School of Management

Open innovation in Swedish startup micro-enterprises

Blekinge Institute of Technology

School of Management

MBA Thesis

Authors: Xinyu Liu and Torbjörn Andersson

Contact information: xinyu.liu@hotmail.se, torbjorn.andersson@outlook.com

Supervisor: Ossi Pesämaa

Date: 2014-05-26

Abstract

Open innovation is the use of external partners to increase the innovation capacity of an organization. By cooperating with customers, universities, or other outside partners, companies can gain access to valuable knowledge and resources not available internally. This process is especially suited for smaller companies, which are often more focused on deep knowledge in a niche area, and may lack the wider knowledge of larger companies.

This thesis looks at the prevalence of open innovation in startup micro-enterprises in Sweden, and how the use of these methods is linked to increased innovation performance. Based on a review of previous relevant research, a model was constructed around six hypotheses, each corresponding to an external collaboration partner. Empirical data was collected by the use of a quantitative survey, distributed to companies matching the target criteria.

Empirical data was then analyzed using statistical software in order to validate if it supported the proposed model. The results show that only two of the six hypotheses, collaboration with customers and technology sourcing, were supported and significant. Two more variables, cooperation with competitors and universities, showed a positive correlation to increased innovation performance, but were not significant.

These results are in line with several previous studies, which have also found a strong support for the link between innovation performance and both customer collaboration and technology sourcing, while showing weaker links to other forms of open innovation.

Keywords: Open innovation (OI), startup, micro-enterprises (MEs), small and medium enterprises (SMEs), and innovation performance.

Acknowledgments

We are very thankful to our supervisor, Dr. Ossi Pesämaa, for guiding us through the thesis process and taking the time to help us in evenings and weekends when needed.

We would also like to thank our course director, Dr. Urban Ljungquist, for valuable comments and feedback, which improved the quality of this thesis.

We also greatly appreciate the contribution made by all the company leaders who took the time to complete the survey, thus making this study possible.

Last but not least, we would like to thank all the other people who supported us during the writing of this thesis.

Xinyu Liu and Torbjörn Andersson

Table of Content

Lists of Figures

List of Tables

1 Introduction

This thesis looks at open innovation and its use by small startup companies in Sweden. In the modern globalized business world, competition is hard in all markets, and one of the main success factors is innovation. However, innovation requires large commitments of time and resources, making new product development a substantial hurdle for smaller companies. Open innovation, the utilization of external resources and partners, has proven to be a successful tool for many such companies to get an edge over their competitors and develop products that would only have been possible at large enterprises in the past.

1.1 Background

Many companies rely on continuously developing new products or services. In the past, companies would perform all development work within the firm, only relying on internal knowledge and creativity. In today's increasingly complex environment of technology and knowledge it is harder for a single company to master all the skills needed to successfully develop a cutting edge product. To meet this challenge, companies either have to go big, employing an increasing number of experts, or go deep, by focusing the company's research on a narrow field in which to become market leaders.

Open innovation (OI) presents a third option. By using external resources and partners, a company can stay relatively small, while at the same time getting access to talent and knowledge not found within the firm. The term "open" innovation refers to the flow of ideas and resources in and out of the company and is seen as the opposite of the traditional "closed" innovation style, in which all the development work is performed within the company's walls.

In 2003, the concept of open innovation was promoted and popularized by Professor Henry Chesbrough at the University of California, Berkeley. In his book, Open Innovation: The New Imperative for Creating and Profiting from Technology, he defined open innovation as:

> *"The use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology "*
> *(Chesbrough, 2003, p. 15)*

Since then, open innovation has gained in popularity, both as a method of innovation and as a topic of study. Open innovation is today divided up in several sub-categories and include both inbound and outbound innovation activities.

In this thesis we explore how widespread the use of open innovation is in small Swedish start-up companies and how it contributes to innovation performance. Open innovation is believed to be an important tool for small companies to accelerate their innovation process and in extension drive the whole economy of the country by creating new successful companies. If open innovation is not utilized by Swedish start-ups, that would put them at a disadvantage compared to their competitors in other countries.

1.2 Problem discussion

In the early days of open innovation, it was foremost used by large international corporations, mainly in the form of customer and supplier involvement, e.g. Xerox (Chesbrough and Rosenbloom, 2002), IBM (Chesbrough and Appleyard, 2007), Nokia (Dittrich and Duysters, 2007), Deutsche Telekom (Rohrbeck et al., 2009), and Procter & Gamble (Huston and Sakkab, 2006; Dodgson et al., 2006). Open innovation in large companies is therefore a topic that has already been thoroughly researched.

However, even though open innovation was first explored by larger corporations it is perhaps even more important to small companies and start-ups, especially in reducing R&D costs and exploring new path to markets.

The attention of researchers within the field has therefore expanded to also focus on the potential of utilizing open innovation in smaller companies, for example (Van De Vrande et al., 2009; Bianchi, 2010; Rahman and Ramos, 2010; Parida et al., 2012; Birkle and Gewald, 2013; Wynarczyk, 2013).

Small and medium enterprises (SMEs) are usually restricted in their innovation process due to limited internal resources (Pittaway et al., 2004). By using open innovation, these companies can overcome their liability of smallness and perform better than they would have if innovation only relied on internal resources (Parida et al. 2012). Although the success of open innovation in larger firms cannot be translated directly to apply to companies of any size, there are several factors that make open innovation beneficial in small companies as well. Small companies typically lack the bureaucracy and hierarchy of larger firms and instead use flat structures which are good at promoting employee participation and creativity (Laforet, 2008). Smaller companies are also more flexible and can quickly adapt to new innovation opportunities (Hutter et al., 2013). The willingness to take risks is also a factor that is to the advantage of SMEs when using open innovation (Parida et al., 2012). Nonetheless, recent studies show that open innovation is still more commonly practiced in larger corporations, as opposed to small companies (Ebersberger et al., 2010). Keupp and Gassmann (2009) also fins that firm size does matter when it comes to adoption and implementation of open innovation. Van de Vrande et al. (2009) suggest that these barriers are related to cultural and organizational issues.

So far, most evidence used to draw conclusions about open innovation originates from US-based companies, and there has not been much research work done in Europe, especially in Sweden. On the other hand, Sweden is considered one of the best

innovation countries in Europe, and it has a great business atmosphere for small companies (European Commission, 2013).

Previous research have found that open innovation has been easier to implemented in social media, service, and software businesses (Parida et al., 2012). Birkle and Gewald (2013) found that in Germany, among 48% of the SMEs that have been adopting open innovation are in media and communication businesses. This sparked an interest to investigate if there are similar patterns to be found among small companies in Sweden.

While more and more studies of open innovation in SMEs are now emerging, there is still very little research devoted to the smallest companies. This study focuses on recently founded micro-enterprises (MEs), and look at how they are using open innovation to increase their innovative potential. Studies have shown that a successful innovation process increases the chances of company survival by 22 % among small companies (Golovko and Valentini, 2011; Cefis and Marsili, 2006). For MEs, the importance of innovation for survival is even greater. However, the study by Ebersberger et al. (2010) mentioned above also indicates that small companies use open innovation to a lesser extent compared to medium enterprises.

MEs have so far received very limited attention from researchers, as they are often regarded as too small to have time and capacity to engage in open innovation activities (Hutter et al., 2013). The emergence of new businesses, starting as micro-enterprises does however play an important role in driving the economy and Hutter et al. (2013), as well as the authors of this thesis, believe that MEs have much to gain from utilizing open innovation.

MEs were also chosen as the focus of this study due to personal interest of the authors, who are both currently working in this type of company.

Startups and MEs have much to gain by exploring external partnerships and cooperation with research partners. Thus far, in the context of open innovation, startups have mainly been seen as a source of external innovation bought by other larger companies to further their innovation efforts, i.e. the MEs have themselves been the external partner. This study instead puts the focus on the MEs and explores their views on open innovation, both inbound and outbound activities.

The emergence of new technologies has also made it easier for MEs to engage in open innovation activities. Web platforms facilitate both collaborations between partners as well as customer and supplier interactions (Hutter et al., 2013). The increasing attention given to innovation by governments and the encouragement to cooperate with universities and municipal partners (often a requirement to secure government funding) is also believed to have given open innovation a boost. In their study, Hutter et al. (2013) concludes that MEs have a great potential of adapting open innovation, as they are often already customer oriented, working on in highly specialized areas, and open to the inflow of external ideas.

To the best knowledge of the authors, this study is the first to investigate the occurrence of open innovation in a broad sample of Swedish startup MEs.

1.3 Problem formulation and purpose

This thesis aims to investigate how Swedish micro-enterprises (MEs), founded in the recent years, are adopting open innovation, and how that affects their innovation performance. The purpose of the study is to test a model in which open innovation is beneficial to innovation performance. To achieve this, the thesis looks at open innovation theoretically to form a number of hypotheses, and then test these hypotheses on startup MEs in Sweden. By the use of a survey, distributed to a large number of MEs, the study establishes how widespread the use of open innovation is and which external partners are most common. The use of open innovation is also linked to the innovation performance of each company. We specifically hypothesizes that inflow of external knowledge is positive for the overall innovation performance of MEs. This has previously been shown to be true for larger companies, but is not necessarily valid for MEs.

Thus, the research question of the study is formulated as follows:

> *Which forms of open innovation are most prevalent among startup micro-enterprises in Sweden, and how is it linked to their overall innovation performance?*

To answer this, a survey is utilized, and the sample consists of a large number of Swedish MEs from business areas that are involved in product or service development. The standard definition of a micro-enterprise by the European Commission is used and companies covering a wide variety of fields are selected. The definition of a startup company is limited to companies founded since January 1, 2009, with less than 10 employees. The survey results are compared with other theoretical and experimental findings.

By finding the answers to this question we hope to better understand the status of open innovation in Sweden, and to identify barriers that prevent MEs from realizing their full innovative potential.

1.4 Contributions

There is a gap between research theory and practical work. The purpose of this thesis is to test if the collaboration with external partners and the use of external resources is beneficial for the innovation performance of MEs, i.e. if open innovation in fact is useful for most MEs as a way to boost innovation performance or if it has a negative effect. In extension, the results of this study could be used to setup a guideline to help MEs in Sweden to understand the role of open innovation, and especially a framework for MEs in deciding when, how, and which open innovation practices they should engage in. The contribution from this thesis could be useful for practitioners and academia of open innovation to enhance their operational efficiency and develop a

better understanding and/or theoretical framework for open innovation.

1.5 De-limitations

Due to time limitation, we cannot link the open innovation with the firms' economic performances, i.e. to find out how open innovation can improve MEs' business performance. Instead we base innovation performance on the firm's own reported innovation efficiency in comparison with its competitors, in accordance with the surveys performed by Parida et al. (2012) and Brettel and Cleven (2011).

1.6 Thesis structure

The thesis follows conventional report structure used in academic reports. Chapter 1 provides an introduction to the topic and outline the purpose of the study. Here, the research question is also formulated. Chapter 2 then takes a deeper look at previous research to give the reader an overview of the subject as well as provide a theoretical foundation for the hypotheses of the thesis. These hypotheses are presented along with the proposed model at the end of Chapter 2. Chapter 3 introduces the reader to the research methodology used in this study and why it was chosen. It also describes the questionnaire design and sample selection processes. Additionally, it includes information on how the survey was conducted and the data analysis method. Chapter 4 presents the results from the statistical analysis performed on the collected data. This is then the foundation for the analysis and discussion of the results, which is presented in Chapter 5, along with a comparison to previous related studies. Finally, the research question is answered in Chapter 6 and practical implications of the conclusions are presented. Suggestions on further research are presented in Chapter 7.

All references are included at the end of the report as well as the complete questionnaire used in the study.

2 Theory

2.1 Micro-enterprises

The definition of micro, small and medium-sized enterprises can be classified by headcount, turnover, or balance sheet total, according to the European Commission's report, which is presented in Table 1. Based on this definition, when a headcount is less than 10 (and turnover is less than 2 million Euro), the firm is categorized as a micro-enterprise. Similarly a company with less than 50 employees is categorized as a small enterprise, and firms with a headcount between 50 and 250 are categorized as medium enterprises. In this study, the authors are only focusing on open innovation in Swedish startup micro-enterprises (MEs). Therefore, Swedish firms with 1 to 9 employees were selected for further study in this thesis.

Enterprise category	Headcount	Turnover	Balance sheet total
Medium	< 250	≤ € 50 million	≤ € 43 million
Small	< 50	≤ € 10 million	≤ € 10 million
Micro	< 10	≤ € 2 million	≤ € 2 million

Table 1: Firm size categories based on headcount, turnover and balance sheet total

According to Heshmati (2001), the micro-enterprises play a key role in the generation of jobs, new ideas and encouragement of entrepreneurial activity, and are major contributors to the well-being of nations. The growth of micro-enterprises is thus very important to the evolution of firms and regional development. Therefore, there is great interest in finding out how open innovation practices have been implemented in Swedish micro-enterprises.

2.2 Open and closed innovation

There is no universal definition of innovation. According to Oxford dictionaries, innovation is a new method, idea, product ((Oxford Dictionaries, 2014), and according to Wikipedia, innovation is something original and, as consequence, new that breaks into the market or society *(*Wikipedia, 2014). In general, innovation is seen as a process of designing, developing and implementing a novel product or service to improve economic, physical and logical parameters in the process (Rahman 2010).

In the traditional innovation process within an enterprise, a development project is initiated by a company, and is then carried out by the employees of that company until it is finished and is then released to the market. This is defined as "closed" innovation. In a book from 2003, that many regard as the starting point of this new movement within innovation, Henry Chesbrough argues that this process needs to evolve and be

adapted to the modern society (Chesbrough, 2003). Nowadays, no one person or company can hold all the knowledge and information within any given field. Therefore, Chesbrough propose an innovation process where "projects can be launches from either internal or external technology sources, and new technology can enter into the process at various stages. In addition, projects can go to market in many ways".

As a contrast to the traditional, closed innovation process, Chesbrough named this new development style "open innovation". With open innovation, companies no longer only rely on its internal knowledge but are instead encouraged to make full use of external sources of technology and information. Figure 1(a) and Figure 1(b) illustrate the paradigm of closed and open innovation in a typical research and development process. As can be seen, in the old, closed innovation process, research projects can only be formed inside firms, and then developed and commercialized into the market that the company normally operates on. In contrast, in the open innovation process, research projects can be formed in collaboration with external partners and then developed and commercialized into conventional or new markets. Also, projects created within the firm can receive input and resources from external sources. In addition, research projects within firm's R&D department can be brought outside of firm, and then developed and commercialized into new markets.

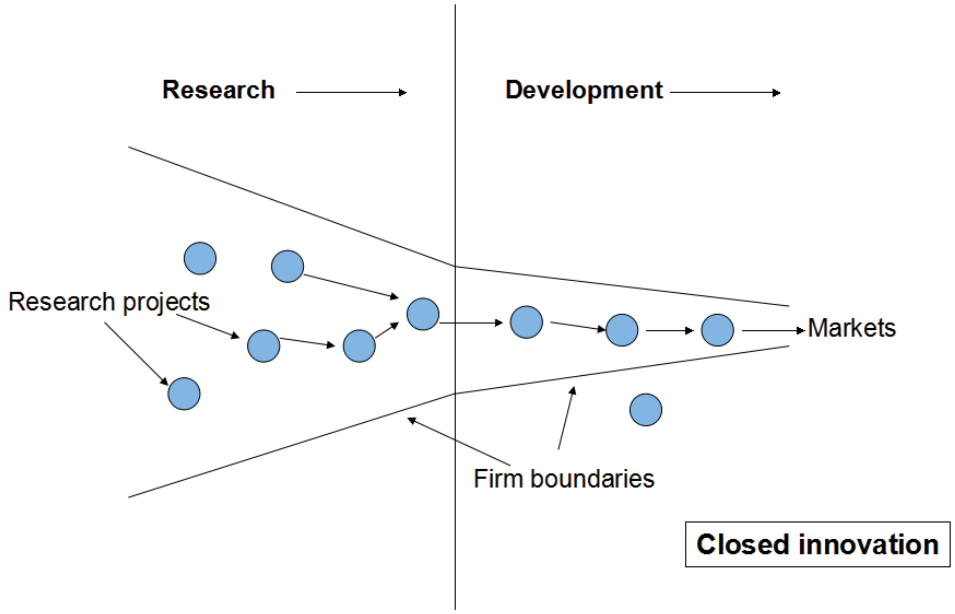

Figure 1(a). Closed innovation vs open innovation
Source: Adapted from Chesbrough (2003)

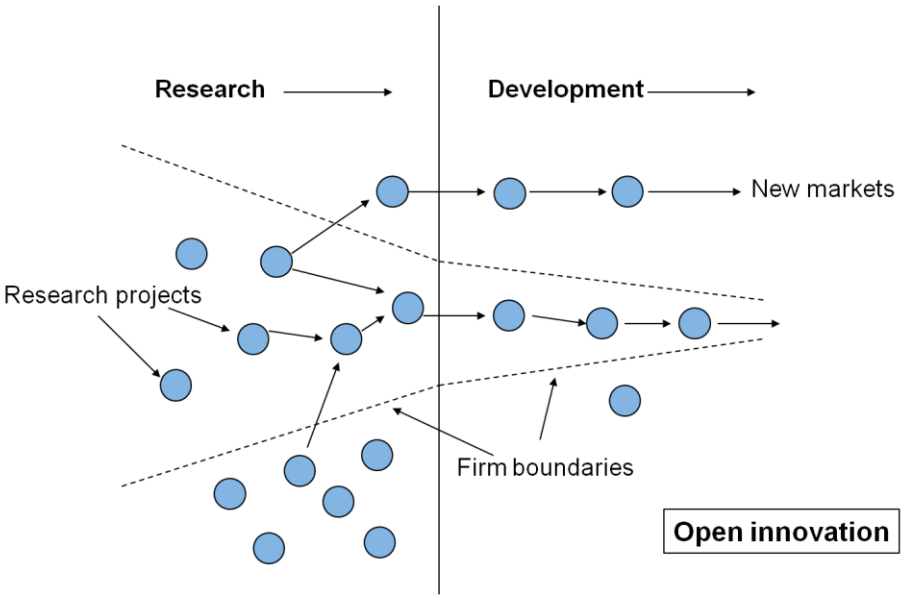

Figure 1(b). Closed innovation vs open innovation
Source: Adapted from Chesbrough (2003)

Chesbrough also highlight the major difference between closed and open innovation in their principles, which is illustrated in Table 2. The major difference is that in the open innovation process, not only the employees, but also external partners and people possessing special competences within niche areas can work together with the firm and create value as long as the firm chooses a suitable open innovation process.

Closed innovation	Open innovation
The smart people in our field work for us.	Not all smart people work for us. We need to work with smart people inside and outside the company.
To profit from R&D, we must discover it, develop it and ship it ourselves.	External R&D can create significant value. Internal R&D is needed to claim some portion of that value.
The company that gets innovation to market first will win.	Building a better business model is more important than getting to market first.
If we create the most and the best ideas in the industry, we will win.	If we make the best use of internal and external ideas, we will win.
We should control our IP, so that our competitors cannot profit from it.	WE should profit from other's use of our IP (license out) and we should license in other's IP whenever it advances our business model.
We will own all results from contract research with universities.	We will partner with universities to create knowledge and encourage use outside our field.

Table 2. Closed innovation vs open innovation. Source: Adapted from Chesbrough (2003)

2.2.1 Benefits of open innovation

Open innovation offers many benefits to companies working with product or service development and has therefore quickly gained followers. Especially large innovative companies such as Xerox (Chesbrough and Rosenbloom, 2002), IBM (Chesbrough and Appleyard, 2007), Nokia (Dittrich and Duysters, 2007), Deutsche Telekom (Rohrbeck et al., 2009), and Procter & Gamble (Huston and Sakkab, 2006; Dodgson et al., 2006), were early adopters.

Open innovation brings an array of external resources and ideas into the internal innovation process. Furthermore, close cooperation with suppliers and customers can increase the creative capacity by making the company aware of market conditions and needs (Dyer and Singh, 1998).

There are also benefits related to the risk of new product development. If a product is developed in collaboration with the customer, there is already a buyer at the end of the product development cycle, and thus the company is exposed to less risk when investing money in such a development process (Ragatz, et al., 2002).

Vanhaverbeke et al. (2008) identify four major advantages of implement open innovation:

- Early involvement in new technology and/or business opportunities
- Access to other organization's R&D
- Access to venture capital funds
- Joint venture and educational investments at university or research laboratories.

2.3 Open innovation research in literatures

Since the concept of open innovation was introduced by Henry Chesbrough (Chesbrough, 2003), it has been a hot topic in economical and management research. Till today, there have been more than 2,800,000 publications related to open innovation on Google Scholar. As Huizingh (2011) states, open innovation is more than a simple management concept and an opposite to closed innovation, but a continuum of openness thinking. Chiaroni et al. (2010) also points out that a company's organization, inter-organizational networks, organizational structures, evaluation processes, and knowledge management systems can be impacted from changes in the transition from closed to open Innovation. In the following part, some major research results on open innovation are summarized and presented according to their research areas.

2.3.1 Open innovation in large enterprises

To understand the process and applicability of open innovation in industry, Chesbrough (2003, 2006, 2007) first did much research on large US enterprises which

were heavily active in R&D. Chesbrough (2003) shows that it is evident that internal R&D in large enterprise is no longer the strategic asset it once was. Chesbrough et al. (2002) show in the case of IBM and Xerox that nowadays the new focus in large enterprises is shifting to how companies can generate new ideas and bring them to market. Many researchers (Huston and Sakkab, 2006; Dodgson et al., 2006; Dittrich and Duysters, 2007; Rohrbeck et al., 2009) find the similar results and support the claim of an industry shift from internal R&D, or closed innovation, to open innovation. Moreover, Enkel et al (2009) show that as the focus now is shifting from purely internal R&D activities, the academic community has started emphasizing that the enterprises should be more open to outside innovation. In general, many researchers agree that open innovation provides greater opportunities for firms to advance and commercialize their technologies and enhances their innovation capability and international competitiveness (Chesbrough, 2003; Laursen and Salter, 2006; Clausen and Pohjola, 2009; Gassmann et al., 2010).

In the period following Chesbrough's introduction of the concept of open innovation, many researchers focused mainly on the adaptation of open innovation approaches and practices in high technology focused large enterprises such as IBM (Chesbrough, 2003), Adidas (Piller and Walcher, 2006) and Procter & Gamble (Dodgson et al., 2006), and the research studies were mainly performed via qualitative approaches, i.e. case studies and in-depth interviews. These research projects helped to identify the multifaceted phenomenon of open innovation and to reach a richer understanding of how the management and organization of innovation is changing within large enterprises.

2.3.2 Open innovation in small and medium enterprises

The European Commission view small and medium enterprises (SMEs) as the backbone of the European economy. In most EU Member States, SMEs make up over 99% of the total number of enterprises and generate a substantial share of GDP, as well as being a key source of new jobs and a breeding ground for entrepreneurship and new business ideas (Nachira, 2002).

In contrast to most research in larger enterprises in the United States, SMEs have received less attention in the open innovation research. Recently, a number of interesting studies have emerged which conclude that open innovation can be applied in smaller firms. Van de Vrande et al. (2009) states that because of the difference in SMEs and large enterprises, the implementation of open innovation and the benefits derived from them are different.

Chesbrough et al. (2006) argued that because open innovation can remove many boundaries, such as location, technology and internal financial and human resources, in developing new products and entering new markets. Therefore, implementation of open innovation could provide access to information, new technologies and modern laboratory facilities, as well as major R&D investment that may take SMEs years to acquire in-house. Due to the small size and lack of resources and knowledge in

comparison with large enterprises, there are potentially many benefits for SMEs when adopting open innovation.

Van De Vrande et al. (2009) studied 605 Dutch SMEs in manufacturing and service sectors. Based on cluster analysis and using a combination of several key variables, they concluded that open innovation practices are increasingly being adopted by SMEs.

Laursen and Salter (2006) argue that due to the flexibility and specificity in accelerating innovation, SMEs may have better capacity for open innovation. Jones and Tilley (2003) state that encouraging innovation in SMEs is central to policy initiatives for stimulating economic development at the local, regional, and even national levels. Mangematin et al. (2003) also show that there has been a trend that biotechnology SMEs typically enters into contracts with big industrial groups to develop their own products. Mytelka (1991) even suggests that a firm's competitiveness is determined more by its external networks than its size.

2.3.3 Open innovation in startup micro-enterprises (MEs)

Innovation is important for large, small, and micro-enterprises alike. Even though open innovation was first adopted by larger companies, it has been concluded that open innovation has the potential to benefit all companies, no matter the size (Chesbrough, 2003; Chesbrough, et al., 2006; Lichtenthaler, 2008).

Large companies usually have sizable R&D departments, employing experts in a wide variety of fields. Internal knowledge is therefore available to a larger extent. In contrast, MEs usually have a deep expertise, but within a very narrow field, employing a limited number of very specialized people, likely all within the field that the company is involved in. If so, it would seem like MEs have even more to gain from using external input in their innovation process.

Furthermore, as the pace of global innovation quickens, and products in most fields become increasingly complex, it is now more difficult than ever for a micro-enterprise to possess all necessary knowledge.

By opening up the innovation process, MEs do not only gain access to a wider range of knowledge, but it also opens for the possibility of a larger help performing certain tasks by outsiders (Parida, et al., 2012). The open innovation activities are usually in the form of collaborations with customers, suppliers, universities or joint development projects with governmental institutions.

MEs can also utilize simpler, more community focused methods, for example use open source coding where they let hobby programmers contribute with code segments. Another example is students doing their master theses in collaboration with firms, thus giving the company access to both the knowledge of the university as well as the actual work performed by the student.

If firms can utilize external resources in their innovation process they can compensate for the lack of internal knowledge and resources (Christensen, 2005; Kogut, 2000; Lichtenthaler, 2008). Moreover, Van De Vrande et al. (2009) find that it is even more suitable for small sized firms to implement open innovation. The benefits can be:

- Access to missing knowledge
- Reduce the cost of development
- Provide possibilities for risk sharing
- Improvements in the product development

In general, MEs also have a less structured innovation process compared to large companies, as well as underdeveloped internal capabilities (Parida, et al., 2012). At the same time, MEs are less bureaucratic and more inclined to take risks, which make them more adaptable to a changing market and more likely to benefit from external input (Parida, et al., 2012).

2.3.4 Open innovation in low technology industry

In this study we do not only look at industries involved in high-tech markets, but rather look at a wide sample of companies from a variety of industries.

Chesbrough and Crowther (2006) showed that the adoption of open innovation can be applied not only to high technology industries, but also to low technology industries. They interviewed several low technology companies and found out that the concepts of open innovation are already used, which led them to the conclusion that open innovation can be used in a wide range of industries.

Chesbrough (2003) and Lichtenthaler (2008) indicate in their research that open innovation increases the efficiency and flexibility of the research-development-commercialization value chain, and therefore can be used in management, supply, and marketing. Rahman and Ramos (2010) point out that the concept of open innovation can not only be used in R&D, but that it also can be used in supply and demand, product process and design, and even culture, regulation and values.

Birkle and Gewald (2013) did a survey of 186 German companies in different industry sectors, and they find out that 48% the companies in the media and communication industry and 19% of the companies in the service industry have adopted open innovation. Their results indicate that open innovation is not limited only to high technology industry. They also find that due to the low technology nature of those companies, they mainly tend to integrate customers and suppliers into their open innovation processes, and have little relation with universities and competitors. Birkle and Gewald (2013) also predict that open innovation will be used in every industry and company to some extent in the future.

Moreover, many other researchers find that the concept of open innovation can be

used in low technology industries (Laursen and Salter, 2006; Bergman et al., 2009; Ili et al., 2010; Sieg et al., 2010; Bianchi et al., 2011; Chiaroni et al., 2011). Unfortunately, most of the open innovation research so far has been focused on one specific industry, such as IT industry or medicines industry. There has been lack of a general picture on the relation between industry category and the implementation of open innovation. In this study the implementation of open innovation in different industry sectors, both in low and high technology industries, will be studied and discussed.

2.3.5 Open innovation in Sweden

Open innovation has been massively investigated in the United States, United Kingdom, Germany, and some other developing countries, for example China, and India. Even though Sweden has been considered as one of the more innovative countries, there has been very little research work done here. Fey and Birkinshaw (2005) conducted a survey through 107 R&D-intensive firms in Sweden and Great Britain to examine external sources for open innovation. They found that by accessing knowledge from universities, alliance partners, and government intitutions the R&D performance was enhanced.

Parida et al. (2012) from Luleå University of Technology performed a survey on inbound open innovation activities in Swedish high technology SMEs. They targeted 252 technology based SMEs in the information technology (IT) sector in Sweden, and their study revealed that different open innovation activities are beneficial for different innovation outcomes. For instance, "...technology sourcing is linked to radical innovation performance, whereas technology scouting is linked to incremental innovation performance" (Parida et al. 2012). However, their research was only focused on one of the open innovation forms, which is inbound open innovation. There also exist outbound activities as another form of open innovation. Moreover, they only target on one specific industry sector, IT, in their research. There is no knowledge on how open innovation has been adopted in other industry sectors, such as medicines or automotive. Most important, they have not done the research on the relationship between open innovation actives and innovation performance. Therefore, in this thesis, we will fill the research gap by investigating open innovation and its related performance not only in the IT industry, but also in other sectors.

2.4 Open innovation processes

Many companies may already be using open innovation processes, without knowing that these are a part of a larger system of innovation tools. By making companies more aware of the ideas of open innovation, they can increase their innovative capacity further, and find new activities that complement the ones that they are already using. In the following part, three of the most popular and well implemented open innovation processes will be discussed.

2.4.1 Inbound and outbound open innovation

Open innovation can be divided into inbound and outbound activities. There is also a third category called coupled activities. Inbound activities bring new knowledge into the company's development process, while outbound activities are external ways to bring the company's ideas to the market (Chesbrough, 2003; Parida, et al., 2012; Gassmann et al., 2010).

Inbound activities typically include networking with external partners (such as universities or other companies) to bring their knowledge into the company, cooperating with customers to let them shape the outcome of the development, and licensing of intellectual properties or direct cooperation with companies within other fields to develop a joint product (Parida, et al., 2012).

Outbound activities focus on getting the most out of a company's internally developed (or externally acquired) innovations by bringing them to the market in ways that include external partners as opposed to the company releasing it by themselves. Outbound activities include the licensing of company intellectual properties to be used by other companies (Parida, et al., 2012), but can also take the form of a spin-off of a new tech-focused company.

Coupled innovation involves both inbound and outbound activities, but is not necessarily a simple combination of the two. It includes cases where all activities takes place outside the company, such as open source development and R&D consortia. However, this is not a common activity in smaller firms. Therefore, in this thesis, we will not cover the theory of coupled innovation extensively since the research question is targeting startup micro-enterprises.

Studies have shown that most companies tend to mainly use inbound open innovation (Chesbrough, 2006; Bianchi, 2010; Grönlund, et al., 2010). The main reason for this is believed to be the lower level of initial commitment that is required for inbound activities. Outbound activities require more resources and dedication by the company (Parida, et al., 2012). The schematic drawing of inbound activities and outbound activities is shown in figure 2. In the following part, the detail of inbound and outbound activities will be explained separately.

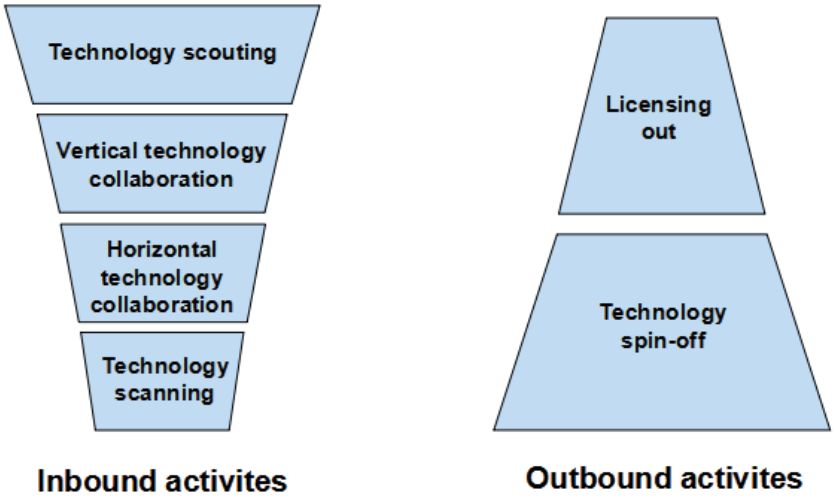

Figure 2. Schematic drawing of inbound activities and outbound activities

2.4.2 Inbound open innovation processes

Inbound activities can be divided into four sub-categories.

Technology scouting

A process in which a company survey the market to detect new technologies that can provide opportunities or create threats for it. Technology scouting is both useful for being aware of the company's position as well as the position of its competitors. The surveyed technology also gets absorbed and becomes an input into future development work (Katila, 2002; Laursen and Salter, 2006; Lichtenthaler and Ernst, 2007; Bianchi, 2010).

Vertical technology collaboration

Vertical technology collaboration is the term for when a company develops a product or service together with either a supplier (upstream collaboration) or a customer (downstream collaboration) (Baum, et al., 2000). To be considered open innovation, the company should not merely consult with suppliers/customers about their opinions, but rather involve the outside partner as a key stakeholder in the development process (Chesbrough, 2003).

There are several methods of vertical collaborations. One example is the lead-user model, in which the innovating company works together with those customers that are pushing the limits of the product and setting high demands. By listening to what these lead users want from the product the company can bring new benefits to their entire customer base.

Horizontal technology collaboration

Horizontal technology collaboration refers to projects carried out with external partners that are on the same level as the company itself, i.e. not a supplier or a

customer. It can refer to collaborations with companies within the same industry, or a totally different one. It can also be with both competitors and partner companies. Collaborations with government agencies and universities are also included in horizontal technology collaboration.

Horizontal collaborations are not only used to gain access to new knowledge but can also be utilized to find uses for a company's innovations in new markets (Pittaway, et al., 2004).

Many of the well known examples of open innovation fall under this category, such as idea competitions, innovation communities and collaborations between companies and the academia.

Technology scanning

Some companies take a radically different approach to product development. Instead of spending money on an internal R&D department, they search for existing ideas and patents for sale or technologies available to license. By purchasing the technology the company saves a lot of time in the development process and can bring innovations to the market faster, as well as saving money on internal R&D costs. Instead the company needs employees who search for and evaluate new technologies for sale on the IP market.

2.4.3 Outbound open innovation processes

Outbound activities can be divided into two sub-categories.

Licensing out

One of the most commonly applied outbound open innovation processes is licensing out of technologies or IPs. By means of licensing out, firms can achieve monetary and strategic opportunities. For instance, The American company Texas Instruments, generated hundreds of millions of dollars in annual licensing revenues (Rivette and Kline, 2000). IBM's licensing revenues of more than $ 1.2 billion in 2004 also illustrate the increasing importance of outbound open innovation (Arora et al., 2001; Chesbrough, 2006). With regard to strategic opportunities, firms can establish their technologies as industry standards, and/or gain access to external technology (Grindley and Teece, 1997).

Technology spin-off

As corporate strategies increasingly focus on generating value, research intensive companies often aim to exploit their technologies externally. Under such circumstances, technology spin-off is the other common outbound open innovation. Ndonzuau et al. (2001) describe the basic process steps for technology spin-off. In the first stage, business ideas are generated; in the second, new venture projects are finalized, in the third spin-off firms are launched, and finally, the creation of economic

value is strengthened.

2.4.4 Technology exploitation and exploration

Following the definition of open innovation by Chesbrough and Crowther (2006), i.e. "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively", Vrande et al. (2009) defined the innovation process according to dimensions and information flow:

- Technical exploitation: meaning innovation activities to leverage existing technological capabilities outside the boundaries of the organization.

- Technical exploration: meaning innovation activities to capture and benefit from external sources of knowledge to enhance current technological developments.

The schematic drawing of technology exploitation and technology exploration is presented in Figure 3. In the following part, the detail of the two processes will be further discussed.

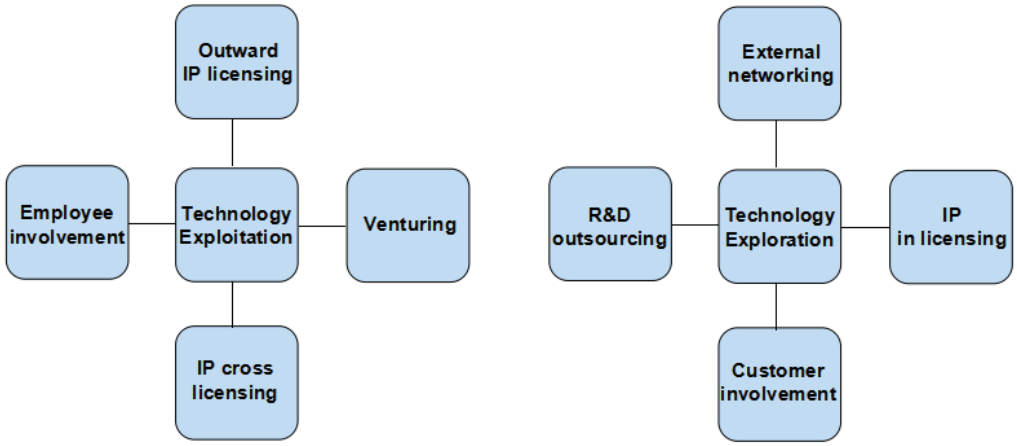

Figure 3. Schematic drawing of technology exploitation and technology exploration

Technology exploitation

In order to make the best use of internal knowledge, enterprises often engage in different practices such as venturing, outward licensing of intellectual property (IP), and the involvement of non-R&D workers in innovation initiatives, which are all related to technology exploitation (Vrande et al., 2009).

Venturing is starting up new organizations based on internal knowledge, for instance, spin off and spin out processes. Chesbrough (2003) and Lord et al (2002) have studied venturing activities in large enterprises. The potential of venturing activities is considered to be enormous, as Chesbrough (2003) showed that the total market value

of 11 projects which turned into new ventures exceeded that of their parent company, Xerox, by a factor of two.

Outward IP licensing is another important part of technology exploitation in open innovation, which aims to commercialize an enterprise's IPs by selling the rights to use them to other enterprises, often with a different business model, to gain profits or extra paths to new market. Lee et al (2010) especially discussed how such external channels to the market serve as additional revenue sources and can help neutralizing potential risk in the value chain of an enterprise.

IP cross licensing is a transformed form of outward IP licensing, in which the purpose is to access external technological knowledge. Chesbrough (2006) states that this kind of technology exploitation is common implemented among complex industries, such as the semiconductor industry, where firms need other firms' IPs to be able to produce their own products.

Employee involvement is another way of capturing and leveraging the knowledge and innovation of en enterprise's own employees. Employees outside the R&D departments with different background, knowledge, and experiences can be great valuable sources to the enterprise's innovation process. Sometimes, firms can achieve astonishing results by involving employees, who are not normally part of the development team, in the innovation process (Narula 2004).

Technology exploration

Technology exploration is the practice of acquiring new knowledge and technology outside company. Vrande et al. (2009) conclude that the most commonly applied technology explorations are customer involvement, external networking, R&D outsourcing and IP in licensing.

Customer involvement is the most common way of obtaining ideas and suggestions on improvement, modification and innovation of firms' products. Hippel (2005) explain that customer regularly modify their machines, equipment and software to better satisfy their own needs, which is a great source of innovation for firms to perfect their products based on customer modifications.

External networking can help firms to form a valuable source in acquiring and preserving connections with external resources. Luukkonen (2005) clarifies that by external networking firms can save both time and money, as knowledge gaps can be overcome rapidly without the need to invest internally.

R&D outsourcing is an activity that firms may use to obtain and capitalize on external knowledge. The most common activities in R&D outsourcing are consulting with universities, research institutes, other firms in the same industry sectors, and sometimes, even with customer and suppliers (Edwards et al., 2005).

IP in licensing is opposite of IP out licensing. The benefit of IP in licensing is straightforward, letting firms use and profit from external IP, such as patents, copyrights, and trademarks, by integrating them into their own business model or

innovation process. In licensing of IPs save the company time that would otherwise had been spent on developing the IP in-house, but on the other hand, it can be costly to license in external IPs.

2.4.5 Triple Helix

The concept of the Triple Helix model, incorporating university-industry-government relationships, was initiated by Etzkowitz (1993) and Etzkowitz and Leydesdorff (1995), and interprets the growing relationship between university, industry, and government in the knowledge society. The fundamental principle of the Triple Helix concept is open innovation. The Triple Helix promotes economic development among universities, industry, and governmental organizations, in order to generate new institutions at their intersections for further production, transfer, and application of knowledge (Etzkowitz and Leydesdorff, 1995).

Leydesdorff (1997) developed the Triple Helix model by defining the different communication systems among these three institutions, such as the operation of markets, technological innovations, and control at the interfaces. Leydesdorff (1997) further pointed out that the new interfaces between these three institutions will produce potentially new forms of communication as in a sustained technology transfer interface or in the case of patent legislation.

Etzkowitz (2003) summaries three main configurations in the Triple Helix model regarding position of the university, industry and government institutional spheres relative to each other, which are also showed in the figure 4:

a) The statist configuration, where government plays the lead role, driving academia and industry, but also limiting their capacity to initiate and develop innovative transformations, for example in Russia and China;

b) The laissez-faire configuration, characterized by a limited state intervention in the economy, for example in US, with industry as the driving force and the other two spheres acting as ancillary support structures and having limited roles in innovation: university acting mainly as a provider of skilled human capital, and government mainly as a regulator of social and economic mechanisms;

c) The balanced configuration, specific to the transition to a Knowledge Society, where university and other knowledge institutions act in partnership with industry and government and even take the lead in joint initiatives. The balanced configuration offers the most important insights for innovation, as the most favorable environments for innovation are created at the intersections of the spheres.

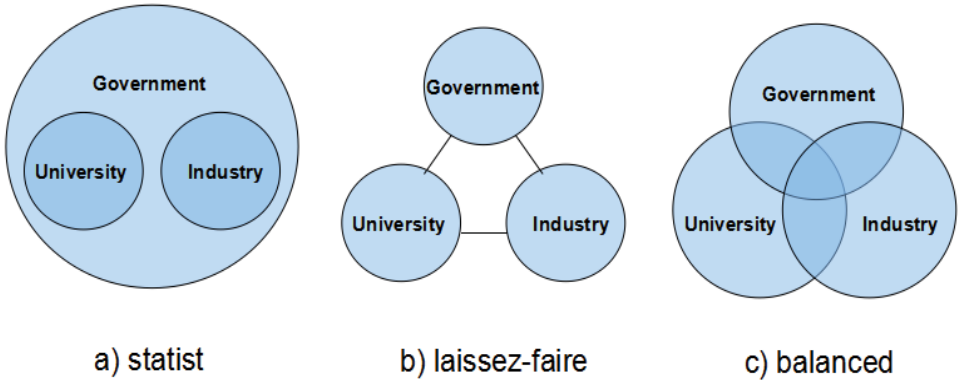

Figure 4. The three main configurations in the Triple Helix model

2.5 Research model and hypotheses

In the previous section, the three most common and important research models on how company implements open innovation have been described. Even though they are developed with different time and different focusing points, many fundamental sources in open innovation are connected or overlapping with each other. In this study, we extract six main sources from these three models: inbound and outbound activities, technology exploration and technology exploitation, and the Triple Helix, as well as the relations among each source are also listed in Table 3.

Source	Example	Models						
		exploration	exploitation	Inbound	Outbound	Government	University	Industry
Customer	User involvement		x					
Suppliers	Raw materials		x		x			x
	Machine/facilities		x		x			x
Competitors	Competitors							x
	Alliance							x
	Benchmarking							x
University	Research center				x		x	
	Institute				x		x	
Government	Agency				x	x		
	Advisory board					x		
	Consulting services					x		
Technology sourcing	Employee involvement	x						
	Venturing	x		x				
	IP inward/outward	x						
	Outsourcing	x		x				

Table 3. The six main sources of open innovation, with relation to different research models

Therefore, in this thesis we will study how Swedish startup micro-enterprises are adopting open innovation based on the following six key factors:

- Customers
- Suppliers
- Competitors
- Universities
- Governments
- Technology sourcing

In this thesis, we propose a theoretical model to investigate the relation between each of these factors individually, in relation to the innovation performance in micro-enterprises in Sweden (see Figure 5). Therefore, we formulate the following explorative hypotheses.

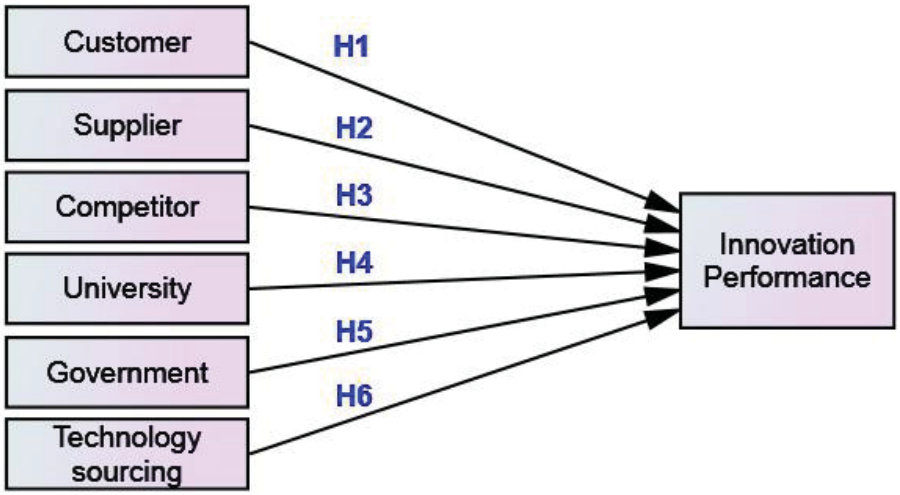

Figure 5. Research model and research hypotheses

Customer involvement

Customer involvement is the most common form of open innovation as well as the form most thoroughly studied (Brettel and Cleven, 2011). It is a downstream vertical collaboration that utilizes knowledge from the final user of the product (Baum et al., 2000). The term customers is here expanded to include both present and potential customers. Earlier studies have shown that up to 75 % of companies involve their customers to some degree in the development of new products (Heydebreck and Herden, 1992). This is not necessarily the same as open innovation as the latter implies a strong involvement of the customer as a central stakeholder, not only incorporating customer feedback, which might often be the case (Chesbrough, 2003)

By involving customers in the innovation process, companies can both get a valuable insight into their customers' needs (Dyer and Singh, 1998) as well as enable pilot trials were products still under development are tested in real situations.

Collaboration with customers also focuses innovation on products that there is a demand for, which makes the innovation more likely to succeed in the market. An extension of this form of collaboration is the lead-user model, where customers that push the performance of a product can work with the developer together to tailor it to their needs (Von Hippel, 2005). These improvements will likely prove useful to other customers as well, thus making it a successful product.

There are also studies that point out that customer collaboration is not only positive. If a company focus their development work on only one customer's needs, the final product may be too specialized to appeal to a broader market (Bonner and Walker, 2004).

The overall consensus in the literature is that collaboration with customers is beneficial to the development of new products. In this study it is therefore hypothesized that that is also the case for startup MEs in Sweden.

> *Hypothesis 1 (H1): Involvement of customers has a positive contribution to innovation performance in micro-enterprises.*

Supplier involvement

Supplier involvement is classified as upstream vertical collaboration (Baum et al., 2000). Suppliers usually possess a deep knowledge within their own niche market. By collaborating with one, or many, suppliers the ME can get access to knowledge and new technologies that is not available internally. Starting a collaboration with a supplier might in many cases be easier than finding a cooperating customer, since the suppliers are always looking to strengthen the bond with their buyers (Brettel and Cleven, 2011).

A strong network of suppliers to rely on for support will also allow the company to focus on their own core competency in the development process and let the suppliers contribute by adapting their delivered components to fit this product (Tether, 2002; Belderbos et al., 2004).

Brettel and Cleven (2011) speculate in some of the risks with supplier collaboration. These include the risk of becoming too dependent of a supplier and the risk that ideas developed through a cooperation will also be used by that supplier in cooperations with competitors of the company.

These risks do not impact the innovation performance of the company, but rather the overall performance in a competitive market. The hypothesis is therefore that cooperation with suppliers will increase the innovation performance of the companies in focus of this study.

> *Hypothesis 2 (H2): Involvement of suppliers has a positive contribution to innovation performance in micro-enterprises.*

Cooperation with competitors

Cooperation with competitors is one of many forms of horizontal collaborations in open innovation theory.

Collaboration with competitors can be useful in several ways. One form of cooperation is to develop a shared product and market it together. This enables the companies to develop a better product then they each would do separately (Pittaway et al., 2004). Such cooperation should also eliminate other negative aspects of competition such as price competition and smaller sales volumes due to a fragmented market.

Even if they do not develop a joint product, companies can still gain advantages through cooperation with competitors by benchmarking their products against each other and developing their products so that they fulfil different customer needs. By differentiating their products, both companies can benefit (Linn, 1994).

Forming horizontal partnerships with competitors will also be beneficial for the company in order to attract external support in their development process from other major external partners (Parida et al., 2012). Such major partners could include government organizations or large enterprises, which may not want to collaborate with a single small company, but cannot disregard a strong group of small companies. Such alliances could also help a group of small companies compete against larger, more established firms (Christensen et al., 2005; Lee et al., 2010).

There are also substantial risks associated with competitor collaborations. Transaction cost might be too high to justify the results and partners may act opportunistically in ways that harm the efforts of the company (Parida et al., 2012).

Previous studies on SMEs show that the link to innovation performance is not as strong for competitor collaboration as for other modes of open innovation. Parida et al. (2012) showed a slight contribution to performance while Brettel and Cleven (2011) only could find a marginal and insignificant link. In this study, the link between collaboration with competitors and innovation performance in MEs is hypothesized to exist and be positive.

> *Hypothesis 3 (H3): Cooperation with competitors has a positive contribution to innovation performance in micro-enterprises.*

Cooperation with universities

Another form of horizontal partnership is collaboration with universities.

Collaboration with universities is perhaps the form of external partnership that is most easily identified as open innovation. Universities possess deep knowledge in a wide variety of subjects and it is clearly visible how such a collaboration bring external knowledge into a company. Universities are often positive to such collaborations.

Studies show that companies that do not leverage universities in their product development process will have a disadvantage compared to those that do, and are less likely to come up with radically new products (Spencer, 2003).

There are several common forms of company-university collaboration. Many research grants, aimed at both companies and university staff, requires collaboration between academia and the industry. It is also not uncommon that professors are engaged in companies, founded by themselves or others, as scientific consultants.

Another form of collaboration between universities and companies is thesis work performed by students. In this case the student forms the link between the knowledge possessed by the university and the task to be performed at the company. Many large companies regularly post projects available to students. For smaller enterprises it is less common, since it requires some time to coach the student, but nevertheless MEs could potentially gain access to valuable knowledge through this type of collaboration.

Companies regard universities as a low risk partner for external knowledge. It can also be argued that cooperation with universities induces less cost than other forms of open innovation (Tether, 2002). Cooperation with universities is seen as a common form of external collaboration with few drawbacks and in this study it is therefore hypothesized that such collaborations are positive for innovation performance, also for MEs.

> *Hypothesis 4 (H4): Cooperation with universities has a positive contribution to innovation performance in micro-enterprises.*

Support from government

Collaboration with government could be either vertical or horizontal depending on if the government is the intended customer of the product or not. In this study, we assume that the government is not the end user, but is instead collaborating with the company via a horizontal partnership. The incentive for a government organization to do so is often to encourage innovation and the creation of successful products, which in turn bring many benefits back to the government, such as local jobs and tax revenues.

From a company's perspective, such collaborations can also bring several benefits. Often it is in the form of funding, as loans, equity, or grants, given to projects that may be to high-risk to attract private investors (Gawarzynska, 2010).

Companies can also collaborate with governmental institutions around products related to governmental regulations or national goals, such as automobile safety or environmental targets (Gawarzynska, 2010).

Governments can also have the role as the coordinating partner, bringing several companies together and inviting other external partners such as universities. Even though cooperation with government may not be very common among MEs the hypothesis presented in this study is that those that do will increase their innovative performance.

> *Hypothesis 5 (H5): Support from governments has a positive contribution to innovation performance in micro-enterprises.*

Technology sourcing

Technology sourcing is a form of open innovation that relies on the purchase or sale of technologies or IPs. A company can improve its innovation capacity by purchasing subparts or ideas instead of developing all components of a product internally (Van De Vrande et al., 2009). The sale of technology and IPs can enable small companies to thrive, even if they do not have the capacity to mass produce products or bring them to the consumer market.

Purchasing technology increases innovation performance by reducing lead times for new innovations (Håkansson and Laage-Hellman, 1984). Purchasing external technology gives the company access to a wide range of solutions and components that they would not be able to develop internally. These established and proven components could then be integrated by the company to new innovative products (Tao and Magnotta, 2006).

In a study of high-tech SMEs by Parida et al. (2012) they find a strong support for the theory that technology sourcing is beneficial for innovative performance. The hypothesis in this study is therefore that technology sourcing also has a positive influence on innovative performance in MEs.

> *Hypothesis 6 (H6): Technology sourcing has a positive contribution to innovation performance in micro-enterprises.*

3 Method

3.1 Selected research methodology

This thesis uses a literature review and a quantitative survey as methods to answer the research question. The choice of methodology is motivated and described in more detail below.

3.1.1 Literature review

A literature review, which included a large number of scientific articles written on the subject, was performed in the initial phase of the project to gain a better understanding of open innovation. This review resulted in a summary of the core theory of open innovation and how it relates to MEs and the research question, presented in the theory chapter. It also yielded an overview of previous research on the topic of open innovation. A literature review is a given part of any study, partly to gain insight about the topic and achieve a deepened theoretical understanding by reviewing other researchers' previous work, but also in order to summarize the subject and present the reader with an overview of the topic (Hart, 1998). A good literature review must be written in a way easy to understand for the reader, and contain no personal biases (Carnwell and Daly, 2001). A risk when writing literature reviews is that the selection of sources and information used is affected by the author's personal interest or opinions. To avoid this, it is important to have a search and selection strategy when gathering information (Carnwell and Daly, 2001). In this thesis, there has only been a limited number of articles available on the specific topic of open innovation in small and micro-enterprises. No articles have therefore been needed to be omitted due to space restraints. To find more general information about open innovation in companies of all sizes, the authors have then looked at the most cited articles on the subject, assuming these to be well established in the research community. The literature review was also performed to validate that our chosen research questions had not previously been answered.

3.1.2 Quantitative survey

To answer the questions posed in this thesis, the choice of method was between a qualitative and a quantitative study. Qualitative studies focus on a smaller sample size and use interviews or case studies to explore a topic (Yin, 2009). Quantitative studies look at a larger sample and attempt to find patterns or trends (Myers, 1997). These two approaches fulfill different functions and it is important to choose the method that best matches the objective of the study. In their review of qualitative and quantitative methods, Sechrest and Sidani (1995) note that qualitative methods are usually best suited for observation and hypothesis formation, while quantitative methods serve as a tool for verification. However, they also point out that this does not always have to be the case. Yin (2009) likewise point out that case studies and surveys both can used for most types of research and that the situations where the two methods are suitable tools often overlap.

In the case of this study, the practice of open innovation has already been identified and there are many documentations of its use in individual companies. A qualitative study, exploring the use of open innovation in one or two sample companies, would therefore not add any new knowledge. Instead the authors have chosen a quantitative method, which can be used to confirm if the model posed in this thesis holds true. A quantitative method can include a larger number of companies, and thus give a larger reliability to the results.

The quantitative method chosen for the study was an online survey. Since the objective was to establish the state of open innovation in general among Swedish startup MEs, a survey was a more suitable method compared to qualitative methods that would have given more in-depth knowledge, but limited the study to one or a handful companies. The drawback of a mass survey is that very little in-depth comments are received from participating companies. A survey will therefore only give a general answer, in support or non-support of the proposed hypotheses, while more in depth knowledge of the reasoning behind each company's decision to use, or not use, open innovation will be lacking.

3.2 Questionnaire design

The questionnaire was constructed around the six hypotheses explored in this study. Each form of open innovation was represented by three questions, rating participants' collaborations with external partners. Participants were presented with statements to which they could agree or disagree according to a 7-point Likert scale. To rate the innovation performance of each company, the survey also included five statements asking participants to rate their company's innovativeness compared to its competitors. The questions in the survey were largely based on previous surveys by Brettel and Cleven (2011) and Parida et al. (2012) to enable a comparison to these studies. The questions were modified to apply to MEs and some questions were also added. For statistical purposes, the survey also asked for information about positions and gender of the participants as well as area of business. Both a Swedish and an English version of the survey were produced. The English version can be found in Appendix 1.

3.3 Sample selection

The survey sample was chosen based on the definition of micro-enterprises by the European Commission (2012). According to that definition, MEs are companies that have less than ten employees and with a maximum turnover of EUR 2 million per year. Since the objective was to study startup MEs, only companies founded Jan 1, 2009, or later was included in the sample.

To find companies matching these criteria, the database "Retriever", provided by Blekinge Tekniska Högskola, was used. The database also includes functions to sort by business area, which enabled a wide selection of businesses to be included. The areas included, according to the Retriever classifications were:

- Water and waste technology
- IT and telecommunication
- Building and design
- Business services
- Food and beverage production
- Media
- PR and advertisement
- Manufacturing industry
- Research and development

The sample was limited to companies registered in Sweden.

3.3.1 Definition of product development

The survey was aimed at a wide sample of companies, not only producing products but also services. In the survey and analysis, the term “product” refers to what is produced by a company. It can be a concrete object, but it also refers to services produced by companies.

3.4 Conduction of survey

There are several ways of conducting surveys, including by telephone, mail, e-mail, and in person. For this thesis, e-mail was selected as the primary method of conducting the survey. It is an efficient way to reach a large number of companies in a short time, since a standard e-mail template can be used for all the companies. However it does not enable the interviewer the possibility of asking direct follow-up questions in the same way as a telephone interview does. The main reason why e-mail was chosen instead of telephone interviews as the main mode of contact was that both authors were working full-time, and unable to make calls related to school work during office hours.

The survey was constructed in Google Forms (Google, 2014). A link to the survey was sent to all selected companies, along with a short introduction to the subject and the study's purpose. An online survey enables the respondents to fill in their answers when they have time to spare. It is also quicker and more convenient, compared to filling in a document that needs to be sent back via e-mail, thus likely increasing the response rate. All the answers can then be downloaded from Google Forms as a spreadsheet document, ready to input into analytical software. Google Forms also includes a number of analytical tools which were used to perform a response analysis and get a sample information overview.

The survey was primarily sent to the CEO of each company. E-mail addresses were obtained by browsing the companies' websites. If no specific e-mail address was available, an e-mail was instead sent to the general contact address of that company. To increase the participation rate, some companies were also contacted by phone during the final phase of data collection. In total, around 500 companies were

contacted. All respondents had the choice to be anonymous.

3.5 Data analysis – Validity and reliability

The data was analyzed statistically to verify the model presented in Chapter 2 above. The results are presented in Chapter 4 below. The software employed was IBM SPSS Statistics version 22 as well as IBM SPSS AMOS version 22. Using factor analysis and regression the answers collected from the survey were compared to the hypothesized model.

Data analysis was also performed to ensure validity and reliability of the collected data. Good validity ensures that the data measures the actual relationships that are being studied and that there is no interference from invalid data (Punch, 1998). In order to verify the validity of the chosen variables, correlation calculations were performed between the original variables. The analysis was completed using IBM SPSS Statistics. Poor validity can be caused by a poorly designed questionnaire, and great care was therefore taken when designing the survey.

The reliability of the data signifies its correctness, or how well it can be trusted as truth. If a company took the survey multiple times and delivered the same answers every time, that would yield a high reliability. To evaluate the reliability of the factors a Cronbach's Alpha analysis was performed. The Cronbach's Alpha measures the proposed framework's internal consistency and therefore its reliability (Nunally, 1994; Walonick, 2010).

AMOS software was also used to verify the results. IBM SPSS AMOS is a professional tool in specifying, estimating and assessing models to analyze hypothesized relationships among variables. In this study we use IBM SPSS AMOS 22 to provide structural equation modeling to our data.

4 Empirical findings

4.1 Response statistics

Out of the nearly 500 companies that were selected and contacted, 40 completed questionnaires were received, resulting in a response rate of 8 %.

According to Fink et al. (2003) and Klassen and Jacobs (2001), online surveys trend to have lower response rates than that of offline survey. Usually the response rate of online survey lies between 9% and 19%. In this study, 8% of the contacted companies responded to the survey, which is slightly below the normal response rate. The reason is mainly believed to be because of the diversity of the sampled group of companies. Many companies also lacked specific contact details to top managerial staff, and e-mails therefore had to be sent to a general contact address in some cases. The authors also noticed a clear difference in response rate, depending on which e-mail address was used as the sender. A Swedish name as the sender resulted in a significantly higher response rate, even though the content of the e-mail was the same.

In this study focus on open innovation in Swedish startup MEs and therefore the selected sample group was wide, covering many industries. As mentioned in Section 3.3, some industry areas, such as business services, food and beverage production, as well as PR and advertisement, may not be as heavily involved in product development as others, and might therefore be more reluctant to participate in a survey about open innovation. For instance, one consulting company gave feedback regarding open innovation saying that they only employ simple technology and therefore only need to rely on their own previous experience.

The response rate for each industry area is shown in the table 4 below. As expected, broadcasting and insurance, which are least involved in technology and innovation have the lowest response rates. On the other side, medicines, environment, and IT have the highest response rates, which is also in line with the response rates shown by Fink et al. (2003) and Klassen and Jacobs (2001).

Industry area	Response rate
Medicines	18%
Environment	14%
IT	10%
Automotive	8%
Consulting	7%
Consumer Products	7%
Electronics	5%
Insurance	4%
Broadcasting	2%

Table 4. Survey response rates within different industry areas

Out of these 40 surveys, 78% were completed by the CEO of the company, and more than 95% of the surveys were answered by senior managing staff, which indicates that respondents have a satisfactory understanding of the company's innovation process. The complete breakdown of the respondents' positions is shown in Figure 6 below.

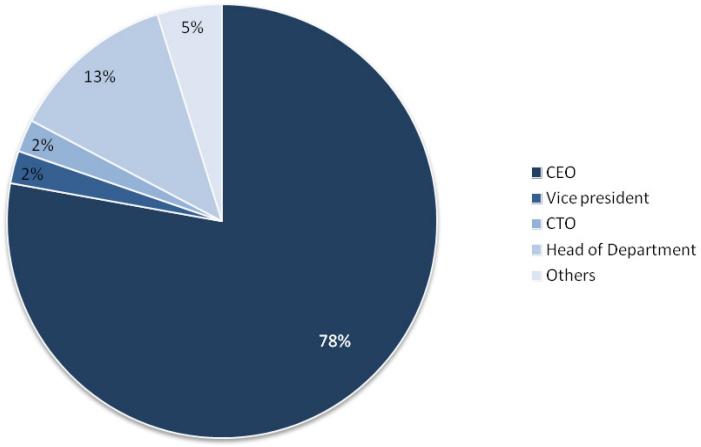

Figure 6. Respondents' position at the company

The study targeted startup MEs from a wide selection of industries, some of which include sample companies that may not be strongly involved in innovation or product development. Respondents were asked to state which industry they belonged to at the beginning of the survey. The replies received were combined into main categories and are presented in Figure 7 below. The results indicate that companies from medicines,

environment, and IT are among the top three industries represented among the responses in this survey, making up more than 50 % of the total responses.

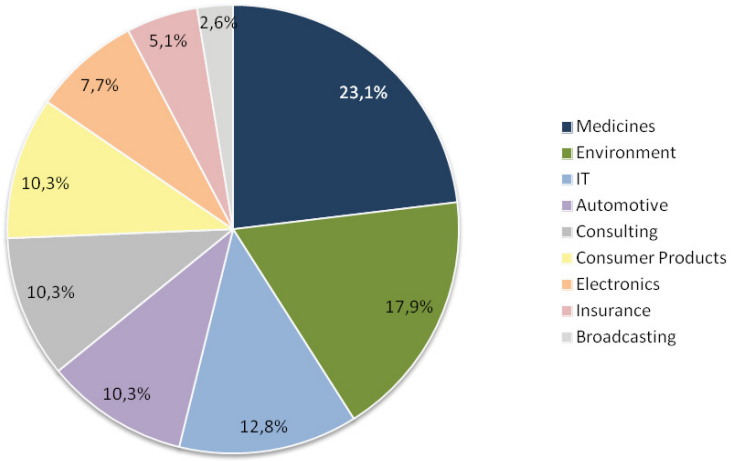

Figure 7. Industry representation

4.2 Descriptive statistics

IBM's software SPSS Statistics version 22 (Statistical Package for the Social Sciences) was employed to analyze the data. The descriptive statistics of the survey data are presented in Table 5.

The first column in Table 5 lists factors investigated in this model. The corresponding symbols in later calculation and its related survey question are listed in the second column. The detailed survey questions are available in Appendix 1. N is the number of responses received, which were 40 in this study. The minimum and maximum are the questionnaire's scale range, which in this case was the Likert scale. Value 1 means respondents strongly disagree with survey questions, and value 7 means respondents strongly agree with survey questions. The mean and standard deviation values are also presented to indicate the central tendency of the data, and the dispersion of data around that mean value, respectively.

Factor	Survey question	N	Min	Max	Mean	Std. Deviation
Customer	Cu1 (1.a)	40	1	7	4.95	1.739
	Cu2 (1.b)	40	1	7	5.65	1.626
	Cu3 (1.c)	40	1	7	4.9	1.837
Supplier	S1 (2.a)	40	1	7	5.18	1.615
	S2 (2.b)	40	1	7	4.43	1.852
	S3 (2.c)	40	1	7	4.83	1.986
Competitor	Co1 (3.a)	40	1	7	2.93	1.817
	Co2 (3.b)	40	1	7	2.6	1.795
	Co3 (3.c)	40	1	7	3.95	1.694
University	U1 (4.a)	40	1	7	4.6	2.329
	U2 (4.b)	40	1	7	3.4	2.437
	U3 (4.c)	40	1	7	3.78	1.981
Government	G1 (5.a)	40	1	7	3.08	2.358
	G2 (5.b)	40	1	7	2.48	1.783
	G3 (5.c)	40	1	7	2.58	1.986
Technology sourcing	T1 (6.a)	40	1	7	3.4	2.098
	T2 (6.b)	40	1	7	2.03	1.860
	T3 (6.c)	40	1	7	3.88	2.334
Performance	P1 (C.a)	40	1	7	4.58	2.086
	P2 (C.b)	40	1	7	5.33	1.817
	P3 (C.c)	40	1	7	4.53	1.754
	P4 (C.d)	40	1	7	4.5	1.935
	P5 (C.e)	40	1	7	4.63	1.835

Table 5. Descriptive statistics of observed variables

4.3 Correlations between original variables

There are six factors and twenty variables in the model proposed in this study. In order to verify the validity of the chosen variables, the first step is to perform correlation calculations between the original variables. The analysis was completed using SPSS and the result is shown in Table 6. Correlation matrix indicates strong correlations among the variables within each factor. Such intercorrelation means variables are multi-collinear. In this correlation matrix, none of the correlations are too high (> 0.9), indicating that no two variables seem to measure the same thing. In addition, none of the correlations are too low either (< 0.1), which would indicate that the variable does not measure anything at all. The analyzed result shows that all the variables are valid, and can be used to perform the next analysis.

	Mean	Std. Deviation	Cu1	Cu2	Cu3	S1	S2	S3	Co1	Co2	Co3	U1	U2	U3	G1	G2	G3	T1	T2	T3	P1	P2	P3	P4	P5
Cu1	4.95	1.739	1																						
Cu2	5.65	1.626	.804**	1																					
Cu3	4.9	1.837	.569**	.456**	1																				
S1	5.18	1.615	0.292	0.294	0.03	1																			
S2	4.43	1.852	.466**	.341*	0.167	.714**	1																		
S3	4.83	1.986	.453**	0.283	0.158	.613**	.855**	1																	
Co1	2.93	1.817	-0.126	-0.013	0	0.026	-0.033	-0.039	1																
Co2	2.6	1.795	-0.056	-0.084	0.084	-0.052	-0.002	-0.036	.889**	1															
Co3	3.95	1.694	0.163	0.105	0.13	0.05	0.207	0.201	.548**	.544**	1														
U1	4.6	2.329	0.115	0.125	0.29	-0.001	0.005	0.001	0.168	0.169	-0.077	1													
U2	3.4	2.437	0.162	0.127	0.142	-0.052	0.05	0.15	-0.064	-0.063	-0.049	.725**	1												
U3	3.78	1.981	0.198	0.2	0.167	0.155	0.185	0.275	0.009	0.03	-0.054	.847**	.771**	1											
G1	3.08	2.368	0.155	0.258	0.127	0.214	0.109	0.119	0.09	-0.034	-0.023	.435**	.595**	.427**	1										
G2	2.48	1.783	0.161	0.145	-0.036	0.186	0.126	0.301	.383*	.371*	0.152	.356*	0.255	.453**	.412**	1									
G3	2.58	1.986	0.196	0.297	0.194	0.111	0.13	.310*	.311*	0.273	0.243	0.278	.344*	.421**	.359*	.717**	1								
T1	3.4	2.098	0.035	0.077	-0.004	0.24	0.288	.370*	0.14	0.023	-0.016	0.002	0.135	0.039	0.296	0.111	0.176	1							
T2	2.03	1.86	0.108	0.262	-0.045	0.121	0.175	0.03	0.067	0.053	-0.095	-0.069	0.005	-0.119	0.177	-0.029	-0.154	.360*	1						
T3	3.88	2.334	0.237	0.278	0.303	.324*	.385*	0.281	-0.118	-0.112	-0.051	.396*	.575**	.482**	.698**	0.173	0.237	0.306	0.236	1					
P1	4.58	2.086	.312*	.332*	0.142	0.172	0.128	0.102	0.265	0.204	0.059	0.223	0.176	0.104	0.081	0.097	0.164	0.19	0.15	0.037	1				
P2	5.33	1.817	.584**	.756**	.331*	0.168	0.13	0.096	0.105	-0.019	0.064	0.28	0.249	0.193	.375*	0.142	0.216	0.211	.365*	.315*	.592*	1			
P3	4.53	1.754	.476**	.449**	0.27	0.241	.506**	.438**	0.108	0.146	0.187	0.266	.338*	.318*	0.274	0.244	.343*	.415**	.378*	.414**	.578*	.592*	1		
P4	4.5	1.935	.389*	.423**	.327*	0.021	0.085	0.101	0.298	0.261	0.07	.347*	0.282	0.246	0.166	0.197	.372*	0.131	0.132	0.066	.848*	.647*	.606*	1	
P5	4.63	1.835	.402**	.544**	.381*	0.2	0.197	0.236	0.167	0.146	-0.056	.348*	0.227	0.284	0.21	0.149	0.241	.383*	.355*	.311*	.648*	.774*	.670*	.726*	1

* $p < 0.05$
** $p < 0.01$

Table 6. The Pearson correlation matrix together with means and standard deviations

4.4 Correlations between variables and components

In order to check the component loadings, which are the correlations between the variables and the components, a component matrix calculation was performed. In SPSS an option was utilized to set the absolute value to >0.5 to suppress small coefficients. The result is presented in Table 7. Hair et al. (2010) suggest a cut-off value of 0.5, which shows all our variables are convergent and have discriminant validity. In Table 7, it is clear that all variables within a single factor are highly correlated, which is shown by the high values within factors. Additional, there is no cross-loading between factors, which indicates the good discriminant validity.

Rotated Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
Cu1	.804						
Cu2	.798						
Cu3	.745						
S1		.773					
S2		.931					
S3		.912					
Co1			.876				
Co2			.916				
Co3			.782				
U1				.874			
U2				.888			
U3				.865			
G1					.517		
G2					.843		
G3					.807		
T1						.635	
T2						.787	
T3						.641	
P1							.904
P2							.622
P3							.604
P4							.886
P5							.774

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 8 iterations.

Table 7. Component Matrix

4.5 Reliability assessment

To evaluate the reliability of the factors we perform the Cronbach's Alpha analysis. The Cronbach's Alpha measures the proposed framework's internal consistency and therefore its reliability (Nunally, 1994). The result is shown in Table 8. According to Nunally (1994), a Cronbach's Alpha value above 0.9 is considered as excellent internal consistency (High-Stakes testing), above 0.7 is considered as good and above 0.6 is

considered as acceptable. If the Cronbach's Alpha value below 0.5, it is then considered as unacceptable (Nunally, 1994). As Table 8 shows, all of the factors are above 0.6, which are acceptable, and two factors, university and performance, are above 0.9, which are excellent internal consistency.

Factor	Survey questions	Cronbach's Alpha
Customer	Involvement with customers (1.a, 1.b, 1.c)	**0.857**
Supplier	Involvement with suppliers (2.a, 2.b, 2.c)	**0.888**
Competitor	Cooperation with competitors (3.a, 3.b, 3.c)	**0.856**
University	Cooperation with universities (4.a, 4.b, 4.c)	**0.901**
Government	Support from governments (5.a, 5.b, 5.c)	**0.782**
Technology	Technology sourcing (6.a, 6.b, 6.c)	**0.678**
Performance	Performance measures (C.a, C.b, C.c, C.d, C.e)	**0.909**

Table 8. Cronbach's Alpha calculation

4.6 Validating the hypotheses

After having performed the above correlation and reliability checks, the hypotheses can be evaluated by using SPSS's linear regression method. To perform this analysis, the related variables are first transformed into one component variable by calculating the average, which is:

- Customer=(Cu1+Cu2+Cu3)/3,
- Supplier=(S1+S2+S3)/3,
- Competitor=(Co1+Co2+Co3)/3,
- University=(U1+U2+U3)/3,
- Government=(G1+G2+G3)/3,
- Technology=(T1+T2+T3)/3,
- Performance=(P1+P2+P3+P4+P5)/5.

The result of the linear regression fitting is shown in Table 9 and its model summary is shown in table 10.

Model	Beta Coefficients	t	Sig.
Customer	.455	3.131	.004
Supplier	-.043	-.287	.776
Competitor	.178	1.284	.208
University	.171	1.077	.289
Government	-.026	-.150	.881
Technology	.274	1.847	.074
a. Dependent Variable: Performance			

Table 9. The main results of linear regression fitting

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.654[a]	.428	.327	1.31926	.428	4.246	6	34	.003

a. Predictors: (Constant), (T1 + T2 + T3) / 3, (Co1 + Co2 + Co3) / 3, (Cu1 + Cu2 + Cu3) / 3, (U1 + U2 + U3) / 3, (S1 + S2 + S3) / 3, (G1 + G2 + G3) / 3

Table 10. Model summary of the linear regression fitting

The beta coefficients presented in Table 9, also known as the standardized regression coefficients can be used to compare the relative strength of the component variables within the model. These beta coefficients are all measured in standard deviations, as opposed to the units of the variables, and can therefore be compared to each other. The p-value, here denoted Sig., is the probability of observing an effect given that the null hypothesis is true (Goodman, 1999). Thus, if a p-value was found to be less than 0.05, then the result would be considered statistically significant and the null hypothesis would be rejected. However, other significance levels, such as 0.1 or 0.01, are also used, depending on the field of study (Schlotzhauer, 2007). In this case, the critical cut-off value of $p < 0.1$ is employed. Applying that rule to the present data yields the results presented in Table 11, which show the validity of the hypotheses proposed in this study.

Hypothesis	Result	Reasons
H1: Customer -> Performance	Supported	Large positive Beta and p-value < 0.1
H2: Supplier -> Performance	Not supported	Negative Beta and p-value > 0.1
H3: Competitor -> Performance	Not supported	Small positive Beta, but p-value > 0.1
H4: University -> Performance	Not supported	Small positive Beta, but p-value > 0.1
H5: Government-> Performance	Not supported	Negative Beta and p-value > 0.1
H6: Technology sourcing -> Performance	Supported	Large positive Beta, and p-value < 0.1

Table 11. Hypothesis results

The empirical findings show strong positive support to H1, and H6, as well as weak positive support for H3, and H4. The two latter are however insignificant since their p-values are larger than 0.1. H2 and H5 exhibit negative results, indicating a support for the opposite theories. This is inconsistent with our proposed model. However, the results for H2 and H5 are also insignificant according to the p-values. Further discussion about these results and their effect on the proposed hypotheses will be presented in the next chapter.

To test hypotheses there is commonly another method which utilizes causal modeling by means of the covariance-based structural equation method AMOS. Therefore, in this study, AMOS is used to double check the analyzed results given by linear regression. The structural model with the variables from transformed component variables gained from SPSS is created by IBM SPSS AMOS 22 software, and is presented in Figure 8.

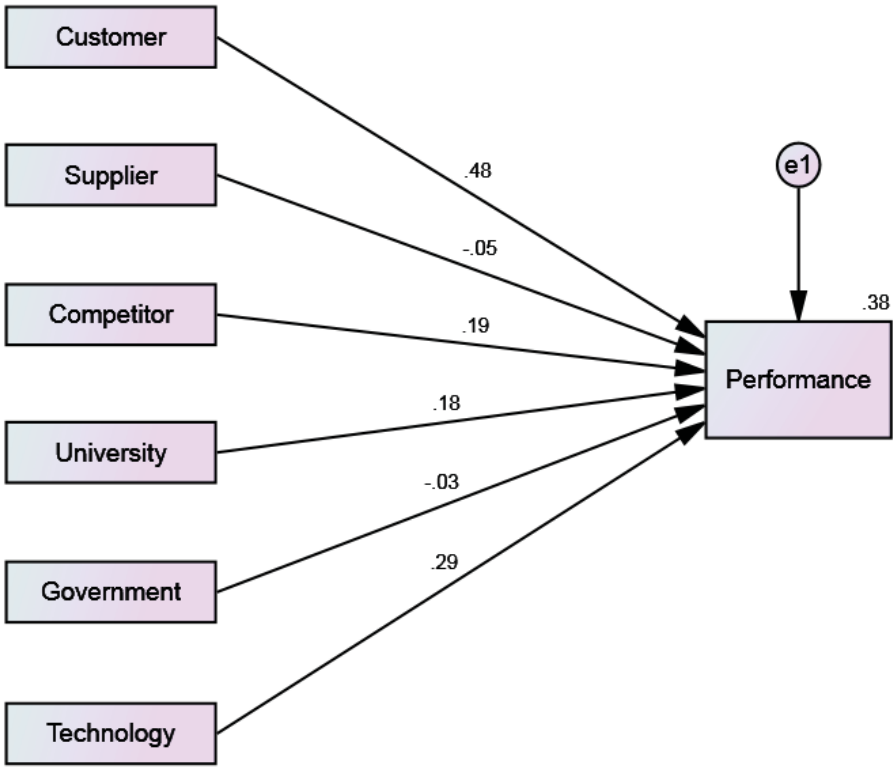

Figure 8. AMOS structural model with standard path coefficient

The values on the arrows linking to the variables are the path coefficients, which provide the weight (standard coefficient) of these links in the path analysis. From the AMOS model above, factors of customer, competitor, university, and technology have positive coefficients to innovation performance and factors of supplier and government have negative coefficient. These results are in line with our analysis results from linear regression. The detail analyzed results are listed in Table 12.

Hypothesis	Description of path	Path Coefficient	C.R.	P	Result
H1	Customer -> Performance	.481	**3.851**	***	**Supported**
H2	Supplier -> Performance	-.049	-.414	.679	**Not supported**
H3	Competitors -> Performance	.189	1.529	.126	**Not supported**
H4	Universities -> Performance	.179	1.409	.159	**Not supported**
H5	Governments -> Performance	-.027	-.204	.838	**Not supported**
H6	Technology souring -> Performance	.286	**2.327**	.020	**Supported**
*** $p < 0.001$					

Table 12. Hypotheses results of AMOS

The Critical Ratio (CR) is another statistical criterion for testing hypothesis. Hox and Bechger (1998) state that a CR value of 1.96 is the cut-off level of revealing statistical significance. Hypotheses 1 and 6 have CR values larger than 1.96, which show the statistics provide support to these two hypotheses. On the other side, hypotheses 2 and 5 have negative CR value, which show the statistics do not provide support to these two hypotheses. These are also consistent with negative path coefficients. Although hypotheses 3 and 4 have positive CR values, they are smaller than the cut-off level for statistical significance, 1.96. This indicates that collaborations with competitors and universities can affect performance to a certain degree, but the empirical findings cannot support that they have a positive contribution to innovation performance in micro-enterprises.

5 Analysis

The empirical results indicate that involvement of customers has a significant and positive relationship to innovation performance in startup micro-enterprises (Beta=0.455 and p-value <0.05). This confirms **hypothesis H1** which stated that customer collaborations would lead to better innovation performance. This result is also in line with several other studies in the literature (Von Hippel, 1986; Souder, Buisson and Garrett, 1997; Gruner and Homburg, 2000). In the study by Brettel and Cleven (2011) on SMEs, they also find a strong support for the claim that such collaborations are beneficial, with a beta coefficient of 0.455 and the strongest significance in their study. Similarly, Parida et al. (2012) also finds support for such partnerships in SMEs, receiving a high beta value and significance for vertical collaborations. They go further by dividing innovations between incremental and radical innovations and conclude that customer (vertical) collaborations mainly increase radical innovation performance.

The strong support for customer collaborations is not surprising. Involvement of customers in the innovation process helps micro-enterprises to understand customer needs and to align their products to match those (Brockhoff, 2003). Moreover, involvement of customers in innovation process can also lead micro-enterprises to more application-oriented development, which has shorter developing periods, less risk, and lower cost (Knudsen, 2007). The high beta coefficient and significance in this study show that these benefits also apply to micro-enterprises.

For collaboration with suppliers, the results show a negative beta coefficient, which indicates that the involvement of suppliers does not have a positive contribution to innovation performance in this sample of micro-enterprises. Brettel and Cleven (2011) do find a significant, but weak positive link between supplier collaboration and innovation performance in SMEs (beta coefficient 0.148), whereas this study finds this form of collaboration to have a negative beta coefficient for MEs, although not significant. Therefore, **hypothesis H2** is not supported. This finding is partly in line with Brettel and Cleven (2011), who speculate in some of the risks with supplier collaboration. Brettel and Cleven (2011) state that close involvement with suppliers may give the risk of becoming too dependent. Furthermore, there is a risk that ideas developed through cooperation with a supplier will also be used by that supplier in cooperations with competitors of the company. Firms must always bear in mind the importance of protecting sensitive knowledge and avoid developing serious dependency when collaborating with suppliers (Doz, 1996).

The empirical results show positive beta coefficient for cooperation with competitors, and cooperation with universities, but the p-values are too large to be significant, which indicate that the data is inconsistent. **Hypotheses H3 and H4** are therefore not supported, although the data show tendencies in the expected direction (both coefficients are positive and p-values are 0.2 and 0.3 while the cut-off value is set to <0.1). Other studies have also found a weak, but positive, support for collaborations

with universities and competitors (Christensen et al., 2005; Lee et al., 2010; Spencer, 2003; Parida et al., 2012). In their study of SMEs, Brettel and Cleven (2011) also find a weak link between cooperation with universities and innovation performance (beta=0.068) but do not find any support for the statement that collaboration with competitors is beneficial. Most research focus on innovation within certain industry categories, such as high-technology based areas or large international companies. However, this study target start-up MEs across a wide range of industries in Sweden. As shown in figure 4, the empirical data come from companies active within medicine, automotive, IT, electronics, environment, consumer products, insurance, and broadcasting. The diversity of the sample may explain why the p-values of H3 and H4 are so high. Many companies are not high-tech based companies and may not require any collaboration with universities to be successful. Cooperation with competitors may also be less common in businesses that market products directly to consumers. On the other hand, the positive beta coefficients indicate that cooperation with universities and cooperation with competitors would more likely be beneficial for MEs rather than harmful when it comes to innovation performance.

For collaborations with government partners, the data analysis yields a negative beta coefficient, just as for suppliers. This indicates that support from governments does not have a positive contribution to innovation performance in micro-enterprises. However, this data is far from being significant and can be disregarded. **Hypothesis H5** does therefore not gain support. Gawarzynska (2010) showed that large companies can get support from government in the form of funding, as loans, equity or grants, given to projects that may be to high-risk to attract private investors. Sometimes, large companies can also collaborate with governmental institutions around products related to governmental regulations or national goals, such as automobile safety or environmental targets (Gawarzynska, 2010). However, in this study, using the data from start-up MEs, this theory do not gain support. Due to their age and size, most of the companies may not have drawn the attention of government institutes, and it is therefore reasonable that they do not form such partnerships to the same extent as more established companies.

Hypothesis H6 states that technology sourcing has a positive impact on innovation performance. This is supported by the data, showing a relatively high beta coefficient for suppliers (0.274). Setting the significance-cut-off point to <0.1 enables this component to be significant. A cut-off point of <0.1 can be justified by the relatively small sample size and the fact that the beta coefficient is as high as it is. Parida et al. (2012) also present high beta coefficients for the relationship between technology sourcing and innovation performance in their study of Swedish SMEs, both for radical and incremental innovation (0.375 and 0.158 respectively). Both these values are shown to be highly significant. It is easy to see why technology sourcing can bring many benefits to small startup companies. By buying technology or IPs that the company does not have resources to develop internally, the innovation speed can increase and risk and costs can be reduced (Håkansson and Laage-Hellman, 1984; Tao and Magnotta, 2006).

Looking at the proposed model, only two of six hypotheses could be supported with significant values, while two more was supported but not significant. Consequently, the model fit is not good, with an adjusted R-square value of 0.327 indicating that only 33 % of the variations in innovation performance can be explained by the model. A larger sample size might have partly alleviated this, but it may also be due to the wide sample of companies from different industries.

Other studies performed using more exploratory methods such as interview have shown some possible reasons why open innovation is not more used by small and micro-enterprises. Hutter et al. (2013) reported that companies showed great interest in open innovation tools when they were demonstrated to them, but that they in many cases did not know that the possibilities existed. Hutter et al. (2013) also uncovered several barriers of entry for these small companies, preventing them from engaging in open innovation activities.

Looking at the response rate and how it varies between different industries also clearly demonstrates that there is a difference of interest regarding the topic of open innovation. This can be due to the perceived usefulness of open innovation by the leaders or due to the fact that open innovation is more common knowledge in some industries.

6 Conclusions

The purpose of this study was to investigate six forms of open innovation and their use among Swedish startup micro-enterprises, and specifically, how the use of these methods is linked to overall innovation performance.

The analysis of the collected data reveals that the model is not fully supported, but that the overall trends are consistent with the hypotheses and previous studies (Von Hippel, 1986; Souder, Buisson and Garrett, 1997; Gruner and Homburg, 2000). The study finds strong support for the hypothesis that customer collaboration is beneficial for innovation performance. Looking at the replies, this is a prevalent form of open innovation practiced by the surveyed companies. There is also a significant link between technology sourcing and high innovation performance. However, this method was not as commonly used among the companies, see Appendix 2.

Collaboration with other external partners, i.e. suppliers, competitors, universities, and government, could not be shown to contribute significantly to the companies' innovation performance. These methods, especially supplier involvement, are currently being used by many of the sample companies, and it is important to point out that the results do not indicate that cooperation with such partners reduce the innovation performance.

Several companies in the study are not engaging in open innovation activities to any great extent. This is also in line with several previous studies on SMEs and small companies that suggest that several barriers exist, preventing small companies from successfully utilizing open innovation (Van de Vrande et al., 2009; Parida et al., 2012; Hutter et al., 2013). Hutter et al. (2013) list some of these barriers, including limited financial resources, lack of time, and lack of knowledge about open innovation. They also identify difficulties in related to capabilities in sales, marketing, and distribution.

In conclusion, this study finds that the most common form of open innovation in startup micro-enterprises in Sweden is customer collaboration, and that there is a clear link between using this method and increasing the company's overall innovation performance. Technology sourcing is also shown to boost the innovation performance slightly, while other forms of cooperation do not gain support. Of the non-supported methods, supplier collaboration is the most common among the sample companies.

Both the most common external partners (customers and suppliers) are examples of vertical collaborations (Baum, et al., 2000). The reason why such partnerships are most common is likely that companies already have contact with, and a relationship to, these upstream and downstream companies, which makes it easier to initiate projects since there is already trust and familiarity built up between them. On the contrary, other external partners like universities or government organizations are harder to reach out to and establish a common interest with.

The increase of innovation performance among companies that cooperate with customers and employ technology sourcing is natural, since these two methods offer two important things; they give insight into customer needs and provides innovation input from the users of the products, and secondly, makes a wide range of technology solutions and inventions available for small firms that do not have the capacity to develop everything internally.

Open innovation is beneficial for the development and survival of MEs and should be encouraged. One way to do this, suggested by Hutter et al. (2013) is by the use of intermediary organizations that can facilitate the networking and technology sourcing efforts of small companies. MEs often do not have the time or resources to find and establish external partnerships themselves. By giving an agency or a governmental institution the role as the coordinator, this organization can then detect potential external partnership opportunities for the involved companies and provide matchmaking between them.

It is also likely that, as open innovation practices become increasingly common, MEs will have a greater knowledge and understanding of such opportunities and seek them out on their own. It is the hope of the authors that studies such as this one will have a small positive impact on the understanding of open innovation and its benefits.

7 Limitations and future research

This study has been performed to contribute to the knowledge of technology and innovation management, and to fill the research gap by investigating open innovation in Swedish startup micro-enterprises within different industry sectors. Although we have poured our effort and knowledge into this study, there are several limiting factors. The primary one is the time constraint. In general, doing survey work has to be planned to several months. Unfortunately, due to the tight schedule on this thesis work, we only had a few weeks available to send out surveys and to analyze data. If we would have had more time and more resources, we would like to have sent out more questionnaires and called or visited interested companies to get more responses, which would in turn have lead us to a better understanding of this topic. A future study on the topic should strive to include a much larger sample group, which would perhaps enable validation of more than two of the hypotheses.

Another interesting topic is how open innovation is adopted in different industries. Why do some industry areas adopt open innovation more readily than others? Due to the small sample size, the authors cannot perform a detailed analysis regarding this topic. However, if a future study would include a large enough sample group, it would be interesting to find out which factors or forms are more prevalent when adopting open innovation and which methods that are corresponding to which industry areas. For example, are insurance companies more likely engage in innovation in collaboration with government institutions? Or are manufacturers of consumer products more likely to engage in innovation with competitors then companies from other industries? The Authors believe that these are very interesting questions for further studies.

Even though the benefits of open innovation are clear to most companies, some startup MEs in our survey are still reluctant to adapt open innovation. Some scholars have also found that there exists several challenges when companies implement open innovation, such as the cost of building and maintaining collaborative networks and dedicated organizational structures (Kirschbaum, R., 2005; Lichtenthaler, U. and Ernst, H., 2009), as well as lack of time and resources (Hutter et al., 2013). Enkel et al. (2009) summarized the most cited risks and barriers for adopting open innovation for larger companies, which are loss of knowledge, high coordination costs, loss of control, high complexity, and lack of time and resources. However, there has been little research on why MEs are reluctant to open innovation. Furthermore, it would be highly interesting to find out if there is any difference between the reasons why small and large enterprises are reluctant to open innovation.

Another interesting follow-up question to our research is how to turn innovation into value. Creating ideas through open innovation is simply not enough if the company cannot create any business value out of them. To stay in business, and remain competitive in the market, companies have to create value from open innovations. After a company gains new knowledge, new ideas, and new technology from customers, suppliers,

competitors, universities, government, and technology sourcing, how will they capture these innovative ideas and transform them into value. That is another important question for future research.

References

Arora, A., Fosfuri, A. and Gambardella, A. (2001), Markets for Technology: The Economics of Innovation and Corporate Strategy, MIT Press, Cambridge, MA.

Baum, J. A. C., Calabrese, T. & Silverman, B. S., 2000. Don't Go It Alone: Alliance Network Composition and Startups' Performance in Canadian Biotechnology. Strategic Management Journal, 21(3), pp. 267-294.

Belderbos, R., Carree, M., Diederen, B., Lokshin, B. and Veugelers, R. (2004) Heterogeneity in R&D Cooperation Strategies. International Journal of Industrial Organization, 22, 1237 – 63.

Bergman J., Jantunen A. and Saksa J., 2009. Enabling open innovation process through interactive methods: scenarios and group decision support systems. International Journal of Innovation Management, Vol. 13, No. 1, pp.139–156.

Bianchi, M., Campodall'Orto, S., Frattini, F. & Vercesi, P. 2010, "Enabling open innovation in small and medium-sized enterprises: how to find alternative applications for your technologies", R & D management, vol. 40, no. 4, pp. 414-431.

Bianchi, M., Cavaliere, A., Chiaroni, D., Frattini, F. and Chiesa, V., 2011. Organisational modes for open innovation in the bio-pharmaceutical industry: an exploratory analysis. Technovation, Vol. 31, No. 1, pp.22–33.

Birkle, M. & Gewald, H. 2013, Open innovation - A phased adoption model and its application to German SMEs. Eighth International Conference on Digital Information Management, pp. 396-401

Bonner, J.M. andWalker, O.C. (2004) Selecting Influential Business-to-Business Customers in New Product Development: Relational Embeddedness and Knowledge Heterogeneity Considerations. Journal of Product Innovation Management, 21, 155 – 69.

Brettel, M. & Cleven, N.J. 2011, "Innovation Culture, Collaboration with External Partners and NPD Performance", Creativity and Innovation Management, vol. 20, no. 4, pp. 253-272.

Carnwell, R. Daly, W. 2001. Strategies for the construction of a critical review of the literature. Nurse Educ. Pract. Vol 1, pp. 57–63.

Cefis, E. and Marsili, O. 2006. Survivor: The role of innovation in firms' survival, Research Policy, 35 (5), pp. 626-641.

Chesbrough, H., 2003. Open Innovation: The New Imperative for Creating and Profiting from Technology. Boston, MA: Harvard Business School Publishing Corporation.

Chesbrough, H. Crowther A. K., 2006. Beyond High Tech: Early Adopters of Open Innovation in Other Industries. R and D Management, 36(3), pp. 229-236.

Chesbrough, H., Vanhaverbeke, W. & West, J., 2006. Open Innovation: Researching a New Paradigm. New York: Oxford University Press.

Chesbrough, H. and Rosenbloom, R.S., 2002. The role of the business model in capturing value from innovation: evidence from Xerox corporation's technology spin-off companies. Industrial and Corporate Change, Vol. 11, No. 3, pp.529–555.

Chesbrough, H. and Appleyard, M., 2007. Open innovation and strategy. California Management Review, Vol. 50, No. 1, pp.57–76.

Chiaroni, D., Chiesa, V. and Frattini, F., 2011. The open innovation journey: how firms dynamically implement the emerging innovation management paradigm. Technovation, Vol. 31, No. 1, pp.34–43.

Christensen, J. F., Michael, H. O. & Jonas S. K., 2005. The Industrial Dynamics of Open Innovation: Evidence deom the Transformation of Consumer Electronics. Research Policy, 34(10), pp. 1553-1549.

CSR Europe, 2008. R&D Open innovation: Networks with SME. Open Innovation Network, 6 November 2008

Dittrich, K. and Duysters, G., 2007. Networking as a means to strategy change: the case of open innovation in mobile telephony. Journal of Product Innovation Management, Vol. 24, No. 6, pp.510–521.

Dodgson, M., Gann, D. and Salter, A., 2006. The role of technology in the shift towards open innovation: the case of Procter & Gamble, R&D Management, Vol. 36, pp. 333-346.

Doz, Y.L. (1996) The Evolution of Cooperation in Strategic Alliances: Initial Conditions or Learning Processes, Strategic Management Journal, 17, pp. 55-83.

Dyer, J. H. & Singh, H., 1998. The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage. The Academy of Management Review, 23(4), pp. 660-679.

Ebersberger, B., Marsili, O., Reichstein, T. and Salter, A. 2010. Into thin air: using a quantile regression approach to explore the relationship between R&D and innovation, International Review of Applied Economics, 24 (1), pp. 95-102.

Enkel, E., Gassmann, O. and Chesbrough, H., 2009. Open R&D and open innovation: exploring the phenomenon. R&D Management, Vol. 39 No. 4, pp. 311-316.

Etzkowitz, H. 2003, "Innovation in Innovation: The Triple Helix of University-Industry-Government Relations", Social Science Information, vol. 42, no. 3, pp. 293-337.

Etzkowitz, H., 2005. Triple Helix,. The Orient Publisher, Beijing.

European Commission, 2013. A recovery on the horizon? – Annual report on European SMEs 2012/2013. European Commission, October 2013.

European Commission, 2012. Evaluation of the SME definition. Kent, UK: Centre for Strategy & Evaluation Services.

Fey, C., Birkinshaw, J., 2005. External sources of knowledge, governance mode and R&D performance. Journal of Management 31 (4), 597 – 621.

Gassmann, O., Enkel, E., & Chesbrough, H., 2010. The future of open innovation. R&D Management, 40(3), 213–221.

Gawarzynska, M., 2010. Open Innovation and Business Sucess. Diplomica Verlag, Hamburg, Germany.

Gilmore, A., McAuley, A., Gallagher, D., Massiera, P. and Gamble, J., 2013. Researching SME/entrepreneurial research, Journal of Research in Marketing and Entrepreneurship, Vol. 15, No. 2, pp.87–100.

Golovko, E. and Valentini, G. 2011. Exploring the complementarity between innovation and export for SMEs' growth, Journal of International Business Studies, 42 (3), pp. 362-380.

Goodman, S. N. (1999). Toward Evidence-Based Medical Statistics. 1: The P Value Fallacy. Annals of Internal Medicine 130. pp. 995–1004.

Google 2014. Google Forms, http://www.google.com/google-d-s/createforms.html, viewed 2014-06-17.

Grindley, P. and Teece, D. (1997), "Managing intellectual capital: licensing and cross-licensing in semiconductors and electronics", California Management Review, Vol. 39 No. 2, p. 9.

Gruner, K.E. And Homburg, C. (2000) Does Customer Interaction Enhance New Product Success? Journal of Business Research, 49, pp. 1-14.

Grönlund, J., Rönnberg-Sjödin, D. & Frishammar, J., 2010. Open Innovation and the Stage-Gate Process: A Revised Model for New Product Development. California Management Review, 52(3), pp. 106-131.

Hair, J.F., Black, B., Babin, B. and Anderson, R.E. (2010), Multivariate data analysis (7th Ed.), London: Prentice-Hall.

Hart, C. 1998. Doing a Literature Review. Sage Publications, London

Heshmati, A. 2001. On the growth of micro and small firms: evidence from Sweden. Small Business Economics, Vol. 17, pp. 213-218

Hox, J.J. & Bechger, T.M., 1998. An introduction to structural equation modeling. Family Science Review, vol. 11, pp. 354-373

Huston, L. and Sakkab, N., 2006. Connect and develop – inside Procter & Gamble's new model for innovation. Harvard Business Review, March, 11p.

Hutter, K., Hautz, J., Repke, K., Matzler, K., 2013. Open innovation in small and micro enterprises. Problems and Perspectives in Management, Vol. 11 No. 1, pp. 12-22.

Håkansson, H., and Laage-Hellman, J., 1984. Developing a Network R&D Strategy. Journal of Product Innovation Management, vol. 1, No. 4, pp. 224–237.

Ili, S., Albers, A. and Miller, S., 2010. Open innovation in the automotive industry. R&D Management, Vol. 40, No. 3, pp.246–255.

Jones, O. and Tilley, F., 2003. Competitive Advantage in SMEs: organizing for Innovation and Change. Wiley, Chichester

Katila, R., 2002. New Product Search over Time: Past Ideas in Their Prime?. The Academy of Management Journal, 45(5), pp. 995-1010.

Kirschbaum, R., 2005. Open innovation in practice. Research Technology Management, Vol. 48, No. 4, pp.24–28.

Knudsen, M.P. 2007. The Relative Importance of Interfirm Relationships and knowledge Transfer for new product development success. Journal of product innovation management, 24, pp. 117-38.

Kogut, B., 2000. The Network as Knowledge: Generative Rules and the Emergence of Structure. Strategic Management Journal, 21(3), pp. 405-425.

Laforet, S. 2008. Size, strategic, and market orientation affects on innovation. Journal of Business Research, 61 (7), pp. 753-764.

Laursen, K. & Salter, A., 2006. Open for Innovation: The Role of Opennsess in Explaining Innovation Performance among U.K. Manufacturing Firms. Strategic Management Journal, 27(2), pp. 131-150.

Lee, S., Park, G., Park, J. & Yoon, B. 2010. Open innovation in SMEs—An intermediated network model, Research Policy, vol. 39, no. 2, pp. 290-300.

Leiponen, A., & Helfat, C. E., 2010. Innovation objectives, knowledge sources, and the benefits of breadth. Strategic Management Journal, 31, 224–236.

Lichtenthaler, U., 2011. Open innovation: past research, current debates, and future directions. Academy of Management Perspectives, Vol. 25, No. 1, pp.75–93.

Lichtenthaler, U., 2008. Open Innovation in Practice: An Analysis of Strategic Approaches to Technology Transactions. IEEE Transactions, 55(1), pp. 148-157.

Lichtenthaler, U. & Ernst, H., 2007. Developing Reputation to Overcome the Imperfections in the Markets for Knowledge. Research Policy, 36(1), pp. 37-55.

Lichtenthaler, U. and Ernst, H., 2009. Opening up the innovation process: the role of technology aggressiveness. R&D Management, Vol. 39, No. 1, pp.38 – 54.

Linn, T.A., 1994. Learning from the Competition. Journal of Accountancy, Vol.177, pp.43 – 46.

Mangematin, V., Lemariè, S., Boissin, J.-P., Catherine, D., Corolleur, F., Corolini, R., and Trommetter, M., 2003. Development of SMEs and heterogeneity of trajectories: the case of biotechnology in biotechnology firms. Research Policy 32, 737 - 750

Myers, M. D. 1997. Qualitative Research in Information Systems, MIS Quarterly, 21(2), pp. 241-242.

Mytelka, L., 1991. Crisis, technological change and the strategic alliance. In: Mytelka, L., Strategic Partnerships and the World Economy. Printer, London, pp. 7 - 34.

Ndonzuau, F.N., Pirnay, F. & Surlemont, B. 2002, "A stage model of academic spin-off creation", Technovation, vol. 22, no. 5, pp. 281-289.

Punch, K.F. 1998. Introduction to Social Research. Sage, London

Ragatz, G. L., Handfield, R. B. & Petersen, K. J., 2002. Benefits Associated with Supplier Integration into New Product Development under Conditions of Technology Uncertainty. Journal of Business Research, 55(5), pp. 389-400.

Rahman, H., Ramos, I., 2010. Open innovation in SMEs: from closed boundaries to networked paradigm. Issues in Informing Science & Information Technology, vol. 7, pp. 471.

Parida, V., Westerberg, M. & Frishammar, J., 2012. Inbound Open Innovation Activities in High-Tech SMEs: The Impact on Innovation Performance. Journal of Small Business Management, 50(2), pp. 283-309.

Pittaway, L. et al., 2004. Networking and Innovation: A Systematic Review of the Evidence. International Jouornal of Management Reviews, 5-6(3-4), pp. 137-168.

Rivette, K.G. and Kline, D. 2000. Rembrandts in the Attic: Unlocking the Hidden Value of Patents, Harvard Business School Press, Boston, MA, p. 221.

Rothaermel, F.T., Deeds, D.L., 2004. Exploration and exploitation alliance in biotechnology: a system of new product development. *Strategic Management Journal,* 25 (3), 201–222.

Rohrbeck, R., Holzle, K. and Gemunden, H.G., 2009. Opening up for competitive advantage –how Deutsche Telekom creates an open innovation ecosystem. *R&D Management,* Vol. 39, No. 4, pp.420–430.

Schlotzhauer, S. 2007, Elementary Statistics Using JMP (SAS Press), Cary, NC: SAS Institute. pp. 166–169

Sechrest, L., Sadini, S., 1995. Quantitative and Qualitative Methods: Is There an Alternative? Evaluation and Program Planning, 18(1) pp. 77-87.

Sieg, J.H., Wallin, M.W. and von Krogh, G., 2010. Managerial challenges in open innovation: a study of innovation intermediation in the chemical industry. R&D Management, Vol. 40, No. 3, pp.281–291

Souder, W.E., Buisson, D. and Garrett, T. 1997. Success through Customer-Driven New Product Development: A Comparison of US and New Zealand Small Entrepreneurial High Technology Firms. Journal of Product Innovation Management, 14, pp. 459–72.

Spencer, J.W., 2003. Firms' Knowledge-Sharing Strategies in the Global Innovation System: Empirical Evidence from the Flat Panel Display Industry. Strategic Management Journal, Vol.24, pp. 217 ‐ 33.

Spithoven, A., Vanhaverbeke, W. & Roijakkers, N., 2013. Open innovation practices in SMEs and large enterprises. Small Business Economics, vol. 41, no. 3, pp. 537-562.

Tao, J. & Magnotta, V. 2006, "How Air Products and Chemicals "Identifies and Accelerates"", Research-Technology Management, vol. 49, no. 5, pp. 12-12.

Tether, B.S. 2002, "Who co-operates for innovation, and why: An empirical analysis", Research Policy, vol. 31, no. 6, pp. 947-967.

Van De Vrande, V., J. P. J. De Jong, W. Vanhaverbeke, and M. De Rochemont, 2009. Open Innovation in SMEs: Trends, Motives and Management Challenges. *Technovation,* 29(6–7), 423–437.

Vanhaverbeke, W., Van de Vrande, V. and Chesbrough, H., 2008. Understanding the advantages of open innovation practices in corporate venturing in terms of real options. *Creativity & Innovation Management,* Vol. 17 No. 4, pp. 251-258.

Von Hippel, E. 1986. Lead Users – A Source of Novel Product Concepts. Management Science, 32, pp. 791–805.

Walonick, D.S. 2010. Statistics Calculator. StatPac Inc.

Wynarczyk, P., 2013. Open innovation in SMEs. *Journal of Small Business and Enterprise Development*, Vol. 20 No. 2, pp. 258-278

Yin, R.K. 2009. Case Study Research: Design and Methods. 4th edition, SAGE Publications, Inc.

Appendix 1

Below is the english version of the survey that was sent out to the sample companies.

A. General

1. Select your gender:

- ○ Male
- ○ Female

2. Your position in the company:

- ○ CEO
- ○ Department manager
- ○ Other: [ ]

3. Specify the industry your company belongs:

[ ]

B. Questions about innovation

1. Involvement with customers

a) We directly involve our present customers in the innovation process.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

b) We keep close contact with our end users to jointly develop our products.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

c) We involve our future potential customers in the innovation process.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

2. Involvement with suppliers

a) We maintain close contact with our suppliers to learn the latest about technological development

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

b) We directly involve our suppliers in the innovation process.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

c) Our suppliers play an important role in the innovation process.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

3. Cooperation with competitors

a) We cooperate with competitors to accelerate innovation.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

b) We exchange information with competitors.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

c) We are inspired by competitors' solutions when doing innovation.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

4. Cooperation with universities

a) We cooperate with universities to accelerate our innovation process.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

b) Our core technology(ies) are a result of university research.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

c) Regular discussions with universities are important for our firm's innovation process.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

5. Support from governments

a) We get financial support from government in our innovation process.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

b) We cooperate with governmental institutions/agencies in the innovation process.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

c) We gain information from government that can be used in the innovation process.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

6. Technology sourcing

a) We purchase technological solutions or intellectual properties to drive our innovation process.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

b) We sold technological solutions or intellectual properties

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

c) We outsource our development work to accelerate the innovation process.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

C. Performance measures

a) We bring new and innovative products/services to the market more often than other firms of comparable size

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

b) In our market we are known for our innovative products/services.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

c) Our new products/services differ substantially from their precursors.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

d) The percentage of new and innovative products/services in the product/service portfolio is significantly higher in comparison to our competitors.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

e) The percentage of sales generated through new and innovative products/services is significantly higher in comparison to our competitors.

	1	2	3	4	5	6	7	
strongly disagree	○	○	○	○	○	○	○	strongly agree

D. Additional comments

Please fill if you would have any comments

Thank you very much for participating this survey!

Appendix 2

Summary of the most used open innovation methods according to the survey.