Competence Barriers to Innovation: The case of German SMEs

Name of student: Katharina Greve *Programme*: BA (Hons) International Business

Year of Study: 3 *Mentored by*: Dr Riccardo De Vita

Abstract

In a world with increased speed of business where companies are confronted with a dynamic environment, innovation plays a significant and decisive role for a company's competitiveness. However, innovation is a difficult process that involves risks that new products, services and technologies fail in gaining commercial success. Tidd et al. (2005) state that the opportunity of enhancing competitiveness also requires the management to have a contrasting set of knowledge and skills in comparison to what is required for an everyday business administration. Yet, even the innovation leader Germany and its strong *Mittelstand* face competence barriers to innovation. To efficiently innovate, these barriers have to be identified and overcome. This paper acknowledges the importance of innovation as a survival and growth imperative and investigates competence barriers to innovation and the consequences these barriers might result in. The competence barriers are explored in a sample of 45 German SMEs. The data was gathered through structured online questionnaires and analysed on the basis of regressions. Findings of the research identify that the most significant barriers are associated with management barriers which hinders companies to be innovative. Thus, these firms experience constraints to expand the business and encounter missed opportunities on financial returns. The results derived through this study highlight shortages of qualified personnel and in particular those lacking skills in innovation management as major competence barrier to innovation.

Keywords: Competence Barriers, Innovation, SME, Barriers to Innovation, Germany, Management.

Introduction

According to a Wall Street Journal article published in 2012, the word "innovation" has been used over 33,000 times in annual reports in 2011, showing a 64% increase in 5 years (Kwoh 2012). Blockbuster, Sony and Yahoo have been among the most innovative companies in their industry. Yet, missed opportunities and failure to innovate made them lose their competitive edge; competitors have driven these companies out of their dominant position. This threat applies to large organisation as well as to medium and small enterprises (Newman 2010). Organisations have to be innovative through different or more effective products, services, technologies, processes or ideas to create sustainable growth. Tidd *et al*. (2005) state that innovative firms outclass their competitors with regards to market share, profits and growth. Therefore, if firms fail to continuously innovate their chances of survival are extremely threatened: "It´s war: Innovate or die" (Cooper 2005: 4). Even businesses in one of the most innovative countries – Germany, were struggling as a consequence of the 2007-8 global financial crisis. According to Zimmermann (2012), the number of German SMEs that undertake innovation activities have drastically decreased and the constant decline in the development of innovations, for almost all the past decade, "has also resulted in a cause for concern" (2012: 1). Furthermore, he argues that the availability of skilled personnel and lacking competences for innovation tasks is a very common barrier for German SMEs. Thus, the objective of this paper is to investigate how competence barriers to innovation are perceived by German SMEs and what are the consequences these barriers might result in.

Literature Review

Due to the importance of innovation to sustain competitive advantage and economic growth, the topic has gained the attention of eminent scholars in management and economics. Schumpeter (1934) identified innovation as a driver for economic growth and argued that the development of new or improved products will encourage economic growth, rather than adjustments to the prices for the same product. The importance of innovation for businesses is stressed by Kleinknecht *et al*. (1997), who similarly to Schumpeter (1934) argue that innovative firms grow faster. The authors also emphasise that new processes and technologies are associated with better allocation of resources, greater productivity and improved quality of routine work (Kleinknecht *et al*. 1997). Firms that undertake innovation activities can

usually provide better quality products and/or more favourable prices whilst benefiting from greater growth potential (Minniti, Bygrave and Audio 2006).

Over time research captured the multi-faceted nature of innovation. This research project considers four types of innovation in accordance with the Oslo Manual (OECD 2005) as displayed in Table 1. This measurement of innovation is used throughout the research because the OECD Oslo Manual is an internationally recognised standard for measurement of innovation (OECD 2005) and is theoretically consistent with the definition of innovation by Tourigny and Le (2004); a new or significantly improved product, service or process introduced by the company during the last three years.

Table 1 Types of Innovation (Oslo Manual, OECD 2005)

Type of Innovation	**Definition**
Product innovation	"Good or service that is new or significantly improved. This includes significant improvements in technical specifications, components and materials, software in the product, user friendliness or other functional characteristics"
Process innovation	"New or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software"
Marketing innovation	"New marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing"
Organisational innovation	"New organisational method in business practices, workplace organisation or external relations"

Innovation in SMEs

Innovation is just as important in SMEs as in large organisations (Cobbenhagen, 2000). Considering, SMEs account for 98% of all enterprises in the European economy, this paper focuses on barriers to innovation in particularly SMEs (European Commission 2012). SMEs are generally more flexible, adaptable and therefore better able to develop and implement new ideas. Along with simple organizational structure and low risk behaviour, equally essential characteristics further facilitate innovative capabilities (Harrison and Watson 1998). Substantial evidence concludes a number of SMEs engage in technological innovations across a variety of sectors and this is the determining factor of their success (Hoffman *et al*. 1998). On the other hand, although possessing the necessary characteristics that better allow

firms to be innovative, Chaminade and Vang (2006), observe that across various industries innovative potential goes unrealized for some SMEs.

Barriers to innovation in SMEs have been studied in various countries (Table 2). The two most commonly reported constraints towards innovation are associated with financial and competence factors such as lack of qualified personnel (Kaufmann and Tödtling 2002). Additionally to the studies in Table 2, the research by Davidsson (1989) and Hakim (1989) focuses on firm growth through innovation. They examine that most small companies experience difficulties in acquiring external financial resources and lack of managerial know-how to manage increasingly complex processes within the company. Moreover, these companies face difficulties to respond accordingly to changes in the market because they often do not have the resources and time to recognize external sources of information and technical competence (Davidsson 1989; Hakim 1989). The more recent studies highlighted in Table 2 demonstrate the relevance of competence barriers in hindering innovation in the period after the financial crisis, also in leading countries such as Sweden and Germany.

Table 2 Previous Studies on Barriers to Innovation (Personal Elaboration based on selected publications (first and second column)

Year	Authors	Location	Financial Barriers	Risk Barriers	Competence Barriers	Organizational Barriers	Legal Barriers	Information Barriers	Networking & Cooperation Barriers
1984	Piatier	Europe (8 countries)	x	x	x	x	x	x	x
1994	Storey	West midlands of England			x	x			
1996	Cooney et al.	Ireland, Sweden, Finland, Belgium	x			x	x		x
1997	Keegan et al.	Ireland, Sweden, Finnland, Belgium	x		x	x	x		x
1998	Ylinenpää	Sweden	x	x	x				
1999	Freel	West Midlands region of England	x		x	x		x	
1999	Mohnen and Rosa	Canada	x	x	x				
2002	Kaufmann and Tödtling	Austria	x	x	x				x
2002	Baldwin and Lin	Canada			x	x	x	x	x
2004	Baldwin and Gellatly	Canada	x				x		
2004	FES	Germany			x				
2004	Tourigny and Le	Canada	x	x	x	x		x	x
2004	HWWA	North Germany			x				
2005	Mohen and Röller	Ireland, Denmark, Germany and Italy		x	x	x			x
2005	Rammer et al.	Bremen/ Germany	x		x				
2005	Leiponen	Finland	x		x				
2005	Freel	Scotland, North England	x	x	x				x
2007	Vinnova	Sweden	x		x	x			
2007	Tiwari and Buse	Hamburg/ Germany	x		x			x	x
2008	SCB	Sweden	x		x				
2008	Segarra-Blasco et al.	Catalonia	x		x			x	x
2009	Madrid-Guijarro et al.	Spain	x	x	x	x			x
2011	Europe Innova and Technopolis Group	EU	x		x		x	x	x

)

Competence Barriers to Innovation in SMEs

Both large and small organisations face financial barriers to innovation. However, small enterprises predominantly experience shortages of qualified personnel for innovation projects (Kaufmann and Tödtling 2002). Non-innovative firms generally do not perceive barriers to innovation as intense in comparison to innovative firms (SCB 2006) and Tourigny and Le's (2004) research highlights shortages of skilled personnel to develop or implement new or significantly improved processes and products as the major barrier to innovation. Several competence barriers to innovation and variables affecting innovation were examined by previous researchers. Table 3 groups them in six categories which are employed in this study.

Table 3 Theoretical Frameworks of Competence Barriers to Innovation

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

Source: Personal Elaboration based on selected publications listed in the second column

Methodology

This research is based on descriptive and explanatory analysis. Given the advantages of online surveys, primary data have been collected through a structured online survey (Hogg 2003, Saunders *et al*. 2007). The sample was selected mainly through the financial database Orbis (Bureau van Dijk 2012), and by utilizing personal contacts to German SMEs. 153 companies from different sectors responded to the survey, 84 respondents fully completing it.

Limiting the selection to those firms with available financial data from the last available year between 2008 and 2012, 45 were identified as SMEs considering their employees and annual turnover (European Commission 2003).

The questionnaire was formulated based on previous literature, statistics and research, as well as piloted. Two sets of regressions investigate firstly, competence barriers to innovation and their consequences and secondly, the innovativeness in relation to the number of employees working in a R&D department. The dependent variables include the potential consequences of competence barriers to innovation. The selected consequences are mainly derived from investigations and findings by Europe Innova and Technopolis Group (2011) and Tiwari and Buse (2007). In the first set of regressions, the independent variables include the competence barriers to innovation. Also like the dependent variables, the independent variables were rated on Likert scales from 0 to 10 which expresses the extent to which firms' ability to innovate was hindered by the six different barriers that are listed in Table 3. The firm's age is included as control variable in both sets of regressions which is based on previous literature (Freel 2005) that states that young firms are not exposed by the incumbency barriers to innovation (Schneider and Veugelers 2008).

Figure 1 Model of the 1st Regression – Competence Barriers and Consequences

$$MOFR_i = \beta_1 + \beta_2 * COMPANY\_PERSONNEL_i + \beta_3 * INDUSTRY\_PERSONNEL_i + \beta_4 * COST\_EXTERNAL\_COMPETENCE_i + \beta_5 * MANAGERIAL_i + \beta_6 * INFORMATION_i + \beta 7 * MARKETING_i + \beta 8 * YEAR_i + u_i$$

Figure 1 displays the first regression which investigates the impact of competence barriers to innovation on the consequences derived through these obstacles. For this model, MOFR stands for Missed Opportunities on Financial Returns. However, this dependent variable is in the second to sixth regression replaced at each time by one of the other dependent variables. The abbreviation and type of the variables are listed in Table 4.

Table 4 Variables used in the first model

Variable abbreviation	Description	Type
MOFR	Missed opportunities on financial returns	Dependent variable
CONTRACTS	Declination of certain contracts/projects	
EXPANSION	Difficulty in expanding the business	
FAILED_MARKETING	Failed marketing of innovations	
INTRODUCTION_PRODUCTS	Constrained to effectively introduce new products or services	
INTRODUCTION_PRO	Constrained to effectively introduce manufacturing processes	
IDEAS	Decreased number of ideas for innovations	
MOFR	Missed opportunities on financial returns	Independent variable
COMPANY_PERSONNEL	Shortage of qualified personnel necessary for innovation, within your COMPANY.	
INDUSTRY_PERSONNEL	Accessibility to qualified labour force necessary for innovation, within the INDUSTRY	
COST_EXTERNAL_COMPETENCE	Cost of acquiring external competence.	
MANAGERIAL	Shortage of managerial know-how to effectively and efficiently manage innovation processes.	
INFORMATION	Lack of information regarding technical development within the industry.	
MARKETING	Lack of marketing capability to market new or significantly improved products, services or processes.	
YEAR	Year of Foundation	Control variable

Each individual consequence listed in Table 4 was regressed against all listed competence barriers to innovation in order to examine statistical significance.

The second set of regressions investigates whether the number and type of innovations introduced in a company internally depend on the number of employees working in a R&D department/unit in that company. Figure 2 displays the function of the first regression of this kind.

Figure 2 Second Model of the 1st Regression – Innovativeness and R&D

$$PRODUCT_i = \beta_1 + \beta_2 * EMPLOYEES_i + \beta_8 * YEAR_i + u_i$$

The dependent variable then replaced by one of the other dependent variables that are listed in Table 4; all other variables were kept the same. The abbreviation and type of the variables are explained in Table 5.

Table 5 Variables used in the second model

Variable abbreviation	Description	Variable type
PRODUCT	Product innovation	Dependent variable
PROCESS	Process innovation	
ORGANISATION	Organisational innovation	
MARKETING	Marketing innovation	
EMPLOYEES	Number of employees (in %) working in R&D department/unit	Independent variable
YEAR	Year of Foundation	Control variable

3.2.2 Multicollinearity and Heteroskedasticity

To ensure unbiased regression results produced by OLS, the Gaussian assumptions have to be satisfied (Gujarati and Porter 2009). Though, the F distribution and critical F distribution showed no evidence of perfect multicollinearity. Inaccuracy was unveiled through the F and t-test results. In this case, the possible heteroskedasticity was tested through the White's general heteroskedasticity test as illustrated in Table 6.

Table 6 Heteroskedasticity Test: White

Heteroskedasticity Test: White

F-statistic	2.126543	Prob. F(34,10)	0.1025
Obs*R-squared	39.53236	Prob. Chi-Square(34)	0.2365
Scaled explained SS	55.13388	Prob. Chi-Square(34)	0.0124

To prove that the results of the regression are not biased, valid and the best possible result, the White heteroskedasticity-consistent standard errors and covariance were run which allows the fitting of a model that does comprise heteroscedastic residuals.

Key Findings

An overview of the respondents' characteristics is summarized in Table 7.

Table 7 Overview of Participants (Based on data collected by the author)

Overview of Participants	
Number of Observations	45
Years of Foundation	1818-2010
Location	16 Federal States of Germany
Sectors	18 different sectors
Innovative Companies	78%
Product Innovations	84%
Process Innovation	56%
Marketing Innovation	60%
Organisational Innovation	56%
Patent Application	40%
Registration of Industrial Designs	16%
Companies with R&D Department/unit	36%

Companies were categorized as innovative if they had introduced a new or significantly improved product, process, organisational or marketing innovation between 1 January 2010 and 31 December 2012. Overall, the vast majority of all respondents can be identified as innovative which is aligned with findings from Statistics Canada that identified about 80% of the surveyed companies as innovative (cited in Tourigny and Le 2004).

The minority of respondents that have a R&D department employ in average about 14% of their employees to work in such a division. Additionally, the data show a relationship between those companies that have a R&D department and whether they applied for patents or industrial designs (Figure 3).

Figure 3: Applications for Patents and Industrial Designs (Based on data collected by the author)

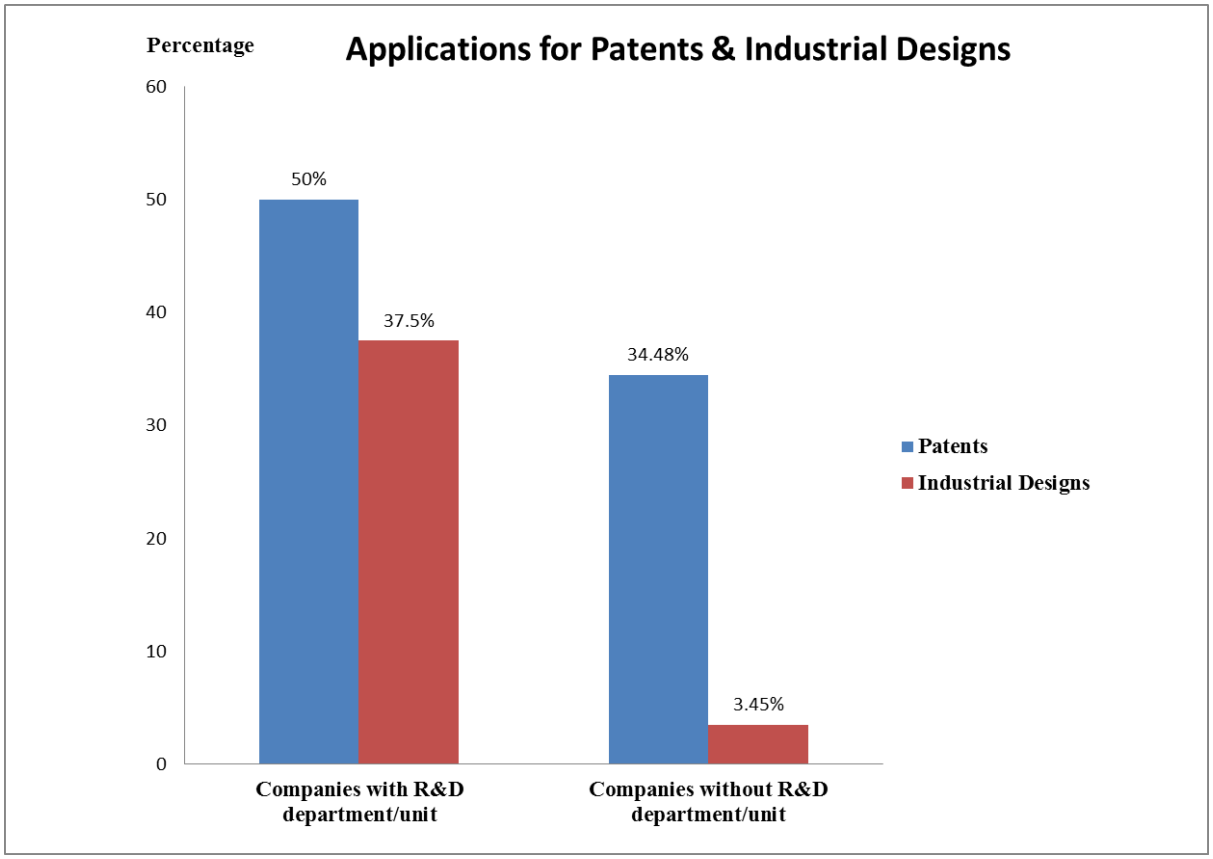

Figure 3 demonstrates that companies with a R&D department/unit have a greater number of applications for patents and also increasing numbers for industrial designs. Half of the companies with R&D department/unit declared to have applied for patents and 37.5% for Industrial Designs during the previous three years. In contrast, only about one third of the sample without R&D department/unit applied for patents and just 3.45% for Industrial Designs.

Intellectual property is a tangible measure of R&D success through organizational support (Gamal 2011). Therefore, it can be argued that R&D departments facilitate applications for patents and industrial designs. The introduction of different types of innovation in relation to whether the company has a R&D department is displayed in Figure 4.

Figure 4 Introductions of Innovations (Based on primary data collected by the author)

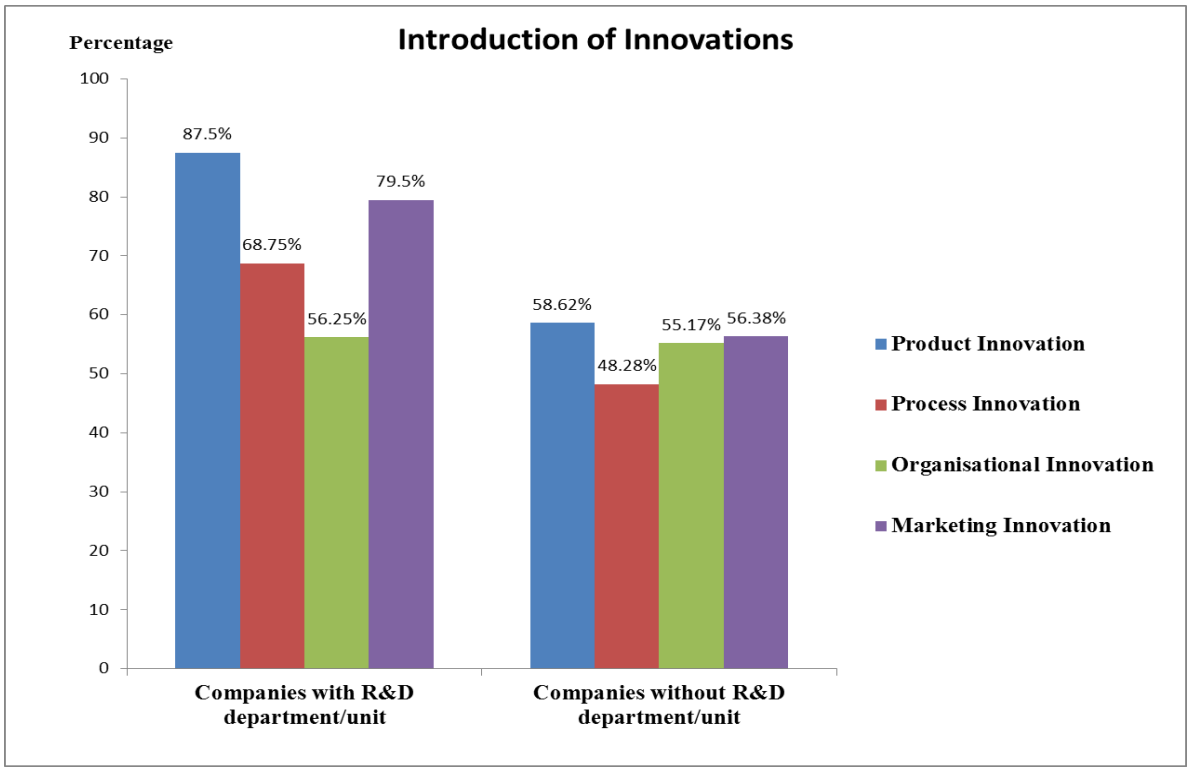

Figure 4 shows that the percentage of product, process and marketing innovations is overall greater when a company comprises a R&D department/unit. The reason may be that these types of innovations require more organisational structure and require more efforts due to their complexity. However, considering that the majority of the sampled SMEs do not have a R&D department/unit but are classified as innovative shows that there are other factors contributing to the innovativeness of these companies.

When reviewing the data, four consequences that derive from competence barriers to innovation were mostly reported; (1) declination of certain contracts/projects, (2) difficulty in expanding the business, (3) constrained to effectively introduce manufacturing processes and (4) missed opportunities on financial returns. These consequences can directly impact growth and profits .These aspects may be determined by the predominance of manufacturing companies that responded to the survey which are more likely to experience obstacles such as constrains to effectively introduce manufacturing processes than for instance a service company.

Table 8 R-squared: Competence Barriers and Consequences

Dependent Variable	R-squared
MOFR	0.594
CONTRACTS	0.418
EXPANSION	0.687
FAILED_MARKETING	0.722
INTRODUCTION_PRODUCTS	0.462
INTRODUCTION_PRO	0.756
IDEAS	0.584

To investigate which of the competence barrier mainly cause certain consequences, seven regressions were run and results are presented in Table 8. Table 8 indicates through R-squared how well the data points fit the statistical model employed. The first observations outlines that the value of the dependent variable, missed opportunities on financial returns (MOFR), is dependent on the explanatory/independent variables by 59.37%. That means 40.63% of the value of missed opportunities on financial returns (MOFR) is caused by other factors that are not included in the model. The same logic applies to the other dependent variables as well as the second set of regressions in Table 9.

Table 9 R-squared: Innovativeness and R&D

Dependent Variable	R-squared
PRODUCT	0.5072
PROCESS	0.390
MARKETING	0.626

Discussion

The outcome of the first set of regressions is presented in Table 8. The value of the coefficient is displayed in the table representing the degree of influence which each individual independent variable has on the dependent variable. The blank fields demonstrate that there is no statistical significance observed.

Table 10 Overview of Competence Barriers and Consequences Regression Results (Based on data collected by the author)

	Dependent Variables (Consequence)						
Independent Variables (Competence Barriers to Innovation)	MOFR	CONTRACTS	EXPANSION	FAILED_MARKETING	INTRODUCTION_PRODUCTS	INTRODUCTION_PRO	IDEAS
COMPANY_ PERSONNEL		0.375					0.509
INDUSTRY_ PERSONNEL		0.918	0.548				0.294
COST_EXTERNAL_ COMPETENCE	0.562		0.141				
MANAGERIAL		0.422		0.361		0.469	
INFORMATION				0.190		0.566	
MARKETING	0.190			0.276	0.665		

The costs of acquiring external competence and the lack of marketing capabilities are perceived to impact the financial returns negatively. Companies are perceived to be hindered to economically operate to full capacity due to lacking competence internally and externally which sometimes makes them unable to fulfil certain contracts. This implies that German SMEs may be even more innovative if there would be more competence and access to qualified labour within the industry. Thereby, the lack of marketing capability impacts the introduction of new products or services. As indicated in Figure 4, the introduction of product innovations is the most common type of innovation within the sample frame. Also, the study by Günday *et al*. (2011) refer to product and process innovation as the most common types of innovation. Process innovation allows for cost reduction or quality improvements through implementing a technical change in the manufacturing process or through material

substitution. Ideas for innovation are driving forces that allow and encourage companies to undertake innovative activities. However, the shortage of qualified personnel and the lacking accessibility to it caused decreasing number of ideas for innovation within the company. Hence, companies struggle to be creative and innovative. Companies may need to rethink their internal training and organisational support that allows employees to be creative.

The lack of skills, including management capabilities highlights a major obstacle and is associated with five out of seven consequences. Also the lack of information can be regarded as management barrier which is therefore observed to occur in relation to a shortage of managerial know-how. Companies seem to be hesitant acquiring external competence to compensate for the lacking competence internally due to the associated costs. Moreover, the lacking external competences make it even more difficult to find the right business partner to outsource certain tasks. Overall, it can be observed that there are patterns between competence barriers which refer mainly to lacking innovation management skills and shortages of qualified personnel which impact the overall business performance. Almost 500,000 jobs in Germany are open and "skilled workers are especially needed" (Kinkartz 2012: Economy).

Based on the literature review, various skills are required to effectively and efficiently manage innovation activities which differ by sector, nature of the business and type of innovation (Europe Innova and Technopolis Group 2011). Nevertheless, a proficient supply of skills in the labour force as well as managerial skills are generally identified as crucial in order to avoid consequences that impact the innovativeness of a company and consequently the business performance (Kleinknecht and Mohnen 2002).

Table 11 Overview of Innovativeness and R&D Regression Results (Based on data collected by the author)

	Innovation			
	PRODUCT	PROCESS	ORGANISATION	MARKETING
EMPLOYEES IN R&D DEPARTMENT	6.805	6.313		6.794

According to the findings that are displayed in Table 11, innovations are predominantly introduced in companies that have a R&D department/unit. Yet, it can be summarised that the investigations show that the amount of employees working in such a department fuel the introduction of product, process as well as marketing innovation. An impact of a R&D

department on organisational innovation could not be identified. The same applies for the number of employees that work within a R&D department/unit which do not show statistical significance in relation to organisational innovation. However, the other three types of innovation show a great dependence on the number of employees working within a R&D department/unit and the number of product, process and marketing innovations that are developed in-house.

Conclusion

The findings highlight the lack of competences in innovation management and shortages of qualified personnel as the main obstacles that German SMEs face to when pursuing innovation. SMEs have limited resources with regards to work force, finance and infrastructure. These factors limit their capacity to successfully manage innovation activities, acquire external competence or the necessary tools or support for innovation activities. According to Gerybadze *et al*. (2010: 1), "research and development and innovation are the drivers of change and the key determinants of growth". Since 2005, Government expenditures on research have increased by 21%. One major program that provides significant funding is the "Excellence Initiative" of the German federal and state governments which supported the recruitment of 4,200 researchers and scientists (The Chronicle of Higher Education 2013). Regardless of these initiatives, the findings highlight the urgent need for more skilled personnel and qualified managers for innovation activities in German SMEs. Baldwin (1999) states that paying greater attention to the recruitment process and to increasingly stress the provision of training to improve the required skills for implementing and managing innovation activities is vital for the success of a company.

In spite of the limitations associated with the sampling strategy, it is possible to derive some implication from this study. This research project highlights the lack of in-house competence, which is argued by Roper (1997), as well as Murray and Worren (1999) to have implications for a company's innovative capacity. Hence, firms should pay greater attention to the recruitment and training of staff to utilize human capital in the best way possible to be innovative. The lack of qualified personnel necessary for innovation has also implications for external institutions. Educational institutions might consider reviewing their courses to equip students with the skills needed from firms before entering the job market.

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