Challenges and success factors in pursuing disruptive innovations: A Finnish high-tech start-up case study

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Abstract
Despite increasing acknowledgment of disruptive innovations for their potential to generate high growth, their high rate of failure necessitates research on what kind of challenges start-ups pursuing disruptive innovations face and how they overcome them. This study contributes to increase understanding in this field by studying the case of a Finnish high-tech start-up's successful new-market disruption in business-to-business context. Identifying disruptive innovations that have market potential, obtaining adequate funding at initial stages of the business, marketing of the disruptive innovation, and the length and riskiness of the process are main challenges in Finland. Success factors derived from the case study and insights of an expert practitioner of the field provide a roadmap for start-ups to overcome these challenges. Findings from this business-to-business study challenge the disruptive innovation theory which has been created in the context of business-to-consumer innovations.

Keywords: Disruptive innovation, new-market disruption, business-to-business, high-tech, start-up, Finland

1. Introduction

Innovativeness plays a central role in the success of the world's top companies as stated by many managers from companies of Deloitte Technology Fast 500 winners in 2012 (Deloitte 2012). This has also been acknowledged by scholars (see Tushman 1997; Hamel 2000). Innovativeness is defined here as the development of a new idea resulting in the application of a new product, service or process (Damanpour 1996; Cumming 1998). Innovations are outputs of innovativeness, and they range from sustaining (also called incremental) innovations to disruptive (also called radical) innovations (Christensen 1997). Most companies tend to focus on sustaining innovations, i.e. using existing technologies to improve and add to established mainstream products that are favored by majority of customers. Disruptive technologies, instead, are rare and, at least at first, offer worse product performance and are not generally valued by mainstream customers; over time, these disruptive technologies will become the mainstream solution and result in the failure of the existing ones belonging to incumbents (ibid.). Disruption can take place in any product or service market, and they often attract new types of customers by offering a completely new type of solution to the existing problem (Christensen et al. 2004). These could be typically cheaper, simpler and smaller products with improved convenience of use. They have occurred in several industries when steamships have disrupted sailing ships, music downloads have disrupted the CD industry, traditional newspapers are facing disruption by online news services, and online shopping is disrupting high street retailing (Trott 2012). Disruptive innovations have had a transforming effect on many industries and positively contributed towards customer welfare and corporate profits. 86 percent of disruptive innovations perform above financial projections, and there is evidence that succeeding in disruptive innovations can lead to high growth (Christensen 2007). On the other hand, it is a fact that many companies do not pursue disruptive innovations as they are highly risky, and a majority of the pursuers fail to successfully develop and market them (Assink 2006; Marmer et al. 2011). Appreciating the increasing acknowledgement of disruptive innovations for their potential to generate high growth and simultaneously recognizing their high failure rate, it is necessary to research and understand challenges that managers face in pursuing disruptive innovations and how they overcome them. This research aims to contribute to this need by answering the following two research questions:

1. What are the main challenges faced by high-tech start-ups in Finland pursuing disruptive innovations?
2. How can these challenges be successfully overcome?

The context of this study is Finnish high-tech start-ups which pursue disruptive innovations. Finland is classified as an innovation-driven economy (Xavier et al. 2013). It has been one of the leaders in several global competitiveness rankings, and the innovation environment is internationally considered as top-class (Florida et al. 2011). The country invests heavily in research and development (R&D), excels in technology, and start-ups are fostered by venture capital funding (Ruohonen 2007). Growth entrepreneurship is politically highly valued in Finland, and for at least the past decade it has been one of the key policy items (Rouvinen and Pajarinen 2012). However, "the paradox of Finland" lies in that even though it is competitive, it does not attract investments, and it is not at top positions in standard of living rankings (Sitra 2005). Furthermore, it has difficulties in fostering young companies to fast growth. While companies younger than 9 years make up 10 percent of all companies with over

1000 employees in the USA, the corresponding share is less than 1 percent in Finland (Nordic Council of Ministers 2010). One reason for this low performance is argued to be the lack of disruptive innovations in Finland (Ruohonen 2007). The hidden potential in creativity and innovativeness is often left unutilized in many Finnish organizations, for reasons such as bureaucracy, short-term thinking, internal competition, stabilized practices, stabilized thinking and management culture (Korpelainen and Lampikoski 1997). Finns are risk-averse and lack appreciation of entrepreneurship (Hyrsky and Tuunanen 1999; Ruohonen 2007). As a result, they favor making "low risk – low return" investments. They also typically expect to achieve growth after two or three years, but it is not possible for businesses based on disruptive innovations to grow that fast (Ruohonen 2007). The enterprise policy in Finland and Tekes (the Finnish Funding Agency for Technology and Innovation) have moved their focus towards supporting risky new ventures, disruptive innovations and their internationalization (Rouvinen and Pajarinen 2012). Therefore, disruptive innovations are expected to play a growing role in the near future. This makes the topic of this research very timely. The findings of this research will be of interest mainly to entrepreneurs and managers of disruptive start-ups in Finland. They may also provide food for thought for other stakeholders in the innovation system, such as policy makers, investors and financiers.

The rest of the paper is organized as follows. In section 2 relevant literature is reviewed, and in section 3 the methodology employed in the research process is outlined. Later, the results of the empirical research are presented in section 4, and the paper ends with a discussion of findings in section 5.

2. Literature Review

2.1 Innovations

Being considered the lifeblood of entrepreneurial activity, innovations have been recognized for long as a major source for creating competitive advantage generating economic growth and technological progress (Schumpeter 1934). However, a systematic analysis of the innovation-performance relationship in start-ups is missing (Rosenbusch et al. 2011), and a better understanding of what makes a successful innovation and innovation process is needed (Rothwell 1992; Leifer et al. 2000; Becheikh et al. 2006). This holds true especially in the case of disruptive innovations where uncertainties regarding their market potential and acceptance prevail (Assink 2006).

Despite different perspectives among entrepreneurs, academics and policy makers, innovations are defined broadly as the development and use of new ideas and behaviors in organizations and narrowly as implemented technologically new products and processes or significant technological improvements in products and processes (Damanpour and Wischnevsky 2006; Massa and Testa 2008). They can be technical innovations such as new products or new services, and administrative innovations such as new markets or new organizational structures. Innovations are classified as product innovations and process innovations, closed innovations and open innovations, and radical (disruptive) innovations and incremental (sustaining) innovations. Whereas product innovations are high-skill intensive and translate into superior growth rates in sales and employment, workers with secondary education are more relevant for process innovations which necessarily do not need to achieve any significant growth (Goedhuys and Veugelers 2012). In both types of innovations, training intensity of the right staff is found to impact organizational innovativeness (Freel 2005). Damanpour and Wischnevsky (2006) further distinguish between generation of innovations and adoption of innovations. The former refers to the creation of an idea and its commercial development (i.e. invention plus exploitation), and the latter addresses the assimilation of new products, services and technologies by the adopting organization (i.e. initiation plus implementation). This research takes the generation perspective and defines innovation process as a set of exploration activities starting from need/problem/opportunity recognition to research, development (idea formulation, problem solving, and prototype solution) and commercialization (Roberts 1988; Rogers 1995). Innovations occur in social learning processes as they involve cumulative creation of new knowledge or novel recombination of existing knowledge (Lundvall 1992; Freel 2003). Indicators of innovation measurements can be based on inputs or outputs of the innovation process. Indicators based on inputs can be R&D budget, existence of formalized R&D, and number of R&D staff, whereas indicators based on outputs can be number of patents, number of innovations, absolute amount of sales of innovative products, and increase in market share (Massa and Testa 2008).

Patterns of innovative activity are determined by the importance of science and technology push and demand pull. Based on differences in sources of technology, users' needs, and means of appropriating benefits, Pavitt (1984) offers a taxonomy of four types of small innovative firms: supplier-dominated firms, scale-intensive firms, specialized equipment suppliers, and science-based firms. De Jong and Marsili (2006) further analyze the characteristics of these types of firms. Supplier-dominated firms are the least innovative ones, and they carry out process innovations only. Their in-house R&D capabilities are weak, and suppliers are their main source of innovations. Scale-intensive firms allocate financial and time resources to innovation, but R&D personnel and the use of external networks for innovation are limited. Their degree of innovativeness is at medium level, balanced between product and process innovations. Innovativeness of specialized equipment suppliers is highest in

product innovations and lowest in process innovations. They rely on customer needs as sources of innovation and use in-house specialized human resources rather than external sources in innovating. Finally, science-based firms display highest level of innovativeness both in products and processes. These firms differ from other types in that they rely on knowledge from universities and research institutes as a source of innovation.

2.2 Disruptive Innovation Theory

Disruptive innovations transform the demand and needs of an existing market and as a result disrupt an existing technical trajectory (competence-destroying) while sustaining innovations refine and improve it (competence-enhancing) (Gatignon et al. 2002). The source of disruption can be a technological discontinuity, a commercial discontinuity, or both, resulting in significant improvements in product performance or cost (Leifer et al. 2001). As illustrated in Figure 1, disruptive innovations either offer more convenience or lower prices to customers at the low end of an existing market (i.e. low-end disruptions) or create new markets by bringing new features to non-customers (i.e. new-market disruptions). Low-end disruptions target overshot customers with lower-cost business models. They are simpler and cheaper but lower-performing at first, thus promising lower profit margins. The rationale behind their emergence is that by over-satisfying customers' needs in hopes of higher margins, large incumbents create a vacuum at lower price points enabling competitors with disruptive technologies to emerge (Christensen and Raynor 2003). New-market disruptions which target non-consumption are revolutionary. In both types of disruptions the common denominator is that entrants are not competing with large incumbents and do not therefore seemingly pose an immediate threat to them. That is why they are usually not recognized as competitors at their introduction.

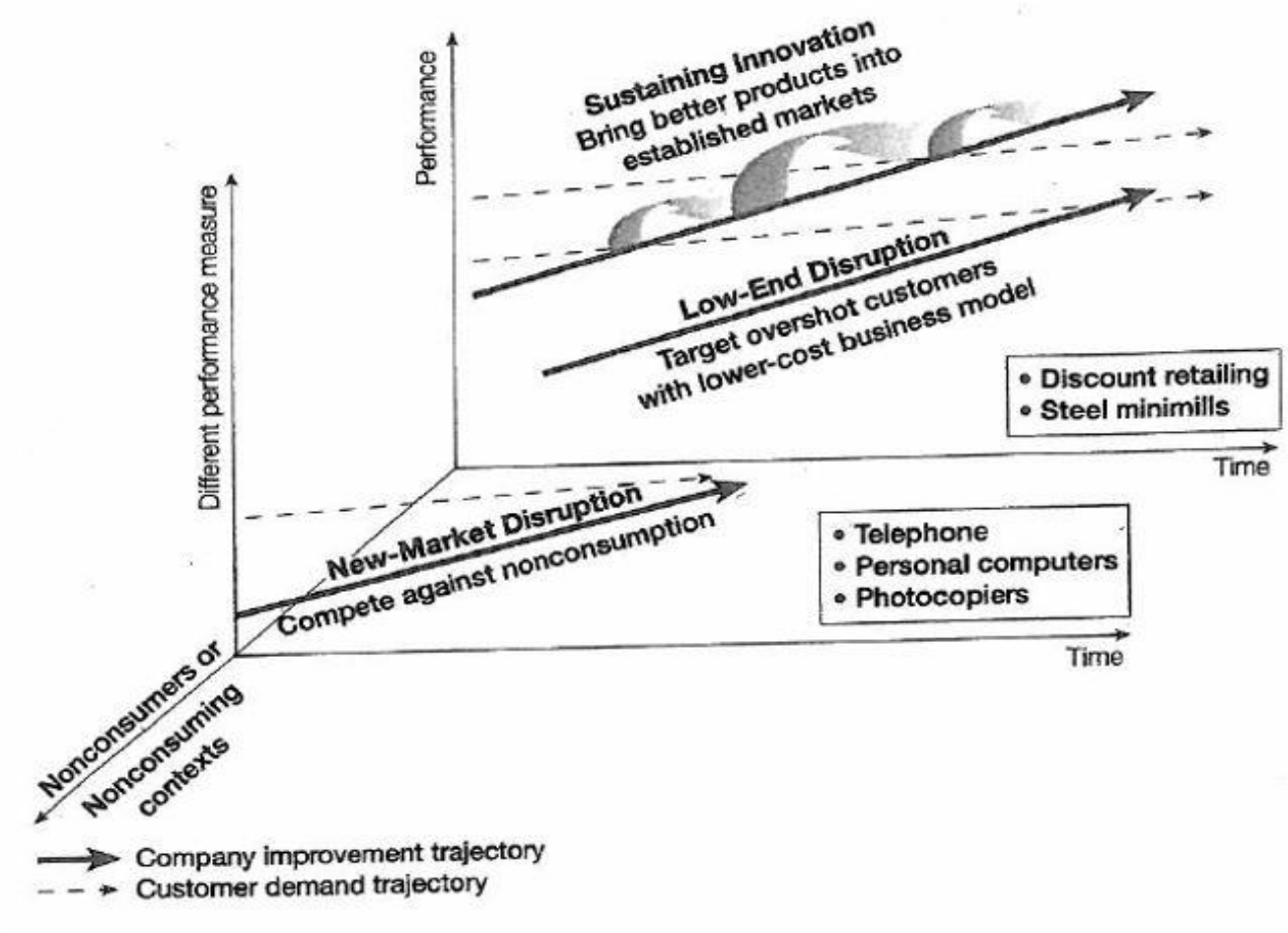

Figure 1. Disruptive innovation theory. Source: Christensen et al. (2004, xvi).

Large incumbents will prefer sustaining innovations over disruptive innovations (Christensen 1997; Christensen et al. 2004; Raynor 2011). This may be due to three reasons. First, as they are focused on their existing customers, they will give their customers what they want and "kill" any other ideas. Secondly, small emerging markets where disruptive technologies typically are aimed at initially are not attractive to large companies due to their low profit potential. Thirdly, the rigid capabilities of large companies can set boundaries for strategic maneuvers to pursue disruptive innovations. According to disruptive innovation theory, large incumbents are likely to beat entrants when the contest is about sustaining innovations, but lose against entrants with disruptive innovations. This is because good management for large incumbents implies market research and thorough planning, which are suitable practices when dealing with sustaining innovations. However, in the case of disruptive innovations, the markets are unknown and market data does not exist. Therefore, forecasts and chosen strategies can be wrong. Tolerance of failure is a major issue that large successful incumbents struggle with. Because of their flexibility to be able to cope with uncertainty and tolerate failure, start-ups are more likely to succeed in disruptive innovations. Many large incumbents tend to wait until these markets will grow "to be interesting" and dismiss disruptive innovations (Christensen and Bower 1996). This gives small start-ups significant protection to initially achieve important first-mover advantages.

According to disruptive innovation theory, disruptive innovations do not target the mainstream market at first, because they underperform compared to existing products. However, over time these innovations will become performance-competitive due to fast technological developments. Mainstream customers will switch to them when they fulfill their existing requirements and offer additional advantages not provided by incumbents' products and/or when the unit prices of the innovations are significantly lower than those of incumbents' products (Christensen and Bower 1996; Adner 2002). As a result of this development, the small entrant company will grow and replace the incumbents.

2.3 Challenges and Success Factors in Pursuing Disruptive Innovations

Innovations have high failure rates, and even in favorable cases, they create unprofitability at initial stages. The key managerial challenge in an innovation-generating organization is matching the organization's technological capabilities with existing and new market opportunities (Damanpour and Wischnevsky 2006). Organizations differ in their abilities to manage this challenge. While organic, small organizations with entrepreneurial cultures and decentralized, flexible structures have higher chances to succeed in pursuing radical (disruptive) innovations, mechanistic, established large organizations with efficiency cultures and centralized structures are more likely to succeed in pursuing incremental (sustaining) innovations (Tushman and Smith 2002). Some scholars refuse this proposition and argue that large organizations with more resources to invest, more skilled workers and organizational capabilities can overcome structural issues through establishment of small, flexible units created especially for innovation (Nord and Tucker 1987; Leifer et al. 2000). Small organizations, on the other hand, can overcome their resource issues through networking. Networking in cognitive, institutional, organizational and spatial proximity enhances capacity for innovation through access to extended knowledge base, complementary resources and financing while reducing uncertainties through risk and cost sharing (Freel 2003; Dewick and Miozzo 2004; Zeng et al. 2010). Interactive learning through knowledge generation, knowledge transfer and knowledge absorption and collective entrepreneurship are critical factors for successful innovations of small organizations (Lundvall 1992).

Some of the barriers against pursuing disruptive innovations are the existence of a dominant concept and tendency to sustain a successful business model together with a highly inward focus (Paap and Katz 2004), excessive bureaucracy and tendency to preserve routines and the status quo resulting in risk averseness and inability to unlearn (Quinn 1985; Sharma 1999), and lack of capabilities in foresighting, innovating and managing under conditions of high risks and uncertainty (Assink 2006).

Disruptive innovations are about doing something unlike that is likely to change the game in the industry (Assink 2006). Most of the disruptive start-ups failing to validate if there is demand for their product will not succeed (Marmer et al. 2011). To maximize the value of the commercialization of an innovation, a company would aim to create significant product changes in a way that minimizes the need for customers to change their behavior when using the new product (Gourville 2006). Distinguishing between circumstances and customers is a formula for success, i.e. a product should be targeted at the circumstances where customers are rather than at customers themselves (Christensen and Raynor 2003). In other words, instead of conducting market segmentation based on product type, price point, demographics and psychographics, it would be more important to understand the circumstances that customers are in when they buy or use a product. Almost 70 percent of start-ups make the mistake to develop product, team, business model, or the financials inconsistently with the customer dimension, for example, by adding unnecessary features to the product or scaling up too early on (Marmer et al. 2011). According to Christensen et al. (2004), another common mistake is that start-ups primarily target the mainstream market and modify their products to match the needs of the mainstream market.

Addressing the "right" customers (not mainstream customers) for the disruptive technology, having small organizations that will get excited about small wins, living up with or planning for failure and building iterative learning inexpensively from

failure, and creating new markets that will value the attributes of disruptive innovations rather than searching for technological breakthroughs are vital for success in managing disruptive innovations (Christensen 1997). According to the assessment framework by Hang et al. (2011), disruptive innovations are more likely to succeed if they are positioned for the low-end market or for a new niche market, and large incumbents in the mainstream market are willing to ignore the disruptors. In addition, chances of success will be higher when a performance overshoot exists in the mainstream market, and it is possible to improve the disruptive technology to achieve improved product performance and price (ibid.). Having a strategic innovation orientation and adopting an outside-in view to understand user experience followed by sense making, problem finding, foresighting, and creating a vision of the future that others do not yet possess, could increase chances of success (Prahalad and Ramaswamy 2003; Rosenbusch et al. 2011; Priem et al. 2012; Petrick and Martinelli 2012). Other identified success factors include applying strategic roadmapping as an evergreen process, having strong leadership to create an impetus for change and to redirect resources, and developing appropriate new business models for delivering disruptive innovations (Petrick and Martinelli 2012).

3. Methodology

The research approach was inductive utilizing case study as the research strategy. Inductive approach was selected since there is need to better understand challenges and success factors in the process of pursuing disruptive innovations in the context of Finnish high-tech start-ups. Acknowledging this need and the inductive approach of the research, case study was selected as the optimal strategy as it enables deep, detailed investigation of relatively new, emerging phenomena and suits particularly well to providing answers to how and why questions for the purposes of theory development (Eisenhardt 1989; Yin 2003). The small number of truly disruptive companies in Finland created a limitation in finding case companies willing to take part in the study. Due to this limitation it was decided to conduct a single case study. As case studies have limitations regarding generalizability (Siggelkow 2007), results are specific to the context of Finnish high-tech start-ups. However, case studies do not always aim to produce a representative sample. A particular organization can be selected because it allows one to gain insights that other organizations would not be able to provide (ibid.). It is extrapolation, not generalization, which is intended in case studies when the researcher aims to relate observations from the case to abstract concepts rather than the population (Alasuutari 1995). In this research, the value of the case company lied in its contributions to provide an understanding of challenges and success factors in Finland and to offer the opportunity to see to what extent disruptive innovation theory is valid in business-to-business (B2B) context.

Primary data from the case study was collected via an interview with one of the founding managers, hereinafter referred to as 'the case manager', of the case company. The case manager has lived through the development of the disruptive innovation and its successful launch in the market. Thus, he had excellent insights about the challenges that the company went through and corresponding success factors. In addition, secondary data about the company was consulted from its website and other publicly available sources such as videos, interviews, articles and news in order to triangulate the data from the interview. Since the case manager did not grant permission to reveal the name of the case company, special attention was paid in this section to avoid its disclosure. The case company engages in production of B2B high-tech products for a specific, old, traditional industrial sector. The case company was established during the last decade. It is renowned for its high growth and intelligent, advanced solutions for industrial customers, thus it is a good example for a successful application of disruptive innovation by a Finnish high-tech start-up. The case company got started from the initiative of people who worked in that specific industry, and from their realization that there was something that had not been yet invented but that could be developed and commercialized to greatly benefit the industry. The industry was rigidly set in its stabilized ways and functioning models, and their solution filled an existing but unacknowledged gap as an answer to changing conditions. Backgrounds of the founders of the company played a considerable role in the creation of the start-up. They knew the industry, business and technology well, and they had a clear vision of what the industry was lacking and how efficiency could be improved. The innovation of the case company can be classified as a new-market disruption.

Furthermore, an expert interview was conducted with Mr. Tuomas Maisala, Director of Spinno Enterprise Center, an expert on start-up financing and management in order to gain further insights on the topic. Spinno Enterprise Center offers internationally recognized pre-incubation and incubation programs to technology and knowledge-based start-ups aspiring to grow fast and achieve international success. Mr. Maisala has been coaching hundreds of Finnish high-tech start-ups since 2001. He was recommended by two other experts from the topic field to be the optimal person to be interviewed due to his extensive experience in the field of Finnish high-tech start-ups. This interview enabled triangulation of data from the case study and contributed to the reliability of results through cross-checking from multiple sources (see Denzin 1978). It also set grounds for understanding to what extent challenges and success factors identified from the case study can be attributed to Finnish high-tech start-ups pursuing disruptive innovations.

The interviews were semi-structured, and they lasted an hour each. They were held via Skype in Finnish, the native language of both the interviewer and the interviewees to avoid any misunderstanding or loss of meaning and to provide optimal conditions for a deep discussion. Interview questions were prepared based on the literature review. With the permission of the interviewees, the interviews were recorded, and transcripts were written. Transcribed data from the interviews and secondary sources was analyzed using the method of content analysis (see Krippendorff 2012). In this empirically grounded method, textual data was organized in the analysis using the codes of "challenge" and "success factor" in line with the research questions. Selecting codes in line with the research questions ensured internal validity of results (Yin 2003). As a result, key challenges and corresponding success factors were identified. A qualitative analysis software package was not used since data was not large.

4. Results

Findings listed in this section were derived from the case study and confirmed by the expert interview. The expert interview confirmed that in Finland disruptive innovations are not born easily. Large companies do not carry out disruptive innovations since they lack required flexibility, and they spare most of their energy to find new solutions for their well-established clientele. Their management, under pressure from investors, prefer to focus on the next quarter's results and thus ignore disruptive innovations which bring returns on a ten-year time scale. Furthermore, as the case manager stated, Finland lacks entrepreneurial culture since entrepreneurship is linked with opportunity to earn more money. He said: "*in Finland one cannot get rich. It is wrong. If one aims to do something big from the very beginning, he is branded a megalomaniac or an opportunist. In Finnish language 'an opportunist' is a negative word*". As a result, there are not many success stories of disruptive innovations in Finland. Rare cases are undertaken by start-ups, such as the case company, and almost all of them are new-market disruptions. Triangulation of data from the interviews showed that there are four categories of challenges faced by Finnish high-tech disruptors. These are identifying disruptive innovations that have market potential, obtaining adequate funding at initial stages of the business, marketing of the disruptive innovation, and the length and riskiness of the process. These challenges and success factors to overcome are presented in Figure 2 and described in detail in the rest of this section.

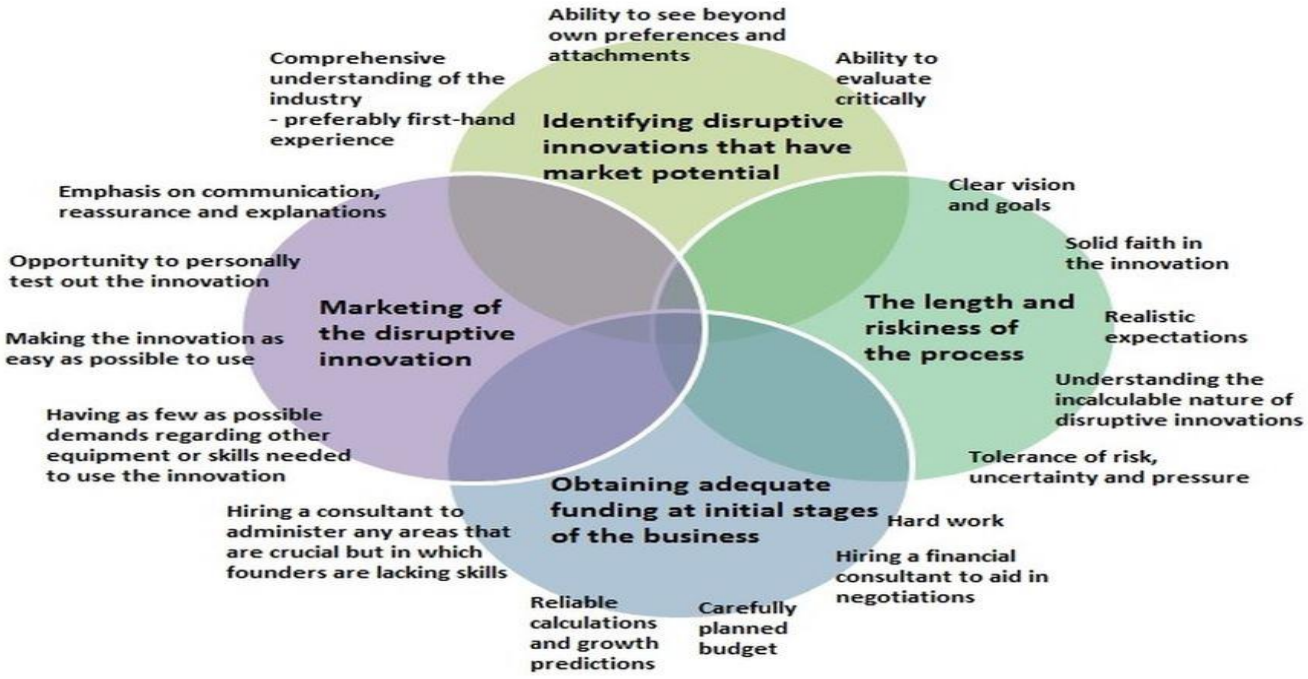

Figure 2. Success factors to overcome identified challenges in pursuing disruptive innovations.

Challenge #1: Identifying disruptive innovations that have market potential. A challenge with disruptive innovations is that the market does not readily exist. It is crucial to think far enough whether there is need and demand for the innovation. The interviews revealed that public and private equity investors in Finland understand well the fact that managing in such uncertainty requires an experienced team. A dream case is when there is a good team with experience from the industry and running a start-up, and there is a unique technological innovation that could be patented. Doing market research is more

guided by the team's understanding of the market, and external consultants are used if needed. When one deals with existing markets, figures and estimations are available, but in the case of disruptive innovations market research is more qualitative based on visions of industry experts to validate whether the solution is possible and whether there will be markets for it. Mistakes are made in estimating the market potential.

Founders' comprehensive understanding of the industry preferably through first-hand experience, their ability to see beyond own preferences and attachments, and their ability to critically evaluate the innovation's market potential are success factors to overcome this challenge. The case manager believed that the disruptive innovation of the case company was not so complicated, but challenges emerged when launching it into the industry. The technology that they developed almost for one year did not end up being utilized in their final products, and the current product idea came along as a side project from the initial idea. This suggests that it is crucial to stay focused with a clear vision from the start but not to blindly go with it and to be open to emerging opportunities. It is equally important to be unique and stand out from the crowd. The case manager perceived creativity as highly important in achieving this objective, and management has supported creativity by encouraging to question all functioning models.

A major success factor was the nature of the disruptive innovation. The innovation provided a solution to a problem that was faced in the industry, delivering noteworthy benefits and also savings to the users, offering a grounded incentive for customers to engage in employing it. The innovation entailed green values which offered customers yet another incentive to employ it. As it is a B2B product, engaging in green values worked as a positive public relations tool for customers. The case manager stated that the innovation was commercialized at an optimal time to fit the environmental trends in the industry. It would not have made sense twenty years ago.

Challenge #2: Obtaining adequate funding at initial stages of the business. The case manager stated that "*the key challenge circles around money at the end*". If the business idea is good and there are right people involved, the key challenge is to find and maintain the funding and the cash flow. Cash flow is everything to start-ups, and it should be carefully looked after. To secure funding, countless of hours of work are needed.

Mr. Maisala further confirmed that many start-ups fail before obtaining any meaningful turnover. However, if they achieve breakthrough, then growth is usually considerably higher than in the case of sustaining innovations as there are not yet similar products from competition. Despite this understanding, funding usually comes after a technology is patented, and it is very small at the initial stage where one only has an idea of a disruptive innovation. The issue is that financiers in Finland lack instruments to suit disruptive start-ups, and as a result there is room for improvement in providing optimal, timely public funding.

Making reliable calculations and growth predictions, having a carefully planned budget, hiring a financial consultant to aid in financing negotiations, hiring a consultant to administer areas in which founders are lacking skills, and hard work are needed to overcome this challenge. The case manager said that responsibilities between the founders were clearly divided from the very beginning. They worked long hours, and with skillful budget planning they relied on self-finance for the first six months. After that they received a few thousand Euro support from a business incubator which enabled them to hire their first consultant to chew on the business idea. They rented a small office room, which was mainly used as a postal address. This was followed by a larger capital loan from a public sector actor in the Finnish innovation system, which enabled them to hire their first employee and to utilize a funding consultant to negotiate on their first proper investment. As one of the success factors of the company, the case manager stated that they have never tried to do something they cannot do and have always utilized professionals where needed. Obtaining funding has never been easy. However, with persistent attitude, hard work, solid faith in the product, using an external funding consultant and searching for funding from the right sources that are familiar with their industry, they gradually managed to build foothold among investors. At the end, the case company became a dream case for investors earning them significant return on their investment.

Challenge #3: Marketing of the disruptive innovation. Marketing of disruptive innovations differs from marketing of sustaining ones. The interviews suggested that in the case of sustaining innovations marketing is cheaper because it is easier to communicate the solution when it is possible to reach the existing market with known pricing principles. In the case of disruptive innovations, it takes time to gain customers. There is need to tell more about the solution, and it usually requires some training and even trial for customers to gain understanding and acceptance.

Emphasis on communication, reassurance and explanations with customers, opportunity for customers to test out the innovation, making the innovation as easy as possible to use, and having as few as possible demands from customers regarding equipment or skills needed to use the innovation all help in successful marketing of the disruptive innovation. Professional market research had nominal value for the case company. The case manager said that it had to be done to convince financiers utilizing a pricey, well-respected market research consultant even though the founders had a strong understanding of the industry. The case manager further argued that being the first-mover has its pros and cons. While lack of competition means that there are no tender bids, selling something is always easier if there are others to promote the sales. Even though there were no direct competitors at the start, the case company considered companies that aimed to solve the same problem with a different solution as competitors. Today there are competitors with more similar solutions but nothing that matches up with

the case company's offering. The case company differentiated itself from competitors by doing sales more closely to the customer. It targeted key players in the mainstream market right from early moments after the launch of the disruptive innovation. This is reflected in the case manager's following words: "*we have tried to go as deep as possible into the customer organization, in a way that would allow us to build our solution into the customer organization so that it is not actually our product but part of the functioning model of the customer organization*". The case company also aimed to make their technical solutions as easy as possible to the customer organization, ensuring that there are as few as possible additional requirements concerning equipment, knowledge and skills. The case company tried to break all functioning models and role models in the industry and introduced new ways of thinking how everything should be done. This attitude brought them a lot of positive feedback.

Challenge #4: The length and riskiness of the process. Mr. Maisala confirmed that disruptive innovations never grow as fast as originally expected. They do not pay out in short-term, nor do they follow a linear path. The process of new-market development is long, and there are risks involved due to high level of uncertainties in the market, the technology, and their fit. There are often surprises, and something can finally break through after several failures.

Having clear vision and goals, solid faith in the innovation, realistic expectations, understanding the incalculable nature of disruptive innovations, and tolerance of risk, uncertainty and pressure, are success factors to overcome this challenge. The case manager suggested that selecting the right founding partners is very important. One should start a business with people who know what they are doing. Dividing the responsibilities from the very beginning and agreeing on ownership proportions should be of high priority. The case manager said that even though one gets richer by owning most of the shares alone, ownership should be rather equally divided if one aims to do something disruptive.

Both the documentary analysis and the interview with the case manager revealed that fast growth and internationalization were conscious objectives that the founders had set very early on. This required outside investors to step in and resulted in drop of the founders' own shares. The case manager did not regret having a relatively smaller share. He said: "*probably I would be wealthier had we chosen a strategy of slow growth. We would have taken less money in, done less R&D and exchanged less, but on the other hand, this would not have been equally fun*". Nowadays, their product is becoming the de facto standard in the industry worldwide. This would not be possible without the fast growth. Outside investment and growth expectations placed by the investors had an impact on the aggressive growth strategy of the company. However, due to the special nature of the industry, investors have also been flexible when necessary. The case manager said that investors finally accepted the long-term nature of their disruptive innovation.

In transition from a start-up into a growth business, the case company hired a professional Chief Executive Officer (CEO). This was demanded by investors as founders rarely possess enough experience and vision of large business operations as much as a professional CEO can. The case manager believed that "*bringing a professional CEO in lifted the company one step upwards*". Selecting the right person, however, is very important. He reminded that appointment recommendations for a professional CEO may come from the investors, but start-ups must be careful because recommendations may not always be the best choices.

5. Discussion

This research analyzed challenges faced by Finnish high-tech start-ups pursuing disruptive innovations and ways to overcome them successfully, from the study of a successful case company. Earlier literature had identified not understanding what makes a successful innovation (Christensen 1997), challenges in matching technological capabilities with market opportunities (Damanpour and Wischnevsky 2006), challenges in coping with uncertainties regarding market potential and not having tolerance to failure (Christensen 1997; Assink 2006; Marmer et al. 2011), sticking with a dominant concept or business model blindly (Paap and Katz 2004), building bureaucratic structures that hinder flexibility and lacking strong leadership to drive change (Quinn 1985; Sharma 1999; Tushman and Smith 2002) as challenges in pursuing disruptive innovations. The empirical study contributes to this field in that it provides a structured classification of four challenges and offers solutions to overcome them in the context of new-market disruptive innovations in Finland. The first challenge is financing. There are not appropriate instruments to assess the success potentials of disruptive start-ups. As a result, they are not likely to receive funding from public and private financiers at early stages when they need it the most. If the pace of adoption of a disruptive innovation is slow, start-ups can suffer a lengthy period of time before they can achieve decent, steady cash flow. Two related challenges are estimating market potential of the innovation and its actual marketing as there are no existing markets for the disruptive innovation. The length and riskiness of the process is the fourth challenge. The above challenges are doubled in Finland given the traditionally negative perceptions in the public towards opportunity recognition and entrepreneurship. These challenges help explaining why there are not many successful disruptive innovations in Finland.

This research also makes a significant contribution to disruptive innovation theory. The case contradicts the theory by exemplifying the possibility of targeting mainstream customers right from the start in the context of pursuing new-market

disruptions. One explanation of the contradiction may be that the disruptive innovation theory was developed primarily for business-to-consumer (B2C) disruptive innovations. In the B2B context, if the solution provided by the innovation is unique and offers clear advantages for business customers, why should mainstream customers not be targeted from the start? Further research is needed to clarify differences between B2B and B2C disruptive innovations.

To overcome these challenges, earlier literature offered to prioritize customers and investors, give them what they want and kill all other ideas (Christensen 1997), not to target mainstream market at first but niche market segments i.e. "right customers" (ibid.) instead, to validate whether there is real demand for the innovation (Marmer et al. 2011), to have an outside-in view to understand user experiences and circumstances that customers are in (Christensen and Raynor 2003; Prahalad and Ramaswamy 2003), to be flexible in coping with uncertainty and plan for failure (Christensen 1997; Paap and Katz 2004), and to implement strategic roadmapping (Petrick and Martinelli 2012). This research contributes further by offering a corresponding set of practical suggestions to entrepreneurs to overcome the four challenges in pursuing new-market disruptions. Firstly, it is important for entrepreneurs pursuing disruptive high-tech innovations to be aware of the difficulties of the process and to acknowledge the unique nature of disruptive innovations, placing emphasis on the challenges caused by the disruptive nature of the innovation. Only then can the challenges be successfully overcome. The founders are required to have a comprehensive understanding of the specific industry in which they operate in, and to critically assess whether there is demand for the innovation. Solid faith in the innovation but also realistic expectations and understanding of the incalculable nature of dealing with disruptive innovations are needed. The founders are recommended to have clear vision and goals right from the beginning but also tolerate failure at times and be flexible to adopt emerging ideas. It is important not to try to do everything alone. Even though money can be scarce, it is smart to utilize external consultants when needed. Hard work, managing relationships with investors and customers, and continuously challenging industry practices are other success factors. It is recommended that founders share responsibilities and rewards fairly equally. Cash flow management is extremely important for start-ups. To manage it well, a carefully planned budget as well as creativity to keep the expenses at minimum are needed. Clear and reliable calculations and growth predictions to present to right financiers and investors who have understanding of the industry are required. Obtaining financing takes a lot of effort, and opportunities are not abundant at initial stages. It also matters to correctly communicate the innovation to customers. Reassurance and specific explanations, together with an opportunity for customers to personally test out the innovation, are needed to convince customers. As disruptive innovations usually require some readjustment or adaptation of the customers' side, it is important to make the new disruptive innovation as easy-to-use as possible and place as few as possible demands from customers regarding other possible equipment or skills to use it.

Given the challenges outlined here, there may also be a number of suggestions for stakeholders in the Finnish innovation system to improve the situation. Competitions could be organized to assess and identify most promising disruptive innovations, and selected innovations could be granted long-term financing by relevant public and private investors and financiers. It is also recommendable for investors and financiers to bear in mind that their investments in disruptive innovations will be rewarding over a long-term and not to pressure for immediate returns. It is important to ensure the availability of consultancy services, and to encourage start-ups to seek professional advice whenever necessary.

This study was subject to at least two limitations. First of all, it was not allowed to reveal the name of the case company and its industry. Although this limits any industry-specific insights and discussions, it can be argued that the findings are common for disruptive high-tech start-ups. This argument is based on the fact that the insights from Mr. Maisala were supporting the findings from the case study. This is a positive indicator regarding the reliability of the findings. Similar research from Finland is recommended in the future to further validate the results of this study. The second limitation is that the results are based on a study of a case of a high-tech new-market disruption from Finland in B2B context. Therefore it is not possible to generalize the results to contexts outside of Finland, high-tech industries, and B2B new-market disruptions. Comparative research from other countries and other industries is recommended to benchmark the results. Case studies of low-end disruptions are encouraged to unveil whether there are differences according to the type of disruption.

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References

Adner, R. (2002). When are technologies disruptive? A demand-based view of the emergence of competition. *Strategic Management Journal*, 23(8), 667-688.

Alasuutari, P. (1995). *Researching Culture: Qualitative Method and Cultural Studies*. London: Sage.

Assink, M. (2006). Inhibitors of disruptive innovation capability: A conceptual model. *European Journal of Innovation Management*, 9(2), 215-233.

Becheikh, N., Landry, R., & Amara, N. (2006). Lessons from innovation empirical studies in the manufacturing sector: A systemic review of the literature from 1993-2003. *Technovation*, 26(5-6), 644-664.

Christensen, C. M. (1997). *The innovator's dilemma: When new technologies cause great firms to fail*. Boston, Massachusetts: Harvard Business School Press.

Christensen, C. M. (2007). Disruption drives growth: Ten years after 'The innovator's dilemma'. *Strategy & Innovation: Breakthrough Insight and Ideas for Driving Growth*, 5(3), 1-20.

Christensen, C. M., Anthony, S. D., & Roth, E. A. (2004). *Seeing what's next: Using the theories of innovation to predict industry change*. Boston, Massachusetts: Harvard Business School Press.

Christensen, C. M., & Bower, J. L. (1996). Customer power, strategic investment, and the failure of leading firms. *Strategic Management Journal*, 17(3), 197-218.

Christensen, C. M., & Raynor, M. E. (2003). *The innovator's solution: Creating and sustaining successful growth*. Boston, Massachusetts: Harvard Business School Press.

Christensen, C. M., Anthony, S. D., & Roth, E. A. (2004). *Seeing What's Next: Using the Theories of Innovation to Predict Industry Change*. Boston, Massachusetts: Harvard Business School Press.

Cumming, B.S. (1998). Innovation overview and future challenges. *European Journal of Innovation Management*, 1(1), 21-30.

Damanpour, F. (1996). Organizational complexity and innovation: Developing and testing multiple contingency models. *Management Science*, 42(5), 693-716.

Damanpour, F., & Wischnevsky, J. D. (2006). Research on innovation in organizations: Distinguishing innovation-generating from innovation-adopting organizations. *Journal of Engineering and Technology Management*, 23(4), 269-291.

de Jong, J. P. J., & Marsili, O. (2006) The fruit flies of innovations: A taxonomy of innovative small firms. *Research Policy*, 35(2), 213-229.

Deloitte (2012). Deloitte announces 2012 technology Fast 500™ rankings: Press release, http://www.deloitte.com/view/en_US/us/Industries/technology/5f0c69032e4fa310VgnVCM1000003156f70aRCRD.htm. Accessed on 9 May 2013.

Denzin, N. (1978). *The Research Act: A Theoretical Introduction to Sociological Methods*. New York: McGraw-Hill.

Dewick, P., & Miozzo, M. (2004). Networks and innovation: Sustainable technologies in Scottish social housing. *R&D Management*, 34(4), 323-333.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, 14(4), 532-550.

Florida, R., Mellander, C., & Stolarick, K. (2011). *Creativity and prosperity: The global creativity index*. Martin Prosperity Institute, http://martinprosperity.org/media/GCI%20Report%20Sep%202011.pdf . Accessed on 20 May 2013.

Freel, M. S. (2003). Sectoral patterns of small firm innovation, networking and proximity. *Research Policy*, 32(5), 751-770.

Freel, M. S. (2005). Patterns of innovation and skills in small firms. *Technovation*, 25(2), 123-134.

Gatignon, H., Tushman, M. L., Smith, W., & Anderson, P. (2002). A structural approach to assessing innovation: Construct development of innovation locus, type, and characteristics. *Management Science*, 48(9), 1103-1122.

Goedhuys, M., & Veugelers, R. (2012). Innovation strategies, process and product innovations and growth: Firm-level evidence from Brazil. *Structural Change and Economic Dynamics*, 23(4), 516-529.

Gourville, J. T. (2006). Eager sellers & stony buyers: Understanding the psychology of new-product adoption. *Harvard Business Review*, June 2006, 98-106.

Hamel, G. (2000). *Leading the revolution*. Boston, Massachusetts: Harvard Business School Press.

Hang, C. C., Chen, J., & Yu, D. (2011). An assessment framework for disruptive innovation. *Foresight*, 13(5), 4-13.

Hyrsky, K., & Tuunanen, M. (1999). Innovativeness and risk-taking propensity: A cross-cultural study of Finnish and U.S. entrepreneurs and small business owners. *Liiketaloudellinen Aikakauskirja*, 3/99, 238-256.

Korpelainen, K., & Lampikoski, K. (1997). *Innovatiivisuus: Muutosvoima*. Porvoo: WSOY.

Krippendorff, K. (2012). *Content Analysis: An Introduction to its Methodology*. Thousand Oaks, California: Sage.

Leifer, R., McDermott, C. M., O'Connor, G. C., Peters, L. S., Rice, M., Veryzer, R. W. (2000). *Radical Innovation: How Mature Companies Can Outsmart Upstarts*. Boston, Massachusetts: Harvard Business School Press.

Leifer, R., O'Connor, G. C., & Rice, M. (2001). Implementing radical innovation in mature firms: The role of hubs. *The Academy of Management Executive*, 15(3), 102-123.

Lundvall, B. (1992). *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Printer.

Marmer, M., Bjoern, L., Dogrultan, E., & Berman, R. (2011). *Startup Genome report extra on premature scaling: A deep dive into why most high growth startups fail*. Startup Genome,

http://gallery.mailchimp.com/8c534f3b5ad611c0ff8aeccd5/files/Startup_Genome_Report_Extra_Premature_Scaling_1.56.pdf. Accessed on 29 April 2013.

Massa, S., & Testa, S. (2008). Innovation and SMEs: Misaligned perspectives and goals among entrepreneurs, academics, and policy makers. *Technovation*, 28(7), 393-407.

Nord, W. R., & Tucker, S. (1987). Implementing Routine and Radical Innovations. Lexington, Massachusetts: Lexington Books.

Nordic Council of Ministers (2010). *Nordic entrepreneurship monitor 2010*. Copenhagen: Nordic Council of Ministers.

Paap, J., & Katz, R. (2004). Anticipating disruptive innovation. *Research Technology Management*, 47(5), 13-22.

Pavitt, K. (1984). Sectoral patterns of technical change: Towards a taxonomy and theory. *Research Policy*, 13(6), 343-373.

Petrick, I. J., & Martinelli, R. (2012). Driving disruptive innovation: Problem finding and strategy setting in an uncertain world: A 10-step strategic roadmapping method can help companies develop an outside-in view of the future to drive change. *Research-Technology Management*, November-December 2012, 49-57.

Prahalad, C. K., & Ramaswamy, V. (2003). The new frontier of experience innovation. *MIT Sloan Management Review*, 44(4), 12-18.

Priem, R. L., Li, L., & Carr, J. C. (2012). Insights and new directions from demand-side approaches to technology innovation, entrepreneurship and strategic management research. *Journal of Management*, 38(1), 346-374.

Quinn, J.B. (1985). Managing innovation: Controlled chaos. *Harvard Business Review*, May-June 1985, 73-84.

Raynor, M. E. (2011). Disruption theory as a predictor of innovation success/failure. *Strategy & Leadership*, 39(4), 27-30.

Roberts, E. B. (1988). Managing invention and innovation. *Research Management*, 31(1), 11-29.

Rogers, E. M. (1995). *Diffusion of Innovations*. New York: Free Press.

Rosenbusch, N., Brinckmann, J., & Bausch, A. (2011). Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs. *Journal of Business Venturing*, 26(4), 441-457.

Rothwell, R. (1992). Successful industrial innovation: Critical factors for the 1990s. *R&D Management*, 22(3), 221-239.

Rouvinen, P., & Pajarinen, M. (2012). Country specific findings – Finland. In: G. Napier, P. Rouvinen, D. Johansson, T. Finnbjörnsson, E. Solberg, & K. Pedersen, *The Nordic growth entrepreneurship review 2012: Final report* (pp. 47-54). Oslo: Nordic Innovation.

Ruohonen, J. (2007). *VICTA – Virtual ICT accelerator*. Technology Review 219/2007, Tekes, http://www.tekes.fi/julkaisut/victa.pdf. Accessed on 9 May 2013.

Schumpeter, J. A. (1934). *The Theory of Economic Development*. Cambridge: Harvard University Press.

Sharma, A. (1999). Central dilemmas of managing innovation in large firms. *California Management Review*, 41(3), 146-164.

Siggelkow, N. (2007). Persuasion with case studies. *Academy of Management Journal*, 50(1), 20-24.

Sitra (2005). Suomi innovaatiotoiminnan kärkimaaksi: Kilpailukykyinen innovaatioympäristö – kehittämisohjelman loppuraportti. Helsinki: Sitra.

Trott, P. (2012). *Innovation management and new product development*. Harlow: Financial Times Prentice Hall.

Tushman, M. L. (1997). Winning through innovation. *Strategy & Leadership Journal*, 25(4), 14-19.

Tushman, M. L., & Smith, W. (2002). Technological change, ambidextrous organizations and organizational evolution. In: J. Baum (Ed.), *The Blackwell Companion to Organizations* (pp. 386-414). Oxford: Blackwell Publishers.

Xavier, S. R., Kelley, D., Kew, J., Herrington, M., & Vorderwülbecke, A. (2013). *Global entrepreneurship monitor 2012 global report*. Global Entrepreneurship Monitor, http://www.gemconsortium.org/docs/download/2645. Accessed on 9 May 2013.

Yin, R. K. (2003). *Case study research: Design and methods*. Thousand Oaks, California: Sage.

Zeng, S. X., Xie, X. M., & Tam, C. M. (2010). Relationship between cooperation networks and innovation performance of SMEs. *Technovation*, 30(3), 181-194.