JÖNKÖPING INTERNATIONAL BUSINESS SCHOOL
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Competence barriers to innovation

A study on small enterprises

Bachelor Thesis within Business Administration

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Abstract

Background Innovation is, in most cases, a necessity for firms in today's changing market place. It has the potential to offer firms numerous advantages, including increased profit and growth. However, innovation is no easy process and there are many barriers and impediments to innovation that needs to be overcome in order to efficiently innovate. A study conducted by Vinnova (2007) showed that 18% of SMEs consider a shortage of qualified personnel as a high barrier to innovation.

Problem How are competence barriers to innovation experienced by small enterprises in the selected sample? Do competence barriers to innovation vary depending on different firm characteristics and in that case how? Which consequences do small enterprises encounter as a result of facing competence barriers to innovation? Are small enterprises that face high competence barriers to innovation more likely to encounter consequences?

Purpose The purpose of this research report is to investigate competence barriers to innovation within small enterprises and the consequences these barriers might result in.

Delimitations A study on small enterprises within the industries of metal manufacturing and information and communication, in the counties of Jönköping, Kalmar and Kronoberg. Generalizations are limited to this sample.

Method The data were gathered through structured telephone interviews and e-mail questionnaires. The results were statistically analyzed by the use of correlation analysis, multiple linear regression and binary logistic regression models. CEOs were respondents.

Conclusion Competence barriers to innovation are considered moderate in this sample. The highest barrier was shortage of qualified personnel necessary for innovation. In general, small enterprises that experienced a higher level of competition also faced higher competence barriers to innovation. The most frequently reported consequences from facing competence barriers to innovation were; inability to accept certain jobs or contracts, decreased profitability and difficulty in expanding the business. Small enterprises which face higher competence barriers to innovation are more likely to encounter consequences.

Definitions

In this Bachelor thesis some concepts and technical language, which are specific for innovation and management, will be used. In order to assist the reader, a number of concepts and technical terms will be defined as to their meaning in this context.

HRM — Human Resource Management. The management of people in organizations. HRM includes, among others, hiring, training, evaluating, directing, rewarding and finally releasing or retiring staff (Britannica Online Encyclopedia, 2008).

Innovation — Vahs and Burmester (1999) defines innovation as the purposeful implementation of new technical, economical, organizational and social problem solutions, that are oriented to achieve the company objectives in a new way (cited in Sauber & Tschirky, 2006).

Innovation management — The management of innovations can be divided into four concerns; which innovation processes to be managed, organizing these processes to occur, create the right conditions of an environment for innovation through these processes and finally to maintain their flexibility as innovation is dynamic (Bessant & Tidd, 2007).

R&D — Research and development. "In industry, two intimately related processes by which new products and new forms of old products are brought into being through technological innovation." (Britannica Online Encyclopedia, 2008).

SMEs — Small and medium-sized enterprises (SMEs). The definition divided SMEs into three different sizes; micro, small and medium. A micro enterprise consists of less than ten employees with an annual turnover less than €2 million, a small enterprise has less than 50 employees and an annual turnover of less than €10 million and a medium-sized enterprise conduct their business with less than 250 employees and an annual turnover less than €50 million. An enterprise was here defined as "any entity engaged in an economic activity, irrespective of its legal form" (The European Commission, 2005).

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1 Introduction

In this section, the background and problem are discussed. Furthermore, it introduces the concept of innovation and presents research questions, purpose and delimitations of this research paper.

1.1 Background

In today's changing environment, where competition is increasing in almost all areas of business, the need for change and innovations has probably never been greater (Tidd, Bessant & Pavitt, 2005). Although innovation is a risky and uncertain process which could make it seem reasonable not to innovate, an approach of doing nothing is seldom an option. In reality, if firms are not ready to continuously renew their products and processes, their chances of survival are seriously threatened (Tidd et al., 2005).

Survival is of course not the only incentive to innovate. Research confirms that innovative firms, i.e. firms that are able to use an innovational process within the organization to improve their processes, or to differentiate their products and services, outperform their competitors in regards to market share, profitability and growth (Tidd et al., 2005). Geroski, Machin and Van Reenen (1993) and Geroski and Machin (1993) conducted research on innovation, profitability and growth and found that innovative firms report higher profits and growth compared to non-innovative firms. While the reported profits and growth figures are not substantially higher than the figures of non-innovative firms, they found that innovation has spill-over effects granting firms which buy the innovations, higher growth rates as well (Geroski et al., 1993). Similar results have been confirmed more recently by Vincent, Bharadwaj and Challagalla (2004), whose overall findings indicated that innovation is both significantly and positively related to "superior performance". Comparable studies have been conducted on SMEs, where Hoogstraaten (2005), among others, could confirm that innovative firms grow faster and have higher turnover compared to non-innovative firms.

Research shows that innovation can offer great advantages. Furthermore, innovation is not limited to a specific group of companies, such as large, high-tech manufacturing companies. On the contrary, the need to innovate is universal, no matter size, sector or technological sophistication (Cobbenhagen, 2000). The change in the economy, from a manufacturing-driven towards a more service, design and information driven economy, requires SMEs to increase their flexibility, adaptability and innovative ability (Jones & Tilley, 2003).

Still, innovation is no simple matter and is considered a difficult process which involves a lot of risk where most new technologies and its products and services fail in reaching a commercial success. As innovation can enhance competitiveness it also requires a different set of knowledge and skills from the management compared to the everyday business administration (Tidd et al., 2005). In addition, firms, no matter size, face numerous barriers which have to be overcome in order to efficiently carry out innovations. The list of innovation barriers is long and includes, but are not limited to; external financing, availability of time and various competencies (Vinnova, 2007; SCB, 2006; Mohnen & Rosa, 1999; Tiwari & Buse, 2007; Ylinenpää, 1997; Tourigny & Le, 2004). The latter barrier is the main focus of this study. Given the high importance of innovation, the authors of this thesis believe that the research area of barriers and impediments which prevents and limits innovation deserves more attention. Therefore, in this thesis competence barriers to innovation and the possible consequences these might result in, will be investigated.

1.1.1 Defining innovation

To familiarize the reader with this topic a brief outline concerning the definition of innovation will be presented. Even though innovation and its processes is seen as a relatively new concept by organizations, it has been subject to discussions over several decades. The term innovation comes from Latin's *innovare*, which means "to make something new" (Tidd et al., 2005). The definition, however, has developed over time and been interpreted very differently (Sauber & Tschirky, 2006). Schumpeter defined innovation in 1939 with "if, instead of quantities of factors, we vary the form of the production function, then we have an innovation" (Sauber & Tschirky, 2006). Being one of the first definitions it was not as specified, it explained that any shift in the production function was to be seen as an innovation.

Witte came up with a more holistic definition in 1973 by saying that innovation is the first use of an invention, not necessarily emerging from research and development, but also comprehending processes from business administration and social science. Using this definition instead meant that an innovation could arise from other departments than research and development, and also from outside the organization. The definition was an important progress in defining and developing the innovation process as it was seen as an eye-opener concerning improvement of internal processes (Sauber & Tschirky, 2006).

Seen in the explanations above, the definition of innovation has become more specific over the years and also identified that the flow of ideas for innovation comes from many different sources. Further, Amara, Landry, Becheikh and Ouimet (2008) explained that the advantages hailing from innovation processes is not only lead by major and radical innovations, but also in increasing the frequency and novelty of these, be it small or large. These small innovation changes that also lead to an advantage were, among others, acknowledged by Rothwell and Gardiner (1985) through their definition of innovation; "... Innovation does not necessarily imply the commercialization of only a major advance in the technological state of the art (a radical innovation) but it includes also the utilization of even small-scale changes in technological know-how" (cited in Tidd et al., 2005).

In this thesis the following definition of an innovation will be used; a new or significantly improved product, service or process introduced by the company during the last three years (Tourigny & Le, 2004).

1.1.2 Innovation Management

To be able to survive in the highly competitive business environment of today, companies must be capable to see and handle change as a necessity for the organization. The management of innovation can be divided into four concerns; what innovation processes to be managed, organizing these processes to occur, create the right conditions of an environment for innovation through these processes and finally to maintain their flexibility as innovation is dynamic. Overall, two factors within companies can be said to decide the success of innovation. The first decisive is the company's resources, for example the workforce, equipment, knowledge and money. The second one is the company's potential to manage these resources (Bessant & Tidd, 2007).

Because the technological development results in more complex working environments, strategic managers have to constantly prepare for change. Strategic leaders need to use the management of innovation as a tool for the organization, in a systemic as well as a technological context, with such an influence that it motivates employees to come up with poten-

tial ideas for these changes (Bessant & Tidd, 2007). Even though education and training are there to increase the creative capacity of employees it may also work as a motivating factor as employees who receive education and training feel appreciated and important for the firm. In addition, the important technological knowledge can exist through the employees of an organization, which should be advanced through continuous updates (Jong & Brouwer, 1999).

To stimulate the innovative effort it is also important to include the following considerations; quantifiable goals based on organizational standards, innovation culture and programs, education and knowledge training supported by information technology and value teamwork. Constructing incentives, such as financial rewards and positive appraisal, is also of importance and have shown to have influence on the creativity of employees (Carneiro, 2008).

1.1.3 Connecting SMEs to innovation and innovation barriers

SMEs have since the Bolton Report in 1971 been widely recognized for their contribution to the economic growth and job creation (Jones & Tilley, 2003). In 2005, roughly 23 million SMEs existed, providing 75 million jobs and represented 99% of all enterprises within the European Union (The European Commission, 2005). Although SMEs represent a major share in GDP, it is believed that many of these smaller organizations lack managerial and technical skills, which inhibit their effectiveness. Improving these skills within SMEs is therefore very important, not only for the enterprises but for an economy as a whole (Jones & Tilley, 2003).

Research has shown that innovation, just as in large firms, is very important in SMEs (Cobbenhagen, 2000). Tidd et al. (2005) argue that SMEs share similarities with large firms concerning innovation, however, there are also differences. Although SMEs and large firms often have the same objectives, such as to develop and combine technological and other competencies to supply goods and services that are superior to competition, there are also differences concerning their respective organizations and technology. SMEs often have structural advantages including ease of communication and speed of decision-making. However, they also experience technological weaknesses, such as inability to develop and manage complex systems and to fund long-term and risky programs (Tidd et al., 2005).

When reviewing innovation activities among SMEs in Sweden, a recent study from Vinnova (2007) showed that among small enterprises with 10 to 49 employees in the metal manufacturing industry, 39% of the firms engaged in innovation activities and 31% conducted R&D. Among this group of companies, 20% reported a shortage of qualified personnel as a high impediment to innovation. As for this sample, the counties of Jönköping, Kalmar and Kronoberg are known for their long tradition of entrepreneurship. Jönköping county, including the region of Gnosjö, is Scandinavia's most densely populated region of producing industries, the majority of firms being SMEs. More than 25% of the people employed in this region are working within the manufacturing industry (Vinnova, 2008).

1.2 Problem

Numerous statistical studies have highlighted competence barriers which impede innovation activities in SMEs. A large amount of SMEs face certain limitations to engage in innovations, as they for instance either lack sufficiently qualified personnel in-house or experience a shortage of marketing capabilities to efficiently market new products and processes

(Vinnova, 2007; SCB, 2006; Mohnen & Rosa, 1999; Tiwari & Buse, 2007; Ylinenpää, 1997; Tourigny & Le, 2004).

At the same time there are many studies indicating the importance of qualified personnel, skills, competence and HRM for the success of innovations. Baldwin and Johnson (1995) found strong evidence that human capital development facilitated by training is complementary to innovation and technological change. Baldwin (1999) later found that successful, innovative firms have developed competencies in wide areas of their respective businesses and that they place high emphasis on formal training in order to acquire new skills. The last result is supported by Freel (2004); "More innovative firms, train more staff". Other studies which also support Baldwin's findings, or have very closely related findings, include; Leiponen (2005), Rao, Tang and Wang (2002) and Shipton, West and Dawson (2006), who all found that skilled human capital, training, HRM and experienced employees are drivers of innovation.

In the light of the above mentioned research the authors of this thesis found this particular problem very interesting. As innovation is a necessary part of today's business, firms need to actively adapt and change in order to survive (Trott, 2008). However, there are many barriers and impediments to innovation that have to be overcome in order for firms to successfully innovate, some being the barriers related to competence. Previous research have shown the importance of qualified human resources for innovation projects. Thus, it is the authors' hope that by analyzing different competence barriers which limit or impede innovation activities in SMEs, a better understanding and insight of this problem and its consequences could be provided. Furthermore, as this Bachelor thesis is written at Jönköping International Business School, the authors found it suitable to conduct this research on firms in the surrounding counties.

1.3 Research questions

Derived from the above stated research problem, the authors of this thesis have sought to answer the following research questions;

How are competence barriers to innovation experienced by small enterprises in the selected sample?

Do competence barriers to innovation vary depending on different firm characteristics and in that case how?

Which consequences do small enterprises encounter as a result of facing competence barriers to innovation?

Are small enterprises that face high competence barriers to innovation more likely to encounter consequences?

1.4 Purpose

The purpose of this research report is to investigate competence barriers to innovation within small enterprises and the consequences these barriers might result in.

1.5 Delimitations

A study on small enterprises within the industries of metal manufacturing and information and communication in the counties of Jönköping, Kalmar and Kronoberg. Generalizations are limited to this sample.

2 Frame of Reference

In this section, the authors of this research paper will present the theoretical framework which have been used to carry out this study. It includes discussions concerning various theories about barriers to innovation and how these theories are suitable for this investigation.

To familiarize the reader with the subject and to create a better foundation of understanding concerning the concepts and theories used in this thesis, a discussion of previous research on barriers to innovation and competence barriers to innovation will follow below. There is also a brief outline of previous research regarding HRM and training, and its connection to innovation, as this research have influences from those areas. Furthermore, the authors of this thesis would like to mention that the theoretical frame chosen for this thesis has, to a relatively large extent, influenced the design of this investigation. Therefore the frame has also been used to interpret and further understand the data collected. In some sense, it also involves theory testing as previously conducted research have been applied in a new area. Finally, the choice of this theoretical frame has also significantly shaped, and been shaped by, the purpose and research questions of this thesis.

2.1 Barriers to innovation in SMEs

By reviewing a relatively large amount of previous research, an extensive list of innovation barriers was found, which have been summarized in table 1 below;

Barriers to innovation in SMEs	Authors
Financial barriers High costs of innovation projects Lack of internal and external financing for innovation projects Difficulty of predicting the costs of innovation	Kleinknecht, 1989; Ylinenpää, 1997; Mohnen & Rosa, 1999; Freel, 1999; Kaufmann & Tödtling, 2002; Tourigny & Le, 2004; Rammer, 2005; SCB, 2006; Vinnova, 2007; Tiwari & Buse, 2007
Risk barriers High risk related to the feasibility of innovation projects High risk related to successful marketing of the innovation Innovation is easily copied by others	
Competence barriers Shortage of qualified personnel for innovation projects Lack of marketing capability to market new or significantly improved products Lack of information on technology relevant for innovation projects	
Organizational barriers Internal resistance to innovation Organizational rigidities which impede innovation projects	
Legal barriers Legislation and regulation having an impact on innovation projects	

Table 1: Barriers to innovation in SMEs.

The larger, descriptive studies reviewed have been conducted by government institutions, including Statistiska Centralbyrån (SCB, 2006), Vinnova (2007) and Statistics Canada (cited in Tourigny & Le, 2004). In general, the results are fairly similar, even across nations. The four most frequently reported innovation barriers stated by SMEs are related to financing, high costs, time and shortage of qualified personnel for innovation projects (SCB, 2006; Vinnova, 2007; Statistics Canada, cited in Tourigny & Le, 2004). Still, there are some notable differences. First, there are variations in the percentage number of firms indicating the different barriers to innovation. Second, SCB has not reported any information concerning a time barrier to innovation. Although not explicitly stated in Statistics Canada's study, a barrier very closely related to time was still measured in the survey; "inability to devote staff

to projects to develop new or significantly improved products or processes on an on-going basis because of production requirements". Third, the data from Statistics Canada only consist of manufacturing SMEs, whereas SCB and Vinnova have reported aggregated data from both manufacturing and non-manufacturing SMEs in different industries. Important findings from the studies are summarized in table 2 below;

High barriers to innovation	Vinnova	SCB	Statistics Canada
Lack of financing for innovation projects	24%	18%	27%
Lack of time needed for innovation projects	45%	-	-
Shortage of qualified personnel for innovation projects	18%	16%	39%
High costs of innovation projects	24%	12%	55%
Inability to devote staff for innovation projects	-	-	58%

Table 2: The most frequently reported barriers to innovation by SMEs. Vinnova (2007); SCB (2006); Statistics Canada (cited in Tourigny & Le, 2004).

A number of studies which have provided more detailed analysis in the subject have also been reviewed. Among others; Kaufmann and Tödtling (2002), Kleinknecht (1989) and Freel (1999) found that the two most common barriers to innovation are the financial aspect; i.e. lack of capital and too high risk associated with innovation projects, and the lack of manpower; i.e. shortage of qualified personnel and lack of time for innovation activities. While the financial aspect is common in both large and small firms, it is the lack of manpower that is more frequent in SMEs (Kaufmann & Tödtling, 2002).

2.2 Competence barriers to innovation in SMEs

Numerous statistical studies have highlighted competence barriers to innovation which impede innovation activities in SMEs. A large amount of SMEs experience a certain limitation to engage in innovation, as they for instance either lack sufficiently qualified personnel in-house or lack marketing capabilities to efficiently market new products and processes (Vinnova, 2007; SCB, 2006; Mohnen & Rosa, 1999; Tiwari & Buse, 2007; Ylinenpää, 1997; Tourigny & Le, 2004).

SCB (2006) provided descriptive statistics on innovation barriers in Sweden between 2004 to 2006. They separated the answers into two groups, firms that engage in innovation and firms that do not. Out of the small enterprises within the manufacturing industry with 10-49 employees which engaged in innovation, 16% reported a shortage of qualified personnel as a high barrier to their innovation activities. Among the same group of firms which did not engage in innovation, 11% experienced a shortage of qualified personnel as a high barrier to innovation activities. Lack of information about technology and lack of information about the market were also reported by the two groups, however, the percentage of firms indicating these barriers were smaller, with 5% and 4% respectively for innovative firms, and 2% respectively for non-innovative firms (SCB, 2006).

Vinnova (2007) conducted a similar survey and found that 20% of Swedish SMEs, that believed R&D to be crucial for the future of the firm, considered a shortage of qualified personnel as a high barrier to innovation. When the answers were aggregated with another group of firms, that consider a shortage of qualified personnel as a moderate barrier to innovation, that percentage increased to 61% (Vinnova, 2007).

While Vinnova (2007) and SCB (2006) are descriptive statistics, other researchers have delved deeper into the problem of competence barriers to innovation and tried to explain the variables behind SMEs' perceptions. Ylinenpää (1997) conducted research on 212 Swedish SMEs, investigating the perceived barriers to innovation. He found that there was a

difference regarding perceived barriers depending on firm performance and innovativeness. In general, less innovative and low-performing firms perceived higher barriers to innovation compared to high-performing and more innovative firms. What is slightly surprising, however, is that Ylinenpää's findings deviate from SCB's (2006) statistics where non-innovative firms in general did not perceive barriers as strong compared to innovative firms. The theory that innovative firms face higher barriers to innovation are also supported by Mohnen and Rosa (1999) and Tourigny and Le (2004). Ylinenpää (1997) only found one innovation barrier related to competence to be a strong barrier to innovation. All other barriers relating to competence were still considered moderate barriers, ranging between 2.9 to 3.3 on a 5 graded scale. He identified seven innovation barriers related to competence, the list follows in a descending order of seriousness; (1) cost of utilizing external competence, (2) insufficient own marketing competence, (3) difficulties to find external competence, (4) lack of market research, (5) insufficient own technical competence, (6) lack of information about technical development, and (7) inadequate knowledge of EU regulations.

Mohnen and Rosa (1999) also studied innovation barriers, however, the study was conducted in Canada and did not exclusively focus on SMEs. Still, more than 80% of the researched firms were SMEs. They carried out a statistical analysis on secondary data which were originally collected by Statistics Canada in 1999. The study focused on service companies from the financial, technical and communication sector. They found that the perception of innovation barriers is dependent on several factors. The variables which they investigated were; "industry affiliation, the size of firms, the perceived competitive environment and whether or not firms engaged in R&D". Since Mohnen and Rosa's (1999) study focused exclusively on firms defined as innovative, they included R&D as an independent variable to make further distinctions in their populations. Among the different innovation barriers perceived by SMEs, one can be linked to competence, shortage of qualified staff for innovation projects. This particular impediment was perceived the highest in the technical sector, however, the significance of this barrier also dropped as the firm size increased. They also discovered that the innovation barrier, a shortage of qualified staff for innovation projects, in general was perceived higher by firms that conducted R&D. This was also the case for firms facing a higher degree of competition. The more competitive the environment, the stronger the innovation barriers were perceived.

Another Canadian study on innovation barriers was conducted by Tourigny and Le (2004). They also based their research on secondary data acquired by Statistics Canada, where the majority of the surveyed firms were of small and medium size. The innovation barriers analyzed in their study were, in a descending order of seriousness; (1) lack of skilled personnel to develop or introduce new or significantly improved products or processes (39%), (2) lack of marketing capability to market new or significantly improved products (18%), (3) lack of information on technology relevant to the development or introduction of new or significantly improved products or processes (15%), (4) lack of access to expertise in universities that could assist in developing or introducing new or significantly improved products or processes (5%), and (5) lack of access to expertise in government laboratories that could assist in developing or introducing new or significantly improved products or processes (5%). The percentage numbers in the brackets represent the number of firms which indicated that particular barrier as a high impediment to innovation. In their analysis, Tourigny and Le (2004) tested six groups of variables influencing the perception of innovation barriers. The groups for the variables were; technology intensity, novelty of innovation, location, impact of government support programs, competitive environment, and firm size. Their findings are consistent with Mohnen and Rosa (1999) and Ylinenpää (1997), that

impediments to innovation vary depending on different firm characteristics. Firms that operate in high technology industries and firms that experience higher competition also perceive higher barriers to innovation. The perception of innovation barriers also vary depending on the location of firms, whether or not firms are novel innovators, if firms apply for government support and also which government support packages they apply for. The impediments to innovation also differs depending on firm size. Tourigny and Le (2004) conclude that innovation barriers, although perceived strong by many firms, can still be overcome.

Ylinenpää's (1997), Mohnen and Rosa's (1999) and Tourigny and Le's (2004) findings are important for this Bachelor thesis. The results are used to guide the design of this investigation, as competence barriers and variables from their studies have been adopted to this research paper. These theories are therefore also utilized in the analysis where they are used to make sense of the empirical data collected from this investigation.

2.3 HRM and training

There are several studies indicating the importance of qualified personnel, competence, training and HRM for the success of innovations. Baldwin and Johnson (1995) found strong evidence that human capital development facilitated by training is complementary to innovation and technological change. Baldwin (1999) later found that successful, innovative firms have developed competencies in wide areas of their respective businesses, and that they place high emphasis on formal training in order to acquire new skills. The last result is supported by Freel (2004); "More innovative firms, train more staff". Other studies which also support Baldwin's (1999) findings, or have very closely related findings, include; Leiponen (2005), Rao, Tang and Wang (2002) and Shipton, West and Dawson (2006), who found that skilled human capital, training, HRM and experienced employees are all drivers of innovation.

For this study there is also a need to define informal, formal and proactive training as the different forms of training will be used to distinguish between their respective impact on competence barriers to innovation. Previous research have utilized the following definitions; "Formal training is defined in the survey as training that is planned in advance and that has a structured format and a defined curriculum. Informal training is unstructured, unplanned, and easily adapted to situations and individuals." (Harley et al., 1998). "Formal training is either on-the-job or off-the-job instruction in a place removed from the production process. Informal training is less structured and performed on the job." (Baldwin & Johnson, 1995). Reactive training is where the firm trains as demand arise and proactive training is highly planned and organized (Shipton et al., 2006). Derived from the above studies, the following definitions of training will be used; Informal training is performed in the workplace, is less structured and implemented by colleagues. Formal training is performed in or outside the workplace, is more structured and implemented by an external source. Proactive training is highly planned and structured, and is aimed to be performed before a need has presented itself.

These theories have been included in this investigation as there was an interest between the authors of this research paper to measure, whether or not, the level of training in small enterprises has an impact on how firms experience competence barriers to innovation. These theories are therefore used for sense making and analysis of the empirical data.

2.4 The theoretical framework tested in this study

In this thesis, several competence barriers to innovation, as well as variables affecting barriers to innovation, were adopted from previous studies. Barriers found during the pre-studies have also been included. The barriers and the variables which have been tested in this study are summarized in table 3 and 4 below.

Competence barriers to innovation	Authors
Shortage of qualified personnel necessary for innovation, within the company.	Ylinenpää, 1997; Mohnen & Rosa, 1999; Tourigny & Le, 2004; Vinnova 2007; SCB 2006; Tiwari & Buse, 2007
Shortage of qualified personnel necessary for innovation, on the market.	Tiwari & Buse, 2007; Ylinenpää, 1997; Mohnen & Rosa, 1999; Tourigny & Le, 2004
Shortage of experienced personnel necessary for innovation, within the company.	Pre-study
Shortage of experienced personnel necessary for innovation, on the market.	Pre-study
Lack of information regarding technical development on the market.	SCB, 2006; Ylinenpää, 1997; Tourigny & Le 2004
Shortage of technically skilled personnel necessary for innovation, within the company.	Tiwari & Buse, 2007; Ylinenpää, 1997; Pre-study
Shortage of technically skilled personnel necessary for innovation, on the market.	Tiwari & Buse, 2007; Ylinenpää, 1997; Pre-study
Cost of acquiring external competence.	Ylinenpää, 1997
Lack of marketing capability to market new or significantly improved products, services or processes.	Ylinenpää, 1997; Mohnen & Rosa, 1999; Tourigny & Le, 2004
Shortage of managerial know-how to effectively and efficiently manage innovation processes.	Tiwari & Buse 2007

Table 3: Competence barriers to innovation.

Firm characteristics	Authors
Innovativeness	Ylinenpää, 1997; Mohnen & Rosa, 1999; Tourigny & Le, 2004
Perceived level of competition	Mohnen & Rosa, 1999; Tourigny & Le, 2004
Industry	Mohnen & Rosa, 1999; Tourigny & Le, 2004
Level of training	Shipton et al., 2006

Table 4: Firm characteristics, affecting competence barriers to innovation.

During the pre-studies, a number of consequences were also mentioned by the interviewed CEOs as a result from facing competence barriers to innovation. These consequences are summarized in table 5 below, and were tested statistically during this study to investigate whether or not they were experienced as a result from facing competence barriers to innovation throughout the selected sample.

Consequences, derived from pre-studies, section 3.5.1
Decreased profitability
Inability to accept certain jobs/contracts
Difficulty in expanding the business
Failed marketing of innovations
Failed innovation projects
Constrained to effectively introduce new products or services
Constrained to effectively introduce new product or manufacturing processes
Decreased number of ideas for innovations

Table 5: Resulting consequences, from facing competence barriers to innovation.

This specific framework was chosen first, because previous studies have shown that the barriers above are competence barriers generally experienced as higher by SMEs. Second, the framework depicts a wide view of the competence barriers and consequences which SMEs face, and therefore provide a comprehensive overview of this particular problem. Third, it allows the authors of this thesis to fulfill the purpose and answer the research questions.

The purpose is once again;

To investigate competence barriers to innovation within small enterprises and the consequences these barriers might result in.

The research questions are;

How are competence barriers to innovation experienced by small enterprises in the selected sample?
Do competence barriers to innovation vary depending on different firm characteristics and in that case why?
Which consequences do small enterprises encounter as a result of facing competence barriers to innovation?
Are small enterprises that face high competence barriers to innovation more likely to encounter consequences?

3 Method

In this section, research approach, research design and method for data collection are presented. Furthermore, statistical method and trustworthiness are accounted for.

In short, the method is a combination of quantitative and qualitative research, where the main focus of the study is placed on quantitative research. This method was, to a relatively large extent, influenced by previous studies as this would facilitate the research process and strengthen reliability (Bryman & Bell, 2003). The details of this research method are presented under each subsequent chapter below.

3.1 Research approach

The research approach applied in this thesis was mainly of deductive nature, however, it also included inductive parts. The deductive part is illustrated by the testing of causal relationships (Saunders, Lewis & Thornhill, 2007; Robson, 2002) between several competence barriers to innovation and different firm characteristics, and further consequences experienced by companies in the sample. In order to test causal relationships, to improve the data collection process and to conduct quantitative research, the concepts needed to be operationalized to take measurable form (Bryman & Bell, 2003). The process of operationalization was facilitated by the use of previous studies. The inductive research, i.e. where theory was developed from observation (Zikmund, 2000), comprise a smaller part in this thesis. It included open questions conducted in the pre-studies where new explanatory variables were discussed. These variables were later tested statistically in the main study.

A highly structured methodology which facilitated replication, both in terms of data collection and analysis was implemented. This study is, as mentioned, to a relatively large extent influenced by previous studies within the area, most importantly being Tourigny and Le (2004) and Mohnen and Rosa (1999). These studies both have the common denominator of barriers to innovation in SMEs. The authors of this thesis have chosen a similar quantitative approach, however, the focus lies exclusively on competence barriers to innovation in order to get a more in-depth view of these barriers. Of special interest was to investigate if different attributes of the companies and their environment had an impact on the perception of competence barriers to innovation. There was also an interest to research if firms that face competence barriers to innovation are more likely to face consequences in their respective businesses as a result of these. Furthermore, as the research deals with intangible concepts, and researchers tend to search for evidence based on selectivity, a large focus has been on objectivity. By using formal measurement and statistical analysis, objectivity and self-control of the researchers are strengthened and the unconscious desire to support evidence already known is reduced. An advantage of the quantitative approach, where many cases are analyzed, is that there is always a possibility to make generalizations based on the findings (Davidsson, 1997). As the objective of this thesis was to make generalizations limited to the selected sample, a quantitative approach became the most suitable alternative. One might argue that a qualitative research approach would have been a viable option for this research topic, since previous statistical research in this field already exists, and that the topic of innovation barriers, due to its intangible nature, offers a good platform for a qualitative discussion. However, as the authors wanted to analyze several distinct cases in order to get a good overview of this problem, a quantitative approach was the only suitable option. Also, as there are no previous quantitative studies which have focused solely on competence barriers to innovation and the possible consequences they might result in, the cho-

sen research approach offered an opportunity, at least to some extent, to conduct unique research.

3.2 Research design

The purpose of this thesis is a combination of descriptive, explanatory and to some extent exploratory research. Descriptively the authors of this thesis have sought to depict the current situation regarding how competence barriers to innovation are experienced by small enterprises in the sampling frame. By collecting data from the selected sample, an overview concerning the opinions of these different innovation barriers were established. Once the data had been collected and presented the results were treated by analyzing certain underlying factors affecting the opinions of small enterprises, accounting for the explanatory part. The exploratory research, i.e. where new insights were sought (Saunders et al., 2007), of this thesis stems from some parts of the pre-studies and the complementary study where the possibility to analyze new variables were found. More specifically, the variables concerning the level of training were tested against competence barriers to innovation, in order to detect a possible relationship. Furthermore, the competence barriers to innovation were then tested against the possible consequences these barriers might result in, also to check for a causal relationship.

3.2.1 Research strategy

The research strategy employed in this Bachelor thesis was a survey, which is generally related to the deductive approach (Saunders et al., 2007). The survey in turn was conducted by the use of structured, anonymous telephone interviews. The approach of using telephone interviews was a suitable method in order to increase the reliability and response rate of the study, as managers generally are more willing to be interviewed than fill out a questionnaire. Another important aspect was that telephone interviews would make sure that only the correct respondents, the CEOs, were participating in the study (Saunders et al., 2007). Further, as the subject was somewhat sensitive, anonymous telephone interviews became the appropriate option in order to overcome bias. There are however also drawbacks with telephone interviews. It can for instance be difficult for the respondent not to have the available response options visible. To overcome this, the questions were kept straightforward and clear (Brace, 2004). Other weaknesses worth to mention with telephone interviews are that there are no possibility for the interviewer to observe the respondent to interpret reactions, or make use of visual aids (Bryman & Bell, 2003). Bias that can occur during the interviews are discussed in section 3.5.

The choice of a survey was also influenced by the purpose of this thesis, which is mainly a combination of descriptive and explanatory research. In addition, as a relatively large amount of quantitative data needed to be collected in order to answer the research questions, a survey method was suitable (Saunders et al., 2007). It could be reasoned that other, more in-depth research strategies would also have been suitable. However, the survey strategy is still argued by the authors to be the most appropriate method to fulfill the purpose of this thesis, as the industries were investigated in a quantitative manner and the data which were collected from this survey research could be used to explain relationships between variables (Saunders et al., 2007). Further, a survey strategy makes it possible for the researchers to have control over the research procedures (Saunders et al., 2007) and to collect data in a fast and efficient way (Zikmund, 2000). Also, as there existed previous research, Tourigny and Le (2004) among others, which explained variables that influence the

perceptions of innovation barriers, these methods could be adopted and adjusted to fit this purpose. Further implications which affected the choice of research strategy were limitations concerning time and restrictions.

3.2.2 A cross-sectional study

This research report is a cross-sectional study, as this research problem, i.e. competence barriers to innovation, have been studied at a given time (Saunders et al., 2007). A cross-sectional study was chosen, first and foremost, due to time restrictions. As this is a Bachelor thesis with relatively narrow deadlines, the possibility to conduct longitudinal studies, when collecting primary data, are difficult. Secondly, a cross-sectional study is a suitable alternative when conducting a survey (Saunders et al., 2007; Zikmund, 2000).

3.3 Getting access and research ethics

In order to conduct the interviews, approval was needed from the managers, who acted as gatekeepers (Bryman & Bell, 2003). In some cases, however, access to the manager was denied already by the person receiving the inquiry. The main reasons were lack of time or that the manager was away on business or vacation. This is further discussed in section 3.7.1. A common reason for denial of access is that the managers find the subject sensitive and, in this case, it might also include to admit weaknesses inside the organization (Saunders et al., 2007). This problem was not experienced by the authors as the interviews were conducted anonymously. In order to attract the interest of the managers, a short presentation of the purpose of the research was given in the beginning of each telephone call. Organizational concerns, such as how much time and resources they would need to spend if participating, were to a large extent eliminated by the short time of the interview (Saunders et al., 2007).

3.4 Selecting sample

The sampling technique utilized was simple random sampling, a fundamental form of probability sampling which signifies that all companies within the population had equally known chance to be included in the sample. As this method is less biased concerning sampling error it is suitable when generalizing (Bryman & Bell, 2003). Even if the sampling was made cautiously, random sampling errors, i.e. statistical fluctuations, can arise, which happens when there exist variations in chance in the chosen units for the sample (Zikmund, 2000).

The companies under investigation are part of two populations, information and communication and metal manufacturing, both consisting of SMEs with 10-49 employees, defined as small enterprises (The European Commission, 2005). It is due to practical reasons recommended to only survey companies with a minimum of ten employees in order to facilitate international comparisons (Oslo Manual, OECD, 1996). As the focus of this study concern small enterprises, companies with more than 49 employees were not included. Further, Therese Sjölundh, CEO at Science Park in Jönköping, explained that CEOs in micro companies, i.e. companies with less than 10 employees, are often the entrepreneur of the company, and the fact that they usually work with limited margins can make it hard for them to participate in research projects (T. Sjölundh, personal communication, 2008-09-18). According to research by Mohnen and Rosa (1999), the innovation barrier of a shortage of qualified personnel decreases in significance as the firm size increases. Therefore a sample of firms with 10 to 49 employees was considered suitable.

The companies in both sample frames are located in the counties of Jönköping, Kalmar and Kronoberg. These counties were chosen as Jönköping county is known to have a high percentage of SMEs, especially in the manufacturing industry (Vinnova, 2008). Vinnova (2008) further described that this is also the case for the neighboring counties Kalmar and Kronoberg. In the study conducted by Vinnova (2007), companies in the metal manufacturing industry generally experienced the shortage of qualified personnel as a higher barrier to innovation, compared to other industries, why this industry was chosen. Furthermore, as this Bachelor thesis is written at Jönköping International Business School, the authors found it suitable to conduct this research on firms in the surrounding counties. The information and communication industry was chosen as it would allow inter-industry comparisons in the analysis and because that industry is characterized by fast innovation and intense competition (Harter, Krishnan & Slaughter, 2000).

The choice of only including CEOs in the study was influenced by Davidsson (1989) (cited in Ylinenpää, 1997) who argued that managers in small companies have important involvement in strategies and operations that concern the company. In research studies trying to understand the behavior of SMEs, the importance of the manager, often also the owner, is therefore crucial (Ylinenpää, 1997). Also Statistics Canada's survey, that was the starting point for Tourigny and Le's (2004) study, used the approach of only including CEOs.

The completeness of the sampling frame is of high importance for the research. If the list of companies is incomplete or incorrect in some way, not all companies have the possibility to be selected, which in turn can decrease the representativeness of the sample (Saunders et al., 2007). All companies selected were listed in the database UC WebSelect. The lists were reviewed in order to test the completeness. This also reduced sample selection error (Zikmund, 2000). The lists were found to include a few companies that had liquidated their business and were therefore excluded from the sampling frame. It is argued by the authors that by conducting this test, the completeness and validity of the list have been maintained (Saunders et al., 2007). Further, details concerning the representativeness of the selected sample will be discussed in section 3.7.4. concerning external validity.

The response rate for the main study was 41.63%, a satisfactory high number, as an expected response rate for academic studies in general is around 35% when top management or representatives for companies are respondents (Baruch, 1999, cited in Saunders et al., 2007). It should, however, be mentioned that response rates can differ a lot (Saunders et al., 2007). For the complementary study, the response rate was 47.83%, as 44 companies out of the 92 answered. Attempts to increase the response rate were made, by sending out additional reminding e-mails.

3.5 Method for data collection

The primary data was collected through structured telephone interviews based on a structured questionnaire, which implies standardization of the questions, i.e. an anonymous interviewer-administered questionnaire (Saunders et al., 2007). As mentioned, to ensure that the manager would be the respondent, collection of data through telephone interviews was suitable. This method would most likely result in a higher response rate compared to a self-administered survey (Saunders et al., 2007). Zikmund (2000), argues that data collected through telephone interviews can be compared to personal interviews when it comes to the quality of the data. The respondent might even answer more reliable, especially when the subject is sensitive, as it is less personal than an interview made in person. The complemen-

tary study was conducted through an e-mail questionnaire, and is further discussed in section 3.5.3.

In order to carry out the research in the most qualified way, systematic, or non-sampling errors, required consideration. It can further be classified as two kinds of groups, respondent and administrative errors (Zikmund, 2000). Non-response errors, part of respondent errors, are discussed in section 3.7.1. Respondent errors can result from characteristics of the interviewee, as some tend to answer in an extreme way, some in a neutral way and others tend to agree to most of the asked questions. These characteristics are important to mention as they can have effects on the results. To avoid interviewer bias, resulting from weak interview techniques that lead the respondent to answer in a certain way, the authors practiced beforehand to stay neutral during the interviews. An important bias to consider when the interview concerns sensitive issues is the reluctance some respondents might have to answer truthfully when weaknesses within the organization are discussed (Saunders et al., 2007; Zikmund, 2000). Other forms of bias can result from respondents who consciously give misleading answers or unconsciously miss out on key terms (Brace, 2004). When it comes to administrative errors, the authors have used structured answering sheets for the answers in order to avoid data-processing errors that can occur when the data is transferred into computers for statistical analysis. In order to keep interviewer error to a minimum, the interviews were as mentioned highly structured and influenced by earlier research (Zikmund, 2000).

3.5.1 Pre-studies

Two pre-studies were conducted in this thesis. The first one had explorative character in order to get a picture of the situation in the companies of interest compared to earlier research, and consisted of two telephone interviews with CEOs in small enterprises. The companies shared the same attributes as the firms in the research population, except for industry affiliation. These were still manufacturing companies but belong to the plastic industry and were not included in the selected sample, in order not to manipulate any data in the sampling frame (Bryman & Bell, 2003). The interviews in the first pre-study consisted of closed questions but also a few open questions regarding innovation barriers in small enterprises, and the possible consequences these could result in. The main findings were that the CEOs experienced lack of technical competence on the labor market. According to one CEO, the rate of technical development on the market exceeds the rate of peoples' development of technical competence. Also, several consequences were discussed, e.g. decreased profitability, obstacles to take on certain jobs and loss of orders from clients.

A second pre-study was conducted through another interview with a CEO of a company with the same attributes as in the first study. This respondent emphasized lack of experienced personnel on the labor market as the most important barrier to innovation, which also had been briefly mentioned by one of the respondents in the first pre-study. Finally, consequences of the competence barriers to innovation were discussed.

In order to ensure high quality of the structured telephone questionnaire it was tested through a pre-test (Oslo Manual OECD, 1996). Hence, a pilot-study including one respondent with the same attributes as the companies in the selected sample was made to evaluate and slightly modify the survey. As probability sampling was employed for the thesis, this respondent was also selected outside the researched sample not to decrease the representativeness of the collected data (Bryman & Bell, 2003).

3.5.2 Designing the structured telephone interview

In order to create a questionnaire for the telephone interview with the most relevant questions it was based on previous literature, research and statistics, and the two pre-studies. The survey was kept short with clear and structured questions in order to avoid a negative effect on the response rate (Oslo Manual OECD, 1996; T. Holgersson, personal communication, 2008-11-04).

The secondary data used was compiled data (Kevin, 1999), i.e. data that has been subject to previous selection and summarization (cited in Saunders et al., 2007). This kind of data is often included in the survey research strategy (Saunders et al., 2007). Important secondary data connected to the design of the survey includes earlier research, such as the data collected by Statistics Canada that was used by Tourigny and Lee (2004) and Mohnen and Rosa (1999). Also Vinnova (2007) was an important source. It was suitable to base most of the questions on these studies and statistics as; they fit well in the context to answer the research questions, the questions have most likely already been piloted and comparison with previous research results is made possible (Bryman & Bell, 2003).

The two opening questions represent one independent dichotomous variable (Tabachnick & Fidell, 2007), coded as 1, if at least one of the questions were answered yes, otherwise 0. These questions were adopted from Tourigny and Le (2004) and Vinnova (2007), and created an attribute variable which found out the characteristics of the respondents (Dillman, 2000). More specifically, companies were classified as innovative if they had introduced a new or significantly improved product, service or process during the last three years. The industry of which the company belong to acted as a second independent dichotomous variable to further characterize the companies.

The statements used in the subsequent section of the survey were rating questions, which are often applied when opinion data is collected. A numeric rating scale was most suitable to use, where the managers could disagree or agree on a scale ranging between 0 to 10 (Dillman, 2000). Five statements, originally applied in the study conducted by Statistics Canada (cited in Tourigny & Le, 2004), could be answered on a numerical scale, including 11 response positions (Zikmund, 2000). The statements were; (1) clients can easily substitute products or services for the products or services of competitors, (2) arrival of new competitors is a constant threat, (3) arrival of competing products is a constant threat, (4) production and manufacturing technologies change rapidly, (5) products or services quickly become obsolete (Appendix 1). Answering 0 implied that the interviewee strongly disagreed, and 10 implied that the interviewee strongly agreed. A scale from 0 to 10 was advised for this particular study by T. Holgersson (personal communication, 2008-11-04). The perceived level of competition variable was then tested and acted as a third independent variable. More specifically, the statements resulted in an opinion variable, where the managers had the possibility to give their view of competition (Dillman, 2000).

The last part of the survey included ten questions concerning competence barriers to innovation which acted as dependent variables. Also these questions acted as opinion variables (Dillman, 2000). The barriers included were the shortage of qualified, experienced and technical personnel, both in-house and on the market. Furthermore, the lack of information concerning technical development on the market, cost of acquiring external competence, lack of marketing capability to market new or significantly improved products, services or processes and a shortage of managerial know-how to effectively and efficiently manage innovation processes (Appendix 1). These questions had their origin in the study conducted by Tourigny and Le (2004), except the question concerning experienced per-

sonnel which was a result from the pre-studies. They were chosen to be able to analyze causal relationships between impediments to innovation and firm characteristics. As they have been applied in earlier research and all treat the specific barriers of interest they are argued by the authors to be highly relevant in the objective to answer the research questions. To avoid bias the questions thought to be more sensitive were placed in the end of the interview (Saunders et al., 2007).

3.5.3 Complementary study

When the primary data had been collected and processed, the authors found it interesting to test additional variables. The subjects of interest were the influences of training on the competence barriers to innovation and the consequences which competence barriers to innovation might result in. These had been left out in the main study as the authors did not see it possible to include them due to time restriction. The complementary study was conducted through an e-mail questionnaire, including three questions for the training variable and nine possible consequences. The choice of an e-mail questionnaire was due to time restriction. The training questions concerned formal, informal and pro-active training and were answered on an identical 11 response position scale (Zikmund, 2000). For the consequence variable, eight consequences were listed. In order for the CEOs to consider all potential answers, a ninth alternative was included, where the CEOs had the option to list their own consequences (Saunders et al., 2007). The listed consequences can be seen in Appendix 2.

3.6 Statistical method

The authors chose to analyze the two data sets, the structured telephone interview and the e-mail questionnaire, through three different types of statistical methods, correlation analysis, multiple linear regression and binary logistic regression. These methods were selected in order to fulfill the purpose and to answer the research questions. Correlation analysis is a measure of association between two variables and was used to measure the strength of the linear relationships (Tabachnick & Fidell, 2007), in this case amongst competence barriers to innovation and between these competence barriers and the level of competition. This was done in order to see if there was a pattern concerning how competence barriers to innovation are experienced by small firms.

The multiple linear regression was used to analyze the data collected from the structured telephone interviews to evaluate the relationship between one dependent variable and several independent variables (Tabachnick & Fidell, 2007). By placing competence barriers to innovation as dependent variables and measure them against several independent variables, the authors were able to see if the competence barriers to innovation in the sample were perceived differently depending on different firm characteristics. The characteristics were; the companies' innovativeness, perceived level of competition and industry. This technique was a simplification of Mohnen and Rosa's (1999) and Tourigny and Le's (2004) multivariate analyses.

To perform the multiple linear regression the data had to be adjusted. The first two questions in the interview assigned the companies as innovative or non-innovative. As previously mentioned, if a company had answered yes to any of these two questions it meant that it had at least introduced one new or significantly improved product, service or process within the last three years (Appendix 1), and thus qualifying as innovative (Tourigny & Le, 2004; Vinnova, 2007). These two questions formed the innovativeness variable and were

given a binary value, 0 for non-innovative and 1 for innovative. The second variable, the perceived level of competition for each company, was given by calculating the individual mean value for question four to eight (T. Holgersson, personal communication, 2008-12-02). The third variable was industry, also binary. Companies belonging to the information and communication industry were given 0 and companies belonging to metal manufacturing were given 1. The three independent variables were then tested against the three most significant competence barriers set as dependent variables. These three competence barriers were selected based on the highest mean values and correlation coefficients (Figure 1; Appendix 3). These three competence barriers were; (1) shortage of qualified personnel necessary for innovation, within the company, (2) shortage of qualified personnel necessary for innovation, on the market, and (3) shortage of experienced personnel necessary for innovation, on the market.

A multiple linear regression was also performed on the training variable investigated in the complementary study. The independent training variable was calculated through a mean value of the three training questions, i.e. informal, formal and proactive training (Appendix 2), for each company. This independent variable was then tested, together with the perceived level of competition variable as the second independent variable, against the same three competence barriers used in the first test set as the dependent variable. These three training questions were also analyzed separately through the same procedure. The three sub-variables to training were thus informal, formal and proactive training. For these multiple linear regression models the authors chose to only include the perceived level of competition variable as it was the only variable with significance in the first multiple linear regression.

The binary logistic regression was applied to the consequences of competence barriers to innovation. This method was used to answer the fourth research question as it predicts a discrete outcome from a set of variables (Tabachnick & Fidell, 2007). This data also needed to be adjusted to perform the logistic regression. Due to low response rate, the authors could not test each individual consequence against the chosen competence barriers. These consequences were therefore lumped together and formed one dichotomous, or binary, dependent variable for each company. If the company had experienced any consequences, from facing competence barriers to innovation, it was given the value 1, and 0 if no consequences had been experienced. A mean was calculated for the same three competence barriers to innovation which were used in the multiple linear regression above. Companies experiencing this mean equal to or above 6, on the 0-10 scale, were given 1, and the companies below, 0. The authors chose this mean level as it is set above both the mean for the scale and the mean for each competence barrier. Through this statistical method the authors were able to see if there existed any likelihood that companies experiencing above moderate to high level of competence barriers, had a higher tendency to have encountered any consequences because of these.

Since the sample sizes were small in both studies the authors used a 5% level of significance (Aczel & Sounderpandian, 2002; T. Holgersson, personal communication, 2008-12-02). All statistical tests were conducted in the statistical program Statistical Package for the Social Sciences, SPSS.

3.7 Credibility of the research

Credibility of the thesis will be discussed under each sub-heading below.

3.7.1 Non-Response

The most common reason for non-response among the CEOs were that they considered their company not to be relevant for the study. Other reasons for non-response were; away on business trips or vacations, inability to take part due to time restrictions or simply refusal to take part in the study. Non-response decreases the representativeness of the population and may cause bias, why considerable efforts were made to get in contact with the non-respondents in order to increase the response rate (Saunders et al., 2007). Further, non-response errors experienced from the interviews, for example refusal from the respondent to answer certain questions were not experienced during the interviews. This kind of bias still needs to be mentioned as there is a possibility that CEOs answered questions without perfectly understanding of them, not to lose face or for other unspecified reasons (Zikmund, 2000).

3.7.2 Reliability

In order to implement a research method that yields high reliability, i.e. the extent to which the measured results are consistent and without errors (Saunders et al., 2007; Zikmund, 2000), the authors of this thesis have applied methods previously used by other authors. This implies a high degree of replication both in terms of data collection and analysis. The use of formal and structured tests of the data, in this case through SPSS, can be argued to increase the reliability (Robson, 2002). Further, the telephone interviews were kept structured to reduce observer error that could arise by all three authors conducting the interviews. As the questions were closed in the survey, observer bias were overcome. The interviews were also kept anonymous to further ensure reliability, due to the sensitive subject of the thesis (Saunders et al., 2007). Therefore the CEOs did not need to worry when admitting weaknesses within organization. The reliability might be reduced due to misunderstanding or any other circumstances which resulted in the managers giving an answer, which would not exactly represent what was intended by the respondent at the point the answer was given. The questions were kept as short and clear as possible, and as the data were collected through telephone interviews, the respondents had the possibility to ask if they still had problems understanding the questions. This is argued by the authors to be important, as high reliability would result in the same answers if the research was conducted again. This could be tested through a retest, which in this case was not possible due to the limited time for the research project (Saunders et al., 2007; Zikmund, 2000).

As this study is highly influenced by previous research, the reliability of the previous studies is important. By using secondary data, mainly derived from government statistics, these issues are reduced. Finally, by adapting method of analysis and questionnaire from earlier research, reliability and validity can be further increased (Saunders et al., 2007).

Furthermore, the data collected from the main and complementary study have been estimated for reliability by applying the Cronbach's alpha test. The reliability is found by testing the scale variance, where an alpha value of at least 0.7 is desirable (Cortina, 1993). This test was applied to all numerical scale variables used in the regression analyses; perceived level of competition, level of training and the three selected competence barriers to innovation. For the main study the Cronbach's alpha was 0.787 and for the complementary study

0.715, both above the reliability level (Appendix 9). These results are further strengthened by only including four and five variables respectively, since adding another variable to the test increases the alpha value, even though it may add to the error variance (Cortina, 1993).

3.7.3 Internal validity

The validity of this thesis will firstly be discussed through the concept of internal validity, i.e. the extent to which the findings of this thesis can be attributed through interventions rather than any flaws in the research design (Saunders et al., 2007). If external factors have had an influence, validity has been affected (Zikmund, 2000). A threat to validity within this research project is that the study was conducted at two different occasions. This might have caused a maturation threat, in the sense that the managers for some reason have changed their view of the problem between the studies (Zikmund, 2000). What can be argued to increase validity is that there were no pre-test or contact with the CEOs before the interviews were conducted. A pre-test of this sort could have caused a testing effect, as the managers would then have had the possibility to prepare for it (Robson, 2002). In order to overcome an instrumentation effect that could arise during the interviews, such as the interviewer changing words or other circumstances that cause an effect in the measuring of the dependent variable (Zikmund, 2000), the telephone interviews were kept highly structured, with short and clear questions. Further, during the pilot study, the interview were tested and slightly modified for the final survey. Sample attrition, which implies that some managers choose to end their participation before the study was fully conducted or split the interview on more occasions (Zikmund, 2000), was not experienced. However, as only approximately half of the respondents replied to the second survey, it still poses a threat to the validity of this thesis. Measurement, or construct validity in this study is high, with the main argument that most questions posed to the CEOs have been adopted from earlier studies (Bryman & Bell, 2003). It must however be considered, that there is always a possibility that the respondents might misunderstand the questions thus affecting the validity (Saunders et al., 2007).

3.7.4 External validity

External validity, closely connected and often referred to as generalizability, concerns to what extent the results can be applicable to other situations than the one studied (Robson, 2002). It is argued by the authors that the external validity is high within this sample, but one must be cautious when making generalizations due to the relatively small number of responses in relation to the population size (Saunders et al., 2007). External validity can also be seen as a question of sampling (Zikmund, 2000). Probability sampling was utilized when selecting individual cases for this thesis, as this technique removes bias during the random selection process. This sampling technique ensures that a sample is representative for the population (Bryman & Bell, 2003). However, in order to collect a sample that would have been representative on the 5% significance level, more firms would have needed to be included in the sample (Saunders et al., 2007). Therefore external validity of this thesis decreases and generalizations should be limited to the sample. If generalizations stretch beyond the sample, these should only be considered as indications.

4 Empirical Findings and Analysis

In this section, the empirical findings derived from the structured telephone interviews and e-mail questionnaires, are presented. It is followed by a descriptive and statistical analysis which connects to the research questions.

The empirical data presented in this study were gathered through two data collection methods, structured telephone interviews and e-mail questionnaires. The structured telephone interviews included responses from 92 small enterprises, 61 from the metal manufacturing industry and 31 from the information and communication industry. The complementary e-mail questionnaire included 44 responses out of the initial 92 responding companies. Furthermore, the empirical data from the two studies have been listed under the research questions to which they are related. The empirical data have also been analyzed through various statistical methods and models which are presented throughout this section. The statistical analysis consists of descriptive statistics, correlation analysis, multiple linear regression and binary logistic regression. The first multiple linear regression was performed on all 92 firms and included data only from the initial telephone interviews. The second multiple linear regression and the logistic regression consisted of 44 answers collected from the complementary study. All correlation and regression results are presented in appendices 3 to 9. Further details concerning the method of the statistical analysis can be found in section 3.6 in the method chapter.

4.1 Research questions 1 & 2

How are competence barriers to innovation experienced by small enterprises in the selected sample?

Do competence barriers to innovation vary depending on different firm characteristics and in that case how?

Under this heading, results which offer information and answers to the above stated research questions will be presented.

4.1.1 Competence barriers to innovation

By presenting the mean results for each competence barrier in figure 1 below, it shows that competence barriers are on average experienced as moderate barriers to innovation in this sample. Although there exist extreme values when reviewing individual cases, there is no single competence barrier that is perceived as very high or very low when aggregated into a mean value. These findings are able to generate similar results as previous research conducted by Ylinenpää (1997). According to his investigation, competence barriers to innovation are in general considered moderate barriers.

What can be seen in figure 1 below is that only three of the barriers were high enough to be above the mean value for the scale, all three involving personnel necessary for innovation; (1) shortage of qualified personnel necessary for innovation, within the company, (2) shortage of qualified personnel necessary for innovation, on the market, and (3) shortage of experienced personnel necessary for innovation, on the market. The two barriers which were experienced as the lowest were; lack of information regarding technical development on the market, and shortage of technically skilled personnel necessary for innovation, within the company. These two barriers also had a mean value well below the mean for all

competence barriers to innovation. One might argue that the low result of Q13, i.e. lack of information regarding technical development on the market, appears logical when considering the vast amount of information available through various sources, be it internet, trade magazines, or other.

When analyzing the different competence barriers to innovation through a correlation analysis, fairly high correlation coefficients were given. Six pairs of variables which all had correlation coefficients above 0.5 were discovered; Q9-Q10 (0.589), Q9-Q11 (0.608), Q10-Q12 (0.737), Q11-Q12 (0.540), Q11-Q14 (0.599), and Q17-Q18 (0.594) (Appendix 3). The value of the correlation coefficient is shown for each pair of variables in brackets. It is interesting to note that firms which responded high on barrier Q10, often also experienced Q12 as a high barrier and to lesser extent also Q15, as these competence barriers are all external to the firms. It seems as though firms which experience one external competence barrier to innovation as high, often also consider all other external barriers to be high. Similar correlation can be distinguished when comparing barriers inside the firm. Q9, Q11 and Q14, which are all internal barriers, show high correlation coefficients when compared amongst each other. Furthermore, Q17-Q18, i.e. lack of marketing capability to market new or significantly improved products, services or processes, and shortage of managerial know-how to effectively and efficiently manage innovation processes, also showed a high correlation coefficient of 0.594. A part of the explanation to this relationship could possibly be found when considering that these two barriers are management barriers and are therefore highly connected. The correlation, however, could also indicate a tendency of response bias, in this case respondents answering in a pattern or extremity bias (Zikmund, 2000).

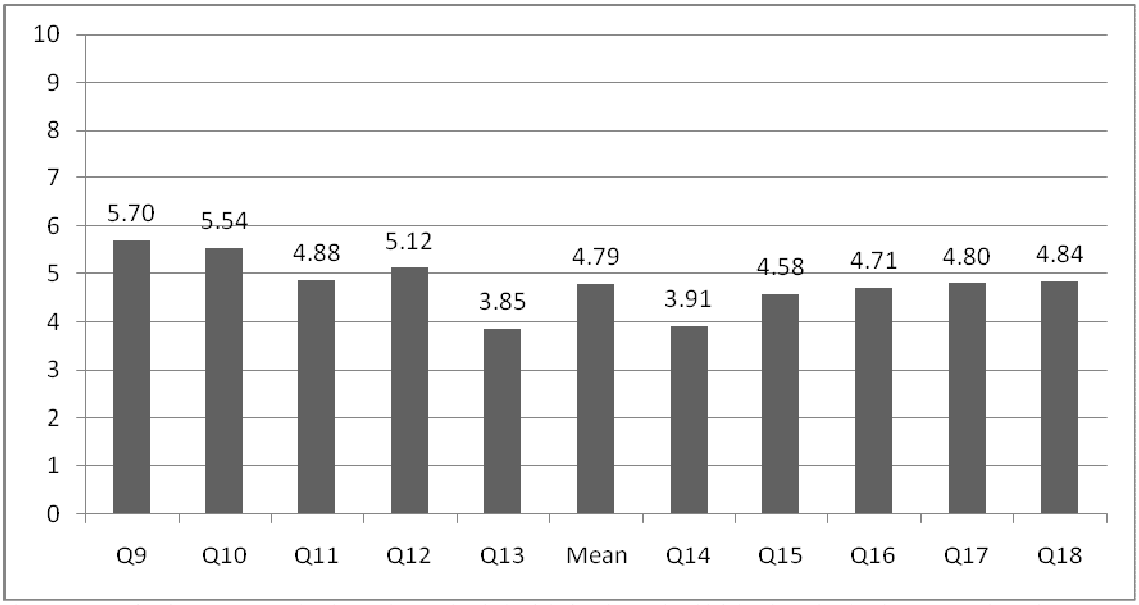

Figure 1: Mean for the competence barriers to innovation in both industries. 10 is a high barrier, 0 is a barrier not experienced. Q9: Shortage of qualified personnel necessary for innovation, within the company. Q10: Shortage of qualified personnel necessary for innovation, on the market. Q11: Shortage of experienced personnel necessary for innovation, within the company. Q12: Shortage of experienced personnel necessary for innovation, on the market. Q13: Lack of information regarding technical development on the market. Q14: Shortage of technically skilled personnel necessary for innovation, within the company. Q15: Shortage of technically skilled personnel necessary for innovation, on the market. Q16: Cost of acquiring external competence. Q17: Lack of marketing capability to market new or significantly improved products, services or processes. Q18: Shortage of managerial know-how to effectively and efficiently manage innovation processes.

4.1.1.1 Innovativeness

When separating the two industries concerning innovativeness, 80.65% of the firms in the information and communication industry and 73.77% of the firms in the metal manufacturing industry were classified as innovative. When reviewing figure 2 below there is an indication in the selected sample, that innovative companies experience the selected competence barriers slightly higher than non-innovative companies. This result could coincide with the studies conducted by Mohnen and Rosa (1999) and Tourigny and Le (2004) where firms classified as innovative generally face stronger innovation barriers.

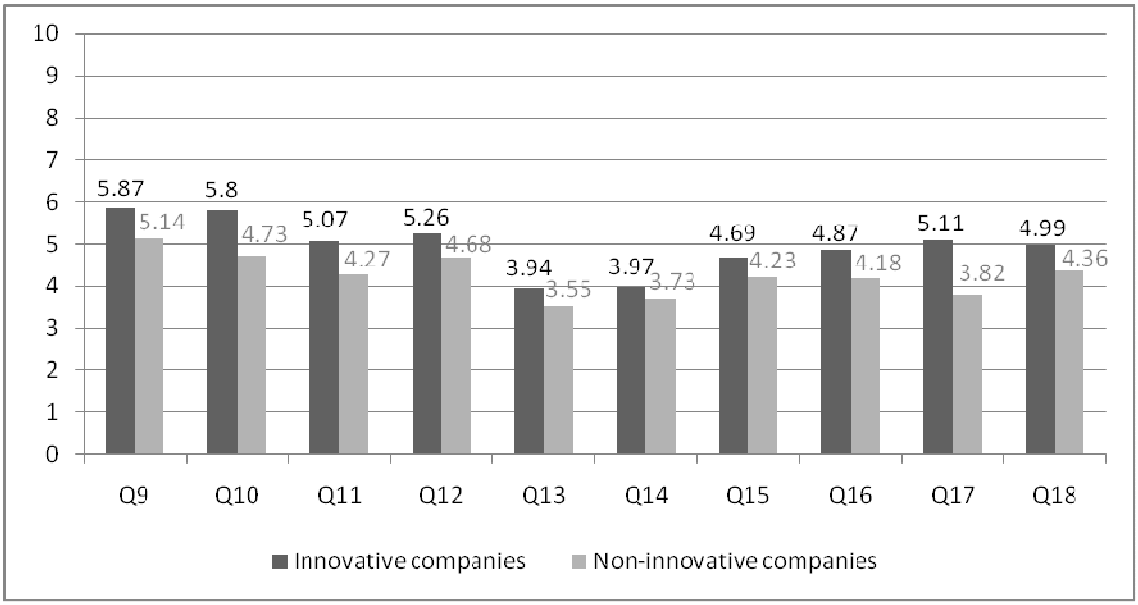

Figure 2: Mean for the competence barriers to innovation between innovative and non-innovative companies. 10 is a high barrier, 0 is a barrier not experienced. Q9: Shortage of qualified personnel necessary for innovation, within the company. Q10: Shortage of qualified personnel necessary for innovation, on the market. Q11: Shortage of experienced personnel necessary for innovation, within the company. Q12: Shortage of experienced personnel necessary for innovation, on the market. Q13: Lack of information regarding technical development on the market. Q14: Shortage of technically skilled personnel necessary for innovation, within the company. Q15: Shortage of technically skilled personnel necessary for innovation, on the market. Q16: Cost of acquiring external competence. Q17: Lack of marketing capability to market new or significantly improved products, services or processes. Q18: Shortage of managerial know-how to effectively and efficiently manage innovation processes.

In order to test this possible causal relationship between innovative firms and how they experience competence barriers to innovation, a multiple linear regression model was conducted. For this statistical analysis, three out of the nine competence barriers to innovation were chosen based on their highest mean values and correlation coefficients (Figure 1; Appendix 3). The competence barriers are, in a descending order of seriousness; (1) shortage of qualified personnel necessary for innovation, within the company, (2) shortage of qualified personnel necessary for innovation, on the market, (3) shortage of experienced personnel necessary for innovation, on the market. The mean values exceeded five and the correlation coefficients were significant with perceived level of competition at a 5% level for all three competence barriers (Appendix 3). Four independent variables were chosen to be included in the models to offer explanation as to if and how SMEs face higher competence barriers to innovation depending on different firm characteristics. In addition to innovativeness, perceived level of competition, industry affiliation and level of training were also included in the model. These variables were adopted or derived from previous research.

According to previous research by Mohnen and Rosa (1999) and Tourigny and Le (2004), firms that are classified as innovative generally face stronger innovation barriers. The underlying logic behind this conclusion is that firms which are more innovative are also more likely to have faced problems and barriers when innovating. In this study, however, the re-

sults from the multiple linear regression were unable to support this theory. The innovativeness variable did not add to the model and showed no statistical significance at the 5% level (Appendix 4). As several previous studies have been able to come to similar conclusions concerning innovativeness and barriers to innovation, the authors of this thesis are inclined to question why these results differ.

A possible explanation behind these findings could be that the majority of the firms in the selected sample were classified as innovative. Due to the relatively small size of the selected sample, the variable innovativeness could therefore not have any significant impact on the results. When the collected responses concerning innovativeness were reviewed, the results showed that 80.65% and 73.77% of the firms in the information and communication industry and the metal manufacturing industry respectively were classified as innovative. Comparing these findings with the results from Vinnova (2007), where 38% of the firms were classified as innovative, it shows that these figures exceed those results with roughly twice as much. Given the fact that the same definition of innovativeness were used in both this and Vinnova's (2007) study, the results should perhaps not deviate to such extent. According to Statistics Canada's findings, roughly 80% of the surveyed firms were classified as innovative (cited in Tourigny & Le, 2004). It should be mentioned that the data included responses from both small and large firms. Still, since a high figure of innovativeness has been measured before, although in Canada, it does not necessarily mean that the results in this study are deviating. A further possible explanation for the deviation could be that the majority of firms in the selected sample operate in an environment which is known for its high level of entrepreneurship (Vinnova, 2008) and that entrepreneurship is closely tied with innovativeness (Bessant & Tidd, 2007). Too many firms could also have been classified as innovative, even though they did not qualify for it, according to the definition. This could partly be due to miscommunication. It was mentioned in the pre-studies, that several of the firms in the selected sample, especially in the metal manufacturing industry, are subcontractors and normally do not introduce any new products as the actual innovation itself is supplied by their clients. What they can do, however, is to introduce new processes. Still, the collected results showed that many firms in the metal manufacturing industry also introduced new products during the last three years. These firms might have answered that they had introduced new products that were actually their customers'. This could also explain, at least to some extent, the high level of innovativeness in the metal manufacturing industry.

4.1.1.2 Perceived level of competition

The perceived level of competition variable was measured on a numerical scale ranging between 0 to 10. The descriptive analysis for this variable is divided into two parts. First, there is a comparison between perceived level of competition between the two industries. By doing so the results helped to provide explanation to the statistical analysis. Second, there is a descriptive presentation showing how competence barriers to innovation were perceived depending on different levels of perceived competition.

Figure 3 below indicates that the competitive environment was perceived differently between the two industries. In the metal manufacturing industry, the companies experienced a longer life span and fewer introductions of products and services. The same industry also indicated a higher threat from new competitors entering the market and that it was easier for customers to find substituting products and services from competitors. For the information and communication industry, the results were the opposite. The products and services had a shorter life span and it was more difficult for customers to find substituting

products and services. The threat of new competitors was also lower, but products and services was introduced more frequently on the market. Interestingly, the production technologies were perceived to change at roughly the same pace in both industries, a level that was also above the mean for the scale.

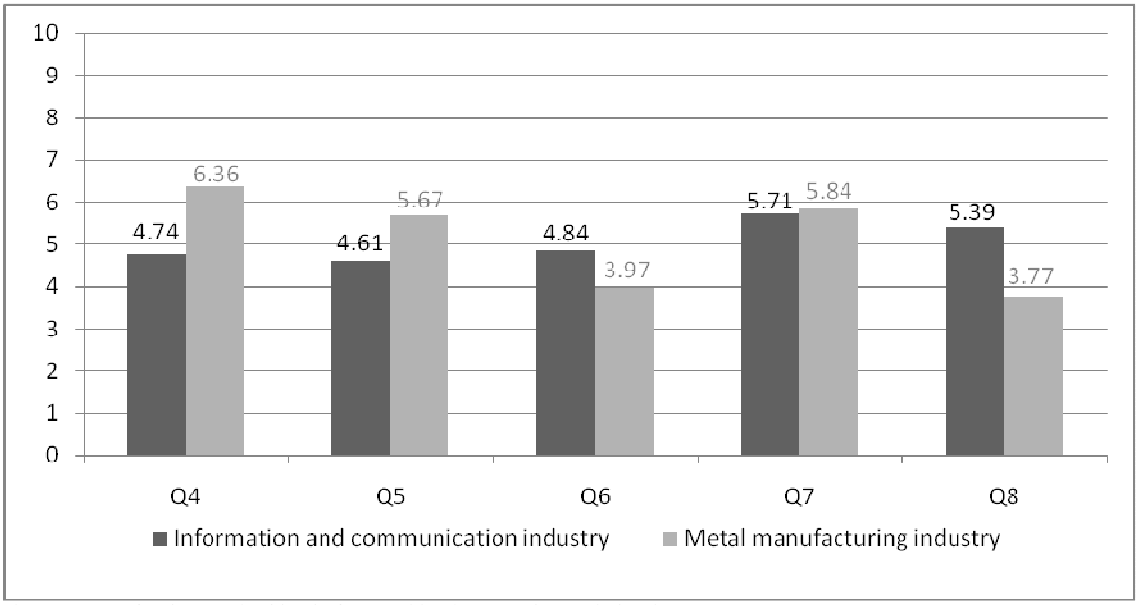

Figure 3: Mean for the perceived level of competition between the two industries. Q4: Clients can easily substitute products or services for the products or services of competitors. Q5: Arrival of new competitors is a constant threat. Q6: Arrival of competing products is a constant threat. Q7: Production and manufacturing technologies change rapidly. Q8: Products or services quickly become obsolete.

In figure 4 below, all 92 firms are divided into three groups depending on the perceived level of competition. The groups are low, medium and high level of competition. By doing this separation, a very clear trend becomes visible. Firms which perceive a lower level of competition also experience lower competence barriers to innovation. Consequently, firms that perceive a higher level of competition thus also experience higher competence barriers to innovation. This causal relationship also holds true for medium level of competition and medium competence barriers to innovation. The regression results for this variable are discussed and explained below.

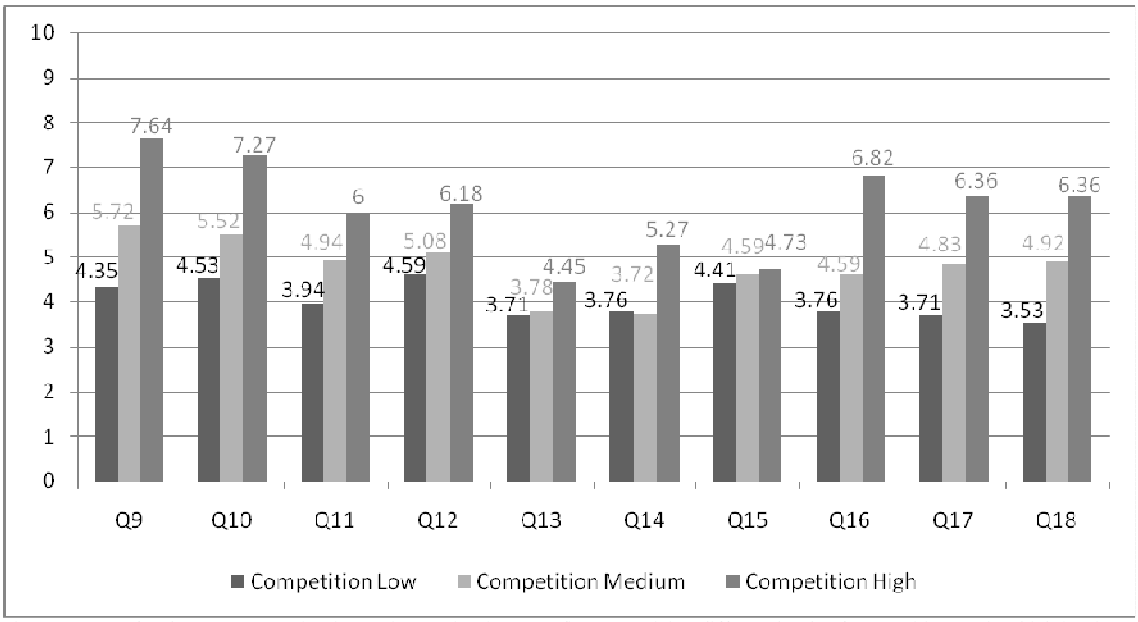

Figure 4: Mean for the competence barriers to innovation between firms perceiving different levels of competition. 10 is a high barrier, 0

is a barrier not experienced. Low ≤ 3.99, Medium ≥ 4 to ≤ 6.99, High ≥ 7 Q9: Shortage of qualified personnel necessary for innovation, within the company. Q10: Shortage of qualified personnel necessary for innovation, on the market. Q11: Shortage of experienced personnel necessary for innovation, within the company. Q12: Shortage of experienced personnel necessary for innovation, on the market. Q13: Lack of information regarding technical development on the market. Q14: Shortage of technically skilled personnel necessary for innovation, within the company. Q15: Shortage of technically skilled personnel necessary for innovation, on the market. Q16: Cost of acquiring external competence. Q17: Lack of marketing capability to market new or significantly improved products, services or processes. Q18: Shortage of managerial know-how to effectively and efficiently manage innovation processes.

These findings concerning how competence barriers to innovation vary depending on perceived level of competition support previous studies, including Mohnen and Rosa (1999) and Tourigny and Le (2004).

When analyzing through the same regression model, the results are significant at the 5% level and show that firms in the selected sample which experience a higher intensity of competition, also experience higher competence barriers to innovation (Appendix 4). This holds true for the firms which considered Q9, adjusted r-square 0.153, and Q10, adjusted r-square 0.077, are strong barriers to innovation. One explanation for this result is grounded in that firms who operate in a more competing environment, are more likely to compete over scarce resources, including human resources, whether it be skilled, technical or otherwise (Tourigny and Le, 2004). This conclusion could provide some insight as to why the barrier Q10, i.e. shortage of qualified personnel necessary for innovation, on the market, is experienced as high. As for Q9, i.e. shortage of qualified personnel necessary for innovation, within the company, Mohnen and Rosa (1999) concluded that "when competition is at its highest, innovation barriers are also experienced the highest" (Mohnen & Rosa, 1999).

4.1.1.3 Industry affiliation

The mean for each competence barrier to innovation within both industries, are presented in figure 5 below.

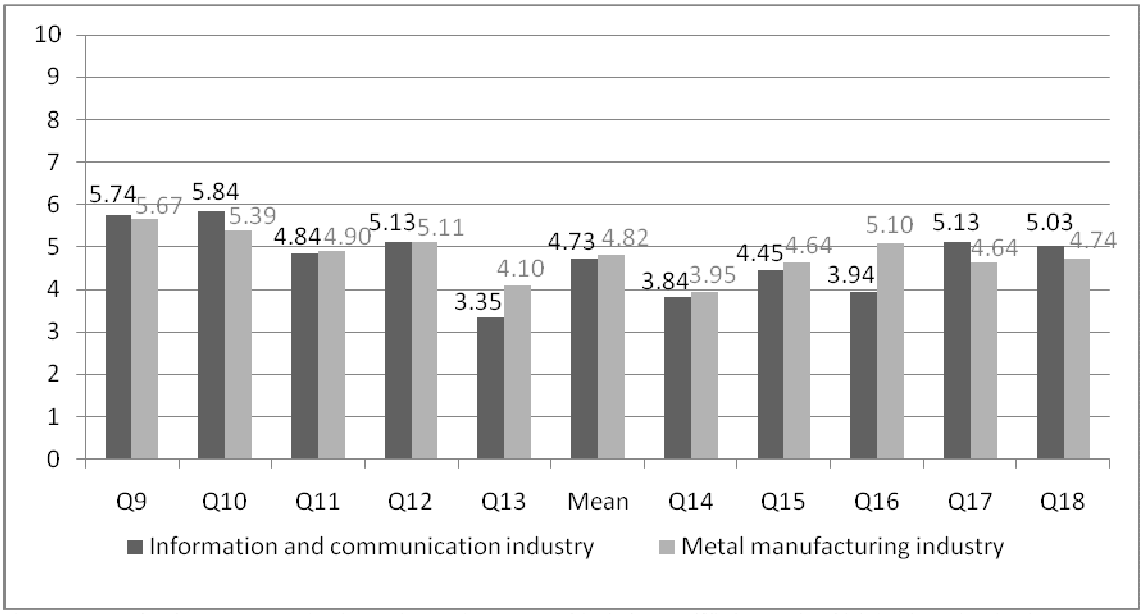

Figure 5: Mean for the competence barriers to innovation separated by industry affiliation. 10 is a high barrier, 0 is a barrier not experienced. Q9: Shortage of qualified personnel necessary for innovation, within the company. Q10: Shortage of qualified personnel necessary for innovation, on the market. Q11: Shortage of experienced personnel necessary for innovation, within the company. Q12: Shortage of experienced personnel necessary for innovation, on the market. Q13: Lack of information regarding technical development on the market. Q14: Shortage of technically skilled personnel necessary for innovation, within the company. Q15: Shortage of technically skilled personnel necessary for innovation, on the market. Q16: Cost of acquiring external competence. Q17: Lack of marketing capability to market new or significantly improved products, services or processes. Q18: Shortage of managerial know-how to effectively and efficiently manage innovation processes.

When firms were separated into their respective industry affiliations, no visible trends became present concerning competence barriers to innovation. Although small differences could be detected, the information and communication industry and the metal manufacturing industry still seemed to experience the different barriers very similar. Shortage of quali-

fied personnel necessary for innovation, within the company, is the competence barrier that is experienced the highest within the metal manufacturing industry. Shortage of qualified personnel necessary for innovation, on the market, is the competence barrier experienced the highest within information and communication. The competence barrier which is considered the lowest in the metal manufacturing industry is shortage of technically skilled personnel necessary for innovation, within the company. In the information and communication industry, lack of information regarding technical development on the market was regarded as the lowest barrier. The highest difference between the industries could be seen in Q16, cost of acquiring external competence. This competence barrier was experienced higher in the metal manufacturing industry compared to the information and communication industry. Save for the result of Q9 in the metal manufacturing industry, a small indication in figure 5 showed that competence barriers to innovation were generally experienced higher on the market than in-house. According to Saunders et al. (2007), respondents could have a tendency to answer in such a way that it places themselves and the organization in a favorable position. This could provide some insight as to why the results indicate that competence barriers to innovation are perceived higher on the market compared to inside the organization.

Industry affiliation was also included and analyzed in the multiple linear regression model. This variable, however, could not provide any significant explanation to the results concerning how competence barriers vary. Tourigny and Le (2004) found evidence in their investigation that firms operating in industries with different degrees of technology intensity faced barriers to innovation differently. This was especially the case for firms in high-technology industries, which in general experienced higher barriers to innovation, including barriers related to competence. The data does not allow any comparison between the two industries concerning the level of technology. What can be seen, however, is that firms from both industries perceive the same level of change in technology intensity. When comparing the mean values in figure 3, for statement 7, i.e. "production technologies change rapidly", the results indicate no difference between the two industries. It could be argued that since both industries face similar changes regarding technology, this could provide some explanation as to why there is no difference in competence barriers to innovation when comparing the two industries. It would be interesting to see whether or not two industries differ concerning how they experience competence barriers to innovation. However, it is reasonable to assume that in order to increase the probability for industry affiliation to provide any significant impact on the results a larger amount of industries should be compared.

4.1.1.4 Training

The training variables was also measured on a numerical scale ranging from 0 to 10. This descriptive analysis is twofold and begins by separating the level of training between the two industries. Second, the firms are divided into groups depending on their level of training, the groups being low, medium and high level of training. Competence barriers to innovation are then assessed in relation to the level of training.

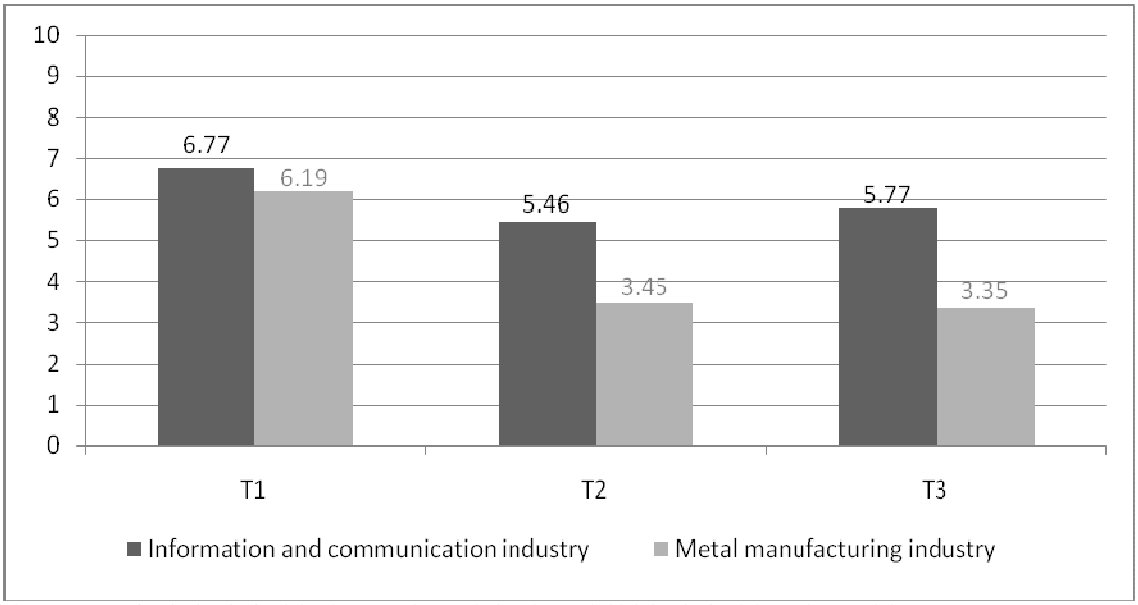

Figure 6: Mean for the level of training between the two industries. 10 is high level of training, 0 is no training. T1: Informal training. T2: Formal training. T3: Proactive training.

Figure 6 above shows that informal training was present, in both industries, to a greater extent than the other two forms of training. This is consistent with Hendry, Arthur & Jones' (1995) research; training in small enterprises is normally integrated in the daily work, where the employees learn from each other. Though the information and communication industry responded with just a slightly higher level for this variable, there was notable difference for the formal and proactive training variables. For these two variables the information and communication industry answered with a level above the mean for the scale, whereas the metal manufacturing industry responded below the mean. Also seen is that the metal manufacturing industry have a higher focus on informal training.

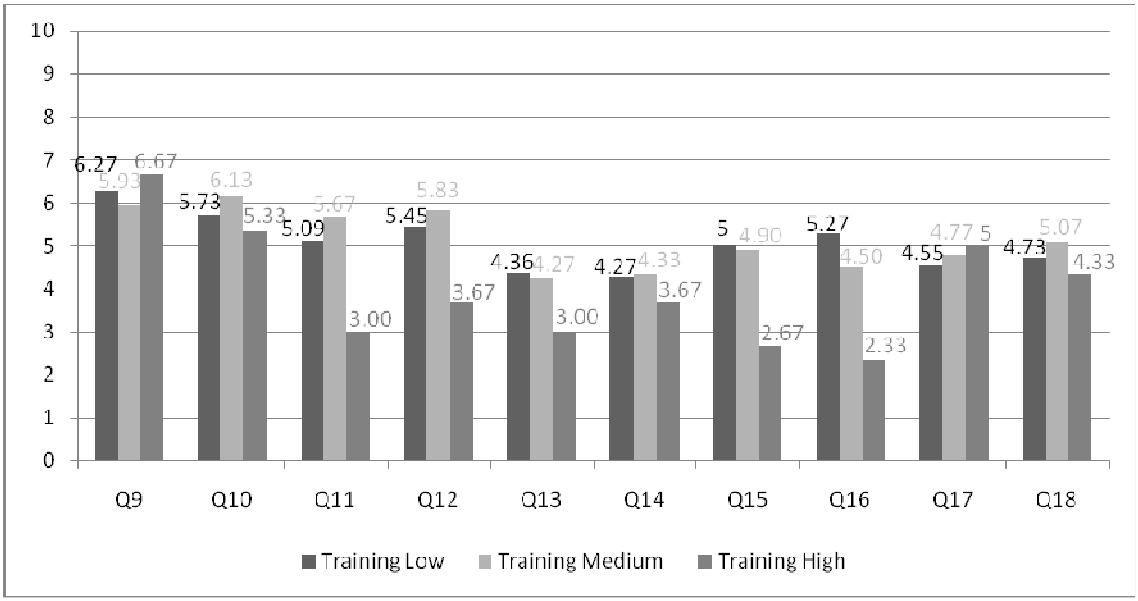

Figure 7: Mean for the competence barriers to innovation between firms with different levels of training. 10 is a high barrier, 0 is a barrier not experienced. Low ≤ 3.99, Medium ≥ 4 to ≤ 6.99, High ≥ 7 Q9: Shortage of qualified personnel necessary for innovation, within the company. Q10: Shortage of qualified personnel necessary for innovation, on the market. Q11: Shortage of experienced personnel necessary for innovation, within the company. Q12: Shortage of experienced personnel necessary for innovation, on the market. Q13: Lack of information regarding technical development on the market. Q14: Shortage of technically skilled personnel necessary for innovation, within the company. Q15: Shortage of technically skilled personnel necessary for innovation, on the market. Q16: Cost of acquiring external competence. Q17: Lack of marketing capability to market new or significantly improved products, services or processes. Q18: Shortage of managerial know-how to effectively and efficiently manage innovation processes.

As previously mentioned, training was included in this study to investigate whether or not it offers any explanatory input as to how competence barriers to innovation are experienced. When looking at figure 7 above, however, no precise pattern is visible. At first sight it seemed as though firms which trained their staff at a higher level, faced lower competence barriers to innovation. This holds true for all competence barriers, save for Q9 and Q17. As no similar previous research have been found by the authors of this thesis, comparisons have not been possible. One might argue, however, that firms which train their staff at a higher level, also experience lower competence barriers to innovation.

The training variable was further analyzed by a multiple linear regression model based on the answers from both the initial study and the complementary study, and consisted of responses from 44 small enterprises, from both industries. The analysis was conducted to check whether or not level of training offers explanatory value as to how competence barriers to innovation are experienced. As there was no evidence in the first multiple regression analysis that could support any large difference between the two industries, the answers were analyzed as a homogenous group. Also, due to the relatively low number of respondents it became difficult to separate the two when the data was analyzed statistically.

The underlying logic as to why training was included as an explanatory variable, was derived from previous literature. Shipton et al. (2006) found a positive relationship between innovative firms and firms that train their staff on a continuous basis. The reverse logic would then imply that firms which face higher competence barriers to innovation would then devote less time and effort to train their staff, especially formal training. By testing it statistically it would allow the authors to check whether or not there is a causal relationship between the level of training and competence barriers to innovation which small enterprises face.

After the impact of training on competence barriers to innovation was analyzed, the results indicated no statistical significance. The adjusted r-square values were low and showed no statistical significance on the 5% level (Appendix 5). Although the analysis indicated no significant relationship, it should be kept in mind, however, that the number of responses analyzed were only 44. It is likely that the low number of firms provided insufficient information for this type of statistical analysis. Therefore the authors of this thesis believe it would still be interesting to include a training variable on future studies with a greater sample size.

4.1.1.4.1 Informal training

In figure 8 below, all firms have been divided into three groups depending on their low, medium or high level of informal training, i.e. training performed in the workplace, which is less structured and implemented by colleagues. This separation was done in order to check for a possible relationship between different levels of informal training and competence barriers to innovation. It seems as though different levels of informal training can offer no descriptive explanation as to how competence barriers to innovation were experienced. When analyzed through a multiple linear regression model these findings showed no significance either. The adjusted r-square values for the regression analysis were low and showed no statistical significance on the 5% level. As previously mentioned, there exist no previous data which have allowed comparisons, therefore no indications as to the meaning of these results have been possible.

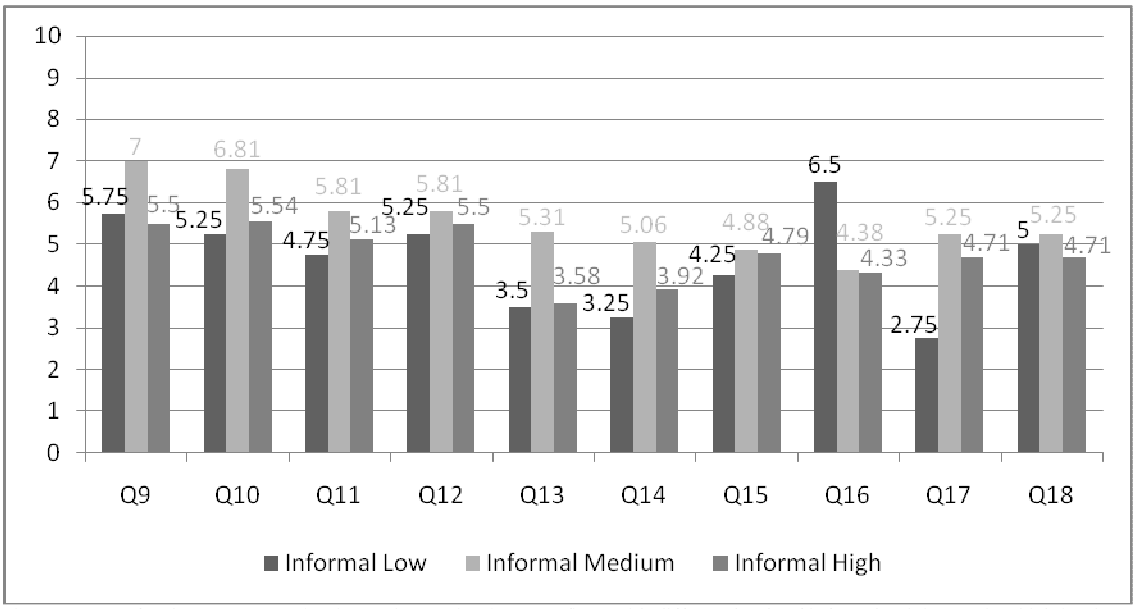

Figure 8: Mean for the competence barriers to innovation between firms with different levels of informal training. 10 is a high barrier, 0 is a barrier not experienced. Low ≤ 3.99, Medium ≥ 4 to ≤ 6.99, High ≥ 7 Q9: Shortage of qualified personnel necessary for innovation, within the company. Q10: Shortage of qualified personnel necessary for innovation, on the market. Q11: Shortage of experienced personnel necessary for innovation, within the company. Q12: Shortage of experienced personnel necessary for innovation, on the market. Q13: Lack of information regarding technical development on the market. Q14: Shortage of technically skilled personnel necessary for innovation, within the company. Q15: Shortage of technically skilled personnel necessary for innovation, on the market. Q16: Cost of acquiring external competence. Q17: Lack of marketing capability to market new or significantly improved products, services or processes. Q18: Shortage of managerial know-how to effectively and efficiently manage innovation processes.

4.1.1.4.2 Formal Training

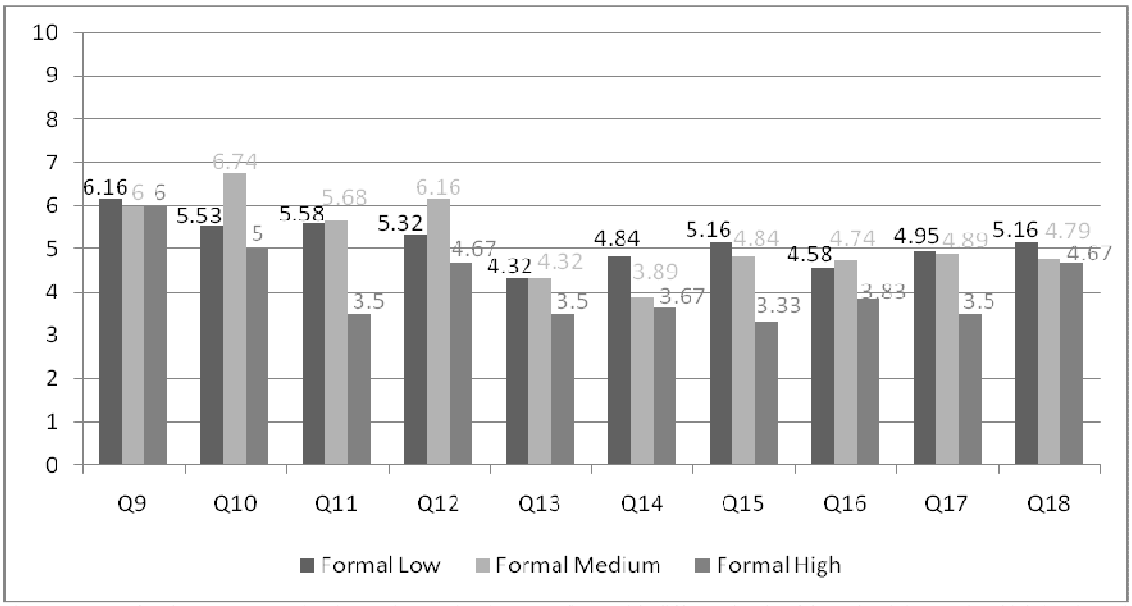

Figure 9: Mean for the competence barriers to innovation between firms with different levels of formal training. 10 is a high barrier, 0 is a barrier not experienced. Low ≤ 3.99, Medium ≥ 4 to ≤ 6.99, High ≥ 7 Q9: Shortage of qualified personnel necessary for innovation, within the company. Q10: Shortage of qualified personnel necessary for innovation, on the market. Q11: Shortage of experienced personnel necessary for innovation, within the company. Q12: Shortage of experienced personnel necessary for innovation, on the market. Q13: Lack of information regarding technical development on the market. Q14: Shortage of technically skilled personnel necessary for innovation, within the company. Q15: Shortage of technically skilled personnel necessary for innovation, on the market. Q16: Cost of acquiring external competence. Q17: Lack of marketing capability to market new or significantly improved products, services or processes. Q18: Shortage of managerial know-how to effectively and efficiently manage innovation processes.

In figure 9 above, all firms have been divided into three groups depending on their low, medium or high level of formal training, i.e. training performed in or outside the workplace, which is more structured and implemented by an external source. Through this separation, a slight pattern becomes visible. It seems as though firms which spent more time and resources on formal training experienced lower competence barriers to innovation. This assumption appears logical as firms which have a high level of formal training al-

so have a high level of human capital as it is adequately trained. This in turn would decrease the significance of barriers related to competencies. The definition of formal training derived from Baldwin and Johnson (1995) and Harley et al. (1998), also mean that the training is derived from an external source, as opposed to informal training, which would logically imply that the knowledge is more likely to be new to the firm, thus increasing its value.

When reviewing figure 9, however, there are also some indications of a possible response bias. Firms which spent a medium amount of time and resources on formal training of their staff, experience higher competence barriers to innovation compared to firms which spent a low amount of time and resources on formal training. These findings deviate from the above logic and a potential response bias, i.e. extremity bias (Zikmund, 2000), could therefore be possible.

Formal training showed some indication of a possible causal relationship with competence barriers to innovation when analyzed descriptively. However, when analyzed through a multiple linear regression model, these findings showed no statistical significance. The formal training variable provided more descriptive, explanatory value, compared to the aggregated training variable but the adjusted r-square values for the regression analysis were still low and showed no statistical significance on the 5% level. The authors of this thesis still believe, however, that it would be interesting to also include this variable in further studies especially since a descriptive causal relationship was visible.

4.1.1.4.3 Proactive training

The variable of proactive training was also analyzed separately based on a similar logic as to why include formal training. Proactive training was defined as highly planned and structured (Shipton et al., 2006) and could be performed before a training need had presented itself. This could imply that firms which have a higher level of proactive training, ensure that suitable and necessary competencies are already included in the organization due to the highly planned and structured training strategy. This in turn could lead to that human resources within the organization are equipped with the necessary knowledge to carry out innovations. Competence barriers to innovation could therefore be considered lower when proactive training is applied.

When reviewing figure 10 below, however, no such relationship can be distinguished. The results vary for each competence barrier and no visible trends can be seen. When analyzed through a multiple linear regression model the findings showed no statistical significance either. The adjusted r-square values were low for each of the three competence barriers to innovation and showed no significance at the 5% level (Appendix 7). Once again, as there exist no previous data which have allowed comparisons, no indications as to the meaning of these results have been possible. Therefore one can only speculate. It could be that proactive training does not have an impact on competence barriers to innovation if not the kind of training, i.e. informal or formal, is given. It is reasonable to assume that formal, as opposed to informal training, is more connected to innovative output. This because formal training is more structured and implemented by an external source, thus increasing its value for the firm since the skills acquired are more likely to be new to the firm. Baldwin (1999) found that a common factor for success among innovator groups was training, especially formal training. There was also some descriptive support in this study which indicated, although to a small extent, that firms with a higher level of formal training also experienced lower competence barriers to innovation. Therefore even though a firm trains its staff in a highly planned and structured manner, i.e. proactive training, the type of training, i.e. informal or formal, is not given and the impact on competence barriers to innovation is

therefore not visible. Provided that there is a causal relationship between formal training and competence barriers to innovation, a relationship between proactive training and competence barriers to innovation is hard to distinguish unless the training form utilized is formal training and not informal training.

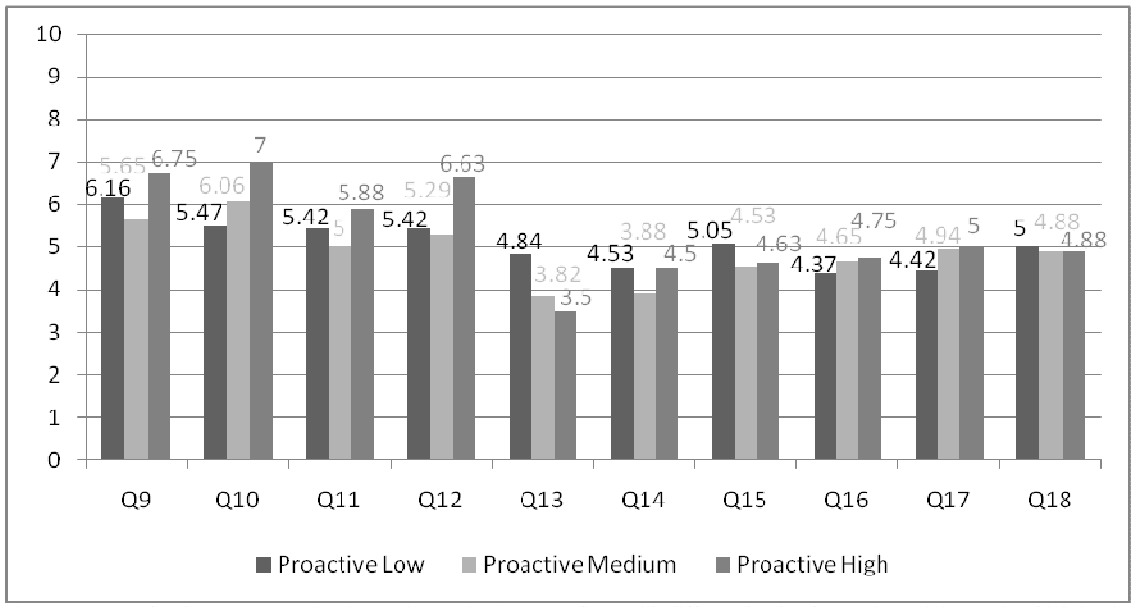

Figure 10: Mean for the competence barriers to innovation between firms with different levels of proactive training. 10 is a high barrier, 0 is a barrier not experienced. Low ≤ 3.99, Medium ≥ 4 to ≤ 6.99, High ≥ 7 Q9: Shortage of qualified personnel necessary for innovation, within the company. Q10: Shortage of qualified personnel necessary for innovation, on the market. Q11: Shortage of experienced personnel necessary for innovation, within the company. Q12: Shortage of experienced personnel necessary for innovation, on the market. Q13: Lack of information regarding technical development on the market. Q14: Shortage of technically skilled personnel necessary for innovation, within the company. Q15: Shortage of technically skilled personnel necessary for innovation, on the market. Q16: Cost of acquiring external competence. Q17: Lack of marketing capability to market new or significantly improved products, services or processes. Q18: Shortage of managerial know-how to effectively and efficiently manage innovation processes.

4.2 Research questions 3 & 4

Which consequences do SMEs encounter as a result of facing competence barriers to innovation?

Are SMEs that face high competence barriers to innovation more likely to encounter consequences?

4.2.1 Consequences

Figure 11 below displays the percentage of consequences, that were experienced by the firms as a result from facing competence barriers to innovation. The data, which consist of answers from 44 companies, were collected through the complementary e-mail questionnaire.

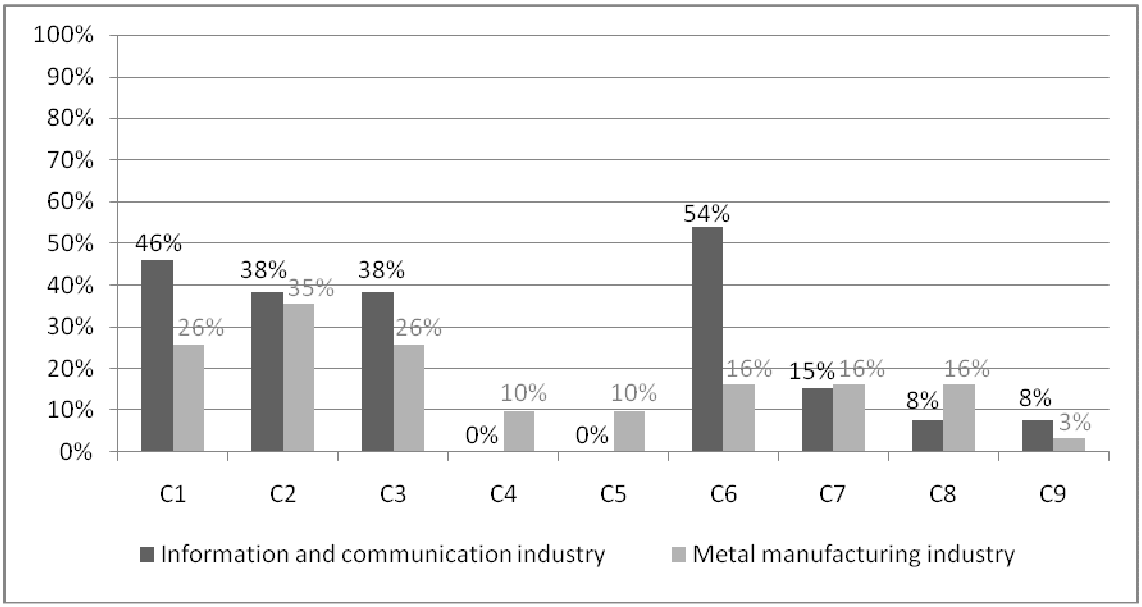

Figure 11: Percentage of firms experiencing different consequences. C1: Decreased profitability. C2: Inability to accept certain jobs or contracts. C3: Difficulty in expanding the business. C4: Failed marketing of innovations. C5: Failed innovation projects. C6: Constrained to effectively introduce new products or services. C7: Constrained to effectively introduce new product or manufacturing processes. C8: Decreased number of ideas for innovations. C9: Other consequences.

It is interesting to note that a quite large number of firms had in fact experienced consequences as a result from facing competence barriers to innovation. Out of the 44 responding companies, 31 had experienced various consequences.

When reviewing the data, the four most frequently reported consequences were; (1) decreased profitability, (2) inability to accept certain jobs or contracts, (3) difficulty in expanding the business and (4) constrained to effectively introduce new products and services. A finding which became especially visible concern the consequence C6, i.e. constrained to effectively introduce new products and services. This consequence was reported most frequently within the industry of information and communication, where a total of 54% of the responding firms reported this consequence. When reviewing the responses for this consequences in the metal manufacturing industry, however, only 16% reported this particular consequence.

This empirical data were also statistically analyzed through a binary logistic regression model. The analysis was performed on the 44 small enterprises which responded in the complementary study. This data were then analyzed in comparison with the data from the main study. The authors were interested in investigating whether or not there existed a relationship between firms which face higher competence barriers and the consequences these barriers might result in, i.e. are small enterprises that face high competence barriers to innovation more likely to encounter consequences? Initially there was an intention to compare specific competence barriers to innovation with specific consequences, however, due to the small number of respondents for this secondary analysis any findings would most likely have been insignificant. Therefore both consequences and competence barriers were transformed and aggregated into binary variables. The data analyzed is presented in table 6 below.

	X_0	X_1
Y_0	10	3
Y_1	11	20

Table 6: Adjusted data for the binary logistic regression, number of firms. X, competence barriers to innovation: 1 if the mean was equal to or above 6, 0 if below. Y, resulting consequences from facing competence barriers: 1 if the firm had experienced any consequences, 0 if not.

According to the data, if a firm experience above moderate to high competence barriers to innovation, there is a 87% probability that the same firm faces consequences as a result from these competence barriers to innovation. The odds that the firms facing above moderate high competence barriers to innovation also encounter consequences are 6.061 times as high compared to firms facing low competence barriers to innovation. These results show significance in the Omnibus test, however, the model could not show any pattern for the firms facing low competence barriers to innovation as the probability for X_0 (Table 6) was close to 0.5, yielding odds values close to 1 (Aczel & Sounderpandian, 2002; Appendix 9).

When reviewing previous research no similar studies were found which would make comparisons possible. However, when considering previous research conducted by Geroski et al. (1993), possible explanations to the results can be found. As previously mentioned, they found supporting evidence that innovative firms in general attain higher profits and growth figures compared to non-innovative firms. With reversed logic one might argue that this would imply that non-innovative firms, or innovative firms which face higher barriers to innovation, would attain smaller profits and growth figures. When reviewing the responses from the selected sample, they show that the top three consequences from experiencing above moderate to high competence barriers to innovation are, in a descending order of seriousness; (1) unable to accept certain jobs or contracts, (2) decreased profitability and (3) difficulty in expanding the business (Figure 11). All three consequences can be directly connected to growth and profit.

5 Conclusion

In this section, conclusions drawn from the descriptive and statistical analyses are presented. Furthermore, all results are listed under each research question.

The purpose of this research report is to investigate competence barriers to innovation within small enterprises and the consequences these barriers might result in.

The above stated purpose has been fulfilled in the sense that competence barriers to innovation, as they are experienced by small enterprises, have been collected and statistically analyzed by the use of correlation, multiple linear regression models and binary logistic regression models. By the use of structured telephone interviews and, to some extent, e-mail questionnaires, 92 CEOs from small enterprises situated in the counties of Jönköping, Kronoberg and Kalmar were included in this study. The firms operated in either of two industries, metal manufacturing or information and communication. The main findings from this study are presented below in relation to the research questions.

How are competence barriers to innovation experienced by SMEs in the selected sample?

As the CEOs had been interviewed, it was found that competence barriers to innovation were experienced as moderate barriers in the selected sample. Shortage of qualified personnel necessary for innovation, within the company, was the competence barrier that was experienced the highest within the metal manufacturing industry, and shortage of qualified personnel necessary for innovation, on the market, was considered highest within information and communication. The competence barrier which was considered the lowest in the metal manufacturing industry was shortage of technically skilled personnel necessary for innovation, within the company. In the information and communication industry, lack of information regarding technical development on the market was regarded as the lowest barrier. Through correlation analysis of all competence barriers, rather high correlation coefficients were found among the barriers. Significant relationships were found amongst the three external competence barriers. A similar relationship was also found amongst the three internal barriers.

Do competence barriers to innovation vary depending on different firm characteristics, and in that case how?

The collected data were analyzed through a multiple linear regression model where it was found that competence barriers to innovation vary depending on perceived level of competition. Small firms which experienced a higher degree of competition also experienced higher competence barriers to innovation. Innovative firms experienced higher competence barriers to innovation when analyzed descriptively, however, when these findings were analyzed through the regression analysis the causal relationship was not significant. Nor was the causal relationship between industry affiliation and competence barriers significant. The authors' choice to include the level of training as a variable showed no relationship with competence barriers to innovation statistically. There was, however, a slight, descriptive indication of a relationship between higher levels of formal training and competence barriers to innovation, i.e. firms with higher levels of formal training seemed to experience lower competence barriers to innovation.

Which consequences do small enterprises encounter as a result of facing competence barriers to innovation?

The three most frequently reported consequences from facing competence barriers to innovation were, in a descending order of seriousness; inability to accept certain jobs or contracts, decreased profitability and difficulty in expanding the business. When comparing these results with respect to previous research conducted by Geroski et al. (1993), which found that innovative firms in general attain higher profit and growth figures, the comparison becomes interesting as the empirical data support the opposite, i.e. firms which face higher competence barriers to innovation experience a decline in profits and growth.

Are small enterprises that face high competence barriers to innovation more likely to encounter consequences?

A binary logistic regression model was performed where the data indicated with a 5% significance level that small enterprises which face above moderate to high competence barriers to innovation are more likely to encounter consequences, e.g. inability to accept certain jobs or contracts, decreased profitability, and difficulty in expanding the business.

6 Discussion

In this section, the authors present their own personal thoughts and opinions concerning the thesis and its contents. Furthermore, implications, limitations and ideas for future research are discussed.

There have been quite many studies focusing on barriers or impediments to innovation. Most researchers have taken a quantitative approach and analyzed the results, using regression models or other statistical tools. Some explanations have been presented as to why these barriers exist and the underlying factors which affect them. Tourigny and Le (2004) found in their study that most innovation barriers do not completely block firms from innovating. They conclude that although serious, these different innovation barriers can be overcome.

Innovation barriers have mainly been treated as an economical research problem and been investigated on a macro level in several countries. Solutions have first and foremost been presented in the form of government support, such as R&D aid. However, not all innovation barriers can be overcome by government support programs. Some internal innovation barriers for instance are also very closely inter-related with management, e.g. various competence barriers to innovation. It is the manager's responsibility to ensure that suitable human resources and necessary skills and competencies are employed in the organization. But many variables which have been statistically tested concerning their influence on innovation barriers can in a very limited way be affected by managers. This holds true for variables such as perceived level of competition, innovativeness, firm size etc. The authors of this thesis therefore believe that it would be interesting to include variables which can, to a much larger extent, be affected by managers. By reviewing innovation barriers from several angles, e.g. management and economical, more solutions could more likely be found. In this thesis, the level of training, i.e. time and resources spent on formal, informal and proactive training of personnel, was investigated concerning its effects on competence barriers to innovation. Unfortunately it showed no significant impact on the results, most likely due to the small number of cases which were investigated. The level of training, however, is a variable which can be affected by managers to a large extent. It would therefore be more interesting to conduct further tests where level of training and similar variables are included.

Many studies have also exclusively focused on innovative firms and the barriers which these firms face when innovating. Not many studies have focused only on non-innovative firms and the barriers which completely prevent them from innovating. A topic that is also worthy of more attention and research.

When reviewing previous literature on innovation barriers, no clear or universal definition is available. Do innovation barriers completely stop innovation or does it simply hinder or slow it down? It is reasonable to assume that in order to better understand the concept of innovation barriers, a clear definition and separation between impenetrable and penetrable barriers should be made. This could help prioritize which barriers that needs more attention in the future.

Finally, as there is no clear definition of innovation barriers, consequences of facing innovation barriers remain unclear. When innovation barriers are not analyzed in relation with the consequences which the innovation barriers might result in, the research lose some relevance. By emphasizing the consequences when researching innovation barriers in future studies, a deeper understanding might be provided.

6.1 Implications

The results of this study shows that competence barriers to innovation are, in general, considered moderate barriers in the investigated sample. However, many small enterprises in the selected sample which face moderate to high competence barriers to innovation are more likely to experience consequences such as decreased profitability or difficulty in expanding the business. This could imply that innovation barriers are in fact quite serious problems for many small firms which deserve more attention by managers.

The competence barrier to innovation which was perceived the second highest among all companies was the shortage of qualified personnel necessary for innovation, on the market. These findings suggest that a group of small enterprises in this sample have difficulties finding personnel on the market, which are qualified for innovation projects. An implication for surrounding Universities could be to review programs and courses offered at the University in order to ensure that a sufficient number of students are proficient within innovation management.

Although, there was only a descriptive causal relationship between higher level of formal training and lower competence barriers to innovation, an implication could be that firms could shift their training methods from informal to formal in order to try to decrease competence barriers to innovation.

6.2 Limitations

There are always certain limitations tied to each individual study, and unfortunately this research paper holds no exceptions. Several measures have been taken in order to ensure the reliability and validity of the thesis, e.g. the research method is to a large extent adopted from previous studies and should therefore strengthen the findings of this thesis. There are always factors, however, which have a negative impact on the issues of validity and reliability.

As the data collection was conducted at two separate occasions and through the use of two different data collection methods, it could have had a negative impact on the results. Furthermore, due to the number of reviewed cases in relation to the population size, the selected sample is not representative for the population at a 5% significance level. Therefore, generalizations in this thesis are limited to the selected sample. All empirical results included in this thesis can therefore only be seen as indications and are not statistically applicable on the entire population.

Another remaining issue, concern the small number of enterprises from the information and communication sector. The sample could contain bias as there are a majority of firms from the metal manufacturing industry included in the sample.

Response bias might also be present. According to previous research, (Saunders et al., 2007; Zikmund, 2000) an interviewee can be subject to different kinds of response bias, e.g. answer in patterns or become confused. Possible bias such as the ones just explained could have affected the reliability and validity of this thesis. When reviewing the collected data there are some evidence which support this bias. There are some firms which have given middle values for many questions, a phenomenon known as extremity bias (Zikmund, 2000) where the respondent have a tendency of giving very high, low or neutral answers. The authors of this thesis would also like, to some extent, counter this argument, however, by saying that having a more dynamic scale could also have generated more truthful an-

swers. Tourigny and Le (2004) for instance only measured whether innovation barriers are strong barriers or not. This excludes the entire list of firms which consider competence barriers to be low or moderate, it might also force a lot of responses which are not necessarily truthful.

6.3 Future research

During the course of this study, a number of ideas for future research were discussed. The first suggestion would be to conduct further studies which focus on non-innovative firms. By analyzing barriers to innovation which prevent firms from innovating, a better understanding as to why some firms do not innovate could be provided.

It would also be interesting to further research the possible consequences resulting from barriers to innovation. When firms perceive higher barriers to innovation, are these firms more likely to experience consequences, such as decreased profitability or difficulty in expanding the business?

Furthermore, a thorough investigation concerning the concept of innovation barriers would be interesting. If a more comprehensive definition of innovation barriers could be provided it might facilitate future research within this field.

A final suggestion would be to steer the research towards management in order to find variables which managers can influence to a larger extent, e.g. training and especially formal training.

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Appendices

Appendix 1 – Structured telephone questionnaire

INNOVATION RELATED QUESTIONS

Question 1

Did your company, during the last three years, 2006 to 2008, introduce new or significantly improved products or services for your clients?

Yes ☐ No ☐

Question 2

Did your company, during the last three years, 2006 to 2008, introduce new or significantly improved product or manufacturing processes?

Yes ☐ No ☐

Question 3

Does your company conduct research and development, i.e. systematic activity to increase the amount of knowledge for new fields of applications, and to develop new or significantly improved products, services or manufacturing processes?

Yes ☐ No ☐

Now five statements will follow, which are answered on a scale between 0 to 10, where 0 indicates that you strongly disagree and 10 that you strongly agree.

COMPETITION RELATED QUESTIONS

Question 4

Your clients can easily substitute your products or services for the products or services of competitors.

0 1 2 3 4 5 6 7 8 9 10

Question 5

The arrival of new competitors is a constant threat.

0 1 2 3 4 5 6 7 8 9 10

Question 6

The arrival of competing products is a constant threat.

0 1 2 3 4 5 6 7 8 9 10

Question 7

Production and manufacturing technologies change rapidly.

0 1 2 3 4 5 6 7 8 9 10

Question 8

Products or services quickly become obsolete.

0 1 2 3 4 5 6 7 8 9 10

Now ten competence barriers to innovation will follow, which are answered on a scale between 0 to 10, where 1 indicates that you experience the barrier low, 10 that you experience it high and 0 that the barrier is not experienced.

COMPETENCE BARRIERS THAT IMPEDE INNOVATION ACTIVITIES

Question 9

Shortage of qualified personnel necessary for innovation, within the company.

0 1 2 3 4 5 6 7 8 9 10

Question 10

Shortage of qualified personnel necessary for innovation, on the market.

0 1 2 3 4 5 6 7 8 9 10

Question 11

Shortage of experienced personnel necessary for innovation, within the company.

0 1 2 3 4 5 6 7 8 9 10

Question 12

Shortage of experienced personnel necessary for innovation, on the market.

0 1 2 3 4 5 6 7 8 9 10

Question 13

Lack of information regarding technical development on the market.

0 1 2 3 4 5 6 7 8 9 10

Question 14

Shortage of technically skilled personnel necessary for innovation, within the company.

0 1 2 3 4 5 6 7 8 9 10

Question 15

Shortage of technically skilled personnel necessary for innovation, on the market.

0 1 2 3 4 5 6 7 8 9 10

Question 16

Cost of acquiring external competence.

0 1 2 3 4 5 6 7 8 9 10

Question 17

Lack of marketing capability to market new or significantly improved products, services or processes.

0 1 2 3 4 5 6 7 8 9 10

Question 18

Shortage of managerial know-how to effectively and efficiently manage innovation processes.

0 1 2 3 4 5 6 7 8 9 10

Appendix 2 – E-mail questionnaire

Now three different procedures of training will follow, which are answered on a scale between 0 to 10, where 1 indicates that the procedure is used to a low extent, 10 to a high extent and 0 that the procedure is not used.

Procedure A
Informal training. Informal training is performed in the workplace, is less structured and implemented by colleagues.

0 1 2 3 4 5 6 7 8 9 10

ANSWER (chose one number on the scale) =

Procedure B
Formal training. Formal training is performed in or outside the workplace, is more structured and implemented by an external source.

0 1 2 3 4 5 6 7 8 9 10

ANSWER (chose one number on the scale) =

Procedure C
Proactive training. Proactive training is highly planned and structured and can be performed before a need have presented itself.

0 1 2 3 4 5 6 7 8 9 10

ANSWER (chose one number on the scale) =

Now consequences resulting from the competence barriers to innovation, previously investigated, will follow. These competence barriers are first repeated, for you to apply the consequences to just these, second the list of consequences is presented.

Competence barriers to innovation
Shortage of qualified, experienced and technically skilled personnel necessary for innovation, within the company.
Shortage of qualified, experienced and technically skilled personnel necessary for innovation, on the market.
Lack of information regarding technical development on the market.
Cost of acquiring external competence.
Lack of marketing capability to market new or significantly improved products, services or processes.
Shortage of managerial know-how to effectively and efficiently manage innovation processes.

Consequences
Have these competence barriers to innovation resulted in any consequences for your company?

If relevant, please chose one or several alternatives from the list below:

A: Decreased profitability
B: Inability to accept certain jobs/contracts
C: Difficulty in expanding the business
D: Failed marketing of innovations
E: Failed innovation projects
F: Constrained to effectively introduce new products or services
G: Constrained to effectively introduce new product or manufacturing processes
H: Decreased number of ideas for innovations
I: Other consequences

ANSWER (answer with the given letters from the list) =

Appendix 3 – Spearman correlation for the scale variables

		Competition	Question9	Question10	Question11	Question12	Question13	Question14	Question15	Question16	Question17
Q9	Correlation	**0.357****									
	Sig.	0.000									
	N	92									
Q10	Correlation	**0.252***	**0.589****								
	Sig.	0.015	0.000								
	N	92	92								
Q11	Correlation	**0.250***	**0.608****	**0.482****							
	Sig.	0.016	0.000	0.000							
	N	92	92	92							
Q12	Correlation	**0.223***	**0.427****	**0.737****	**0.540****						
	Sig.	0.032	0.000	0.000	0.000						
	N	92	92	92	92						
Q13	Correlation	0.147	**0.426****	**0.258***	**0.329****	**0.213***					
	Sig.	0.161	0.000	0.013	0.001	0.041					
	N	92	92	92	92	92					
Q14	Correlation	0.131	**0.444****	**0.355****	**0.599****	**0.324****	**0.475****				
	Sig.	0.213	0.000	0.001	0.000	0.002	0.000				
	N	92	92	92	92	92	92				
Q15	Correlation	-0.009	**0.242***	**0.330****	**0.254***	**0.399****	**0.349****	**0.276****			
	Sig.	0.929	0.020	0.001	0.015	0.000	0.001	0.008			
	N	92	92	92	92	92	92	92			
Q16	Correlation	**0.270****	**0.212***	**0.272****	**0.206***	**0.246***	0.168	**0.311****	0.061		
	Sig.	0.009	0.043	0.009	0.049	0.018	0.110	0.003	0.564		
	N	92	92	92	92	92	92	92	92		
Q17	Correlation	0.160	**0.301****	**0.360****	0.176	**0.263***	0.204	**0.412****	0.106	**0.359****	
	Sig.	0.127	0.004	0.000	0.094	0.011	0.051	0.000	0.315	0.000	
	N	92	92	92	92	92	92	92	92	92	
Q18	Correlation	**0.264***	**0.269****	**0.226***	0.199	**0.280****	**0.237***	**0.379****	**0.276****	**0.232***	**0.594****
	Sig.	0.011	0.010	0.030	0.058	0.007	0.023	0.000	0.008	0.026	0.000
	N	92	92	92	92	92	92	92	92	92	92

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

		Competition	Training	Q9	Q10
Training	Correlation	0.028			
	Sig.	0.859			
	N	44			
Q9	Correlation	**0.339***	-0.035		
	Sig.	0.024	0.819		
	N	44	44		
Q10	Correlation	**0.362***	0.128	**0.593****	
	Sig.	0.016	0.407	0.000	
	N	44	44	44	
Q12	Correlation	**0.305***	0.100	**0.445****	**0.743****
	Sig.	0.044	0.518	0.002	0.000
	N	44	44	44	44

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix 4 - Multiple linear regression, Main study

Question 9: Shortage of qualified personnel necessary for innovation, within the company.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Industry, Competition, Innovative[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Question9

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.425[a]**	**0.181**	**0.153**	**2.351**

a. Predictors: (Constant), Industry, Competition, Innovative

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**107.214**	**3**	**35.738**	**6.468**	**0.001[a]**
	Residual	**486.264**	**88**	**5.526**		
	Total	**593.478**	**91**			

a. Predictors: (Constant), Industry, Competition, Innovative

b. Dependent Variable: Question9

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	**1.956**	**0.984**		**1.987**	**0.050**		
	Innovative	**0.645**	**0.577**	**0.108**	**1.118**	**0.267**	**0.993**	**1.007**
	Competition	**0.646**	**0.153**	**0.407**	**4.215**	**0.000**	**0.998**	**1.002**
	Industry	**-0.066**	**0.520**	**-0.012**	**-0.128**	**0.899**	**0.994**	**1.006**

a. Dependent Variable: Question9

Question 10: Shortage of qualified personnel necessary for innovation, on the market.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Industry, Competition, Innovative[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Question10

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.328[a]**	**0.108**	**0.077**	**2.549**

a. Predictors: (Constant), Industry, Competition, Innovative

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**69.125**	**3**	**23.042**	**3.547**	**0.018[a]**
	Residual	**571.701**	**88**	**6.497**		
	Total	**640.826**	**91**			

a. Predictors: (Constant), Industry, Competition, Innovative

b. Dependent Variable: Question10

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	**2.788**	**1.067**		**2.613**	**0.011**		
	Innovative	**0.980**	**0.625**	**0.158**	**1.567**	**0.121**	**0.993**	**1.007**
	Competition	**0.447**	**0.166**	**0.271**	**2.690**	**0.009**	**0.998**	**1.002**
	Industry	**-0.406**	**0.564**	**-0.073**	**-0.720**	**0.473**	**0.994**	**1.006**

a. Dependent Variable: Question10

Question 12: Shortage of experienced personnel necessary for innovation, on the market.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Industry, Competition, Innovative[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Question12

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.254[a]**	**0.064**	**0.032**	**2.346**

a. Predictors: (Constant), Industry, Competition, Innovative

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**33.285**	**3**	**11.095**	**2.016**	**0.118[a]**
	Residual	**484.399**	**88**	**5.505**		
	Total	**517.685**	**91**			

a. Predictors: (Constant), Industry, Competition, Innovative

b. Dependent Variable: Question12

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	**2.965**	**0.982**		**3.019**	**0.003**		
	Innovative	**0.530**	**0.576**	**0.095**	**0.921**	**0.359**	**0.993**	**1.007**
	Competition	**0.343**	**0.153**	**0.232**	**2.245**	**0.027**	**0.998**	**1.002**
	Industry	**0.000**	**0.519**	**0.000**	**0.001**	**0.999**	**0.994**	**1.006**

a. Dependent Variable: Question12

Appendix 5 - Multiple linear regression, Complementary study, Training

Question 9: Shortage of qualified personnel necessary for innovation, within the company.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Training, Competition[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Q9

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.432[a]**	**0.186**	**0.147**	**2.131**

a. Predictors: (Constant), Training, Competition

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**42.615**	**2**	**21.307**	**4.692**	**0.015[a]**
	Residual	**186.181**	**41**	**4.541**		
	Total	**228.795**	**43**			

a. Predictors: (Constant), Training, Competition

b. Dependent Variable: Q9

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	**2.455**	**1.778**		**1.381**	**0.175**		
	Competition	**0.731**	**0.240**	**0.431**	**3.045**	**0.004**	**0.991**	**1.009**
	Training	**-0.011**	**0.240**	**-0.007**	**-0.047**	**0.963**	**0.991**	**1.009**

a. Dependent Variable: Q9

Question 10: Shortage of qualified personnel necessary for innovation, on the market.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Training, Competition[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Q10

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.355[a]**	**0.126**	**0.084**	**2.403**

a. Predictors: (Constant), Training, Competition

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**34.195**	**2**	**17.097**	**2.960**	**0.063[a]**
	Residual	**236.783**	**41**	**5.775**		
	Total	**270.977**	**43**			

a. Predictors: (Constant), Training, Competition

b. Dependent Variable: Q10

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	**1.674**	**2.005**		**0.835**	**0.409**		
	Competition	**0.637**	**0.271**	**0.345**	**2.351**	**0.024**	**0.991**	**1.009**
	Training	**0.230**	**0.270**	**0.125**	**0.851**	**0.400**	**0.991**	**1.009**

a. Dependent Variable: Q10

Question 12: Shortage of experienced personnel necessary for innovation, on the market.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Training, Competition[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Q12

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.282[a]**	**0.079**	**0.034**	**2.266**

a. Predictors: (Constant), Training, Competition

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**18.134**	**2**	**9.067**	**1.766**	**0.184[a]**
	Residual	**210.503**	**41**	**5.134**		
	Total	**228.636**	**43**			

a. Predictors: (Constant), Training, Competition

b. Dependent Variable: Q12

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	**2.469**	**1.890**		**1.306**	**0.199**		
	Competition	**0.465**	**0.255**	**0.274**	**1.819**	**0.076**	**0.991**	**1.009**
	Training	**0.164**	**0.255**	**0.097**	**0.644**	**0.523**	**0.991**	**1.009**

a. Dependent Variable: Q12

Appendix 6 - Multiple linear regression, Complementary study, Informal training

Question 9: Shortage of qualified personnel necessary for innovation, within the company.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Informaltraining, Competition[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Q9

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.436[a]**	**0.190**	**0.150**	**2.126**

a. Predictors: (Constant), Informaltraining, Competition

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**43.467**	**2**	**21.734**	**4.808**	**0.013[a]**
	Residual	**185.328**	**41**	**4.520**		
	Total	**228.795**	**43**			

a. Predictors: (Constant), Informaltraining, Competition

b. Dependent Variable: Q9

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	**3.127**	**2.083**		**1.501**	**0.141**
	Competition	**0.690**	**0.258**	**0.406**	**2.676**	**0.011**
	Informaltraining	**-0.081**	**0.186**	**-0.066**	**-0.437**	**0.665**

a. Dependent Variable: Q9

Question 10: Shortage of qualified personnel necessary for innovation, on the market.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Informaltraining, Competition[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Q10

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.346[a]**	**0.120**	**0.077**	**2.412**

a. Predictors: (Constant), Informaltraining, Competition

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**32.511**	**2**	**16.256**	**2.795**	**0.073[a]**
	Residual	**238.466**	**41**	**5.816**		
	Total	**270.977**	**43**			

a. Predictors: (Constant), Informaltraining, Competition

b. Dependent Variable: Q10

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	**4.139**	**2.362**		**1.752**	**0.087**
	Competition	**0.542**	**0.292**	**0.294**	**1.854**	**0.071**
	Informaltraining	**-0.138**	**0.211**	**-0.104**	**-0.655**	**0.516**

a. Dependent Variable: Q10

Question 12: Shortage of experienced personnel necessary for innovation, on the market.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Informaltraining, Competition[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Q12

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.266[a]**	**0.071**	**0.025**	**2.276**

a. Predictors: (Constant), Informaltraining, Competition

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**16.179**	**2**	**8.089**	**1.561**	**0.222[a]**
	Residual	**212.458**	**41**	**5.182**		
	Total	**228.636**	**43**			

a. Predictors: (Constant), Informaltraining, Competition

b. Dependent Variable: Q12

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	**3.669**	**2.230**		**1.645**	**0.108**
	Competition	**0.430**	**0.276**	**0.253**	**1.557**	**0.127**
	Informaltraining	**-0.037**	**0.199**	**-0.030**	**-0.183**	**0.855**

a. Dependent Variable: Q12

Appendix 7 - Multiple linear regression, Complementary study, Formal training

Question 9: Shortage of qualified personnel necessary for innovation, within the company.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Formaltraining, Competition[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Q9

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.434[a]**	**0.188**	**0.149**	**2.129**

a. Predictors: (Constant), Formaltraining, Competition

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**43.041**	**2**	**21.520**	**4.750**	**0.014[a]**
	Residual	**185.755**	**41**	**4.531**		
	Total	**228.795**	**43**			

a. Predictors: (Constant), Formaltraining, Competition

b. Dependent Variable: Q9

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	**2.195**	**1.399**		**1.569**	**0.124**
	Competition	**0.729**	**0.239**	**0.429**	**3.048**	**0.004**
	Formaltraining	**0.054**	**0.174**	**0.044**	**0.310**	**0.758**

a. Dependent Variable: Q9

Question 10: Shortage of qualified personnel necessary for innovation, on the market.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Formaltraining, Competition[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Q10

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.353[a]**	**0.125**	**0.082**	**2.405**

a. Predictors: (Constant), Formaltraining, Competition

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**33.821**	**2**	**16.910**	**2.923**	**0.065[a]**
	Residual	**237.157**	**41**	**5.784**		
	Total	**270.977**	**43**			

a. Predictors: (Constant), Formaltraining, Competition

b. Dependent Variable: Q10

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	**2.301**	**1.580**		**1.456**	**0.153**
	Competition	**0.604**	**0.270**	**0.327**	**2.237**	**0.031**
	Formaltraining	**0.160**	**0.197**	**0.119**	**0.811**	**0.422**

a. Dependent Variable: Q10

Question 12: Shortage of experienced personnel necessary for innovation, on the market.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Formaltraining, Competition[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Q12

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.267[a]**	**0.071**	**0.026**	**2.276**

a. Predictors: (Constant), Formaltraining, Competition

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**16.286**	**2**	**8.143**	**1.572**	**0.220[a]**
	Residual	**212.350**	**41**	**5.179**		
	Total	**228.636**	**43**			

a. Predictors: (Constant), Formaltraining, Competition

b. Dependent Variable: Q12

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	**3.178**	**1.495**		**2.125**	**0.040**
	Competition	**0.446**	**0.256**	**0.263**	**1.745**	**0.089**
	Formaltraining	**0.043**	**0.186**	**0.035**	**0.233**	**0.817**

a. Dependent Variable: Q12

Appendix 8 - Multiple linear regression, Complementary study, Proactive training

Question 9: Shortage of qualified personnel necessary for innovation, within the company.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Proactivetraining, Competition[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Q9

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.432[a]**	**0.186**	**0.147**	**2.131**

a. Predictors: (Constant), Proactivetraining, Competition

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**42.605**	**2**	**21.302**	**4.691**	**0.015[a]**
	Residual	**186.190**	**41**	**4.541**		
	Total	**228.795**	**43**			

a. Predictors: (Constant), Proactivetraining, Competition

b. Dependent Variable: Q9

Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients		
	Model	B	Std. Error	Beta	t	Sig.
1	(Constant)	**2.397**	**1.314**		**1.824**	**0.075**
	Competition	**0.733**	**0.240**	**0.432**	**3.049**	**0.004**
	Proactivetraining	**0.000**	**0.134**	**0.000**	**-0.004**	**0.997**

a. Dependent Variable: Q9

Question 10: Shortage of qualified personnel necessary for innovation, on the market.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Proactivetraining, Competition[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Q10

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.381[a]**	**0.145**	**0.104**	**2.377**

a. Predictors: (Constant), Proactivetraining, Competition

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**39.419**	**2**	**19.709**	**3.490**	**0.040[a]**
	Residual	**231.559**	**41**	**5.648**		
	Total	**270.977**	**43**			

a. Predictors: (Constant), Proactivetraining, Competition

b. Dependent Variable: Q10

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	**2.275**	**1.465**		**1.552**	**0.128**
	Competition	**0.582**	**0.268**	**0.315**	**2.172**	**0.036**
	Proactivetraining	**0.193**	**0.150**	**0.187**	**1.290**	**0.204**

a. Dependent Variable: Q10

Question 12: Shortage of experienced personnel necessary for innovation, on the market.

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	**Proactivetraining, Competition[a]**	**.**	**Enter**

a. All requested variables entered.

b. Dependent Variable: Q12

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**0.306[a]**	**0.094**	**0.050**	**2.248**

a. Predictors: (Constant), Proactivetraining, Competition

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	**21.467**	**2**	**10.734**	**2.124**	**0.132[a]**
	Residual	**207.169**	**41**	**5.053**		
	Total	**228.636**	**43**			

a. Predictors: (Constant), Proactivetraining, Competition

b. Dependent Variable: Q12

Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	**2.867**	**1.386**		**2.069**	**0.045**
	Competition	**0.424**	**0.253**	**0.250**	**1.672**	**0.102**
	Proactivetraining	**0.147**	**0.141**	**0.155**	**1.040**	**0.305**

a. Dependent Variable: Q12

Appendix 9 - Binary logistic regression, Complementary study, Consequences

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	**44**	**100.0**
	Missing Cases	**0**	**0.0**
	Total	**44**	**100.0**
	Unselected Cases	**0**	**0.0**
	Total	**44**	**100.0**

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
0	**0**
1	**1**

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			Consequence		
		Observed	0	1	Percentage Correct
Step 0	Consequence	0	**0**	**13**	**0.0**
		1	**0**	**31**	**100.0**
		Overall Percentage			**70.5**

a. Constant is included in the model.

b. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	**0.869**	**0.330**	**6.917**	**1**	**0.009**	**2.385**

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Competence	**6.304**	**1**	**0.012**
		Overall Statistics	**6.304**	**1**	**0.012**

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	**6.536**	**1**	**0.011**
	Block	**6.536**	**1**	**0.011**
	Model	**6.536**	**1**	**0.011**

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	**46.876**[a]	**0.138**	**0.196**

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than 0.001.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	Competence	**1.802**	**0.758**	**5.654**	**1**	**0.017**	**6.061**
	Constant	**0.095**	**0.437**	**0.048**	**1**	**0.827**	**1.100**

Appendix 10 – Cronbach's Alpha

Main study

Case Processing Summary

		N	%
Cases	Valid	**92**	**100.0**
	Excluded[a]	**0**	**0.0**
	Total	**92**	**100.0**

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
0.787	**4**

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Competition	**16.359**	**43.156**	**0.356**	**0.831**
Question9	**15.763**	**29.193**	**0.636**	**0.713**
Question10	**15.915**	**25.880**	**0.754**	**0.642**
Question12	**16.339**	**30.173**	**0.665**	**0.697**

Complementary study

Case Processing Summary

		N	%
Cases	Valid	**44**	**100.0**
	Excluded[a]	**0**	**0.0**
	Total	**44**	**100.0**

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
0.715	**5**

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Training	**22.6500**	**45.926**	**0.023**	**0.788**
Competition	**22.4620**	**40.071**	**0.365**	**0.708**
Q9	**21.4075**	**28.597**	**0.579**	**0.619**
Q10	**21.4984**	**23.571**	**0.752**	**0.522**
Q12	**21.8848**	**27.065**	**0.659**	**0.578**