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Linking Top Management Team Characteristics and Innovation Speed - A Study of High Technology Academic Spinoffs.

MSc in Innovation and Entrepreneurship

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Abstract

This thesis examines how top management team (TMT) characteristics influence innovation speed. By using a theoretical framework of resource-based view and dynamic capabilities, I identify three characteristics of the top management team that may influence innovation speed.

I developed three hypotheses suggesting that polychronicity, industry experience and entrepreneurial orientation of the TMT will accelerate innovation speed. My empirical data indicates that polychronicity and entrepreneurial orientation of the TMT accelerates the innovation speed in high technology academic spinoffs. However, no support was found for industry experience. My sample consists of 42 Norwegian high technology academic spinoffs. My empirical material has some implications and directions for further research.

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1. Introduction

In this study I will attempt to answer my research question, which is: What TMT characteristics will accelerate the innovation speed in high technology academic spinoffs? I will use a resource-based view and dynamic capability lens to identify these characteristics.

In this section I will go through the relevance of this study, research question and objective, and the chapter outline.

1.1. Relevance of Study

This research provides insight about the antecedents of innovation speed in high technology academic spinoffs. This is particularly relevant due to the increasing globalization and speed of technology development. The pace of today’s technology markets is rapid; accordingly the speed of product development is increasing in its importance to gain a competitive advantage.

Within five years, about half of all startups suffer a quiet death (Schutjens and Wever 2000: 136). In this regard, many authors attempt to find success factors in new ventures, and reveal the secrets of successful entrepreneurs. It has been a popular research topic, especially since Birch (1979) found that small firms create more jobs than their bigger counterparts. However, a significant amount of existing research have focused on success factors in terms of firm performance, and ignored the increasing importance of innovation speed as a success factor in new ventures.

1.2. Research Question and Objectives

The objective of this paper is to identify determinants of innovation speed in Norwegian high technology academic spinoffs. By using a theoretical framework based on resource-based theory and dynamic capabilities, the study aims to identify characteristics among the top management teams in academic spinoffs, which may reduce innovation time.

Innovation speed, defined here as the time elapsed between initial product development efforts and the first sale of the corresponding product, can be especially important for academic spinoffs since these companies often compete in highly innovative environments (Walter, Auer et al. 2006). Academic spinoffs and startups have been found to contribute to job creation, economic development and growth in terms of exports, employment, taxes paid, research and development, and innovations and play an important role in bringing new technologies to the market (Heirman and Clarysse 2007: 303). Academic spinoffs can benefit from accelerated innovation speed by (1) to gain early cash flow for greater financial independence; (2) to gain external visibility and legitimacy; (3) to gain early market share; and (4) to increase the likelihood of survival (Schoonhoven, Eisenhardt et al. 1990). This underlines the importance of innovation speed in academic spinoffs.

The literature on innovation speed has mainly focused on well-established organizations, with many projects going on simultaneously (Gupta and Wilemon 1990; Brown and Karagozoglu 1993; Kessler and Chakrabarti 1996; Flood, Fong et al. 1997; Kessler and Chakrabarti 1999; Lynn, Skov et al. 1999; Kessler and Bierly III 2002; Terziovski and Morgan 2006). Further, much of the research on this area has relied on case studies (Gupta and Wilemon 1990; Terziovski and Morgan 2006; Knockaert, Ucbasaran et al. 2009). I want to address this gap in literature by using existing literature on innovation speed in established organizations and TMT characteristics that are important for high technology startups[1]. Then I will identify TMT characteristics that may accelerate the innovation speed in high technology academic spinoffs.

My research question is: What TMT characteristics will accelerate the innovation speed in high technology academic spinoffs?

1.3. Chapter Outline

The paper is organized as follows. Section two presents the theoretical/empirical framework and central propositions tested in the paper. Section three describes the methodology and its contents. The results of the empirical model are presented in section four, including the

[1] Startups and spinoffs will be addressed interchangeably, as they have somewhat equal points of departure.

descriptive statistics and regression analysis. This is followed by a discussion of the results with implications and directions for further research in section five, and the concluding remarks in section six.

2. Theory and Hypotheses

The theory section will include a literature review of resource-based theory and dynamic capabilities. Many authors have intertwined these two topics (Makadok 2001; Helfat and Peteraf 2003), and I will also draw on theory from both these topics to develop my theoretical framework around innovation speed and TMT characteristics. My focus will be to identify TMT characteristics and capabilities that may enhance innovation speed in high technology academic spinoff companies. I will start with a brief introduction of resource-based theory and dynamic capabilities, and how my focus on TMT characteristics and innovation speed fit in this framework. Following these topics is a more thorough literature review of research on innovation speed, before I narrow down the focus and start with theory on TMTs and how they may enhance the innovation speed to gain faster market entrance.

2.1. Resource-based View and Dynamic Capabilities

The resource-based view (RBV) of the firm was developed in the late fifty's by Penrose (1959), and offered an alternative method for identifying a firms competitive advantage. In essence, the RBV is a method that is used to identify competitive advantage in the form of resources instead of the traditional product-market view. Two of the most reputable researchers within resource-based theory are Barney and Wernerfelt, and their definitions have been widely accepted among authors and scholars. Barney (1986:101) defines resources as "all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enables a firm to conceive of and implement strategies that improve its efficiency and effectiveness". Wernerfelt (1997:172) states that a firm's resources at a given time could be defined as those (tangible and intangible) assets which are tied semi permanently to the firm. Examples of resources are: brand names, in-house knowledge of technology, employment of skilled personnel, trade contacts, machinery, efficient procedures, capital, etc. The resource-based view states that firms gain and sustain competitive advantages by deploying resources and capabilities that are valuable, rare and costly-to-imitate (Barney 1991).

Winners in the global marketplace have been firms that can demonstrate timely responsiveness and rapid and flexible product innovation, coupled with the management capability to effectively coordinate and redeploy internal and external competences (Teece 2009: 555). Teece (2009) refers to this ability as dynamic capabilities to emphasize two key aspects that were not the main focus of attention in previous strategy perspectives. The term "dynamic" refers to the capacity to renew competences so as to achieve congruence with the changing business environment; certain innovative responses are required when time-to-market and timing are critical, the rate of technological change is rapid, and the nature of future competition and markets difficult to determine (Teece 2009: 555). The term "capabilities" emphasizes the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competences to match the requirements of a changing environment (Teece 2009: 555). From these definitions, it is clear that the top management team has an important role under this perspective, and is the reason why I will focus on the TMT characteristics to determine possible effects on innovation speed.

According to the logic of RBV, sustained competitive advantage occurs when capabilities are not only valuable and rare, but also imitable, immobile, and non-substitutable (Eisenhardt and Martin 2000:1110). Dynamic capabilities are typically valuable. They may be rare or at least not possessed by all competitors equally, as is apparent in much of the empirical research (Eisenhardt and Martin 2000). Further, they argue that dynamic capabilities can be a source of competitive advantage, but not sustainable as many of the resources in resource-based theory are. This is principally the difference between a resource and a dynamic capability. Small and medium sized enterprises and new ventures need unique and dynamic capabilities that allow them to survive, achieve legitimacy, and reap the benefit of their innovation (Zahra, Sapienza et al. 2006: 4).

The value of a well-composed TMT seems to fulfill these criteria to a certain degree, as TMTs are imitable and often non-substitutable. In this regard, a top management team can serve as a dynamic capability, especially for startups, where the TMT have great influence on every aspect of the firm (Shrader and Siegel 2007). Verona (1999) states that the influence of a strong senior management can positively affect product development outcome. It is also important to formally highlight the relationship between capabilities and performance in product development. Teece (2004: 1323) states that the ability to recognize opportunities depends in part on the individual's capabilities and extant knowledge, particularly about user needs in relationship to existing as well as novel solutions. Teece (2009) also suggests that the competitive advantage of firms lies within its managerial and organizational processes, shaped by its asset position, and the paths available to it. Deeds et al. (2000) state that the skills, knowledge, and background that executives bring with them play a critical role in determining the organization's strategic choices. At last, Teece (2009) defines dynamic capabilities as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.

Pioneering is the ability to enter markets before competitors, and utilize this advantage to gain competitive benefits. According to the resource-based view of the firm, a pioneering capability derives from its heterogeneous and immobile resources (Barney 1986). The TMT represents one particular human capital resource that potentially differentiates pioneering from non-pioneering firms (Flood, Fong et al. 1997). The TMT are responsible for allocating and investing in company resources, and this is why I will take a closer look upon the dynamic capabilities of the TMT. Research suggests that pioneering firms possess particular skills and resources, which are not found in their non-pioneering counterparts (Lieberman and Montgomery 1988; Kerin, Varadarajan et al. 1992; Flood, Fong et al. 1997).

Verona (1999: 133) suggest that by drawing from resource-based theory focused on identifying capabilities affecting firm performance, one can offer a more analytical explanation of the product development drivers. He supports my view that by using a RBV and dynamic capabilities framework, I can identify the drivers and capabilities that may affect innovation speed. This introduces the next section, where I will investigate innovation speed.

2.2. Concept of Innovation Speed

The RBV states that firms gain and sustain competitive advantages by deploying resources and capabilities that are valuable, rare and costly-to-imitate (Barney 1991). From my point of view, innovation speed fits the definition as to be a cornerstone of competitive advantage. This is also supported by Kessler et al. (1996), who argues that managers typically regard time as something that is constantly ticking away (i.e., a scarce resource), and as a consequence they attempt to analyze and optimize its use. Time is a scarce resource, and to manage time effectively is valuable and an important factor of innovation speed.

Innovation speed is defined as the time elapsed between: 1) initial development efforts, including the conception and definition of an innovation; and 2) ultimate commercialization, which is the introduction of a new product into the marketplace (Mansfield 1988; Vesey 1991; Kessler and Chakrabarti 1996; Kessler and Bierly III 2002). This definition has been adopted by many researchers and scholars, and serves as a basis for my definition. Markman et al. (2005) uses commercialization time as a surrogate for innovation speed. My study includes technology-based academic spinoffs, and from these definitions I choose to define innovation speed as: The time elapsed between initial product development efforts and the first sale of the corresponding product. This may also be referred to as commercialization time by many authors.

Research suggests that the ability to accelerate innovation processes can confer strategic advantages (Eisenhardt and Martin 2000). Reducing the time to market is important due to the increasing cost of slow product development (Gupta and Wilemon 1990). Lieberman and Montgomery (1988) suggest that speed can facilitate either first-mover or second-mover strategies, depending on which is favored by industry conditions, because innovation speed can build competitive advantage. Being a first mover may confer the advantages of brand loyalty and technological leadership, preemption of scarce assets, and exploitation of buyer switching costs (Lieberman and Montgomery 1988). Spence (1981), suggests that early entrants may accrue learning and network externality advantages that are self-reinforcing over time in industries characterized by increasing returns. Also, Kessler et al. (1996) states that the ability to compress time is a unique capability that may confer a sustainable competitive advantage.

Schoonhoven et al. (1990), summarize the importance of innovation speed; (1) to gain early cash flow for greater financial independence; (2) to gain external visibility and legitimacy; (3) to gain early market share; and (4) to increase the likelihood of survival. Further they find that organizations with a lower level of technological innovation had relative lower monthly expenditures. From these findings one can see that it is more costly for new technology ventures to develop products than their non-technology counterparts, thus the importance of accelerating the innovation speed in technology ventures is evident. By reducing the time to market you will not only beat your competitors to the first customers, you will also save valuable money and resources. The importance of innovation speed is demonstrated in this quote from an interview of a chief executive in a high technology company: "Time is a real fact, and it is an awesome fact. If you get the product out six months later, even though it may be better, the market may be lost, and so you have failed" (Jelinek and Schoonhoven 1993: 314).

The literature on innovation speed has mainly focused on well-established organizations, with many projects going on simultaneously (Gupta and Wilemon 1990; Brown and Karagozoglu 1993; Kessler and Chakrabarti 1996; Flood, Fong et al. 1997; Kessler and Chakrabarti 1999; Lynn, Skov et al. 1999; Kessler and Bierly III 2002; Terziovski and Morgan 2006). It is difficult for spinoffs to extract useful information from these scholars, because there is less people involved in the product development and they have less internal communication problems (Heirman and Clarysse 2007). This is also supported by Allocca et al. (2006), who finds in their study that the antecedents to innovation speed found for large firms should not be generalized to small and medium-sized firms. Further, much of the research on this area has relied on case studies (Gupta and Wilemon 1990; Terziovski and Morgan 2006; Knockaert, Ucbasaran et al. 2009), and it could be difficult to generalize the findings in these studies.

Even though Markman et al. (2005) have examined the role of innovation speed in determining the number of new ventures at the University Technology Transfer Office (UTTO) level; they do not examine the factors influencing innovation speed. Because of this gap in literature, I will use existing literature regarding innovation speed as a performance measure in established organizations and link it to TMT characteristics that are important for high technology startups. Then I will identify TMT characteristics that may accelerate the innovation speed in high technology academic spinoffs. First, I will investigate the research on innovation speed, which introduces the next section: Research on innovation speed.

I will end this section with a suitable quote: "The liability of slow product development is growing. Leisurely product introductions look more and more like corporate suicide". [2]

[2] Speeding New Ideas to Market. Fortune, March 2, 1987.

2.2.1. Research on Innovation Speed

The speed of new product development has received a great deal of research attention, as demonstrated in reviews of research on new product development (Kessler and Chakrabarti 1996). There have been substantial amounts of research on factors that contribute to increasing the speed of new product development. These include the effect of project team characteristics and senior management support on project lead time and productivity (Rothwell, Freeman et al. 1974; Gupta and Wilemon 1990). Katz et al. (1981) find in their study of development projects that the presence of gatekeepers, who gathered information and communicated it to team members and also facilitated external communication of the team increased project effectiveness and performance . Further, Eisenhardt et al. (1995) finds that extensive testing, frequent project milestones, a powerful project leader, and a multifunctional team accelerates product development. In mature industry segments, they find that the involvement of suppliers, use of computer-aided design, and overlapping development steps is equivalent to fast pace.

In Kessler et al. (1999) study, they investigated factors that may differentiate fast from slow innovation processes. They showed that different factors influenced the speed of radical and incremental projects. For radical projects they found that greater numbers of champions, lower level of champion influence, lower tenure of project leaders, and greater tenure of project members sped up the radical projects. For incremental projects they found that less number of champions, greater level of champion influence, lower educational level of project members, greater project member experience, and greater tenure of project members sped up the incremental projects. This indicates that characteristics among leaders and members are important for innovation speed. However, this study includes only established organizations and the reality might be different for startups.

In Griffin's (1997) study, she found that cross-functional teams are associated with larger cycle time reductions for newer products. Other scholars have also supported this (Gupta and Wilemon 1990; Trygg 1993; Carmel and Bird 1997). Gupta et al. (1990) reveal in their study that the involvement of project champions, creativity, and flexibility is associated with accelerated development time. They argue that innovation speed is important due to the continuous development of new technologies that quickly obsolete existing products, the changing customer needs and requirements, which truncate product life cycles, higher new product development costs and the increased domestic and global competition. Further, a greater number of U.S. companies are realizing that their competitiveness in world markets depends on their ability to quickly develop and market new products that customer's value.

In a study by Markman et al. (2005), they found that the faster university technology transfer offices (UTTOs) can commercialize patent-protecting technologies, the greater their licensing revenues streams and the more new ventures they spin off. They also identified several determinants of speed. They found that UTTO resources and the competency in identifying licensees are related to commercialization time, and that the participation of faculty-investors in the licensing process is a critical determinant of commercialization time.

Cooper (1994) identifies eight key success drivers in product development in his study of 306 new product projects. He found that several factors drove the two measures of cycle time reduction – time efficiency and adherence to the time schedule. These factors were a cross-functional team, a strong market orientation and customer focus, planning and quality of execution of technological activities. Cycle time reduction was one of Cooper's 8 key success drivers, and comparing the top performers with the bottom performers in product development, he found that top performers had larger cycle time reduction than their bottom counterparts. This strengthens my view that innovation speed is an important factor when considering strategies for product development.

McDonough (1993) examined the relationship between speed of new product development and technology, and characteristics of project leaders and project team members. He found that the number of years the leader had been in his or her present position had a negative effect on innovation speed for routine projects. For radical projects both age and level of education had a negative effect on innovation speed. For project team members he found that the level of education had a positive effect on innovation speed in routine projects, while the average number of years the team had been with the company had a negative effect on innovation speed in radical projects.

All of these findings suggest that characteristics influence innovation speed in different directions. In the next section I will investigate innovation speed in high technology academic spinoffs, and examine the impact and the benefits of accelerating the innovation speed in these companies.

2.2.2. Innovation Speed in High Technology Spinoffs

University spinoffs, sometimes referred to as university spin-outs or academic spinoffs, are business ventures that are founded by one or more academics who choose to work in the private sector and transfer a core technology from the parent organization (Walter, Auer et al. 2006: 545). Further, they argue that spinoffs contribute to technology transfer in two stages. First, they transfer technology from their parent organization to themselves and, second, they transfer the technology to customers (Perez Perez and Sanchez 2003). Academic spinoffs is frequently monitored by potential competitors, firms that may be capable of imitating products and/or services quickly on a large scale—or simply acquire the firm (Walter, Auer et al. 2006: 544). This is one of the challenges spinoffs may face, and they also struggle to establish close links to customers and suppliers after their spinout (Stuart, Hoang et al. 1999).

Innovation speed in technology spinoffs is likely particularly important because these companies often compete in highly innovative environments (Walter, Auer et al. 2006: 544). Further, Schoonhoven et al. (1990: 177) states that the more quickly a new venture develops its first product and ships it to the first costumer, the more quickly it will embark on the path to greater financial independence. They also point out that faster product development will increase the likelihood of survival, and that shipping the first product for revenues is thought to be a favorable indication of survival for new organizations.

According to McGrath (1999), the value of investment option is inversely proportional to the elapsed time between an initial investment and the start of positive cash flows. This shows that companies with the ability to speed up the innovation cycle will be more attractive to investors, which is crucial for startups.

To summarize, my understanding of innovation speed is the time elapsed between initial product development efforts and the first sale of the corresponding product. In industries populated by entrepreneurial high technology firms, the rapid development of new products is a key determinant of success (Deeds, DeCarolis et al. 2000). According to Sonnenberg (1993), innovation speed is a capability that, when combined with core processes, can yield significant competitive advantage for a firm. Further, Verona (1999) states that a resource based view of product development can better identify the different dimensions of functional and integrative capabilities. Innovation speed and product development is closely linked, and

I will use a resource-based and dynamic capability lens to identify the TMT capabilities that may enhance innovation speed for spinoff companies. This introduces the next section, which is startup TMT characteristics and innovation speed.

2.3. Startup TMT Characteristics and Innovation Speed

Entrepreneurial teams are important, particularly for growth-oriented ventures. The human and social capital of the team is among the major assets of a new firm (Cooper 2007). Top management team characteristics are a key contingency factor influencing the relationship between firm-level innovation and firm performance (Lumpkin and Dess 1996). This supports my view that TMTs are important in spinoff companies, and this is also supported by Shrader et al. (2007) who suggest that the link between managerial characteristics and performance is stronger for new ventures, given their simpler structures, lack of organizational inertia, and less complex strategies. They also propose that a significant percentage of the value of technology-based new ventures is likely to be determined by the quality of the company's employees, especially the top management team. Also, Gupta et al. (1990) found in their study of large technology-based firms, that the reasons for product development delays and the actions which can accelerate the process are manageable. This shows that TMT characteristics can be an important capability for innovation speed. Hence, my focus will be on the characteristics of the TMT that may influence performance regarding innovation speed.

A firm may fail to modify its resources or capabilities in response to a change in the external environment. As a result, a capability that was once an asset may become a liability if it is not appropriate for the product development project (Reed and DeFillippi 1990). The TMT as a capability will not be influenced by changes in the external environment, as most of their characteristics are persistent.

Strategic decisions are associated with characteristics of the top managers in an organization (Hambrick and Mason 1984). Further, Wiersema et al. (1992) demonstrated how top management characteristics influence the likelihood of strategic change. Examples of such characteristics are age, tenure in the organization, functional background, education, socioeconomic roots, and financial position (Hambrick and Mason 1984:196). This shows that the characteristics of top management influence strategic decisions and strategic change, and thus there may also be characteristics that will influence innovation speed.

TMT characteristics are shown to influence strategic decision-making speed (Talaulicar, Grundei et al. 2005), firm performance (Goll and Rasheed 2005), strategic choices (Hitt and Tyler 1991), and innovativeness (Wiersema and Bantel 1992; Tyler and Steensma 1998) in firms. This indicates the impact of TMT characteristics on various operational related topics, and I believe innovation speed also is an important performance related topic. However, these characteristics are investigated in the context of established organization and may not be applicable for startups. Next, I will examine characteristics that are important in startups.

Innovation speed is as earlier stated a measure of performance, and previous studies have compared TMT characteristics with performance in the form of financial criteria in startups. Shared strategic cognition of top management teams is often cited as having a direct link to new venture performance (Ensley and Pearce 2001). Shared strategic cognition is the degree to which TMT members hold a common mental model of the organization's strategy (Ensley and Pearce 2001). Ensley et al. (2005) found in their study that TMT cohesion and group potency have a positive effect on new venture performance. Team potency is the degree of collective efficacy within a group toward achieving its goals (Guzzo, Yost et al. 1993), while cohesion is an affective state that influences motivation and commitment (Klein and Mulvey 1995). Certo et al. (2006) showed in their study that greater functional heterogeneity among TMT members is positively associated with return of assets. This demonstrates some characteristics of the TMT that influence performance in startups, but not performance related to innovation speed, which will be investigated further.

A study done by Flood et al. (1997) investigated the relationship between characteristics of the TMT and the extent of pioneering. Pioneering is the capacity of a firm to seize unsatisfied customer needs and develop new products ahead of rivals (Flood, Fong et al. 1997:291). They advanced a four-stage process model of pioneering behavior in top management teams, and looked at important characteristics in different stages in the innovation process in well-organized companies. They found that TMT skills and attributes influence pioneering in very complex ways. Among the attributes they found significant for pioneering firms were; more externally oriented TMT, older managers dominate, and less educated top managers. However, I will not go into the different stages in this study. Startups do not have the luxury to divide the tasks among the employees of the organization. Startup TMT consists of just a few people that are involved in product development (Heirman and Clarysse 2007). I believe focus should be aimed towards identifying characteristics and capabilities that are important for the whole innovation process and at the same time may accelerate the innovation speed.

The only study that combines innovation speed in startups with resource-based theory and dynamic capabilities is a study by Heirman et al. (2007). They looked at tangible assets such as starting capital and the stage of product development at funding and intangible assets such as team tenure, experience of founders, and collaborations with third parties, as important antecedents for innovation speed in startups. They found that the amount of initial financing has no significant effect on innovation speed. Next, it is shown that team tenure and experience of founders leads to faster product launch. Alliances with other firms do not significantly affect innovation speed, and collaborations with universities are associated with longer development times. This supports my claim that if the resource-based and dynamic capability lens is applied, important characteristics for innovation speed within high technology academic spinoffs may be identified.

Stinchcombe (1965) and Boeker (1989) argue that conditions and events surrounding the creation and immaturity of new ventures affect their exposure to obligations of newness and smallness, and can also have a long-lasting effect on their future development. Given the potentially powerful initial and historical effects, Heirman et al. (2004: 5) argue based on these views, that the startup's initial new product development capabilities may be an important antecedent of its innovation speed. I have identified three features that have been frequently addressed by authors, but not in the context of innovation speed. Two capabilities of the TMT have been identified, namely entrepreneurial orientation and polychronicity. Further, industry experience among the members of the TMT seems to explain some of the success in new technology-based ventures (Dahl and Reichstein 2007).

Many authors and scholars identify industry experience as an important characteristic for both leaders and top management teams in innovation processes (Dahl and Reichstein 2007). It is also my belief that industry experience may enable the TMT to increase the innovation speed. When a new firm is established, organizations are reproduced, because founders will rely on routines with which they are already familiar from their previous employment experience, and which they have already shown to be successful (Dahl and Reichstein 2007). Further, they state that the quality of the routines will determine the future success and performance of the new firm. Individuals with industry experience may also possess larger networks with more relevance to the startup company than other individuals. The networking capability of a startup is important, and Walter et al. (2006) finds in their study that the networking capability of a firm is positively related to various performance measures. Project teams with long-term experience in the technology and market do better at new product development than teams that lack this experience because experienced teams have a higher understanding of customer needs and the technology know-how to fulfill them (Maidique and Zirger 1985: 303; Heirman and Clarysse 2004: 22). This is also supported by Schoonhoven et al., who states that rather than creating extensive amounts of new knowledge, firms may build on what is known to advance the state of the art (Schoonhoven, Eisenhardt et al. 1990). When possessing more industry knowledge, it will limit the search for new knowledge, thus creating more time for the TMT to use on other challenges in the startup company. This may result in a shorter development time, and enable the firm to enter the market before competitors. Accordingly, industry experience is an important capability of the TMT and may increase the innovation speed of startup companies.

Entrepreneurs are individuals who are admired and much research has been carried out to reveal the secrets of successful entrepreneurs. Entrepreneurs start companies and contribute to the advances humans have made in technology. Hence, my perception is that an entrepreneurial orientation in the TMT of startups may increase company success and result in a faster market introduction for products. Lumpkin et al. (1996: 136) clarifies the distinction between entrepreneurship and entrepreneurial orientation: "Entrepreneurship is defined as new entry. That is, new entry explains what entrepreneurship consists of, and entrepreneurial orientation describes how new entry is undertaken". Further they state that an entrepreneurial orientation refers to the processes, practices and decision-making activities that lead to new entry. I will explain the contents of the construct entrepreneurial orientation in a sub-topic later. My understanding is entrepreneurial orientation as a capability of the TMT, which may enable them to gain faster market access. There have been several studies that confirms that entrepreneurial orientation within firms have a positive relationship on firm performance (Miller 1983; Miller 1988; Covin and Covin 1990; Naman and Slevin 1993). However, this is firm performance regarding financial criteria, and not innovation speed which is my measure of performance. Stam et al. (2008) finds a significant and positive relationship between the entrepreneurial orientation construct and the number of products and services introduced to the market during the past year ahead of competitors. The sample in this study was the founding teams of 90 new ventures, and this indicates that entrepreneurial orientation may have a positive effect on innovation speed. They do not find any direct effects on sales growth, sales per employee, or profit attainment.

One might claim that an organization or a spinoff company utilizing effective work methods and strategies may increase their innovation speed. If a TMT is characterized by high decision-making speed, it may also decrease the time of product-entry to the market. Soutiaris et al. (2010) finds in their study of 305 new technology ventures, that decision-making speed has a positive effect on financial performance. This relationship is mediated by polychronicity, which refers to the extent that TMT members mutually prefer and tend to engage in multiple tasks simultaneously (Souitaris and Maestro 2010: 653). Onken (1999) suggests that an organizational culture can be a powerful resource to manage and could lead to a competitive advantage if it enhances the firm's performance. Hall (1959) defines polychronicity as a cultural dimension. A cultural dimension is hard to copy, and therefore a competitive advantage. My proposition is that polychronicity is a capability of the TMT, which enables them to engage in several tasks simultaneously and thereby enables faster decision-making and thus may lead to an increase of innovation speed. Soutiaris et al. (2010: 657) argue that the core benefit of TMT members attending unscheduled interpersonal interactions is an information advantage, which enables them to make decisions more effectively and on better grounds. König et al. (2010) states that polychronicity is better for performance only if the environment demands multitasking, and it can be argued that the high-velocity environments in technology spinoffs fit this description. As previously stated, startups have a limited number of employees. For this reason, the employees often carry the responsibility for several tasks simultaneously, and thus may have an advantage of being polychronic.

The empirical evidence presented in Flood et al. (1997) exploratory research indicates that relationships do exist between characteristics of the TMT and firms' pioneering behavior in high-velocity environments. However, the study has shown that TMT skills and attributes influence pioneering in very complex ways. This is a gap in literature, and especially studies regarding innovation speed in academic spinoffs are limited. In the next section I will investigate industry experience, polychronicity and entrepreneurial orientation, and put forward hypotheses.

2.3.1. Effect of polychronicity on innovation speed

Polychronicity is when people value, and hence practice, engaging in several activities and events at the same time (Bluedorn 1998: 110). This definition is taken from a published interview with Edward T. Hall, who first mentioned the term in the book "The Silent Language" in 1959 (Hall 1959). This argument shows that polychronicity can be an important resource for organizations.

Slocombe et al. (1999) showed that a match between an individual's polychronic orientation and experienced work polychronicity (e.g., the polychronic behaviors and preferences of supervisors and co- workers) was associated with higher levels of willingness to exert effort, desire to remain in the organization, and belief in the acceptance of organizational goals. One reason for these effects may be that people, who engage in several tasks at the same time, will experience more variety in the responsibilities at work. A working environment that encourages to consequently executing one task at a time may lead to less diversity in responsibilities, and make the work place uninteresting.

Madjar et al. (2006) found that individuals with high levels of polychronicity generated more ideas and were more creative when required to rotate through three tasks as compared to working sequentially on the three tasks, which proved that polychronic people perform better than others on tasks requiring multitasking (Kˆnig and Waller 2010: 185). Such employee creativity makes an important contribution to organizational innovation, effectiveness, and survival (Amabile, Conti et al. 1996; Nonaka and Takeuchi 2007). Hence it is my perception that also the TMTs of new ventures will have a positive effect of being polychronic and actively execute several tasks and decisions at the same time. Engaging in several decisions at the same time may enable the TMT to make them better when based on a broader picture, and hence make these decisions faster.

Souitaris et al. (2010) found in their study that TMT polychronicity has a positive effect on firm performance in the context of dynamic and unanalyzable environments. Talaulicar et al. (2005: 519) also states that technology-based startup companies operate in high-velocity environments. These findings indicates that polychronicity also will have a positive effect on firm performance in startups, and Eisenhardt (1989) found in a study of top management teams that the consideration of multiple alternatives simultaneously led to faster and better decisions in a high-velocity environment. It seems when summarizing the results from theory, that polychronicity may be an important characteristic of the TMT to influence innovation speed. If a TMT makes faster and better decisions, it may result in an increase of innovation speed. Hence my first hypothesis is:

H1: Polychronicity will have a positive effect on innovation speed.

2.3.2. Effect of Industry Experience on Innovation Speed

All entrepreneurs bring knowledge and skills from their past work activities and education experience to their firms (Shane 2000). All entrants into an industry carry skills and routines embodied in their founders, who are very likely to influence the new firm's future development and success. Founders of spinoffs are likely to bring specific knowledge about a wide range of issues to their new firm, e.g. customer demand, products, technologies, suppliers, and competitors (Helfat and Lieberman 2002: 742).

A study done by Dahl et al. (2007) found that spinoff companies with a TMT which had industry-specific experience, positively affects the likelihood of survival. The reason for this may be that industry experience enables the TMTs of these companies to better understand the consequences of the strategies they choose to pursue.

Eisenhardt et al. (1990: 510) also states that people with long experience in the industry bring knowledge of how the industry operates. This indicates that industry experience may serve as factor that enables the individuals to see upcoming threats and opportunities, and thereby increase innovation success by having the actions and strategies prepared beforehand. Longer careers in a particular company or industry should enhance a managers knowledge of the technological trends in the industry and make him/her more open to investments in innovation that are necessary to capitalize in these changes (Daellenbach, McCarthy et al. 1999: 200). Such investments in innovation may be to increase the innovation speed of product development, if this is a critical success factor to capitalize in a particular industry. Experience from the same environment enables these individuals to focus the investments on areas of the company that are crucial for product success.

The theory of human capital also provides support for the view that managerial characteristics such as experience should influence strategic choice and firm performance among technology-based new ventures. That is, human capital theory suggests that an experienced entrepreneurial team should be more productive than a less experienced team, since experience is a valuable asset that has been shown to increase worker productivity and the economic value of the firm, as well as managerial compensation. Experience also allows managers to make more informed strategic choices (Shrader and Siegel 2007: 895)

Gannon et al. (1992) argue in their study that managers with greater industry-specific experience engage in less exhaustive information search procedures. When these procedures become less time consuming, managers have more time to focus on other aspects of the firm. Flood et al. (1997) states that high levels of managerial experience would aid management's ability to recognize market opportunities and experience would enhance product development and launch speed. Hence my perception is that more experienced founders with valuable industry-specific knowledge should have a higher probability of success compared with less experienced founders. My measure of success is innovation speed, which leads to my second hypothesis:

H2: Industry experience has a positive effect on innovation speed.

2.3.3. Effect of Entrepreneurial Orientation on Innovation Speed

Many authors argue that entrepreneurial behavior is vital for firms of all sizes to prosper in competitive environments (Miller 1983; Lumpkin and Dess 1996; Covin and Slevin 1998). Entrepreneurial aspects such as opportunity identification, risk taking, and resource mobilization have been highlighted as critical success factors for academic spinoffs (Roberts 1991; Steffensen, Rogers et al. 2000), where entrepreneurial behavior is believed to stimulate growth and economic performance.

Authors and scholars have investigated the topic of entrepreneurship for many years, and a common method for measuring entrepreneurial behavior through five dimensions has been adopted by many researchers. These dimensions are autonomy, innovativeness, risk taking, proactiveness and competitive aggressiveness. They have been useful for characterizing and distinguishing key entrepreneurial processes, that is, a firm's entrepreneurial orientation (Lumpkin and Dess 1996: 136). Innovativeness reflects a firm's tendency to enter into experimentation, support new ideas and depart from established practices (Lumpkin and Dess 1996: 142). Proactiveness refers to the propensity to anticipate future needs and changes in the operating environment, and to pioneer new methods and techniques, thereby creating a first-mover advantage vis-à-vis competitors (Lumpkin and Dess 1996: 146). Risk-taking propensity denotes the willingness to make investments in projects that have uncertain outcomes or unusually high profits and losses (Lumpkin and Dess 1996: 144). Autonomy refers to the independent action of an individual or a team in bringing forth an idea or a vision and carrying it through to completion (Lumpkin and Dess 1996: 140). Competitive aggressiveness refers to a firm's propensity to directly and intensely challenge its competitors to achieve entry or improve position, that is, to outperform industry rivals in the marketplace (Lumpkin and Dess 1996: 148). These definitions suggest that organizations that have an entrepreneurial orientation focus attention and efforts towards opportunities, have an aggressive mindset towards beating competitors to market, and as a result may accelerate the innovation speed.

Innovation speed is the measure of performance in this study, and there have been several studies confirming the effect of entrepreneurial orientation on firm performance. Among these are Jantunen et al. (2005), who finds in his study of 217 manufacturing and service organizations that entrepreneurial orientation within the firm has a positive effect on its international performance. In another study done by Keh et al. (2007) the results indicate that entrepreneurial orientation plays an influential role on the acquisition and utilization of marketing information, and also has a direct effect on firm performance.

Entrepreneurship is often said to exist in a firm that engages in product-market innovation, undertakes somewhat risky ventures, and is first to come up with "proactive" innovations, beating competitors to the punch (Miller 1983: 771). This indicates that entrepreneurial orientation within a firm may accelerate the innovation speed, and is also vital in competitive environments. Based on existing research, my belief is that entrepreneurial orientation is an important characteristic for the TMTs university spinoffs, and thus will have a positive effect on innovation speed.

H3: Entrepreneurial orientation in the TMT has a positive effect on innovation speed.

2.4. Model Summary

After summarizing theory and my hypotheses I propose the following model:

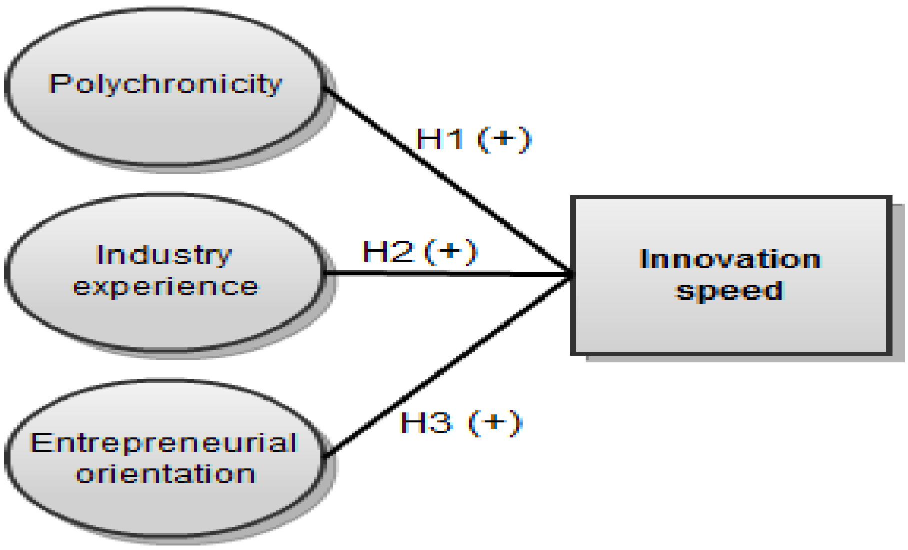

Figure 1 - Research Model

The figure demonstrates how polychronicity, industry experience, and entrepreneurial orientation may have a positive effect on innovation speed, meaning a reduction of the development time.

In the next section I will go through the methodology, which includes sample selection, data collection, and the measures.

3. Methodology

Methodology can be defined as "the approach and strategy used to conduct research" (Wilson 2010:3). On the other hand, methods refer to the different ways by which data can be collected and analyzed (Wilson 2010:3). In my research design I have chosen a quantitative research approach, which is usually associated with numerical analysis (Wilson 2010:13). Easterby-Smith et al. (2008:82) states that quantitative methods involves data which is either in the form of, or can be expressed as, numbers. Hyde (2000:84) underlines that a quantitative approach to research might draw a large and representative sample from the population of interest, measure the behavior and characteristics of that sample, and attempt to construct generalizations regarding the population as a whole. Further, Easterby-Smith et al. (2008:234) state that all quantitative researches do the same two things: they identify what features tell the best story about the data (summarizing the data) and then they look at patterns in the data that can be used to draw conclusions about the study's research questions. I have chosen a quantitative approach to my research question because I want to be able to generalize possible findings, and investigate a large number of companies. Qualitative methods can also be time consuming, and difficult to extract useful data from. My impression from the literature review is that much research regarding innovation speed has been accomplished by case studies, and I want to contribute with research from the quantitative perspective.

3.1. Sample selection

The research sample consists of high technology academic spinoffs in Norway, and the questionnaires were emailed to 147 leaders. The data is gathered from several different industries, including biotechnology, IT, and oil & gas. The criteria for this study are that the companies have to be Norwegian high technology academic spinoffs and no older than 15 years. I received the most current list containing high technology academic spinoffs from the Norwegian Research Council.

3.2. Data Collection

The data in this thesis has been collected through questionnaires, which have been sent to the leaders of the 147 companies. Data were collected via questback, and 56 leaders completed the questionnaires. 66 of the 147 companies read the email, which mean 81 of the companies that I sent the email to never saw the survey. The reason for the low completion rate could be that many of the companies on the list had gone bankrupt or had been dissolved. In addition, many spinoffs have surrogate entrepreneurs who are only in the company for a short period. When approaching the companies, I realized that the contact information for these companies was old, and it was difficult to attain the correct contact information. To increase the responds rate, I called all of the companies on the list to remind them of the survey. I also sent them personal emails, explaining the importance of this research project with a link to the survey. In addition, I added several other companies, which I had received from Campus Kjeller, to the list. My efforts led to 56 respondents, including 9 partially completed forms that had to be discarded. I also removed 5 companies that were more than 15 years old, and had responded "0" under development time and start up year. I ended up with a sample of 42 companies, which is a 30 % response rate. Taking into account that only 66 people saw the email, the response rate is approximately 64%.

3.3. Measures

In this section I will account for the selection of my dependent variable, independent variables and control variables. My measures include "*innovation speed", "polychronicity", "entrepreneurial orientation", "industry experience",* type of *"industry"* and "*company size"*.

3.3.1. Dependent Variables

The measure of performance in this thesis is innovation speed. Research on innovation speed has mainly focused on established organizations, and has measured innovation speed in the amount of patents, licensing speed and revenues. The sample in this thesis is academic spinoffs and the measures previously used by other scholars are not applicable here, because many of these companies are still in the stage of product development. To measure the innovation speed I asked when the development of the prototype started, and when they had/expect to have their first sale. This is in line with Heirman et al. (2007), who measured innovation time as the number of months between founding and time at which the product was ready for sales.

3.3.2. Independent Variables

The independent variables in this thesis are "*polychronicity*", *"industry experience"* and *"entrepreneurial orientation"*. Questions to capture this were taken from previous literature. To measure entrepreneurial orientation I adopted items from Walter et al. (2006), who refer to the key features of a TMTs' entrepreneurial orientation. The items were measured with a five-point Likert-scale. When measuring "*polychronicity"* I used Souitaris et al. (2010) five items on a five-point Likert scale. "Industry experience" was measured as the number of years of industry experience within the management team, including former employments. This is in line with Stam et al. (2008) study. All the questions from the survey are in Appendix 8.1.

3.3.3. Control Variables

I considered the size of the spinoff organization as a control variable and measured it as the log of total employees, as large organizations have more resources to conduct R&D and this may influence the innovation speed. Smaller firms may face more severe challenges in exploiting opportunities because of their small resource bases.

I also tested for effects of the industry in which the spinoffs were operating. The variable was coded as a dummy variable and controls the impact of such differences in industry. Doutriaux (1987) found in his study of academic spinoffs that the growth behavior of service firms is very different from the behavior of manufacturing firms. Also, Heirman et al. (2007) found in their study that software firms differ from firms in other technologies with regard to the factors that determine innovation speed. This shows that the industry the companies operate in might affect the innovation speed. I also predict that life science companies will have a longer product development time, since these companies have to pass time-consuming regulatory steps (Khilji, Mroczkowski et al. 2006). The dummy variable assigned: Life science = 1 and ”others” = 0.

3.3.4. Data analysis

In this section I will explain my approached when analyzing the data from the survey in SPSS.

“Entrepreneurial orientation” and “*polychronicity*” are two dimensions that are measured with five questions each (see appendix 8.1.). Two of the questions in the “*polychronicity”* dimension were reverse coded from the others, so the first thing I did was to create two new variables based on these questions, which had the right direction.

I also checked all of the questions for Kurtosis and Skewness, and none of the variables have factors that need further consideration. The Kurtosis is ranges from -0,933 to 0,309, which indicates that the normal distribution is slightly peaked. Skewness ranges from -0,465 to -0,099, which indicates that the majority of questions contain a greater number of larger values. According to MuthÈn et al. (1985: 187) the values for both skewness and kurtosis are acceptable for further study.

All the scales in this study were subjected to exploratory factor analysis (principal components analysis using varimax rotation with a criterion of eigenvalue greater than 1.0) to check the validity of the questions measuring “*entrepreneurial orientation”* and “*polychronicity*”. Varimax is the most used method for orthogonal rotation, and the goal is to identify groups of variables, which are subject for high correlation with each other and low correlation with other groups of variables (Ulleberg and Nordvik 2001). When all the ten variables were included in the factor analysis, it resulted with a “Kaiser-Meyer-Olkin measure of sampling frequency” of 0.653. This is no more than adequate, and the rotated component matrix is presented in table 6 (see Appendix 8.2.)

There are some questions within “*entrepreneurial orientation”* that affects “*polychronicity*” and have a low chronbach´s alpha, which should be above .70 (Cortina 1993: 101). To increase the validity of *“entrepreneurial orientation”*, I discarded the three questions with lowest reliability. I also discarded the question from "*polychronicity"* influencing *"entrepreneurial orientation"* the most. The "Kaiser-Meyer-Olkin measure of sampling frequency" increased to 0,707, which fully satisfies the guidelines suggested by Kaiser (1974: 35).

The final measurement items and coefficient alpha for each scale are presented in Table 7 in Appendix 8.2.

As you can see, all scales demonstrated good reliability, and the items load cleanly on two factors. The questions measuring "*polychronicity"* and "*entrepreneurial orientation*" have chronbach´s alpha over .70, which is satisfactory according to the guidelines presented by Cortina (1993: 101). These questions represent two of my dimensions. The final model will also include the independent variable "*industry experience*", but this variable do not require validity check because there is only one construct measuring industry experience.

In the next section I will go through my results, both descriptive statistics and regression analysis.

4. Results

Under this section I will go through the results in this study, including the descriptive statistics and the regression analysis.

4.1. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Development_Time	42	1	13	3.90	3.434	11.796
Industry	42	0	1	.29	.457	.209
Organization_Size	42	0	2	.68	.445	.198
PolyWeWouldRather	42	1	5	3.14	1.181	1.394
We believe people should try to do many things at the same time	42	1	5	3.10	1.078	1.161
We tend to juggle several activities at the same time	42	1	5	3.64	1.008	1.016
We believe it is best for people to be given several tasks and projects to perform simultaneously	42	1	5	2.90	1.031	1.064
In my team, people are very dynamic	42	2	5	4.05	.854	.729
In my team, willingness to continuous progress is the joint foundation	42	3	5	4.19	.634	.402
Valid N (listwise)	42					

Table 1 - Descriptives

Following I will do a quick review of the different variables, and explain where they fit in my research model.

"Development_Time" represents my dependent variable measuring innovation speed. The average development time is approximately four years in my final sample of spinoff companies. The shortest development time in my sample is one year, and the longest development time is thirteen years.

"Industry" is my first control variable, and consists of two values, "Other" and "Life science". The mean is 0.29, which indicates that my sample consists of less life science companies than other companies.

"Organization_Size" is my second control variable, and is measured as log of number of employees.

"PolyWeWouldRather" is one of the variables included in my polychronicity dimension. The mean is 3.14 on a Likert scale from 1-5. The variable has been reverse-coded from "*We would rather focus on one project each day than on parts of several projects". "We believe people should try to do many things at the same time"* is one of the variables included in my polychronicity dimension. The mean is 3.10 on a Likert scale from 1-5. "*We tend to juggle several activities at the same time"* is one of the variables included in my polychronicity dimension. The mean is 3.64 on a Likert scale from 1-5. *"We believe it is best for people to be given several tasks and projects to perform simultaneously"* are one of the variables included in my polychronicity dimension. The mean is 2.90 on a Likert scale from 1-5.

"In my team, people are very dynamic" is one of the variables included to measure entrepreneurial orientation. The mean is 4.05 on a Likert scale from 1-5. "*In my team, willingness to continuous progress is the joint foundation"* is one of the variables included to measure entrepreneurial orientation. The mean is 4.19 on a Likert scale from 1-5.

Table 2 provides the Pearson correlation coefficients for my dependent variable and independent variables:

		Development_Time
Development_Time	Pearson Correlation	1
	Sig. (1-tailed)	
	N	42
Tenure	Pearson Correlation	-.306*
	Sig. (1-tailed)	.024
	N	42
FacPolychronicity	Pearson Correlation	-.404**
	Sig. (1-tailed)	.004
	N	42
FacEntrepreneurial Orientation	Pearson Correlation	-.174
	Sig. (1-tailed)	.136
	N	42

*. Correlation is significant at the 0.05 level (1-tailed).

**. Correlation is significant at the 0.01 level (1-tailed).

Table 2 - Correlation Matrix

The results from this analysis indicate a strong and negative relationship between "*FacPolychronicy*" and "*Development_Time*". This indicates support for my first hypothesis, predicting that "*polychronicity*" has a positive effect on innovation speed. My measure of innovation speed is in years, from initial development efforts to first product sold on the market. A negative relationship thus indicates that higher scores on "*polychronicity*" will result in less development time.

My results also indicate support for my second hypothesis, predicting a positive effect from industry experience on innovation speed. The finding is significant at the 0.05 levels, and yields a negative relationship between industry experience and "*Development_Time*".

Entrepreneurial orientation shows no significant relationship with development time, thus indicating no support for my third hypothesis.

The results from my Pearson correlation coefficients show interesting relationships, and indicate support for two of my hypotheses. In the next section I will investigate my hypotheses with regression analysis, and introduce my control variables.

4.2. Regression Analysis

My regression analysis model includes the control variables "*type of industry*" and "*organization size*". Independent variables are "*polychronicity*", "*entrepreneurial orientation*" and years of "*industry experience*". My model summary is presented in table 3.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.388[a]	.151	.107	3.245
2	.569[b]	.324	.230	3.014

a. Predictors: (Constant), Organization_Size, Industry

b. Predictors: (Constant), Organization_Size, Industry, FacEntrepreneurial Orientation, FacPolychronicity, Tenure

Table 3 - Model summary

Model 1 represents my control variables. They predict 15,1 % of the variance in my dependent variable "*development time*". Model 2 represents my independent variables included with the control variables. As table 3 shows, the "R square" is more than doubled when my independent variables enter the equation. My model with control variables accounts for 32.4 % of the variance in development time. If I do a regression without the control variables, my independent variables predict 24,1 % of the variance in development time (see Appendix 8.3.). Much of the initial effect in the model including control variables comes from the variable "*industry*". When "*industry"* has the value 1, it means that this is a life science company. This will predict a certain amount of the variance in "*development time*", as the life science companies in my data have significantly longer development time. My model including control variables is thereby more "robust" than the numbers explain which comes from the model excluding control variables.

Table 4 presents the ANOVA of my regression model:

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	72.855	2	36.427	3.459	.041[a]
	Residual	410.764	39	10.532		
	Total	483.619	41			
2	Regression	156.616	5	31.323	3.448	.012[b]
	Residual	327.003	36	9.083		
	Total	483.619	41			

a. Predictors: (Constant), Organization_Size, Industry

b. Predictors: (Constant), Organization_Size, Industry, FacEntrepreneurial Orientation, FacPolychronicity, Industry experience

c. Dependent Variable: Development_Time

Table 4 – ANOVA

My first model including only control variables is significant at the 0,05 level. The second model has a lower significance, and overall I can conclude that my model is statistically significant. In table 5 the regression model coefficients are displayed:

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	4.307	1.107		3.890	.000		
	Industry	2.101	1.177	.280	1.785	.082	.887	1.128
	Organization_Size	-1.474	1.209	-.191	-1.219	.230	.887	1.128
2	(Constant)	5.060	1.341		3.774	.001		
	Industry	1.928	1.146	.257	1.682	.101	.807	1.240
	Organization_Size	-.794	1.148	-.103	-.692	.494	.848	1.179
	Industry experience	-.024	.019	-.183	-1.241	.223	.860	1.162
	FacPolychronicity	-.907	.507	-.264	-1.787	.082	.860	1.162
	FacEntrepreneurial Orientation	-.858	.487	-.250	-1.764	.086	.935	1.069

a. Dependent Variable: Development_Time

Table 5 - Regression model coefficients

In the first model, none of the control variables are statistically significant. As expected, *"industry"* is the variable influencing the development time the most. Biotechnology firms usually have longer product development time than other companies, as previously discussed. This is demonstrated with a positive beta value, which indicates that biotechnology firms will have longer development time than other firms.

The second model yields some interesting results. "*Industry"* is not significant; however it shows that this control variable has a high positive value. When I investigate the results closer, I find that most of the life science companies have longer development time than their counterparts in other industries. This is in line with existing research, and was expected due to all the regulations and complex procedures influencing product development in the biotechnology industry. My second control variable, "*Organization_Size"* is not significant, but it influences development time in a negative direction. This indicates that the size of the companies may be an important control variable, as my results show that it may increase innovation speed. This result is also somewhat expected, as bigger companies with more employees will have more resources and thereby can increase innovation speed by utilizing more available resources.

The results from my Pearson correlation coefficients made me believe that industry experience would influence development time more than entrepreneurial orientation. However, in my regression analysis I find that "*Industry experience"* has little effect on development time, and is not significant. "*Entrepreneurial orientation"* and "*polychronicity"* is statistically significant when I account for the direction of my hypotheses. All of my hypotheses say that the measure will have a positive influence on innovation speed. The measure is development time, which means that a negative direction implies that the variables will have a reducing effect on development time, and thereby increasing innovation speed. The significance in circumstances where the hypotheses indicate direction can be dimidiated (Wilson 2010). This makes my findings on "*Entrepreneurial orientation"* and *"polychronicity"* significant at the 0.05 level. My model shows that for every unit increase in "*Entrepreneurial orientation",* a 0.858 unit decrease in development time will be expected, holding all other variables constant. For every unit increase in "*Polychronicity",* a 0.907 unit decrease in development time is expected. When investigating the standardized beta coefficients, I find that "*polychronicity"* is marginally predicting more of the variance in "*development time"* than "*entrepreneurial orientation*".

The degree of multicollinearity was investigated by analyzing variance inflation factors (VIFs) of variables. The highest VIF is 1,24, and this value suggests that multicollinearity is not a problem in this regression analysis (Mansfield and Helms 1982).

My empirical results show support for my hypothesis regarding "*entrepreneurial orientation*" and "*polychronicity*". My empirical evidence indicates that these two dimensions have a positive effect on innovation speed. However, industry experience is not significant in my regression model. These finding will be discussed in the next section.

5. Discussion

In this section I will go through my findings and discuss theoretical and practical implications. I will also address the limitations, and propose directions for further research.

To address my research question, I chose to use a RBV and dynamic capability lens. After researching the literature I ended up with three hypotheses. This section will be used to address the different hypotheses and then my research question. This study aims to understand the relationship between RBV and dynamic capabilities on one hand and innovation speed in high technology academic spinoff on the other. Using a quantitative methodology, my research reveals the importance of possessing certain TMT characteristics in order to commercialize faster.

First, I expected polychronicity to have a positive effect on innovation speed, which in turn would decrease the time elapsed between initial product development efforts and the first sale of the corresponding product. I based my assumption on existing literature on polychronicity, which have shown to increase a firm's performance (Souitaris and Maestro 2010).

H1: Polychronicity will have a positive effect on innovation speed.

My empirical results indicate that polychronicity has a positive effect on innovation speed. Both my correlation coefficients and regression analysis shows that the TMT´s polychronic orientation has a reducing effect on development time. Polychronicity enables people to perform several tasks at the same time, thus maintaining a wider perspective on tasks and strategies. If the TMT have one decision or task to accomplish, looking into other decisions at the same time enables them to base their decisions on more information. Some tasks may also require a maturing process, and accomplishing other task in the meantime makes the work environment more effective. My findings suggest that polycronicity has a positive effect on innovation speed, which may be caused by faster decision-making. This is in line with existing research, which shows polychronicity to have a positive effect on decision-making speed (Souitaris and Maestro 2010).

Secondly, I expected industry experience to have a positive effect on innovation speed. The importance of having industry experience among the members of the TMT has been argued by many authors and scholars, and has been shown to have an impact on various areas of new venture performance (Gannon, Smith et al. 1992; Dahl and Reichstein 2007; Shrader and Siegel 2007)

H2: Industry experience has a positive effect on innovation speed.

The effect of industry experience has limited support in my empirical data. TMT industry experience has a positive effect on innovation speed in my correlation coefficients, but I find no support for my hypothesis in the regression model. One possible explanation may be the effect of control variables, where organization size may have a moderating effect on industry experience. As organization size increases, it will also result in an increase of the overall industry experience of the TMT. This may affect industry experience in the overall regression model when including control variables. However, when performing an analysis excluding the control variables, I do not find the effect of industry experience significant. As many scholars have claimed, industry experience is important when starting new ventures, but I do not find strong enough support in my empirical data to support that industry experience has a positive effect on innovation speed.

Finally, I expected entrepreneurial orientation to have a positive effect on innovation speed. Also this assumption was rooted in existing literature, which indicated that entrepreneurial orientation is an important characteristic to possess in new ventures (Jantunen, Puumalainen et al. 2005; Keh, Nguyen et al. 2007).

H3: Entrepreneurial orientation in the TMT has a positive effect on innovation speed.

My empirical data analysis indicates that entrepreneurial orientation has a positive effect on innovation speed. However, the initial correlation coefficients did not show any significant effect from entrepreneurial orientation on innovation speed. Several scholars have argued the importance of entrepreneurial orientation (Lumpkin and Dess 1996; Jantunen, Puumalainen et al. 2005; Keh, Nguyen et al. 2007), yet there have been many who have not found any significant relationship with firm performance. When isolating firm performance as innovation speed, entrepreneurial orientation thus seems to have a positive effect on performance. From my perspective, the skill set of a successful entrepreneur is important to inhabit in a TMT of university-based spinoffs. Characteristics like being risk-averse, novelty seeking and dynamic fits well with the high-velocity environments in technology industries. When starting up new firms, or managing a completely new product in existing firms, it is important to have the ability to tolerate risk and adapt to new changes in technology or in the marketplace. My empirical evidence indicates that such an entrepreneurial orientation in the TMT is beneficial for increasing the innovation speed.

Through a literature review and gathering of empirical evidence, I have found answers to my initial research question:

What TMT characteristics will accelerate the innovation speed in high technology academic spinoffs?

In my literature review and theoretical framework, I found indications of TMT characteristics that may influence the innovation speed in high technology academic spinoffs. The resource-based and dynamic capabilities framework demonstrated that the top management teams in startups and new product development are very important to achieve innovation success. Drawing the line from TMTs as a success factor, I found that industry experience, entrepreneurial orientation, and polychronicity might be important dimensions influencing the innovation speed. My empirical data gathering and analysis of high technology academic spinoffs yields support for two of my three hypotheses, indicating that firms with TMTs with a high preference for polychronicity and entrepreneurial orientation outperform others when it comes to innovation speed.

5.1. Theoretical and Practical Implications

My theoretical contribution lies within research on innovation speed as a performance measure for high technology academic spinoffs. Much of the existing research on innovation speed has focused on success criteria in established firms (Gupta and Wilemon 1990; Brown and Karagozoglu 1993; Kessler and Chakrabarti 1996; Flood, Fong et al. 1997; Kessler and Chakrabarti 1999), which may not be generalized to small spinoff companies. By using a resource-based view and dynamic capabilities framework, I have identified the TMT as an important resource and asset for high technology academic spinoffs. My contribution to theory is that polychronicity and entrepreneurial orientation are important dimensions of the TMT to accelerate innovation speed. My empirical results indicate a positive effect on innovation speed from these two dimensions.

The positive effect from entrepreneurial orientation is in opposite to Slater et al. (2000), who finds no relationship between business profitability and entrepreneurial orientation . Lee et al. (2001) found only weak evidence of a positive relationship between entrepreneurial orientation and the startup's performance. Walter et al. (2006) finds no direct relationship between entrepreneurial orientation and sales growth, sales per employee, or profit attainment, in spinoffs companies. In this regard, my results are interesting, and suggesting innovation speed as a performance measure, I find evidence supporting the effect of entrepreneurial orientation on performance. One possible explanation for my contradictory results is my different measure of performance. Entrepreneurial orientation may influence the innovation speed more than other performance criteria, as innovation speed can be more related to the constructs of entrepreneurial orientation. For example, to be dynamic and eager at being first to market may appeal more to innovation speed than the profitability of the firm.

König et al. (2010) argue that only jobs and environments with high requirements to multitasking may benefit from polychronic employees. The environments surrounding high technology spinoffs are characterized by high velocity, and my empirical finding provides support for König et al. (2010) arguments regarding polychronic environments. TMTs in startup companies have many responsibilities, and the CEO might as well be the one who is cleaning the floor one day, to push things to extremes. This environment seems to demand high standards when it comes to being able to accomplish several tasks at the same time, and my findings indicate that polychronicity enhances innovation speed. Onken (1999) finds a positive relation between polychronicity as a cultural dimension of the organizations culture and several financial related criteria. My findings support his research, thus in the context of high technology academic spinoffs. He also finds positive relationships between a polychronic company culture and preference for doing things quickly. This may explain some of my results, that polychronicity serves as a mechanism making employees having a preference for doing tasks fast, thereby increasing innovation speed.

I have demonstrated how to use a resource-based view and dynamic capability framework to identify capabilities and resources to enhance innovation speed in startup companies. My experience is that this is a good framework to employ when identifying TMT characteristics and other capabilities, which may influence innovation speed. Through my study I will also stress the importance of innovation speed for future scholars. My theoretical and empirical review has revealed that innovation speed and the effect of it is highly beneficial for startup companies, both financial and to gain a competitive advantage.

To summarize, my theoretical contribution is that polychronicity and entrepreneurial orientation are capabilities in the TMTs, which enhances the innovation speed in Norwegian high technology spinoffs. I have also experienced a practical implication during my study, namely the convenience of using a resource-based and dynamic capability framework when identifying the antecedents of innovation speed. In the next section I will introduce the limitations of my study, and also propose directions for further research.

5.2. Limitations

My overall regression model including control variables, accounts for 32.4 percent of the variance in the dependent variable development time. When excluding control variables, I get a 24.2 percent variance explained. This result is below expectation, and I would prefer a percentage above 50. The reason for these numbers is also some limitations in my empirical data. These numbers are also explained by limitations in my empirical data.

The final sample consists of 41 high technology academic spinoffs. A higher number of participants would have yielded better results and more robust models. The list used to send out the survey was also somewhat outdated, as explained in the section 3.2., and several participants did not fulfill the surveys firm age criterion, and had to be removed.

Another weakness with the empirical data is the 5-point Likert scale. In combination with a low number of total respondents, this made the results less clear. The initial data analysis revealed many responses in the middle of the scale, and if I were to design the survey again I would have used at least a 7-point Likert scale. This would have enabled the respondents to filter their responses better, and also yield results with a higher “resolution”. It is also possible that a measure in months instead of years would give sharper results when measuring the development time. Much of the existing research has measured development time in months, and by doing this I would have been able to differentiate the results more accurately.

The research only studied technology startups that develop products including medical devices, biotechnology products, software, oil & gas, and so on. Therefore, the results cannot be generalized to non-technological startups due to different market trends and life cycle variations. Furthermore, the study used data from Norwegian technology spinoffs to test the hypotheses. As a result, validity of the results to other country settings is questionable and awaits further research in other kinds of settings.

My empirical findings regarding entrepreneurial orientation are somewhat weak. The regression model reveals a significant contribution from entrepreneurial orientation on innovation speed, opposite of the correlation coefficients, which do not show a significant relationship. The empirical evidence supporting a positive effect from entrepreneurial orientation on innovation speed is thereby not as strong as the evidence for polychronicity.

In addition, to measure my dependent variable I asked when the development of the prototype started, and when they had/expect to have their first sale. It might be difficult for the leaders in the companies to remember that exact year. However, I did double check secondary sources to validate the construct development time.

5.3. Further Research

Future research may consider the effect of other characteristics of the TMT on innovation speed of high technology academic spinoffs. My suggestions are to measure former startup experience of the members of the TMT, and also management experience as an addition to industry experience. Other characteristics of the TMT, which may influence innovation speed are functional experience and education levels, which are widely known under the upper echelons perspective (Hambrick and Mason 1984). It would be interesting to see if a higher education level or diverse background among the members of the TMT may influence innovation speed. Another factor to consider is propensity against risk. Thus being a minor part of the entrepreneurial orientation dimension, risk may be measured on independently, and a lot of authors have developed good tools to measure risk propensity. I would recommend Williams (1965) “job preference inventory”, which has been widely accepted among researchers and scholars and tested for validity and reproducibility. Williams also suggest that people who have a high propensity for risk-taking will support alternatives with more uncertainty, while people with lower risk propensity tend to choose alternatives reflected by security. This may influence innovation speed, as strategies of safety often may be more time consuming and less bold, which may be associated with a lower innovation speed. To further explore these differences, I would suggest an exploratory comparative case study of firms, which are selected on the basis of innovation speed. Half of the firms should have a slow innovation speed, and the other half should have a fast innovation speed. By studying working methods, strategies and company cultures, one should find some significant differences in these speed counterparts, which may be further investigated in a quantitative study on a larger scale.

A new study with a larger sample of new technology ventures is also preferable. As noted in limitations, this thesis only consists of 42 respondents, which is rather adequate. By increasing the sample and expand the measurement scale, future research will get more “robust” findings.

To generalize the findings, further research should do a study on non-technological new ventures. As noted under “limitations”, this study only includes Norwegian high technology academic spinoffs. If my findings were to appear in non-technology new ventures as well, it would strengthen the results and make a solid foundation to theory contribution regarding innovation speed.

To be able to generalize the findings, further research should do a similar study in other parts of the world as culture might have an influence on the TMTs preference for working methods and strategy-making (Hofstede 1984). Many studies of other characteristics and performance measures have shown that there is a different preference for strategies and working methods across cultures (Roberts 2001).

Innovation speed may increase the demand on the firms resources and could lead to a focus on less risky projects instead of radical innovation processes (Crawford 1992). Further research should look into the downsides of faster product development, and create a model that takes this into consideration.

A study on firms that went bankrupt may also increase our knowledge on TMT characteristics and capabilities, which are important for innovation speed. Did the failing firms inhabit a preference for polychronicity or entrepreneurial orientation? How was the failing firms' attitude towards innovation speed?

6. Conclusion

The starting point of this thesis was based on one research question:

What TMT characteristics will accelerate the innovation speed in high technology academic spinoffs?

After a literature review and gathering of empirical evidence, I have found answers to my initial research question. First and foremost I found support and evidence for the importance of TMTs in startup companies. Pisano (1997) emphasizes the powerful role of senior managers in shaping technological capabilities through decisions and actions that take place during the development process. By using resource-based theory and the dynamic capabilities framework, I identified three characteristics of the TMT, which may influence the innovation speed in high technology academic spinoffs. I generated three different hypotheses based on existing research, supposing that polychronicity, entrepreneurial orientation and industry experience are important factors of the TMT, which may enhance innovation speed.

My empirical data indicates that TMT polychronicity and entrepreneurial orientation have a positive effect on innovation speed. However, I found only weak evidence for the effect of industry experience on innovation speed. My results are interesting, and address a gap in existing literature where innovation speed is infrequently investigated under these circumstances of high technology academic spinoffs. Entrepreneurial orientation is already shown to be important for the growth and profitability of academic spinoffs (Naman and Slevin 1993; Covin and Slevin 1998), and as my results suggest, it may also accelerate the innovation speed. Thus, polychronicity is a topic, which traditionally has received little attention from authors and scholars and first in recent years has attracted more interest (König and Waller 2010). My theoretical contribution is strongest within my findings regarding polychronicity, and I stress that more scholars should look into polychronicity in the context of new ventures and the structure of TMTs. König et al. (2010) also support my view, stating that polychronicity should rather be investigated in relation with performance than as a cultural dimension.

In my thesis I have employed a framework of resource-based theory and dynamic capabilities. This is a perspective that has been useful for identifying the antecedents of innovation speed.

This view has shown to be better than the traditional product-market view when identifying competitive advantage beyond performance and product benefits. I will suggest future researchers and scholars to make use of this framework when investigating innovation speed, as it has been very helpful for creating a basis for my empirical data collection.

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8. Appendix

8.1. Survey questions

What is the cumulative number of years of industry experience within the management team, including former employments?

Please indicate the industry the company is operation in:

When did the technological development (i.e. development of prototype) start?

When did you company start selling their first product/service or expect to do so?

* **Multitasking**

	1 Disagree Strongly	2	3	4	5 Agree Strongly
We believe people should try to do many things at the same time					
We would rather focus on one project each day than on parts of several projects					
We tend to juggle several activities at the same time					
We think it is best and tend to complete one task before beginning another					
We believe it is best for people to be given several tasks and projects to perform simultaneously					

*

Team Orientation To what extent do the following statements apply to your top management team?

	1 Disagree Strongly	2	3	4	5 Agree Strongly
In my team, people are very dynamic	🗁	🗎	🗏	🗐	🗄
In my team, innovation is emphasized above all	🗁	🗎	🗏	🗐	🗄
In my team, people are willing to take risks	🗁	🗎	🗏	🗐	🗄
In my team, willingness to continuous progress is the joint foundation	🗁	🗎	🗏	🗐	🗄
In my team, people are eager at being always first to market	🗁	🗎	🗏	🗐	🗄

8.2. Factor Analysis Results

Rotated Component Matrix[a]

	Component	
	1	2
PolyWeWouldRather	.849	.026
Poly_WeThinkItsBest	.831	.208
We believe people should try to do many things at the same time	.898	-.013
We tend to juggle several activities at the same time	.687	.011
We believe it is best for people to be given several tasks and projects to perform simultaneously	.852	.110
In my team, people are very dynamic	-.133	.806
In my team, innovation is emphasized above all	.251	.637
In my team, people are willing to take risks	.356	.539
In my team, willingness to continuous progress is the joint foundation	-.135	.786
In my team, people are eager at being always first to market	.107	.662

Table 6 - First factor analysis. Varimax rotation with Kaiser Normalization

Rotated Component Matrix[a]

	Component	
	1	2
PolyWeWouldRather	.844	-.034
We believe people should try to do many things at the same time	.900	-.154
We believe it is best for people to be given several tasks and projects to perform simultaneously	.880	.006
We tend to juggle several activities at the same time	.715	.065
In my team, people are very dynamic	-.033	.891
In my team, willingness to continuous progress is the joint foundation	-.012	.901

Table 7 - Second factor analysis. Varimax rotation with Kaiser normalization.

8.3. Regression Analysis with Control Variables Excluded

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.492[a]	.242	.182	3.107

a. Predictors: (Constant), Tenure, FacEntrepreneurship, FacPolychronicity

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.382	1.066		5.049	.000
	FacPolychronicity	-1.147	.509	-.334	-2.253	.030
	FacEntrepreneurship	-.702	.490	-.204	-1.433	.160
	Industry Experience	-.030	.019	-.232	-1.552	.129

a. Dependent Variable: Development_Time