Importance	1	2	3	4	5	6	7	8	9	10
Percentage of share in company	Magnitude	1	2	3	4	5	6	7	8	9	10
	Importance	1	2	3	4	5	6	7	8	9	10
Share of royalties received	Magnitude	1	2	3	4	5	6	7	8	9	10
	Importance	1	2	3	4	5	6	7	8	9	10
Other:	Magnitude	1	2	3	4	5	6	7	8	9	10
	Importance	1	2	3	4	5	6	7	8	9	10
Other:	Magnitude	1	2	3	4	5	6	7	8	9	10
	Importance	1	2	3	4	5	6	7	8	9	10

Relational Capital

20) How many collaborations with partner agents did your company have at the founding moment? And currently?

Founding moment	Currently

21) Which UU support institution has assisted you in attracting adequate partners for collaboration since the founding moment until now, how large was this influence and how much was this appreciated?

0	Utrecht Holdings	Importance	1	2	3	4	5	6	7	8	9	10
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		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Utrecht Valorization Centre	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Utrecht Inc.	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Other:	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Other non-UU related organizations:	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	None											

22) How many alliances does your network partners have?

.....

23) Which UU support institution has assisted you in creating and improving your current network position, what was the magnitude of this influence and in which way do you perceive this supporting activity as beneficial?

O	Utrecht Holdings	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Utrecht Valorization Centre	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Utrecht Inc.	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Other:	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	Other non-UU related organizations:	Importance	1	2	3	4	5	6	7	8	9	10
		Appreciation	1	2	3	4	5	6	7	8	9	10
O	None											

Performance

24) What is your turnover and profitability (%) currently and at the moment of founding?

	Founding moment	current
Profitability (%)		
Turnover (euro)	0-50.000 euro	0-50.000 euro
	50.000 - 200.000 euro	50.000 - 200.000 euro
	200.000 - 500.000 euro	200.000 - 500.000 euro
	500.000 - 1.000.000 euro	500.000 - 1.000.000 euro
	1.000.000 - 2.000.000 euro	1.000.000 - 2.000.000 euro
	2.000.000 - 4.000.000 euro	2.000.000 - 4.000.000 euro
	4.000.000 - 10.000.000 euro	4.000.000 - 10.000.000 euro
	10.000.000 or more	10.000.000 or more

25) Would you like to receive the results of this questionnaire?

Appendix C:

Digital version is provided, for table is too large to be offered hardcopy and to protect classified company information.