Master Thesis - Stephanie Schulz

SMEs' benefits in EU funded research projects

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Abstract

Today the European Union (EU) is one of the three biggest economic areas in the world, next to Asia and the United States of America. Therefore, they are strongly competing on break-through technologies, in order to increase competitiveness. One way of the EU to approach this is to co-finance innovative project ideas, by opening calls for tender within their Framework Programmes (FPs). The projects are carried out in consortia of large firms, small and medium-sized firms (SMEs), and research institutions.

As previous research showed, it is especially challenging for SMEs to participate in these projects, which is the reason why this Master Thesis deals with the benefits SMEs can derive from participating in EU funded research projects and hence answers the main research question `To what extent do SMEs benefit from participating in EU funded research projects?' The thesis is relevant from a theoretical as well as practical perspective, since there is a gap in literature on SMEs' benefits in EU FPs, and furthermore, the EU wants to increase SME participation, since they are pivotal players in European industries.

The analysis of this study showed that realized benefits are lower than the expected ones, and that realized drawbacks are also lower than expected. Since the realized benefits are only marginally lower than expected, EU funded research projects can be determined as an attractive alternative/addition to in-house R&D activities for SMEs. The fact that firms expect higher drawbacks than realized, calls for a correction of this misperception by politicians. Furthermore, it turned out that firm size, as well as prior experience in this type of projects influences the realized benefits, although not statistically significantly. The expectation to learn new skills has most effect on the realized benefits, followed by networking, reduced costs and uncertainty, as well as increased competitiveness, access to complementary resources, and access to specialized knowledge from academia. The answer to the overall research question is that the extent to which SMEs benefit from participating in EU funded research projects varies, since it depends on the type of benefit. However, since the realized drawbacks were lower than expected, EU funded research project participation can be determined as less burdensome than believed.

In order to increase SME participation in the future, the EU should develop a sound marketing strategy on the projects, with the assistance of national contact points. This could be done in the form of an increased number of brokerage events during which more attention is paid to informing on the benefits of EU funded research projects. Furthermore, two-stage evaluation procedures could reduce the bureaucratic burden, which was the most expected and realized drawback.

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List of abbreviations

EU	European Union
MS	Member State
ERA	European Research Area
R&D	Research and Development
FPs	Framework Programmes
SMEs	Small and medium-sized enterprises
EC	European Commission
HR	Human Resources
FP7	7th Framework Programme (2007-2013)
RBV	Resource Based View
SCA	Sustained Competitive Advantage
VRIN/O	Valuable, rare, inimitable, non-substitutable and organizable resources
TCE	Transaction Cost Economics
IPRs	Intellectual Property Rights
VIFs	Variance Inflation Factor

1 Introduction

1.1 Context of the research

Since its foundation in 1952, the European Union (EU) developed into a highly complex institution to which its Member States (MS) have transferred upon many competences. Today, it is one of the three biggest economic areas in the world, next to Asia and the USA, and hence strongly competing with them on break-through technologies (Czarnitzki et al., 2007). In order to increase its competitiveness, one aim of the EU is to foster the European Research Area (ERA) through increasing the percentage of GDP spent on Research and Development (R&D) to 3% (Europe 2020, 2010). Therefore, the EU launches annual calls for research projects in its Framework Programs (FPs), which are carried out in consortia, of industry, small and medium-sized enterprises (SMEs) and research institutions in collaboration, to commonly develop future technologies and services, boosting R&D as well as innovation in Europe. After a call has been published, the established consortia have to write a project proposal, which they submit to the European Commission (EC) and which will then be evaluated by independent experts. Afterwards, the EU contribution for successful applications will be negotiated. If all parties agree, a grant agreement will be signed (Guide for applicants, 2012). The time between a call deadline and signing this document is called time-to-grant and lasts up to 320 days on average (Sixth FP7 Monitoring Report, 2013, p. 41).

SMEs are pivotal players in European industries. They are defined as "[…] enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million euro, and/or an annual balance sheet total not exceeding 43 million euro" (Article 2 of the Annex of Recommendation 2003/361/EC)[1]. They cover 99% of European companies, which makes them important in terms of increasing employment, economic growth, innovativeness and competitiveness within the EU (Interim Evaluation of the Seventh Framework Programme, 2010; The new SME definition, 2005). However, they often lack access to financial resources and face with limited capacities in terms of Human Resources (HR), which on the one hand also limits their ability to engage into complex R&D consortia projects (Duysters & Lokshin, 2011; Leitner, 2011) but on the other increases their need for support, especially for R&D activities, which are known to be expensive and risky but important for creating competitive advantage as well (Hitt et al., 2002; Tsang, 1998; Dyer & Singh, 1998).

As mentioned above, SMEs have the opportunity to apply for EU funded research projects, with which this thesis will deal. However, a problem is that SME success rates (17%), referring to projects that have been selected for funding, are still low compared to large industry levels (26%) as well as the success of all applicants (20%), including research and non-profit institutes (Sixth FP7 Monitoring Report, 2013, p. 12). This leads to further declining participation rates due to the fact that time and money spent on creating consortia and writing proposals, which are rejected, were wasted. Furthermore, it is important to mention that 72% of the various SMEs that were granted funding in FP7 participated only once and only 1.1% of them participated more than ten times (Sixth FP7 Monitoring Report, 2013, p. 17), indicating the complexity of EU funded projects.

[1] In EC. (2005). The new SME definition

1.2 Theoretical and practical relevance

There are currently only few papers existing, which deal with research collaboration in EU FPs, and especially few tackle the latest, FP7. This increases the relevance of this thesis. Existing papers analyze evaluation studies of the EC, review existing evaluation evidence for earlier FPs (FP4-FP6), and analyze FP participations themselves as well as their funding levels, and additionality of the FPs, amongst others. Those articles covering this topic, found in the Web of Science, are outlined in the theoretical framework (Chapter 2) more in depth. There is the need to enlarge the existing body of literature and knowledge in this field, especially when it comes to the latest FP (FP7) and the role of SMEs.

This is supported by Luukkonen (1998), who claims that the evaluations of the FPs are biased due to the fact that they are written by actors of the political system which hampers criticism. This increases the need for independent studies, which also take into account outcomes and experiences with projects rather than only expectations and intentions, in order to gain insights on the fulfillment of the latter ones (Luukkonen, 1998). Moreover, Pavitt (1998) states that FPs should focus on increasing participation of SMEs.

Even less literature deals explicitly with benefits for SMEs as well as the low participation rates, which further increases the relevance of this study. Some articles encourage closing the currently existing literature gap on expected and realized benefits of FP participation (Luukonen, 1998). Hence, this thesis contributes to enlarging the existing body of knowledge and literature by analyzing the presence of factors that drive collaboration for innovation between large firms, SMEs, and research institutions, in EU FP projects. Moreover, the type of SMEs that participate in EU funded research projects will be identified. Additionally, this study looks at the expected and realized benefits as well as drawbacks and barriers of SMEs that have been engaged into these projects. It is expected by the researcher, that a gap exists between expectations and outcomes. On the basis of the results, advice to EU politicians on how to boost the realized benefits and encouraging higher levels of SME participation will be provided. Hence, the thesis is relevant from a practical perspective as well.

1.3 Problem statement and research goal

The following problem statement results from the facts above: In order to overcome the resource constraints, limiting their ability to undertake R&D on their own, innovative SMEs are in need of partners with whom they can conduct collaborative research projects, as those funded by the EU. Hence, it is a problem that SME participation rates in FPs are relatively low.

Therefore, the research goal of this thesis is to identify the expected and realized benefits, drawbacks and barriers and based on this develop advice on how to close the (expected) gap through fulfilling the intended and augmenting the realized benefits of SMEs, aiming at increased SME participation in the future, which in turn helps to boost Europe's competitiveness in the world.

1.4 Research questions

The above mentioned research goal leads to the following overall research question:

'To what extent do SMEs benefit from participating in EU funded research projects?'

The central research question includes the analysis of drawbacks as well, in order to assess the extent to which SMEs benefit from EU funded research project participation. The below-mentioned sub-questions will facilitate the answering of the overall research question and structure the analysis of the thesis:

1. 'Which factors drive collaboration for innovation between large firms, SMEs, and research institutions?'
2. 'What type of SMEs participate and what are their expected benefits?'
3. 'To what extent are SMEs expected benefits realized?'
4. 'Which expected benefits have most effect on the realized benefits?'
5. 'Which drawbacks do EU funded research projects involve?'

The overall research question is descriptive since it aims at gaining insights on SMEs' benefits from EU funded research project participation. The first sub-question will be answered on the basis of existing research articles. The second research question investigates the type of SMEs (amongst others: size, innovativeness, profitability) and their expected benefits from participating in EU funded research consortia, through a questionnaire, which will be described more in depth in the data collection (part 3.1). The third sub-question uses the answers of respondents as well, examining to what extent the predicted factors and expected benefits have been realized. Sub-question four analyzes which expected benefit has most effect on the realized ones, and sub-question five analyzes the drawbacks identified by literature and respondents' answers to the questionnaire.

1.5 Outline of the thesis

This study is structured along a theoretical framework, which provides an overview on the most relevant theoretical perspectives, as well as the major drivers for research collaboration between industry and academia they identified. Following, the role of universities and research institutes is described. Subsequently, a part on factors driving EU funded research project participation is included. Afterwards, the major benefits and drawbacks from research collaboration are outlined and the hypotheses are developed. The third chapter of this thesis shows the research methodology, comprising the data collection, as well as the research design, response rates and the data analysis. The following chapter shows the results and analysis by providing the answers to the sub questions, as well as testing the hypotheses. The thesis closes with discussions and recommendations, starting with a summary of the key findings, followed by the implications for science and practice, as well as the limitations of the study. It ends with future research recommendations.

2 Theoretical Framework

This part of the thesis outlines the most important concepts and theories concerning research collaboration identified by academic research articles. Research collaboration includes collaborating in projects as well as networking activities. It is important to distinguish between alliances formed for R&D purposes and those, which are not because the former ones are focusing on special tasks and are usually fixed in nature, ending after the finalization of the common project. Contrarily, the latter ones involve a long-term agreement and linking businesses of partners (Duysters & Narula, 2004). This thesis deals with alliances dedicated towards conducting international collaborative R&D projects, more precisely research work undertaken in consortia from different MS of the EU (international).

This framework starts with a description of the different theoretical perspectives used. Due to the fact that they are all relevant and overlap partly, they are combined here, in order to capture a full picture on the topic. Afterwards, factors driving research collaboration between industry and academia, which is a prerequisite of EU FPs, will be outlined. Thereafter, the benefits as well as drawbacks and barriers of EU funded research collaboration will be named. At the end of this chapter, hypotheses based on the theoretical findings will be developed, which will then be tested in the analysis.

2.1 Different theoretical perspectives

The presence of strategic alliances, especially in the field of R&D, has increased tremendously over the past decades. This can mostly be explained by the increasing complexity, and hence increasing costs and risks, for R&D as well as the growing internationalization of innovation (Bougrain & Haudeville, 2002; Spithoven & Teirlinck, 2013; Teece, 1986; Fisher et al., 2013; Bayona Sáez et al., 2002; Alexander et al., 2000; Barber & Scherngell, 2011). Thus, many different streams of literature are dealing with factors that drive research collaboration, its benefits and drawbacks. As mentioned above, the three most relevant streams are combined in this thesis.

This study takes into account literature on the resource-based view (RBV), which elaborates on how firms can create inter-organizational competitive advantage from collaboration. It distinguishes between physical capital resources (e.g. technology, plant, inventory, machinery, geographic location, access to raw materials), human capital resources (e.g. skills, training, experience and relationship of employees), and organizational capital resources (e.g. reporting system and relationships to external partners) (Barney, 1991). Furthermore, it claims that a firm's sustained competitive advantage (SCA) is based on valuable, rare, inimitable, non-substitutable (Barney, 1991), and organizable resources (VRIN/O)(Barney, 1995). Although some major critique has been raised, as for instance that VRIN/O is neither necessary nor sufficient for SCA and that the definition of resource is unworkable (Groen et al., 2010), the RBV remains an important and often applied theory in academic articles. To provide only few examples, Hitt et al. (2002) mention that the unequal skills owned by the various partners of an alliance are value-creating since they urge firms to learn from each other and based on this cerate SCA as well as trust relationships. Moreover, Spithoven and Teirlinck (2013) claim that RBV shows the interplay of innovation collaboration and the broadening of specialized company internal capabilities.

This shows the relevance of RBV for this thesis since it can explain motives for international R&D consortia formation as creation of rents, expansion of resource usage, diversification of resource usage, imitation and disposal of resources (Tsang, 1998). Besides that, Dyer and Singh (1998) identified four potential sources of inter-organizational competitive advantage, namely

relation-specific assets, knowledge-sharing routines, complementary resources and capabilities as well as effective governance, which are all important in EU FP projects.

The second important theory is that of transaction cost economic (TCE). It deals with governance and organization (Williamson, 2010), with a special focus on outsourcing decisions and choices (Teece, 2010), and hence collaboration with others is a main element of this theory (Williamson, 2005), which makes it very relevant for this thesis, when it comes to the cost encountered while engaging in cooperative research. In this specific field the most important ones are the information costs, which are occurring when the firm looks for information on the FPs, like the rules for participation or new calls as well as potential partners. Secondly, the costs a company faces when bargaining with partners on the task distribution (work package distribution) and writing proposals as well as those arising when negotiating the grant agreement with the Commission. Lastly, the costs incurred when a partner breaches the contract or drops out, the enforcement costs, are present (Hitt et al., 2002). It is important that the firm is able to control these costs, through sharing them with their partners when collaborating, in order to perceive value from it. This is the case when "[…] it is more efficient than alternative organizational hierarchies or the market" (Hitt et al., 2002, p. 435). However, according to Tsang (1998) RBV is more balanced concerning cost and value perspectives when applied to inter-organizational collaboration than TCE, due to the fact that it provides a large amount of factors driving this type of collaboration.

Lastly, Social Network Theory (SNT) contributes to this study since it deals with how organizations enter into relationships with others and how they can learn from it. As will be discussed below it is of utmost importance for firms, which want to engage into collaborative research to have access to a network of partners and continuously increasing it. A network is defined as "[…] a number of nodes [which] are related to each other by specific threads […] [involving] complex interactions, adaptations and investments within and between the companies over time […] [, whereby] each node or business unit, with its unique technical and human resources is bound together with many others in a variety of different ways through its relationships" (Ford & Hakansson, 2002, p. 133). Ford & Hakansson (2002) mention that the more companies invest into networks, the more important will be the content and that networks enable to influence but also imply being influenced by others. However, organizations need an absorptive capacity, meaning that they have to be able to transfer the acquired knowledge or technology to their specific individual needs, in order to benefit from knowledge spill-overs (Cohen & Levinthal, 1990).

Spithoven and Teirlinck (2013) underline the point that all three streams outlined above are important because "Firms may engage in cooperation in order to acquire missing knowledge, complementary resources of finance, to spread risks to enlarge social networks, or to reduce costs" (p. 143). Put together, these three provide a full picture on why firms engage into research collaboration with research institutes as well as the benefits and drawbacks, which might be encountered. This allows capturing the different motives of firms to collaborate in R&D projects. The following part deals with factors driving research collaboration more in depth.

2.2 Factors driving research collaboration between industry and academia

This part outlines the most important factors driving research collaboration between large firms, SMEs, and research institutions and hence answers the first sub-research question. Since the three streams of literature overlap concerning several factors, they have been grouped into categories by the researcher, in order to facilitate reading and avoiding redundancies. The first category of factors deals with those related to human resources, followed by one on costs, risks, and resource factors. The third category is labeled government incentives, and the fourth network factors, which is followed by one on firm-related factors and another one on industry

factors. Lastly, consortia factors will be outlined. Table 1 at the end of this chapter summarizes the various factors in order to provide a structured overview.

2.2.1 Human resource related factors

As already mentioned in the introduction to this chapter, research collaboration can lead to inter-organizational learning, which in turn creates competitive advantage. This type of learning can be achieved through the simultaneous co-specialization of employees engaged into the project. It is most effective when a common language, concerning terminology of technology, is shared. Research alliances provide employees with access to additional competences and capabilities (Dyer & Singh, 1998). When the firm possesses the necessary absorptive capacity, it can internalize these knowledge spillovers, which can then lead to new intra-firm ideas (Cohen & Levinthal, 1990; Sakakibara, 2002; Dyer & Singh, 1998; Hagedoorn et al., 2000; Czarnitzki, 2007; Barber & Scherngell, 2011). Therefore, the engagement into research consortia speeds up the learning process and enables firms to react to the ever more complex market conditions and technologies (Mahnke & Overby, 2008). However, this in turn requires the assignment of highly qualified personnel to these projects (Leitner, 2011) in order to benefit from this source of innovativeness. This implies that companies have to assign staff, which is already experienced in managing and coordinating partnerships, to the common R&D projects, in order to maximize the learning effects (Duysters & Lokshin, 2011; Barajas & Huergo, 2010). Hagedoorn et al. (2000) add that repeated collaboration boosts the sharing of knowledge and information between partners and Barajas & Huergo (2010) claim that HR skills on conflict management among partners further increases future collaboration.

Katz and Martin (1997) stress that the need for specialization in complex technology areas as well as the growing emergence of interdisciplinary areas are major drivers for research collaboration. Moreover, the motivation and acceptance of employees to learn out of mistakes and failures is another factor (Barajas & Huergo, 2010).

Additionally, the presence of so called 'gatekeepers', who collect information on potential partners, research funding opportunities, inform partners on planned projects, and mediate between the various parties involved, increases the likelihood that firms engage into collaborative R&D activities (Bayona Sáez et al., 2002). This in fact shows the difficulty for SMEs to engage into such projects due to the fact that they are often confronted with limitations in the number of overheads they can assign to execute these tasks.

All in all, a dominant driving factor for firms to engage in this type of collaboration is the acquisition of new knowledge and skills of employees through joint learning and trust in areas where the firm itself does not own them (Spithoven & Teirlinck, 2013; Duysters & Lokshin, 2011; Tether, 2002). However, this also implies that highly skilled staff has to be assigned to common research projects in order to integrate this knowledge (Duysters & Lokshin, 2011; Barajas & Huergo, 2010), which is especially challenging for small firms.

2.2.2 Costs, risks and resource related factors

Next to HR factors, costs, risks and resource incentives foster the engagement into joint research projects. First of all, companies seek collaborative arrangements when they require access to capacities they do not possess, which can be commonly developed through partners with complementary resources (Paier & Scherngell, 2011). Another major driver for research collaboration is the growing complexity, which simply cannot be addressed by one company alone due to resource constraints (Bougrain & Haudeville, 2002; Spithoven & Teirlinck, 2013; Alexander et al., 2000). This is a tremendously important driver for SMEs since they encounter

resource constraints more frequently than large firms (Bougrain & Haudeville, 2002; Tsang, 1998).

Furthermore, joint research undertakings facilitate the extension to new and previously unknown research and technology areas and uncertain environments, whereby costs and risks of inefficacy are shared, which are the most important factors for collaboration identified in the existing body of academic literature (Spithoven & Teirlinck, 2013; Skakibara, 2002; Duysters & Lokshin, 2011; Hitt et al., 2002; Tether, 2002; Hagedoorn et al., 2000; Barajas & Huergo, 2010). Hitt et al. (2002) as well as Hagedoorn et al. (2000) underline this by explicitly mentioning that transaction costs are lowered through research collaboration. Boundaries in the access to finances are also a driver for the participation in governmentally funded research projects (Blanes & Busom, 2004), with which the following sub-part will deal. Moreover, the falling prices for travelling and communication contributed to international research collaboration (Katz & Martin, 1997).

Summarizing it can be said that research collaboration enables the combination of different but complementary VRIN/O resources of the various partners, which could not have been achieved by one of them alone (Dyer & Singh, 1998). This enables partners to develop synergies among each other and overcoming resource constraints, which can lead to economies of scale and scope, as well as reduced TCE (Hitt et al., 2002).

2.2.3 Government incentives

In the past decades, governments intensively promoted the joint engagement of industry, universities and research institutes in pre-competitive research by opening calls for funded projects, which aim at increasing competitiveness of industries (Bougrain & Haudeville, 2002; Tether, 2002). In case application effort is not too high and rules for participation are favorable, firms apply for public funds, which represent a driving incentive for them to collaborate with academic partners since the co-funding further reduces outlays for R&D (Blanes & Busom, 2004; Beise & Stahl, 1999; Luukkonen, 2000; Bayona Sáez et al., 2002; Belkhodja & Landry, 2007). Busom & Fernández-Ribas (2008) found that governmental research funding increases the probability for research collaboration by 28%. Government programmes aim at motivating also those who are disadvantaged to engage into collaborative research (Skakibara, 2002). Further reasons why governments call for tenders are to correct market failures and to speed up technological innovations, again in order to increase competitiveness (Hagedoorn et al., 2000).

Concluding Johnson (2008) expresses the importance of public research funding by stating that many (break-through) technologies have only been developed because they were supported by government.

2.2.4 Network factors

Among the factors mentioned above the continuous extension of a firm's existing network is an important factor for research collaboration, identified by theory (Spithoven & Teirlinck, 2013). Network factors can be power and control. Moreover, a network can be used as a signaling mechanism and the network itself is regarded as a source of innovation, since it enables firms to exchange and transfer knowledge with their partners, which facilitates learning and creates trust relationships (Sakakibara, 2002; Leitner, 2011; Zaheer, 2010; Hagedoorn et al., 2000; Barber & Scherngell, 2011). Teece (1986; 2000) claims that relationships to partners are needed in order to successfully conduct R&D activities. In order to benefit from networks, as well as collaborative R&D projects, it is of tremendous importance to select partners carefully and adequately (Bayona Sáez et al., 2002). Furthermore, networks increase visibility and reputation of firms and facilitate the search for partners, either from industry or public research, for new,

future projects (Barajas & Huergo, 2010; Belkhodja & Landry, 2007; Katz & Martin, 1997; Dyer & Singh, 1998; Arnold et al., 2005). The partial overlap with the human resource factors can be explained by the fact that a network is made up of firms' employees and that common learning is one goal of networking. This factor is an important driver since firms could not engage into and retain the benefits from research collaborations without a network.

2.2.5 Firm related factors

A firm related factor is the presence of a company internal R&D department, which facilitates the management of research projects as well as the access to external partners (Bougrain & Haudeville, 2002; Skakibara, 2002; Busom & Fernández-Ribas, 2008). Dyer et al. (2001) found that a specialist on alliances within this department "improves knowledge management efforts, measures external visibility, provides coordination, and eliminates both accountability problems and intervention problems" (p. 38), which further facilitates the participation in collaborative R&D. Limitations in R&D capacities, age and practice in research consortia as well as a critical size are needed for participation, which is a disadvantage of SMEs compared to larger, more resourceful companies (Sakakibara, 2002; Blanes & Busom, 2004; Busom & Fernández-Ribas, 2008).

2.2.6 Industry factors

Besides the above mentioned factors, the industry in which a firm operates has been found to play a role when it comes to research consortia: Firms in industries with weak competition and appropriability participate more, as well as those who have access to networks, as outlined in the previous sub-part (Sakakibara, 2002; Blanes & Busom, 2004; Busom & Fernández-Ribas, 2008; Barajas & Huergo, 2010).

2.2.7 Consortia factors

Next to that, Narula (2004) claims that the reduced time span until innovation in research consortia is a further incentive to collaborate. Barber and Scherngell (2011) state that technological closeness amongst consortia partners increases collaboration among them and geographical closeness facilitates this further (Bayona Sáez et al., 2002).

2.3 The role of universities and research institutes

Universities and research institutes possess and produce basic as well as applied knowledge. Hence, when collaborating with firms, they can contribute to enlarging the existing knowledge of companies' employees, which is especially important in pre-competitive collaborative research projects (Bayona Sáez, 2002; Tether, 2002). Furthermore, universities tend to be intertwined with those from other countries, which eases the access to international knowledge networks for the firms, and consequently speeds up the process of internationalization in companies (Bayona Sáez et al., 2002). Barajas and Huergo (2010) even identified universities to be among the most desired partners, when conducting collaborative R&D, for firms. Furthermore, Johnson (2008) and Alexander et al. (2000) claim that triple helix research, involving not only industry and university but also government partners, and hence many diverse sources of knowledge, is important for knowledge integration as well as the success of R&D. Besides that, governments have promoted the approximation of university research towards industry needs aiming at increased competitiveness (Tether, 2002). Bayona Sáez et al. (2002) further claim that relationships from collaboration between firms and research institutes last longer compared to those among firms only. Furthermore, it gives firms access to a wider network of international

scientists and keeps industry partners informed on industrial standards, government needs, as well as the activities of other firms operating in the same industry (Bayona Sáez et al., 2002; Tether, 2002).

The EU FPs' rules for participation require the collaboration of industry and academia, as outlined in part 2.4.1, which increases this type of interaction among the various participants (Luukkonen, 2000; Bayona Sáez et al., 2002). The role of universities and research institutes in EU funded research projects is the same as outlined above.

2.4 Factors driving EU funded research project participation

This part starts with a short introduction to the EU FPs and afterwards assesses the extent to which the factors identified in part 2.2 are present in EU funded research consortia, and outlines additional factors. A distinction between the factors will not be done in separate sub-parts here, since only few additional ones turned out to be drivers for EU FP participation. However, in order to facilitate reading the category names from the former part will be used within the text.

2.4.1 The EU Framework Programmes

As shortly outlined in the context of the research, not only national governments but also the European Commission publishes calls for tender to co-finance R&D activities in order to guarantee and increase the EU's competitiveness.

It is a prerequisite to establish self-organized research consortia consisting of at least three partners from European industries (large companies as well as SMEs), universities and public research institutes being established in at least three different MS in order to be eligible for funding (Defazio, 2009; Luukkonen, 2000).

The aim of this is to boost collaboration among European researchers, increase their mobility as well as innovativeness. Furthermore, the calls launched address high-level, interdisciplinary and complex research topics. Besides that, knowledge exchange between the different partners is encouraged (Defazio, 2009). "The aim of the funding is to enhance the research potential of participants through the benefits of collaboration" (Defazio, 2009, p. 294). Part 2.5 will outline the benefits derived from research collaboration from a theoretical perspective and the analysis in part 4.1.2 will show to what extent they have been realized. The criteria for selecting projects to be funded are " [...] scientific excellence, added value for the European Community, the potential contribution to furthering the economic and social objectives of the Community, the innovative nature, the prospects for disseminating/exploiting the results, and effective trans-national collaboration [...]" (Barber & Scherngell, 2011, p. 252). As mentioned in the context of the research (part 1.1), the proposals are assessed and chosen for funding by external experts.

2.4.2 Additional factors

The consortia projects funded by the EC involve knowledge production and transfer, when conducted effectively (Belkhodja & Landry, 2007), meaning that the main HR related drivers are the same as in part 2.2.1 in EU funded research projects.

Participating more often in FPs decreases transaction as well as coordination costs, which motivate firms to become and remain active in these collaborative projects (Barajas & Huergo, 2010). Overall, the same costs, risks and resource factors as in part 2.2.2 drive EU funded research project participation.

The subsidies provided by the EU promote several large-scale projects, which lead to economies of scale when conducted effectively (Skakibara, 2002). This makes EU funding an attractive concept for firms. Furthermore, EU funded research projects provide additionality, which means additional benefits/effects, compared to national funding due to the principle of subsidiarity (Luukkonen, 2000). The calls enhance the practical use of the innovations, which increases exploitation of the results for companies, being another driver (Fisher et al., 2013). EU funded projects are a source of additional funding which aims at speeding up innovation and competitiveness (Arnold et al., 2005). Furthermore, these projects are aligned to actual socio-economic problems and open up new venues for research (Fisher et al., 2013). Hence, additional government incentives to those mentioned in part 2.2.3 drive participation in these projects.

Barajas and Huergo (2010) state that the network existing at European level simplifies and hence drives collaboration, which is supported by Paier and Scherngell (2011) claiming that out of the network trust relationships and "scientific friendship" (p. 94) can emerge, which is "[…] the most important factor of choice of collaboration" (p. 101). Hence, the network related drivers are the same for EU funded research projects as outlined in part 2.2.4. However, Arnold et al. (2005) identified that when international networking is important to firms, FPs are chosen rather than national funding, since participation at European level connects the firm to actors from different MS, which fosters the internationalization (Bayona Sáez, 2002). Thus, the network factor is more important at EU level.

The FP projects are pre-competitive in nature, which allows firms to collaborate with direct market competitors (Luukkonen, 2000). Paier and Scherngell (2011) identify earlier experience with FPs (cf. H_2), complementarity of resources and knowledge as well as thematic and geographical closeness as important drivers. The prior experience is related to the access firms have to the current calls as well as rules for participation, which influences the decision to take part as well as the success of the consortium (Barajas & Huergo, 2010). The visibility of participating companies is increased due to the fact that they are listed in the FP7 Participant Portal as well as the CORDIS website of the EC. EU FP projects usually involve shared Intellectual Property Right (IPRs), which drives firms to engage into these projects since "[…] whenever the success of an alliance depends on the exchange of knowledge – as is the case in R&D alliances – equity-sharing governance arrangements are preferable because they give [all] parties the incentives necessary for them to bring all relevant knowledge to the table" (Dyer et al., 2001, p. 43). Additionally, risk aversion of the firm influences the decision to participate (Belkhodja & Landry, 2007). Lastly, a firms screening and signaling activities are factors for participation in EU FPs (Fontana et al., 2006).

All in all, the factors identified in part 2.2 are drivers for EU funding as well. However, several additional factors concerning IPR protection, internationalization, risk aversion as well as screening and signaling (cf. network factors) have been mentioned by scholars, specifically addressing EU FP projects. Table 1 below summarizes the factors driving research collaboration between academia and industry in general literature, as well as in those articles dealing with EU funded research projects.

Table 1: Overview on factors driving research collaboration between industry and academia

	Factors in literature on general research collaboration	Factors in literature on EU funded projects
HR related	Interorganizational learning leading to SCA (Dyer& Singh, 1998)	The same as general factors
	Access to additional competencies and capabilities (Dyer & Singh, 1998) leading to knowledge spillovers (Cohen & Levinthal, 1990; Sakakibara, 2002; Dyer & Singh, 1998; Hagedoorn et al., 2000; Czarnitzki, 2007; Barber & Scherngell, 2011)	
	Need for specialization in complex technology areas (Katz & Martin, 1997)	
	Growing emergence of interdisciplinary research areas (Katz & Martin, 1997)	
	Motivation and acceptance to learn (Barajas & Huergo, 2010)	
	Gatekeepers (Bayona Sáez et al., 2002)	
Costs, risks, and resources	Access to complementary resources (Paier & Scherngell, 2011)	The same as general factors
	Extension to new research and technology areas (Spihoven & Teirlinck, 2013)	
	Shared R&D risks and costs (Spithoven & Teirlinck, 2013; Skakibara, 2002; Duysters & Lokshin, 2011; Hitt et al., 2002; Tether, 2002; Hagedoorn et al., 2000; Barajas & Huergo, 2010)	
	Lowered TCE (Blanes & Busom, 2004)	
	Boundaries in the access to finance (Blanes & Busom, 2004)	
Government incentives	Calls for funded projects (Bougrain & Haudeville; Tether, 2002) → further reduce R&D outlays (Blanes & Busom, 2004; Beise & Stahl, 1999; Luukkonen, 2000; Bayona Sáez et al., 2002; Belkhodja & Landry, 2007)	The same as general factors
	Many technologies could only be developed with funding (Johnson, 2008)	**Additional factor:** Economies of scale and scope (Sakakibara, 2002)
		Additional factor: Additionality (Luukkonen, 2000)
		Additional factor: Enhanced practical use and exploitation of results (Fisher et al., 2013)
Network	Extension of existing network (Spithoven & Teirlinck, 2013)	The same as general factors
	Source of innovation, knowledge spillovers and transfer, learning, power, control, as well as signaling mechanism (Sakakibara, 2002; Leitner, 2011; Zaheer, 2010; Hagedoorn et al., 2000; Barber & Scherngell, 2011)	
	Increase visibility and reputation (Barajas & Huergo, 2010; Belkhodja & Landry, 2007; Katz & Martin, 1997; Dyer & Singh, 1998; Arnold et al., 2005)	
Firm related	Presence of internal R&D department (Bougrain & Haudeville, 2002; Spithoven & Teirlinck, 2013; Alexander et al., 2000)	The same as general factors
	Size (Sakakibara, 2002; Blanes & Busom, 2004; Busom & Fernández-Ribas, 2008)	**Additional factor:** Fosters internationalization (Bayona Sáez, 2002)
	Age of the firm (Sakakibara, 2002; Blanes & Busom, 2004; Busom & Fernández-Ribas, 2008)	
	Practice in research consortia (Sakakibara, 2002; Blanes &	**Additional factor:**

	Busom, 2004; Busom & Fernández-Ribas, 2008)	Screening and signaling mechanisms (Fontana et al., 2006)
Industry	Industry (Sakakibara, 2002; Blanes & Busom, 2004; Busom & Fernández-Ribas, 2008; Barajas & Huergo, 2010)	The same as general factors
Consortia	Reduced time-span until innovation (Narula, 2004)	The same as general factors
	Technological and geographical closeness of partners (Barber & Scherngell, 2011; Bayona Sáez et al., 2002)	
Role of universities & research institutes	Possess basic and applied knowledge (Bayona Sáez et al., 2002; Tether, 2002)	The same as general factors
	Provide access to international knowledge networks (Bayona Sáez et al., 2002)	
	Increase success of R&D projects (Tether, 2002)	

2.4.3 Answer to the first sub-question

This part of the theoretical framework answered the first sub-question 'Which factors drive collaboration for innovation between large firms, SMEs, and research institutions?' based on existing theoretical articles. It turned out that employees of the various firms engaged into collaborative research projects have to be highly skilled and able to absorb and integrate the knowledge acquired during participation in order to foster company internal learning processes, which lead to competitive advantage. Secondly, the shared costs and risks in collaborative research have been identified as major drivers. Moreover, the fact that governments promote and co-finance collaborative research activities of academia and industry is an important motivation. Besides that, the access to external networks, which facilitate the formation of research consortia through the access to suitable partners boost, this type of research activity. Moreover, firms need a critical size and age to collaborate and an internal R&D function as well as prior experience in joint research projects facilitate the foundation of cross-industrial and cross-border research consortia. Lastly, universities and research institutes are important partners since they concurrently provide industry partners with basic and applied knowledge as well as access to international knowledge networks.

All in all, in can be summarized that the factors driving research collaboration between large firms, SMEs, and research institutions, identified in part 2.2, apply to a large extent as drivers for EU funded research projects as well. This can be explained by the fact that it is a prerequisite of EU FP participation to establish consortia comprising partners from industry as well as science. The internationalization effect is larger compared to national collaboration since partners from different MS have to be engaged into the consortium. Furthermore, additionality is higher as well due to the fact that EU calls differ from that of national governments for the sake of subsidiarity. Besides that, scholars explicitly mentioned the exploitation of results from EU research projects as a factor for participation. Lastly, IPR protection mechanism, screening and signaling as well as risk aversion tend to be more important when participating in EU level collaborative research.

The following part will explicitly outline the benefits resulting from research collaboration, based on the factors listed above.

2.5 Benefits from research collaboration

This chapter summarizes the major benefits, identified above, which can be derived from collaborative R&D actions.

Concerning HR skills, new techniques, procedures, reputation, and products, are important benefits (Arnold et al., 2005; Spithoven & Teirlinck, 2013). The increased HR skills include technical, communicative and social ones (Bougrain & Haudeville, 2002). Technical ones refer to the knowledge on new research methods, techniques, procedures and approaches (Tsang, 1998; Katz & Martin, 1997), construction of prototypes, pilots and new products (Arnold et al., 2005). Communicative skills include knowledge on problem solving in consortia (Luukkonen, 1998; Dyer & Singh, 1998) as well as stimuli for creativity (Sithoven & Teirlinck, 2013; Katz & Martin, 1997). The social skills refer to knowledge on management of collaborative actions (Luukkonen, 1998; Dyer & Singh, 1998; Katz & Martin, 1997). All in all, this means that collaborative actions are a catalyst for organizational learning, when absorbed correctly (Alexander et al., 2000; Cohen & Levinthal, 1990). The number of different partners increases the possibility to generate new knowledge and skills (Defazio et al., 2009).

The fact that partners come from different MS as well as sectors of industry, increasingly dependent on each other, leads to the identification of common needs and also diminishes the irreversibility of SMEs (Bougrain & Haudeville, 2002; Ford & Hakansson, 2002). Furthermore, this extends current networks (Luukkonen, 2000; Katz & Martin, 1997). Repeated and long-term collaboration establish trust between the various parties, which is beneficial for future collaboration and facilitates interchanges (Hitt et al., 2002). EU funded projects increase the patent activity and visibility of firms (Katz & Martin, 1997; Defazio et al., 2009; Fontana et al., 2006). This in turn means that collaborative R&D improves the profitability (Czarnitzki et al., 2007; Becker & Dietz, 2004). Lastly Becker & Dietz (2004) claim that firms themselves will spent more extensively on R&D activities, when engaged into such projects. As the previous chapter showed major benefits are also derived through sharing costs and risks and hence overcoming resource limitations for conducting R&D. Hence, the costs incurred become a "reversible form of investment" (Narula, 2004, p. 156). Additionally, EU FPs supplement national funding and the dedicated SME programmes boost their benefits (Arnold et al., 2005). Pavitt (1998) supports this by saying that SMEs learn best practice management procedures from such collaborations.

All in all, cooperation boosts organizational learning as well as realization of innovations in a rapid face, and hence the accomplishment of project goals (Luukkonen, 2002). Besides that, they increase the likelihood for economies of scale and scope, future engagements with consortia partners, the access to eligibility rules and the latest calls and increased internationalization of firms. Arnold et al. (2005) state that participants experienced that the benefits compensated and even exceeded the costs of collaboration.

On the other hand, participation in EU FPs involves several barriers and drawbacks, as the following part will show.

2.6 Barriers and drawbacks from research collaboration

Despite the several benefits outlined above, participation in collaborative research projects incurs additional costs, which can become barriers to apply for public funding and lead to gridlock and drawbacks in existing consortia.

Several scholars mention the complexity and bureaucracy of EU FP as burdensome. This includes the cost of time spent on writing research proposals to apply for funding, which involves the creation of a common terminology, and the distribution of work packages among the diverse partners. This is further complicated through language and cultural barriers since applications have to be written in English, which is a foreign language for most partners (Luukkonen, 1998; Arnold et al., 2005; Bougrain & Haudeville, 2002; Mahnke & Overby, 2008; Spithoven & Teirlinck, 2013; Katz & Martin, 1997; Narula, 2004; Busom & Fernández-Ribas,

2008; Tsang, 1998). The management of these processes is especially difficult and costly for companies without an alliance function who additionally face the threat of information leakage to partners (Luukkonen, 1998; 2000; Czarnitzki, 2007; Alexander et al., 2000).

The diversity of the partners further increases the complexity of managing these consortia, especially for SMEs, which increases the threat that they are less effective compared to smaller ones (Duysters & Lokshin, 2011; Spithoven & Teirlinck, 2013; Arnold et al., 2005; Dyer & Singh, 1998). SMEs furthermore need projects, which are closer to the market in order to commercialize them in the short-term, which is difficult since the projects are pre-competitive (Luukkonen, 1998). After proposals have been chosen for funding, there are many regulations concerning accounting procedures, and legal arrangements (Arnold et al., 2005). Moreover, there is the threat of partners that drop out during the process, do not contribute adequately, or free ride (Spithoven & Teirlinck, 2013). Besides that competition between partners may arise leading to the destruction of the consortium in the worst case (Hitt et al., 2002). Furthermore, the time to grant is very long, embracing the negotiation on the funding with the Commission as well. This is very disadvantageous for SMEs due to the fact that it delays the project start and entails further investments (Barajas & Huergo, 2010; Arnold et al., 2005). Several authors further claim that the size of EU contributions is too small, which is another drawback (Luukkonen, 1998; Arnold et al., 2005; Pavitt, 1998). Another complication arises from the fact that partners for collaboration do mostly not remain the same in other/new projects, which makes it difficult to establish routines and trust relationships (Mahnke & Overby, 2008).

However, the low participation rates presented in the context of the study (part 1.1) indicate that many of the applications fail, which is supported by scholarly literature (Luukkonen, 1998; Dyer et al., 2001; Hitt et al., 2002; Narula, 2004). This is a major drawback due to the fact that many cost have been spent on establishing the consortium and writing the proposal. Arnold et al. (2005) state that the high success rates of universities and research institutes decrease the chances of industrial engagement. Furthermore, large companies tend to be favored over smaller ones since they possess greater resources (Arnold et al., 2005; Duysters & Lokshin, 2011; Narula, 2004; Bayona Sáez et al., 2002). Also those participants who have been doing FP projects before have higher success rates (cf. H_2), which is a drawback for newcomers (Frenken et al., 2013). Further constraints for SMEs are the firm size, lack of capable employees, resources in terms of time but also finances, limited absorptive capacity further decreasing the potential benefits of learning effects (Spithoven & Teirlinck, 2013; Blanes & Busom, 2004; Narula, 2004; Barajas & Huergo, 2010; Kaufmann & Tödtling, 2002). Mahnke and Overby (2008) underline the latter point by finding that all firms have a limiting point concerning the management of complexity, which is much lower in small firms. Another problem is that SMEs still interact only rarely with partners from science outside the FPs (Kaufmann & Tötdling, 2002). Moreover, SMEs are less able to screen the calls extensively and signal their interest to engage into consortia and have smaller product ranges, which decreases the amount of suitable calls (Kaufmann & Tödtling, 2002). Lastly, Tether (2002) found out that SMEs are less attracted by FPs since they focus rather on process than product innovations.

In addition there are drawbacks concerning IPRs: On the one hand the move towards projects which are closer to market created problems in this field, on the other hand the shared IPRs are regarded as unattractive by many firms (Luukkonen, 2000; 2002).

This part outlined the several barriers and drawbacks of research collaboration with a special focus on those for SMEs. Hence, it answered the first part of the fifth sub-question. The analysis will show whether these barriers and drawbacks have been encountered in practice as well and thus answer the second part of this sub-question. Table 2 below summarizes the most important benefits and drawbacks as well as barriers. The proceeding part outlines the research methodology.

Table 2: Overview on benefits and drawbacks/barriers of research collaboration

Benefits	Drawbacks/Barriers
Learning effects and knowledge integration (Spithoven & Teirlinck, 2013; Bougrain & Haudeville, 2002; Luukkonen, 1998)	Complexity and bureaucracy (Luukkonen, 1998; Arnold et al., 2005; Bougrain & Haudeville, 2002; Mahnke & Overby, 2008; Spithoven & Teirlinck, 2013; Katz & Martin, 1997; Narula, 2004; Busom & Fernández-Ribas, 2008; Tsang, 1998)
Increased HR skills → technical, communicative and social (Bougrin & Haudeville, 2002)	Language and cultural barriers (Luukkonen, 1998; Arnold et al., 2005; Bougrain & Haudeville, 2002; Mahnke & Overby, 2008; Spithoven & Teirlinck, 2013; Katz & Martin, 1997; Narula, 2004; Busom & Fernández-Ribas, 2008; Tsang, 1998)
Enhanced reputation and products (Arnold et al., 2005; Spithoven & Teirlinck, 2013)	Information leakage (Luukkonen, 1998; 2000; Czarnitzki, 2007; Alexander et al., 2000)
Broader scope, scale and speed of firms own projects (Luukkonen, 1998)	Accounting procedures and legal arrangements (Arnold et al., 2005)
Improved profitability (Czarnitzki et al., 2007; Becker & Dietz, 2004)	Threat that partners drop out or free ride (Spithoven & Teirlinck, 2013)
Increases patent activity and visibility (Katz & Martin, 1997; Defazio et al., 2009; Fontana et al., 2006)	Competition between partners might arise (Hitt et al., 2002)
Overcoming financial constraints (Luukkonen, 1998)	Funding is too small (Luukkonen, 1998; Arnold et al., 2005; Pavitt, 1998)
Shared costs and risks (Luukkonen, 1998; Bougrain & Haudeville, 2002)	Composition of partners changes between projects (Mahnke & Overby, 2008)
Reduced TCE (Spithoven & Teirlinck, 2013)	Large companies tend to be favored over smaller ones (Arnold et al., 2005; Duysters & Lokshin, 2011; Narula, 2004; Bayona Sáez et al., 2002)
Access to complementary resources (Hitt et al., 2002; Beise & Stahl, 1999)	SMEs face constraints in: • Size • Capable employees • Resources (time & finances) • Absorptive capacity (Spithoven & Teirlinck, 2013; Blanes & Busom, 2004; Narula, 2004; Barajas & Huergo, 2010; Kaufmann & Tödtling, 2002).
Supplements to national funding (Arnold et al., 2005)	Problems with shared IPRs (Luukkonen, 2000; 2002)

2.7 Hypotheses

The previous parts of this chapter provided a full picture on the factors driving research collaboration, its benefits and drawbacks, through combining the most relevant existing streams of academic literature. Out of these insights, the following hypotheses can be developed.

As mentioned before, Arnold et al. (2005) state that participants experienced that the benefits compensated and even exceeded the costs of collaboration. This in turn would mean that expectations are met, or even surpassed by the realized benefits. However, their argument is only based on estimations.

In order to test this with a data set, it is hypothesized that:
H_1: The realized benefits of SMEs in EU funded research projects are higher than the expected ones.

Furthermore, it would be interesting to know which expected benefit has most effect on the realized ones, leading to sub-question 4.

Moreover, scholars state that repeated collaboration increases the sharing of knowledge and information between partners and increases the likelihood of future collaboration (Hagedoorn et al., 2000; Barajas & Huergo, 2010).

Therefore, it is hypothesized that:
H_2: Firms with high experience in EU funded research projects have higher realized benefits than firms with less experience in these projects.

Lastly, internal R&D departments are claimed to facilitate the management of research projects as well as the access to new partners (Bougrain & Haudeville, 2002; Skakibara, 2002; Busom & Fernández-Ribas, 2008). Besides that, a critical size is needed for participation, which is a disadvantage of SMEs compared to larger, more resourceful companies (Sakakibara, 2002; Blanes & Busom, 2004; Busom & Fernández-Ribas, 2008).

Therefore, it is hypothesized that:
H_3: Smaller firms have different realized benefits than larger firms.

3 Research Methodology

3.1 Data collection

The data collection consists of two parts: An in-depth literature review and an online survey in the form of a questionnaire in order to analyze SMEs' expected and realized benefits as well as drawbacks and barriers of EU FP participation.

3.1.1 General set-up of the questionnaire

The questionnaire is anonymously and it will take respondents app. 10 minutes to answer all the questions. It is in English, which at the first sight presents a threat since it is not the national language of respondents but this is controlled for by the fact that EU FP calls and proposal applications are only available and accepted in English. Hence, the respondents should be familiar with the terminology used in the questionnaire. They are asked to refer to the most recent EU funded research project in which the firm participated. The questionnaire is divided into 6 parts. Part 1 deals with information on the firm. Part 2 asks respondents to evaluate the benefits and part 3 the drawbacks and barriers, expected before participation (ex ante). Part 4 deals with the benefits and part 5 with the drawbacks and barriers that have been realized after participation (ex post). The last part (6) shortly asks respondents to evaluate the national research funding opportunities in Germany. The survey is conducted online via SoSci survey, in order to reach many respondents concurrently and inexpensively, which makes it an appropriate measure for a thesis project. Additionally, it is important to mention that the questionnaire will be open for response for a time-span of four weeks (26/11/2013-24/12/2013), during which two reminders will be distributed. The first after one week (03/12/2013) and the second one will be sent out one week before closing the link (17/12/2013), aiming at an increased number of responses. The sample will be outlined in part 3.2.2 and the response rate in part 3.3.

3.1.2 Measures and scales of the questionnaire

The questionnaire parts 2-6 are designed along statements from theory and EU documents, which have to be evaluated on a Likert scale ranging from 1 to 5, whereas 1 means strongly disagree and 5 strongly agree. Consequently, 2 means disagree, 3 means neutral or undecided, and 4 means agree. This shows that answers are rank-ordered and measured at an ordinal level. Closed questions are used and the initially qualitative data are transformed into measurable ones through the Likert scale. The closed questions decrease the time spent on answering the survey, which is important when asking busy managers to involve into a project like this. Moreover, it is necessary to complete the data set by asking for firm related factors (cf. part 1). These qualitative data will be transformed into quantitative ones by using a coding scheme. The detailed conceptualizations and operationalizations of the variables, as well as the coding are displayed in Table 14 in the Appendix of this research. A short overview on the definitions of the variables can be found in the Table 3 below. It starts with the variables from the research questions and hypotheses, and continues with the single benefit, as well as drawback variables (each expected and realized), from the questionnaire. The variables have been chosen by carefully analyzing the existing body of literature and EU documents on benefits and drawbacks in EU funded research projects. The expected as well as realized benefits and drawbacks have been measured on the Likert scale described above. It was chosen in order to facilitate the answering of the questionnaire by continuously providing the same scale for respondents and hence avoid confusions caused by many different scales. For the measurement of firm related variables mostly existing scales have been used, which can be found in Table 14 in the Appendix.

Table 3: Definitions of the most important variables

Variable	Definitions	Reference(s)
Participation in EU funded research projects	To be successfully chosen for funding by the EC and hence taking part in carrying out consortia research projects	----
Factors driving research collaboration	Incentives and/or reasons for firms to work together in R&D projects	Adapted from Oxford Dictionary The single factors are described in the theory part
Type of SME	Refers to the firm size, and the number of employees working in R&D, as well as the presence of an R&D department, and the money they spend on R&D	Barajas & Huergo, 2010; Blanes & Busom, 2004; Busom&Fernández-Ribas, 2008; Tether, 2002; Spithoven & Teirlinck, 2013; Duysters & Lokshin, 2011; Narula, 2004; Sakakibara, 2002; Hitt et al., 2002; Belkhodja & Landry, 2007; Becker & Dietz, 2004
Experience in research collaboration	Whether the firm did R&D collaboration before participating in EU funded research projects	Sakakibara, 2002; Blanes & Busom, 2004; Busom & Fernández-Ribas, 2008
Experience in EU funded research projects	Number of EU funded research projects in which the firm participated	Paier & Scherngell, 2011
Expected benefits	Advantages, gains and profits, SMEs expect to gain from participating in EU funded research projects	Adapted from Oxford Dictionary References for the various benefits are listed below
Realized benefits	Advantages, gains and profits, which really occurred and could be recognized by SMEs after finalizing the EU funded research project	Adapted from Oxford Dictionary References for the various benefits are listed below
R&D costs	The money which has to be invested by a firm to conduct R&D projects	Narula, 2004; Sithoven & Teirlinck, 2013; Blanes & Busom, 2004
Risk of uncertainty	The risk whether R&D projects fail	Spithoven & Teirlinck, 2013; Duysters & Lokshin, 2011; Tether, 2002, Hagedoorn et al., 2000, Tether, 2002; Alexander et al., 2000; Johnson, 2008; Luukkonen, 1998; Narula, 2004;
Learning of new skills	The acquisition of previously unknown skills within the firm	Spithoven & Teirlinck, 2013; Luukkonen, 1998; Alexander et al., 2000; Bougrain & Haudeville, 2002; Dyer & Singh, 1998; Sakakibara, 2002; Tether, 2002; Bayona Sáez et al., 2002; Barajas & Huergo, 2010
Enlarging firm's existing network	Getting to know new partners to which the firm connects	Spithoven & Teirlinck, 2013
Increasing competitiveness	Becoming better than or as good as other players in the market	Arnold et al., 2005; Bougrain & Haudeville, 2002; Sakakibara, 2002; Hagedoorn et al., 2000; Barajas & Huergo, 2010
Increasing visibility	The firms receives more attention from others (e.g. newspapers, (potential) partners, market players etc.)	Katz & Martin, 1997
Access to complementary resources	The access to resources from others, which the firm does not possess itself, which are then combined	Sakakibara, 2002; Narula, 2004; Hagedoorn et al., 2000; Hitt et al., 2002; Barajas & Huergo, 2010; Deazio et al., 2009; Alexander et al., 2000; Dyer, Kale & Singh, 2001; Bougrain & Haudeville, 2002; Spithoven & Teirlinck, 2013; Becker & Dietz, 2004

Finding of new partners for future research	Getting to know new contacts which fulfill requirements for a future project	Barajas & Huergo, 2010
Access to specialized skills from universities and research institutes	Acquisition of basic and applied research skills in the required field	Alexander et al., 2000
Facilitates development of prototypes and pilot lines	The construction and assembly of examples is more likely	Bayona Sáez et al., 2002; Arnold et al., 2005
Expected drawbacks	Disadvantages or problems, SMEs expect before participating in EU funded research projects	Adapted from Oxford Dictionary References for the various drawbacks are listed below
Realized drawbacks	Disadvantages or problems, that really occurred and could be recognized by SMEs after the finalization of the EU funded research project	Adapted from Oxford Dictionary References for the various drawbacks are listed below
Difficult access to information on funding opportunities	The acquisition of information on calls, budgets and project contents from the EU	Barajas & Huergo, 2010
Too far from commercialization	The introduction to the market is a long-term objective of the project	Luukkonen, 2000
Costs of management	The cost for coordinating the assigning of tasks, timing of contributions, meetings, communications, and travelling	Busom & Fernández Ribas, 2008; Duysters & Lokshin, 2011; Hitt et al., 2002; Arnold et al., 2005; Spithoven & Teirlinck, 2013; Luukkonen, 1998
Bureaucratic complexity; additional costs	The rules for participation of EU projects are difficult	Gulati, 1995; Duysters & Lokshin, 2011; Hitt et al., 2002; Luukkonen, 1998; Arnold et al., 2005; Barajas & Huergo, 2010
Time negotiation of grant agreement	The time until the Commission and the consortium agreed on the amount of funding contributions of the EU	Johnson, 2008; Barajas & Huergo, 2010
Cultural differences	Business cultures as well as national cultures of partners are not the same	Katz & Martin, 1997; Bayona Sáez et al., 2002; Hitt et al., 2002
Language barriers	Partners speak different languages and English is mostly not their maternity language, which can lead to complicated communication	Spithoven & Teirlinck, 2013; Tsang, 1998; Mahnke & Overby, 2008
Free-riding	Partners do not deliver inputs but benefit from the contributions of others	Czarnitzki, 2007; Spithoven & Teirlinck, 2013
Drop out of partners	The decision of partners to exit the consortium	Mahnke & Overby, 2008
Knowledge leakages	The loss of important competitive knowledge to partners	Czarnitzki, 2007; Luukkonen, 1998; 2000; Alexander et al., 2000

Additionally, it is important to mention that Likert scales are a very common measurement procedure in questionnaires. This is beneficial since many respondents are already familiar with them and for those who are not they are easy to understand. The questionnaire always uses the same unipolar scale, entailing descriptions on either side of the scale, described above, which avoids confusion and misunderstandings. Moreover, the scale includes all options from strongly disagree until strongly agree, so that all respondents have the opportunity to allocate their opinion somewhere on the scale.

Lastly, it is important to mention, that not only the Likert scaling remains constant throughout the survey but also the questionnaire as such is structured in a logical way, facilitating cognitive thinking and comprehension of respondents. This is achieved by asking respondents first to think back to their expectations before participation (ex ante), and evaluate the statements on expected benefits, drawbacks and barriers and only then switching to the state of the art, thinking of the realized benefits, drawbacks and barriers after participation (ex post). Hence, they do not have to switch back and forth in time, which might confuse them and lead to unreliable answers.

The complete questionnaire can be found in the Appendix of this thesis. The following part elaborates on the research design and sampling procedure.

3.2 Research Design

This part outlines the benefits, limitations and suitability of the research design as well as the sampling procedure.

3.2.1 Benefits, limitations and suitability of the research design

Since the data are collected through a questionnaire, which is only one observation at one point in time, the research design is cross-sectional. The data collection and research design have several benefits, as for instance that an online survey is relatively inexpensive and enables the researcher to capture a relatively large sample. However, it also involves some threats and limitations. First of all, questionnaires address topics cursorily and furthermore researchers cannot observe respondents behavior. The predetermined questions and statements make questionnaires inherently inflexible, meaning that there is neither an opportunity to change or add questions or variables afterwards, nor to clarify their meaning to respondents (Babbie, 2010).

This implies threats to validity. Cross-sectional studies in general do have a relatively low internal validity. This study first of all faces the threat of self-selection, which will be explained in the sample, part 3.2.2, below. Moreover, history might become a threat, which means that respondents might have received notice of either being selected or rejected for EC project funding during the time-span of the survey. This might cause extreme cases, since respondents might decide to fill in the questionnaire as a reaction of the funding notice, expressing their either high satisfaction or disappointment. Although the survey is relatively short, maturation might bias the results, because respondents might get bored or tired from filling in the questionnaire (Campbell et al., 2002). External validity refers to the degree to which study results remain the same over changes in units, treatments, outcomes, and settings (UTOS) (Cronbach, 1982; Campbell et al., 2002). This study can be replicated in different settings without affecting the outcome, since the online questionnaire can be filled in at any place with Internet access. As the following parts will show, the sample size is very small, and hence does not allow generalizations over units. Furthermore, a change in treatment (here: questionnaire) might cause different results. All in all, external validity is relatively good. The biggest pitfall of this study design concerning validity is that the observation is based on one moment in time and might be different in a few months or years (Babbie, 2010). Repeating the study later and with a larger sample can control for this. Besides that, there is the threat of omitting variables and multicollinearity, when conducting cross-sectional studies (De Vaus, 2001).

Concerning reliability, surveys are strong since all respondents receive the same stimulus (the questionnaire) and reliability is even higher when statements are formulated clearly and thus avoid room for interpretations of respondents (Babbie, 2010).

Although, the cross-sectional design involves some limitations, it is suitable for the purpose of this study, since the researcher is interested in past and current benefits of SMEs engaged into EU funded research projects. Moreover, it would be interesting to repeat this study after a few years in order to see whether SME participation in FPs increased. Furthermore, the thesis project has limitations in budget and time, which excludes several other research designs and is the reason why only German SMEs (cf. 3.2.2 sample below) will be surveyed although responses from different MS would further increase the relevance of the study. Careful wording of the statements as well as using the same unipolar Likert scale to evaluate statements on benefits, drawbacks and barriers in the questionnaire will increase reliability.

Concluding, De Vaus (2001) claims that a cross-sectional design is cost-effective and timesaving, as well as most suitable for descriptive research. Thus, the research method seems appropriate for achieving the research objective.

3.2.2 Sample

The sample for this study is drawn from an overall population of participants in EU funded research projects. This includes large firms, SMEs, universities and research institutes. However, as outlined in the problem statement, especially SMEs have low participation rates, and this study aims at identifying the benefits they can derive from participation. Hence, only SMEs that have already participated in EU funded research projects will be included into the sample, which makes the sampling procedure purposive. The exclusion of other types of participants is not a problem for the sampling since the study is only concerned with SMEs.

A threat in this sampling procedure and internal validity, as mentioned above, is the self-selection bias, which is present when conducting online questionnaires, meaning that respondents are free to decide whether they participate or not. On the one hand, this makes the research very ethical since no one is forced to fill in the questionnaire, on the other hand this might lead to a sample of extreme cases, as high performers and those who are extremely dissatisfied and encountered many drawbacks and barriers and want to express these, hoping for improvements in the future. Furthermore, self-selection might lead to increased responses from SMEs with a critical size, since they are more resourceful and can afford to participate in EU funded research projects, as well as spending time on filling in the survey. In order to control for this threat, firm size was included as a control variable in the questionnaire.

As mentioned above, the survey will be distributed to SMEs, which have already participated in EU funded research projects, due to the fact that only they enable the researcher to draw conclusions on the (anticipated) gap between expected and realized benefits, drawbacks and barriers. This implies that SMEs that did not participate are excluded from the study. They could give answers on their expectations as well as whether and in case what drawbacks hindered their participation, which would be an interesting subject for future research but does not contribute to identifying which benefits can be derived from EU funded research project participation. Hence, the units of analysis are SMEs, which have been involved into these projects.

The survey will be distributed in Germany, which is an interesting case, since it has a well-established national innovation system, with research institutes as official parts of the system, as Fraunhofer and Max-Planck (Czarnitzki et al., 2007). They collaborate with industry in contract research with the goal to foster industrial innovations, applied research, and hence increase competitiveness of Germany (Beise & Stahl, 1999; Alexander et al., 2000). Furthermore, the German government increased funding steadily over the past decades (Czarnitzki et al., 2007; Alexander et al., 2000), which resulted in higher percentage of GDP allocated to R&D funding

(app. 2.8%)[2] compared to other EU MS and remaining OECD countries (Beise & Stahl, 1999). Besides that, Germany has a relatively high proportion of innovative firms (app. 80%)[3], which is underlined by the Innovation Union Scoreboard (2013) that classifies Germany as innovation leader. According to Alexander et al. (2000), a major benefit of the German innovation system is that SMEs enjoy equal chances for funding as large firms. Lastly, it is important to mention that especially Fraunhofer Society is very active in EU funded research projects as well, and helps German SMEs to participate in these projects (Alexander et al., 2000).

All in all, it is interesting and appropriate to sample German SMEs for this study, since there are many innovative ones, and with the assistance of Fraunhofer Society there should be many SMEs participating in EU funded research projects. Hence, there should be many who are able to give answers concerning the benefits and drawbacks they encountered.

Before the final questionnaire was sent out, a pre-test with 3 German SMEs and 1 researcher was done, who all responded. This brought minor improvements, concerning the design and some clarifications, which increased the validity of the final version that was sent out to respondents.

In order to achieve higher response rates, the Enterprise Europe Network (EEN)[4], as well as several associations and interest groups at EU level distributed the link via mail to SMEs that have been engaged in EU FP projects. This includes a snowball as well as random element in the sampling procedure. All in all, these intermediaries sent the link to 117 German SMEs. After 4 days only 6 responses to the questionnaire have been received. In order to reach a representative sample, the researcher decided that additional initiative is needed.

Hence, the researcher used the CORDIS website of the EC to search randomly for projects in which German SMEs have been involved and contacted these via phone herself, asking whether she may send them the survey link. This was a very time intensive effort since the telephone numbers available on websites of the companies were those of the service desk usually. It occurred frequently that staff answering the phone has not heard of any EU funded research project, which is the reason why it took some time to identify the company's internal contact person(s), being in charge of these projects. It also occurred that the people to whom the call was forwarded knew about their participation in an EU funded research project but could not answer the questionnaire since they did not execute it, which caused further forwarding to other persons in the firm. The researcher had to explain each of them why they would suit the sample and why they should answer to the questionnaire, which lead to several repetitions and an increase in the time spent on getting the correct mail addresses.

Moreover, it turned out that those persons responsible usually held important positions in the firm, as CEO, CFO, or part of the management board (cf. Table 5). Hence, they were often difficult to reach, due to the fact that they were in meetings or on business trips, which required recalling the same company several times. It was not possible to send them a mail with the necessary information on the study and the survey link directly, because employees were not allowed to give CEO's mail addresses to the researcher. Some receptionists offered to write a mail to their 'info@' addresses, which they would then forward to the contact person within the firm, which the researcher did. However, in order to be confident that the right person received the mail, follow-up calling was done in these cases. These procedures explain why the researcher was busy searching for firms in the CORDIS, calling as well as recalling them, for 3 weeks

[2] Source: Eurostat
http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/introduction

[3] Source: Eurostat
http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Proportion_of_innovative_enterprises,_2008-2010_(%25_of_all_enterprises)_yb2.png&filetimestamp=20130301133122

[4] The EEN is the central SME contact point for the Framework Programs of the EU being represented in all its Member States.

(02/12/2013-23/12/2013). The fact that year's end closing and strategic planning for the coming year are done in December made it even more difficult to reach managers and especially convincing them to spend time on filling in the questionnaire.

3.3 Responses

All in all, the researcher called 148 German SMEs and observed a clear cut-off point in the responses received from the day when she started calling onwards, marked by a bold line in the table below, depicting the development of the response rate.

Table 4: Development of response rate

Starting date survey:	Friday week 1	1 week Remind 1	Friday week 2	2 weeks	Friday week 3	3 weeks Remind 2	Friday week 4	Closing date survey:
26/11/13	29/11/13	03/12/13	06/12/13	10/12/13	13/12/13	17/12/13	20/12/13	24/12/13
0 responses	6 responses	11 responses	21 responses	29 responses	38 responses	43 responses	53 responses	53 responses

A first reminder to distribute the survey link was only sent to the intermediaries, whereas a second one was also sent to those companies, who agreed to receive the mail containing the link after calling. Since there is a steady increase in responses, the daily calling turned out to be an effective instrument. In order to provide a full picture of the answers received, it is necessary to mention that the total sample size was 265 (148+117), and that originally 66 respondents started the questionnaire. However, 13 of them did not complete it and were hence kicked out of the summary table above directly. It is important to mention that the following calculations as well as the analysis will be based on a total number (N) of 36 responses. Others have been excluded for various reasons, as for instance being larger than 250 employees (1), and hence falling out of the EU's SME definition, being from other countries than Germany (6), or giving answers to less than 80% of the questions (10).

Of the 148 German SMEs, which have been called, only 77 (52.0%) agreed to receive the mail. The other 71 (48.0%) immediately decided that they do not want to participate in the study. 16 (20.8%) of the 77 declared to fill in the questionnaire for sure. This clearly demonstrates the high response rate from calling. However, in order to be able to calculate the overall response rate, including the mails distributed by intermediaries, the 148 contacted firms will be used, in order to take the same information base. This means that the researcher cannot control how many firms who received the mail without having the opportunity to refuse beforehand from intermediaries, deleted it directly because they are not interested at all to participate. Although it weakens the overall response rate it is necessary in order to have a reliable result. Hence, the overall effective response rate is: 36/(148+117) = 13.6%. As a reference, the response rate including only the 77 SMEs which agreed to receive the mail would be: 36/(77+117) = 18.6%.

An overview of the firm characteristics of respondents is provided in the table below.

Table 5: Overview on firm characteristics of respondents

Respondents' position	%	# employees	%	% of employees in R&D	%	Presence of R&D department	%
CEO/CFO/CCO/General Manager	63.9	0-9	33.3	0%-20%	38.9	no	38.9
Head/Manager in R&D	11.1	10-19	22.2	21%-40%	25.0	yes	61.1
Head/Manager in sales	8.3	20-99	25.0	41%-60%	5.6		
Other	16.7	100-199	11.1	61%-80%	11.1		
		200-249	5.6	81%-100%	11.1		
Missing	0	Missing	2.8	Missing	8.3	Missing	0
Mean		Mean	2.31	Mean	2.24	Mean	1.61

All in all, the sample is suitable for this thesis, although the effective number of responses (36) is quite low, due to the fact that there are time constraints and the researcher spent an appropriate time and effort on generating answers.

All aspects considered, the data collection and research design suit the research goal and enable the researcher to answer the research questions as well as test the hypotheses, by applying the following analysis techniques.

3.4 Data analysis

The collected data from the survey questionnaire will be analyzed along the sub-questions outlined in part 1.4, except for sub-question one, which was answered completely by the literature review in the theoretical framework. After the analysis, the overall research question can be answered.

For hypothesis H_1: 'The realized benefits are higher than the expected ones', two new variables, labeled 'total realized benefits' and 'total expected benefits', based on the means of the ten variables for each, will be created and compared by carrying out a one-sample t-test. In order to answer sub-question 4 'Which expected benefit has most effect on the realized ones?' a multiple regression analysis will be done, whereby the newly created variable 'total realized benefits' is the dependent variable and the ten expected benefits are the independent variables of the model. For hypothesis H_2: 'Firms with high experience in EU funded research projects have higher realized benefits than firms with less experience in these projects', responses are assigned into three groups according to respondents' level of experience with EU funded research projects. Afterwards, the means are calculated and the groups are compared against each other with an analysis of variance (ANOVA). Concerning hypothesis H_3: 'Smaller firms realize different benefits than larger ones', the SMEs will be assigned into three size categories, as outlined in part 4.2.3, and the means of each realized benefit will be calculated. Afterwards, an ANOVA will be done, in order to analyze whether there are differences between the three size groups. Lastly, an overview of the expected and realized drawbacks based on the means will be provided, in order to answer sub-question five 'Which drawbacks do EU funded research projects involve?'

4 Results and Analysis

This chapter provides the answers to the sub-questions as well as the analysis of the hypotheses. In order to facilitate the reading, the analysis and answers to research questions are provided first, since they comprise some descriptive information. This eases the understanding of the statistical analysis of the hypotheses, which has been carried out in SPSS version 21.

4.1 Analysis and answers to the sub-questions

This part provides the answers to the sub-questions of this research. Due to the fact that the first sub-question 'Which factors drive collaboration for innovation between large firms, SMEs, and research institutions?' has been answered in the theory chapter (part 2.4.3) already, it is not repeated here.

4.1.1 Analysis and answer sub-question 2: 'What type of SMEs participate and what are their expected benefits?'

As table 5 showed, according to the sample mostly SMEs between 0 and 99 employees (80.5%) participate in EU funded research projects, whereas the mean is at app. 13 employees. Furthermore, they have on average 30% of employees working in R&D, and 61.1% of the firms do have internal R&D departments. The analysis further showed that 84.4% of respondents were engaged into research collaboration with universities and/or research institutes prior to participating in EU funded research projects, which increased the number of projects in which they participated, as the following table shows. It has to be mentioned that the participant who did 2-4 EU projects, but was not engaged into prior research collaboration, might have started 2 EU projects at the same time, without having collaborated before. However, this is just an assumption.

Table 6: Prior research collaboration and EU FP participations

		# of EU funded research project participations					Total
		1	2-4	5-7	8-10	>10	
Prior research collaboration	No	4 (33.3%)	1 (7.7%)	0 (0%)	0 (0%)	0 (0%)	5 (15.2%)
	Yes	8 (66.7%)	12 (92.3%)	3 (100%)	3 (100%)	2 (100%)	28 (84.4%)
	Total	12	13	3	3	2	33

Note: Those who answered 'don't know' have been excluded

Moreover, the firms in this sample allocated on average app. 7.5% of total turnover to R&D in 2012, which was on average between 500.001€-5.000.000€. Compared to 2011 the turnover slightly increased on average, and the firms made equal profit in the past years, with few cases having increases. However, only 25% introduced a new product in a new market, whereas 61.1% introduced a new product in an existing market. This means that firms with many product innovations participate in EU funded projects, but these are introduced in existing markets mostly. Furthermore, 8.3% of the participants introduced products, which were new to all of their customers, and 72.2% introduced products new to some of their customers. Besides that, 16.7% of the SMEs do not have any competitors in the market and 75% only few competitors. Lastly, 63.9% of the products were not available five years ago, but 66.7% were already available one year ago.

All in all, the firms participating in EU funded research projects can be regarded as moderate innovators, since most of them do have products, which are new to some of their customers, have only few competitors in the market and their products or services are mostly younger than five years but older than one year. Moreover, the innovations are most of the time introduced in existing markets. The participating firms tend to be relatively small, have own R&D departments, spend on average app. 7.5% of their turnover on R&D, are profitable and experienced in research collaboration before participating in EU funded research projects. The following table 7 provides an overview on their expected benefits, based on the means.

Table 7: Descriptives of the expected and realized benefits

	Expected benefits		Realized benefits	
Variable	Mean	Standard deviation	Mean	Standard deviation
Enlarged existing network	4.19	0.82	3.80	0.99
Learning of new skills	3.89	0.96	3.83	0.92
Increased competitiveness	3.86	0.97	3.49	1.17
Increased visibility	3.64	0.93	3.65	0.98
Finding of new partners	3.64	1.02	3.63	0.97
Access to specialized skills from academia	3.56	1.11	3.69	0.96
Reduced uncertainty	3.47	1.23	3.43	0.98
Development of prototypes and pilot lines	3.44	1.29	3.24	1.02
Access to complementary resources	3.33	1.07	3.35	0.98
Reduced costs	2.83	1.22	3.00	1.28

Answers were measured on a 5-point scale, whereby 1 = strongly disagree, and 5 = strongly agree
(A more detailed description can be found in the Research Methodology)
Variables are rank-ordered from highest to lowest expected benefit mean

As the table shows, SMEs mostly expected that their 'network would become larger' (4.19), they would 'learn new skills' (3.89), 'increase their competitiveness' (3.86) and 'visibility' (3.64), 'find new partners for future research collaboration' (3.64), and 'access to specialized skills from academia' (3.56). These are followed by the 'reduced uncertainty' (3.47), 'development of prototypes and pilot lines' (3.44), 'access to complementary resources' (3.33), and 'reduced costs' (2.83).

4.1.2 Analysis and answer sub-question 3: 'To what extent are SMEs expected benefits realized?'

The previous table showed the averages of the realized benefits of SMEs in EU funded research projects. It can be seen that on average they realized more reduced R&D costs, access to complementary resources and specialized skills from academia, and more visibility than expected, whereas the network, on average, did enlarge less than expected, as well as the learning of new skills, increased competitiveness, and the development of prototypes and pilot

lines. The realized finding of new partners and reduced uncertainty were almost similar to the expectations.

All in all, it can be concluded that SMEs on average realized an enlarged network, learned new skills, increased their competitiveness and visibility, found new partners, and could access specialized skills from academia. Concerning reduced uncertainty, the development of prototypes and pilot lines, access to complementary resources as well as reduced costs, they were neutral/undecided on average, and thus no clear conclusions can be drawn on the realization. All in all, the extent to which SMEs realize their expected benefits depends on the type of benefit and therefore varies.

4.1.3 Analysis and answer sub-question 4: ' Which expected benefits have most effect on the realized benefits?'

In order to be able to answer this sub-question, a multiple regression is done. Whereby the dependent variable is total realized benefits and the independent variables are the ten expected benefits here. The dependent variable was created in SPSS, based on the means of the ten single realized benefits. Its mean is 3.57. In order to be able to perform a multiple regression, several assumptions have to be met. First of all, the errors of the residuals have to be uncorrelated, else there would be multicollinearity. This can be checked for by the Durbin-Watson test, as well as some other indicators, as will be discussed during the analysis below. Moreover, the variances of the independent variables have to be held constant in order to avoid homoscedasticity. Lastly, the model and the observed data should be mostly similar, so differences should be zero (Field, 2013). As will turn out during the analysis all the assumptions are met for this multiple regression. Table 7 provided a good overview on the data, by showing the means and standard deviations of all variables. Furthermore, tables 15 until 19 in the Appendix provide a full overview on the results of the multiple regression.

In order to find out which expected benefit has most effect on the realized ones, it is necessary to look at the Pearson correlations of the independent variables with the dependent one. As the table below shows, the 'learning of new skills' has most effect on realized benefits, followed by 'enlarging the existing network', 'reducing risk of uncertainty for carrying out R&D', 'increased competitiveness', and 'access to complementary resources' as well as 'specialized knowledge from academia'. These are all statistically significant ($p<0.05$), whereas 'learning of new skills' is most significant ($p=0.000$). The remaining independent variables' correlations are statistically not significant ($p>0.05$), furthermore these correlate only marginally with the realized benefits. A bold line demarcates this in the table below. Furthermore, it can already be mentioned, that there are no substantial correlations (above 0.9), which would cause multicollinearity, between the independent variables, since all correlations within the matrix have been below 0.9 (Field, 2013).

Table 8: Pearson correlations of predictors with realized benefits
(computed based on the means of the ten single realized benefits)
(rank ordered from highest to lowest)

Independent variables	Pearson correlation	1-tailed significance
Learning of new skills	0.62	0.00
Enlarge existing network	0.48	0.00
Reduce risk of uncertainty	0.44	0.00
Reduce R&D costs	0.39	0.01
Increased competitiveness	0.38	0.02
Access to complementary resources	0.38	0.02
Access to specialized skills from academia	0.35	0.03
Finding new partners	0.29	0.06
Development of prototypes and pilot lines	0.29	0.06
Increased visibility	0.24	0.10

In this analysis r^2 (cf. table 15) shows that 'reduced R&D costs' cause 14.8% of the variances in realized benefits, whereas 'learning of new skills' and 'reduced uncertainty for carrying out R&D' together cause 27.9% (42.7%-14.8%) of the variance, and 'enlarging the firms network' only 6.7% (49.5%-42.7%). What is interesting is, that 'facilitating of finding new partners' does not account for any variance (0.0%), and 'access to specialized skills from academia' also only marginally (0.3%). This might be the case because 84.8% of respondents did research collaboration before participating in EU funded research projects already, so that they realized this benefit already before and hence did also not expect it anymore.

As mentioned above, the Durbin-Watson (cf. table 15) test indicates whether the errors are independent/uncorrelated. A value of 2 indicates that the residuals are not correlated (Field, 2013). In this multiple regression the test statistic is at 2.100, which is very close to 2 showing that there is no multicollinearity. Furthermore, all variance inflation factors (VIFs) are below 10 and the tolerance values are above 0.2 (cf. table 17). Thus, the assumption that errors are uncorrelated has been met.

The F-ratios (cf. table 16) in this regression are all significant ($p<0.05$) and greater than 1, which shows that all models significantly improved the ability to predict the realized benefits, compared to not fitting the model.

All b-coefficients (cf. table 17) do have positive relationships with realized benefits, except for 'increase visibility', 'facilitate finding of new partners', and 'development of prototypes and pilot lines', meaning that when realized benefits increase, these three expected benefits decrease. For the other independent variables this means that when realized benefits increase by one point on the Likert scale, they increase by their b-coefficients as well. For instance, when realized benefits increase by 1 point, the expected benefit 'learning of new skills' increases by 0.31 points on the Likert scale, if the effect of the other independent variables in the model are held constant. The standardized beta shows that when 'reduced R&D costs' increase by 1 standard deviation (1.26), realized benefits increase by 0.87 (1.26x0.69), which is again only applicable if all other predictors are held constant. Furthermore, there is a problem concerning confidence intervals, since they cross zero, meaning the relationship between the independent variables and realized benefits could be either negative or positive, which tremendously weakens the models. However, this could be the case due to the low sample size (n=29) in this multiple regression analysis. Hence, the model cannot be generalized to the overall population.

The Casewise diagnostics (cf. table 18) showed that only one case (26) has a value falling out of the range of ±2 (2.008). 95% of the cases should lie within this range. In this sample of 29, 1 case is less than 5% of the cases, namely 3.4%. Furthermore, the 2.008 is very close to 2.0. Hence, the sample can be declared as a relatively accurate model. Besides that, no case has a Cook's distance <1, so no case has an undue influence on the model. The histogram (Figure 1 in the Appendix) shows that the data for realized benefits are distributed very normal.

All in all, the multiple regression analysis showed that learning of new skills has most effect on the realized benefits. Furthermore, the enlarged network, reduced risk of uncertainty and R&D costs, increased competitiveness, access to complementary resources and specialized skills from academia have significantly high effects on the realized benefits. This means that those SMEs which decided to participate in EU funded research projects because they expected the above listed benefits, indeed realized them to a large extent. Hence, their expectations were met and they should be satisfied with the outcome of the EU funded research project, and thus most likely willing to participate in such a project again.

Lastly, it is important to remember that since the sample of this study is very small, the model cannot be generalized to the overall population. Anyways, for this sample of SMEs participating in EU funded research projects the analysis is at least valid. It would be interesting if a future research project, which is more resourceful and does not have time constraints as this thesis, would investigate on this with a larger sample, being generalizable to society at large.

4.1.4 Analysis and answer sub-question 5: 'Which drawbacks do EU funded research projects involve?'

The following table 9 shows that especially bureaucratic complexity of the applications was expected and also realized as a drawback. Some drawbacks have been evaluated with or close to 3, which means undecided/neutral. Furthermore, several realized drawbacks, namely 'cultural differences', 'language barriers', 'free-riding of partners', 'drop out of partners', and 'knowledge leakages', have been ranked with or close to 2 (disagree), meaning that they have not been realized. Concerning those ranked with or close to three no conclusions can be drawn.

Table 9: Descriptives of the expected and realized drawbacks

	Expected drawbacks		Realized drawbacks	
Variable	Mean	Standard deviation	Mean	Standard deviation
Bureaucratic complexity of application	4.00	0.91	3.66	0.97
High management costs for projects	3.37	1.11	3.12	1.07
Delayed project start due to grant agreement negotiations	3.34	1.26	2.80	1.37
Projects are too far from commercialization	3.17	0.99	3.18	0.99
Information are difficult to access	3.14	1.14	2.86	0.91
Knowledge leakages	2.59	0.99	2.06	0.81
Free-riding of partners	2.57	1.01	2.20	0.90
Language barriers	2.54	1.25	2.12	1.12
Cultural differences	2.43	1.31	2.23	1.17
Drop out of partners	2.38	1.02	2.06	1.26

Answers were measured on a 5-point scale, whereby 1 = strongly disagree, and 5 = strongly agree
(A more detailed description can be found in the Research Methodology)
Variables are rank-ordered from highest to lowest expected drawback mean

The realized drawbacks were significantly lower than the expected ones for 'bureaucratic complexity of application' (4.00/3.66), 'delayed project start due to grant agreement negotiations' (3.34/2.80), 'language barriers' (2.54/2.12), 'free-riding of partners' (2.57/2.20), and 'knowledge leakages' (2.59/2.06). All other differences were not significant at a one-sample t-test with an alpha of 0.05. However, also for these the realized drawbacks were lower than the expected ones, except for 'projects are too far from commercialization' (3.17/3.18).

All in all, the most relevant drawback EU funded research projects seem to involve from this list, is the bureaucratic complexity of the application process, since it was on average ranked with 4 (agree) and realized with 3.66 (close to agree). However, the realized bureaucratic burden was significantly lower than the expected.

4.2 Analysis of Hypotheses

4.2.1 Analysis H_1: The realized benefits of SMEs in EU funded research projects are higher than the expected ones

In order to test this hypothesis a one-sample t-test was carried out in SPSS. First of all, two new variables have been created, one called 'total expected benefits', and the other 'total realized benefits'. They are based on the means of the ten expected, and the ten realized benefits, respectively. The mean of the total expected benefits is 3.59 and the one of the total realized

benefits is 3.57. The test showed the following results: t(32)=0.18. The mean difference is 0.02 and the significance is 0.43, which means that it is not statistically significant (p>0.05). This means that total realized benefits are not likely to be higher than the total expected ones. This confirms that there is a gap between expected and realized benefits as anticipated by the researcher. This outcome shows that participants expected to gain more from EU funded research projects than they realized. In the last chapter of this thesis, a recommendation to politicians will be provided on how to increase the realized benefits in order to boost future SME participations.

4.2.2 Analysis H_2: Firms with higher experience in EU funded research projects have higher realized benefits than firms with less experience in these projects

In order to carry out the analysis for this hypothesis, the number of EU participations has been divided into three groups. The first one comprises those, who have participated only once and is hence labeled 'low experience in EU funded research projects'. The second group includes 2-4 participations and is called 'moderate experience in EU funded research projects', whereas the last group has more than 5 participations and is therefore named 'high experience in EU funded research projects'. The table below shows their frequencies and means statistics.

Table 10: Frequencies and means statistics of EU participations

Group/(EU participations)	N	%	Mean expected benefits	Mean realized benefits
Low experience 1 /(1)	14	38.9	2.6	3.3
Moderate experience 2/(2-4)	14	38.9	3.0	3.6
High experience 3/(>5)	8	22.2	3.1	3.8

The table clearly shows that there are only few respondents who participated more than five times. However, contrarily to the Sixth FP7 Monitoring Report (2013), only 38.9% (compared to 72%) participated only once, whereas 61.1% participated more than once. This might be the case since Germany has many highly innovative SMEs, whereas the Monitoring Report refers to participants in all MS. This further shows that German SMEs tend to be relatively active in EU FPs compared to those in other MS. To test this would be an interesting topic for future research. Furthermore, the table depicts that those with more experience had higher expectations but also higher realizations according to their means. In order to analyze whether the realized benefits were higher for those with more experience, an ANOVA was done. The table below shows the descriptive statistics.

Table 11: Descriptive Statistics ANOVA experience in EU funded research projects

Level of experience	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Low experience	10	3.3	0.91	0.30	2.65	3.95
Moderate experience	13	3.6	0.60	0.17	3.26	3.98
High experience	8	3.8	0.47	0.17	3.42	4.21

The N deviates marginally from the table above, since some cases have been excluded in the ANOVA due to missing answers. The general fit of the model is $F(2,28)=1.30$; $p=0.15$, and the total amount of variation, shown by the sum of squares, is 14.54. The model can explain 1.24 of the units only and the mean square is 0.62 between, and 0.48 within groups. The 95% confidence intervals show that the true value of the mean is between 2.65 and 3.95 for low experienced, between 3.26 and 3.98 for moderate experienced, and between 3.24 and 4.21 for high experienced participants. All in all, this analysis shows that the group means are not significantly different at an alpha-level of 0.05. This is most likely the case because the sample of this study is so small. However, since the table clearly shows that those with higher experience in EU funded research projects have higher realized benefits, it is likely to assume that the hypothesis is confirmed, although not statistically significant. The remaining tables for this analysis can be found in the Appendix (tables 20 and 21).

4.2.3 Analysis H_3: Smaller firms have different realized benefits than larger ones

In order to test whether there is a difference between the realized benefits of smaller and larger firms, firm size has been divided into three groups. Group 1 are very small firms with 0-9 employees, group 2 are small firms with 10-99 employees and group 3 are medium sized firms, having 100-249 employees. First of all, the means for the various realized benefits of each group have been calculated, which can be seen in the table below.

Table 12: Means and frequencies firm size and realized benefits

	# of employees		
	0-9	10-99	100-249
N	12	17	6
Realized benefits			
Reduced R&D costs	3.00	3.19	2.50
Reduced uncertainty	3.08	3.69	3.50
Learning of new skills	3.92	3.81	3.83
Enlarged network	3.83	3.69	4.17
Increased competitiveness	3.75	3.56	2.83
Increased visibility	3.55	3.94	3.17
Access to complementary resources	3.08	3.63	3.17
Finding new partners	3.83	3.56	3.50
Access to specialized skills from academia	3.83	3.63	3.67
Development of prototypes and pilot lines	3.17	3.38	3.00

Afterwards, an ANOVA has been carried out, in order to test whether there are differences in the means of the three groups, which showed the descriptives depicted in the table below.

Table 13: Descriptive statistics ANOVA firm size and realized benefits

Firm size	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
0-9	10	3.63	0.60	0.19	3.20	4.06
10-99	16	3.61	0.64	0.16	3.26	3.95
100-249	5	3.32	1.09	0.49	1.96	4.68

Again, the N deviates marginally from that in table 12, due to the fact that again some cases have been excluded in the ANOVA, since answers were missing. The general fit of the model is $F(2,28)=0.365$; $p=0.35$, which is very low, and the total amount of variation is 14.55, here. The model can explain 0.37 of the units only and the mean square is 0.19 between, and 0.51 within groups. The 95% confidence intervals show that the true value of the mean is between 3.20 and 4.06 for very small firms, between 3.26 and 3.95 for small firms, and between 1.96 and 4.68 for medium-sized firms. All in all, this analysis shows that the group means are not significantly different at an alpha-level of 0.05. Anyways, it is again likely to assume that the hypothesis is confirmed, due to the fact that there are clear differences in the group means. This in turn, leads to the conclusion that smaller firms do realize different benefits than larger ones. The result is again not statistically significant most probably due to the small sample size. The remaining tables for this analysis are attached in the Appendix (tables 22 and 23).

5 Discussion and Conclusions

This chapter outlines the key findings of the research and the theoretical as well as practical implications resulting from it. Besides that, recommendations to policy makers are provided on how to increase awareness of the benefits of EU funded research projects, as well as the FPs itself. Afterwards, the limitations of the study are outlined and the chapter closes with future research recommendations.

5.1 Key findings

The analysis showed that the extent to which SMEs benefit from participating in EU funded research projects (overall research question) depends on the type of benefit as well as the experience in these projects and the size of the SME. The most important drivers for research collaboration between academia and firms are highly skilled personnel, and being experienced in research collaboration, according to scholarly literature. Furthermore, theory identified shared costs and risks as major drivers, as well as the co-financing by government. Several other motivations are accessing broader networks, and hence identify new potential partners for future research collaboration. Lastly, the engagement of universities is regarded as beneficial since they are connected in worldwide networks and do basic research.

The answers to the second sub-question showed that the firms participating in EU funded research projects can be regarded as moderate innovators, and tend to be relatively small, have own R&D departments, spend on average app. 7.5% of their turnover on R&D, are profitable and experienced in research collaboration before participating in these projects. SMEs expected benefits have mostly been realized when it comes to reducing costs, enlarging the network, and accessing specialized knowledge from academia. Furthermore, they could increase their visibility. As the multiple regression showed, the expectation to learn new skills has most effect on realized benefits. This means that those SMEs that expected to learn new skills from participating in EU funded research projects could most often realize their expected benefit. Lastly, the major drawback of EU funded research projects is the bureaucratic complexity (sub-question 5).

The hypothesis testing led to the conclusion that firms with higher experience in EU funded research projects do most likely have higher realized benefits compared to those with less experience, and that small firms most likely do realize different benefits than larger ones. This conclusion can be drawn since the data showed a clear trend, although the latter two were not statistically significant due to the low sample size. Testing this with a larger sample is another topic for future research.

Concluding, it is important to state that the overall realized benefits seem likely to be lower than the overall expected ones, which calls for actions by politicians. The main research question as well as the sub questions could be answered and the extent to which SMEs benefit from participating in EU funded research projects varies, since it depends on the type of benefit. However, since the gap between the expected and realized benefits is not too big, as table 7 showed, and since the realized drawbacks are less than the expected ones, it can be claimed that participation is beneficial, in general. However, changes towards increased realized benefits are needed.

5.2 Implications for science

First of all, it is important to mention that the combination of the three streams of literature, RBV, TCE, and SNT, provided a substantial overview on the factors, benefits and drawbacks of research collaboration, as well as the role of universities and research institutes. The theoretical predictions have been tested in the survey of this study, in which it turned out that most claims could be confirmed.

At first, Hagedoorn et al.'s (2000) and Barajas and Huergo's (2010) claim that repeated collaboration increases the likelihood of future collaboration is supported by the data collected in this study, although not at a statistical significant level. As mentioned before, this is most likely caused by the low sample size. Besides that, there seems to be a difference in realized benefits when it comes to firm size, as predicted by Sakakibara (2002), Blanes and Busom (2004), and Busom and Fernández-Ribas (2008).

The most important driver in this study is the learning of new skills (Spithoven & Teirlinck, 2013; Bougrain & Haudeville, 2002; Luukkonen, 1998; Dyer & Singh, 1998), since it has most effect on the realized benefits, followed by networking (Spithoven & Teirlinck, 2013), and reduced costs and uncertainty (Spithoven & Teirlinck, 2013; Skakibara, 2002; Duysters & Lokshin, 2011; Hitt et al., 2002; Tether, 2002; Hagedoorn et al., 2000; Barajas & Huergo, 2010; Luukkonen, 1998; Bougrain & Haudeville, 2002). This means that the firms, which expected these benefits had the highest realized benefits and therefore, experienced EU funded research projects as beneficial.

However, Arnold et al.'s (2005) statement that realized benefits exceed expected ones, which was based on estimates only, could not be confirmed for this sample.

Furthermore, as predicted by many scholars, complexity and bureaucracy were indeed the most expected but also realized drawbacks, also at a statistical significant level (Luukkonen, 1998; Arnold et al., 2005; Bougrain & Haudeville, 2002; Mahnke & Overby, 2008; Spithoven & Teirlinck, 2013; Katz & Martin, 1997; Narula, 2004; Busom & Fernández-Ribas, 2008; Tsang, 1998). However, neither language and cultural barriers (Luukkonen, 1998; Arnold et al., 2005; Bougrain & Haudeville, 2002; Mahnke & Overby, 2008; Spithoven & Teirlinck, 2013; Katz & Martin, 1997; Narula, 2004; Busom & Fernández-Ribas, 2008; Tsang, 1998) nor information leakages (Luukkonen, 1998; 2000; Czarnitzki, 2007, Alexander et al., 2000) were expected drawbacks and have also not been realized. The same applies to the free-riding and drop out of partners (Spithoven & Teirlinck, 2013). Concerning high management costs and delayed project start, the expected means (3.37 and 3.34, respectively) show that some respondents did expect it. However, these values are close to neutral and were furthermore evaluated as neutral for the realized drawbacks. The remaining ones have been evaluated as neutral for expected as well as realized drawbacks.

This means that most benefits, which scholars identified, are present in this study and some have not only been expected but also realized. This finding shows that EU funded research project participation is beneficial in general. Concerning the drawbacks it turned out that most of them have neither been expected nor realized, which means that future studies with larger samples on this matter are desirable, in order to correct the currently existing misperception that EU FPs involve many drawbacks. This could support politicians to encourage SMEs to participate more in these projects in the future. Further future research recommendations will be provided in part 5.5.

This research furthermore identified several new findings, which contribute to enlarging the existing body of literature by closing the literature gap on expectations and realizations of firms in EU FPs. A new insight is that those German SMEs that participate are moderately innovative.

This might be the case since highly innovative SMEs might be able to innovate and research on their own, whereas least innovative SMEs might not be able to handle the complexity of EU funded research projects. Furthermore, it turned out that the expectations to learn new skills, network, reduce risk and costs, increase competitiveness and access complementary resources as well as specialized skills from academia had most significant effects on the realized benefits. Besides that, a newness coming from this study is that the extent to which SMEs benefit depends on the type of benefit, meaning that some are more and others less beneficial. Hence, no conclusions on the overall benefit of EU FPs should be drawn based on single benefits but rather the sum of all benefits. Another new finding is that all in all the realized benefits are lower than expected. Therefore, the findings of this thesis confirm the expected gap between expected and realized benefits, which might explain the low participation rates of SMEs. However, this expected causal relationship has to be tested in future studies. Lastly, a newness of this research is that it dealt with the latest FP7 (2007-2013), on which currently not many studies do exist, especially not with the focus on SMEs and their benefits.

5.3 Implications for practice

According to the sample of this study, the realized benefits in EU FPs have to be increased. However, the fact that the realized drawbacks were lower than expected, indicates that currently there seems to be a misperception in society on EU funded research projects, in the sense that they are regarded as more burdensome than they turned out to be.

This in turn means that the EC has to implement better promotion, information as well as brokerage events informing on the benefits of these projects. In other words, a sound marketing strategy should be developed, aiming at changing the expectations that drawbacks are high and benefits low. Possible marketing channels could be advertisement in specialist journals, which are read by managers of SMEs, or encouraging the national contact points to proactively contact highly innovative SMEs and introduce the concept of FPs to them. In these marketing campaigns special attention could be paid to the learning of new skills, networking as well as reduced costs and uncertainty, increased competitiveness, and access to specialized skills from academia, since they had most effect on the realized benefits. Moreover, communications should flow into both directions, meaning that SMEs should communicate more actively what exactly they regard as beneficial and where they see room for improvements. This could help to close the gap between expected and realized benefits as well as drawbacks.

In the Horizon 2020, the new FP for 2014-2020, negotiations between the European Parliament and the EC it was debated to set a threshold of funding, dedicated to SMEs of 15%. This would lead to the mandatory inclusion of SMEs into consortia, where they might not really be needed in order to execute the project. Therefore, this is regarded as unbeneficial by the researcher, since this could decrease the effective functioning of consortia, due to a larger amount of partners, and might hence complicate the management and thus be regarded as disturbing by the initial consortium. On the other hand, this might lead to the perception of SME managers that they were redundant or could not contribute as they wish, causing the perception that they are distracted from their innovation activities and that time spent on the project was wasted. If this would be the case, SME participation would not be increased through this mechanism but rather the opposite would occur.

The bureaucratic burden, which was the most dominant drawback identified in this study, could be reduced by implementing two-stage evaluation procedures for the majority of projects. This means that in the first stage only a draft of the project and its partners has to be handed in and will be evaluated. Only in case it is regarded as interesting and eligible for funding, the EC asks applicants to hand in an all comprising proposal, which in the second stage evaluations will then either be selected or rejected for funding. This reduces the time spent on writing proposals, especially when they were unsuccessful, which in turn might decrease the expectation of

participants that the time spent on writing unsuccessful proposals was wasted. A major step in this direction was implemented in the new FP Horizon 2020, of which the first call have been launched in December 2013.

5.4 Limitations of the study

The study was limited in terms of budget as well as time. This lead to a relatively small effective response rate (n=36), although large effort was spent on generating more responses. Furthermore, the study is limited to German SMEs participating in EU funded research projects. This lead to the fact that findings of the empirical analysis are not generalizable to the overall population and further complicated the multiple regression analysis. Hence, the external validity of the study is lower than expected in the methods part.

Furthermore, as discussed in the research methodology, questionnaires involve predetermined statements, which cannot be changed afterwards. This increases the threat of misunderstandings by participants. Selecting careful wording and a logical set-up, as well as pretesting controlled for this. However, one can never be certain that all participants fully understand the terminology and statements.

Additionally, the threat of history cannot be controlled for, meaning that some respondents might have experienced high realized benefits because they were selected for funding shortly before filling in the survey. Besides that the omitting of variables threat remains present, since it is likely that there are other expected and realized benefits as well as drawbacks than the ten included in the questionnaire. Lastly, the study is limited to one MS of the EU only. All this weakens the internal validity of the study.

Lastly, a threat to external validity is that a change in the questionnaire (treatment) might lead to different results.

5.5 Future research recommendations

Since Germany has been labeled as innovation leader, and also has an attractive national innovation funding system, it would be interesting to compare the findings of this research to other countries, with a less developed national innovation system, as for instance Spain, since the percentage of GDP allocated to funding R&D nationally varies greatly compared to Germany (Germany app. 2.8%; Spain app. 1.4%)[5]. Furthermore, they have a large difference in the proportion of innovative firms (Germany app. 80%; Spain app. 40%)[6], which is underlined by the Innovation Union Scoreboard (2013) that classifies Spain as moderate innovator. Lastly, the comparison with a Member State like Bulgaria, which has been identified as modest innovator and scored lowest of all MS (Innovation Union Scoreboard, 2013), would be interesting. A possible research question for such a study could be: 'To what extent do national innovation systems influence SMEs' decision to participate in EU funded research projects?' or 'In how far do SMEs from highly innovative Member States participate differently in EU funded research projects compared to those from less innovative Member States?' Differently could refer to participation itself (e.g. high/medium/low), as well as the size and complexity of consortia (e.g. large/medium/small), the number of participations of SMEs (e.g. very often/often/sometimes/never), or the participation in the different FP programmes, like

[5] Source: Eurostat
http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/introduction

[6] Source: Eurostat
http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Proportion_of_innovative_enterprises,_2008-2010_(%25_of_all_enterprises)_yb2.png&filetimestamp=20130301133122

nanomaterials and production, information and communication technologies, transport, or energy, to mention only some.

Furthermore, future research could deal with the expected and realized drawbacks more in depth, in order to find out 'Which drawbacks have most effect on SMEs' decision to participate in EU funded research projects?' The aim of the study could be to give advice on how to reduce drawbacks, so that future participation of SMEs could be increased.

Moreover, a future research could take into account the participation of SMEs in Public-Private Partnerships, in which the private side is represented by European industries and the public side by EU institutions, mainly the EC, Directorate General Research and Innovation, as well as the theme related Directorates (e.g. Transport). The advantage of these institutions is the frequent exchange with politicians and hence the possibility to express future research needs and relevant topics, giving companies the chance to influence upcoming calls for projects. This in turn enables them to start searching for consortia partners very early and preparing proposals as well. Hence, the presence of SMEs in these Public-Private Partnerships and the influence on participation rates could be tested. A possible research question would be 'To what extent does the participation of SMEs in Public-Private Partnerships have an effect on SMEs' success rates in EU FPs?' Again, success rate refers to projects that have been selected for and granted funding by the EC and independent experts.

Another interesting research would be to interview participants of this survey, by recalling them and asking whether they participated in this study, and ask why they chose undecided/neutral as evaluation of the benefits so often. Potential explanations could be that they did not think of what to expect before participating or had in mind different benefits than those asked in the survey, or did not fully understand what the statements meant to test. This might increase the validity of a repeated study with the same research question as this thesis but with a larger sample.

All in all, a future research trend on this topic would be desirable. However, this should aim at larger sample sizes, in order to be generalizable.

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http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Proportion_of_innovative_enterprises,_2008-2010_(%25_of_all_enterprises)_yb2.png&filetimestamp=20130301133122
Retrieved: 13/09/2013

Canadian Government:

% of turnover spent on R&D:
http://www.ic.gc.ca/eic/site/061.nsf/eng/00592.html
Retrieved: 10/11/2013

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Definition nation:
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Retrieved: 17/11/2013

Further definitions:
http://www.oxforddictionaries.com
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Appendix

The Questionnaire

The introductory text below was sent by mail to the intermediaries as well as SMEs.

The questionnaire asks you to evaluate statements concerning your expected and realized benefits, drawbacks and barriers of your most recent EU funded research project participation along a 5-point scale.

EU funded research projects are defined here as projects called for by the European Commission within the EU Framework Programmes (FPs), which are conducted in consortia.

The questionnaire is divided into five parts. Part 1 asks for information on the firm and part 2 for the innovativeness of the firm. Part 3 deals with the evaluation of expected benefits, drawbacks and barriers of your most recent EU funded research project participation along a 5-point scale, whereas part 4 is concerned with the realized benefits, drawbacks and barriers along the same scale. Lastly, part 5 asks two short questions on national funding opportunities.

Please note that questions do not have to be answered mandatorily and can hence be skipped by pressing next without filling anything out.

Thank you very much for supporting me.

1 How many employees does the firm have?

0-9 10-19 20-99 100-199 200-249 > 250

2 What is your position?

I am … (text field)

3 Does the firm have an R&D department?

No Yes

4 How many employees (%) work in R&D?

0%-20% 21%-40% 41%-60% 61%-80% 81%-100%

5 How much % of total turnover was allocated to R&D budget in 2012?

0.00%-3.00% 3.01%-8.00% 8.01%-15.00%>15%

6 In which country are you located?

Germany Spain

7 Which industry does the firm belong to?

Agriculture, hunting and forestry
Mining and quarrying
Food products and beverages manufacturing
Textile manufacturing
Paper and paper products manufacturing
Coke, refined petroleum products and nuclear fuel manufacturing
Chemicals and chemical product manufacturing
Rubber and plastic products manufacturing
Basic metals manufacturing
Machinery and equipment manufacturing
Office, accounting and computing machinery manufacturing
Electrical machinery and apparatus manufacturing
Motor vehicles, trailers and semi-trailers manufacturing
Other transport equipment manufacturing
Furniture manufacturing
Recycling
Electricity gas and water supply
Construction
Transport, storage and communications
Education
Other

8 What was the total turnover of the firm in 2012?

0€-5.000€
5.001€-50.000€
50.001€-500.000€
500.001€-5.000.000€
5.000.001€-50.000.000€
50.000.001€-500.000.000€
>500.000.000€

9 How did turnover of 2012 develop compared to 2011?

Strong decrease decrease equal increase strong increase

10 How was the result of your firm over 2012?

Large loss loss breakeven profit large profit

11 How did the results of 2012 develop compared to 2011?

Sharp decrease decrease equal increase sharp increase

12 Did the firm cooperate with universities and/or research centers to conduct R&D projects before participating in EU funded research projects?

No Yes Don't know

13 In how many EU funded research projects has the firm been engaged until now?

1 2-4 5-7 8-10 >10

14 Which type of new product/market combinations has the firm realized the past year?

Introduced a new product in a new market
Introduced a new product in an existing market
Introduced an existing product in a new market
Introduced an existing product in an existing market
None of the above

15 Will all, some, or none of your (potential) customers consider your product or service new and unfamiliar?

All Some None

16 Right now, are there many, few, or no other businesses offering the same products or services to your (potential) partners?

Many others Few others No others

17 Were the technologies or procedures required for this product or service generally available more than five years ago?

No Yes

18 Were the technologies or procedures required for this product or service generally available more than one year ago?

No Yes

The following questions are about the expectations you had before starting the most recent EU funded research project in which you participated.

EXPECTED BENEFITS

19 Before participating in our most recent EU funded research project we expected that participation would…

	strongly disagree				strongly agree
…reduce R&D costs	1	2	3	4	5
…reduce the risks of uncertainty for carrying out R&D	1	2	3	4	5
….lead to the learning of new skills	1	2	3	4	5
…enlarge the firm's existing network	1	2	3	4	5
…increase the competitiveness of the firm	1	2	3	4	5
…increase the visibility of the firm	1	2	3	4	5
…provide access to complementary resources	1	2	3	4	5
…facilitate the finding of new partners adequate for future research collaboration	1	2	3	4	5
…provide access to specialized skills from universities and research institutes	1	2	3	4	5
…facilitate the development of prototypes and/or pilot lines	1	2	3	4	5

EXPECTED DRAWBACKS AND BARRIERS

20 Before participating in our most recent EU funded research project we expected that…

	strongly disagree				strongly agree
…information on calls and rules for participation would be difficult to access	1	2	3	4	5
…the EU funded research projects would be too far from commercialization	1	2	3	4	5
….the costs for the management of these projects would be high	1	2	3	4	5
…bureaucratic complexity of applying for funding would be high	1	2	3	4	5
…the negotiation of the grant agreement with the European Commission would delay the project start	1	2	3	4	5
…cultural differences would complicate collaboration	1	2	3	4	5
…language barriers would occur	1	2	3	4	5
…partners would free-ride	1	2	3	4	5
…partners would drop out during the project	1	2	3	4	5
…knowledge leakages to others would occur	1	2	3	4	5

The following questions are about the benefits, barriers and drawbacks you realized after completing the most recent EU funded research project in which you participated.

REALIZED BENEFITS

21 Looking back at our most recent EU funded research project, we can conclude participation has…

	strongly disagree				strongly agree
…reduced R&D costs	1	2	3	4	5
…reduced the risks of uncertainty for carrying out R&D	1	2	3	4	5
….lead to the learning of new skills	1	2	3	4	5
…enlarged the firm's existing network	1	2	3	4	5
…increased the competitiveness of the firm	1	2	3	4	5
…increased the visibility of the firm	1	2	3	4	5
…provided access to complementary resources	1	2	3	4	5
…facilitated the finding of new partners adequate for future research collaboration	1	2	3	4	5
…provided access to specialized skills from universities and research institutes	1	2	3	4	5
…facilitated the development of prototypes and/or pilot lines	1	2	3	4	5

REALIZED DRAWBACKS AND BARRIERS

22 Looking back at our most recent EU funded research project, we can conclude that…

	strongly disagree				strongly agree
…information on calls and rules for participation were difficult to access	1	2	3	4	5
…the EU funded research project was too far from commercialization	1	2	3	4	5
….the costs for the management of these projects were high	1	2	3	4	5
…bureaucratic complexity of applying for funding was high	1	2	3	4	5
…the negotiation of the grant agreement with the European Commission delayed the project start	1	2	3	4	5
…cultural differences complicated collaboration	1	2	3	4	5
…language barriers would occurred	1	2	3	4	5
…partners did free-ride	1	2	3	4	5
…partners dropped out during the project	1	2	3	4	5
…knowledge leakages to others occurred	1	2	3	4	5

This part asks you to evaluate the research funding opportunities in your nation state. It can be an alternative to EU funding and calls are launched by national governments. In case you are not familiar with these funding opportunities, please skip this part by pressing 'next'.

23 National research funding opportunities in my country are more attractive than EU funding opportunities

Strongly disagree				Strongly agree	
1	2	3	4	5	don't know

24 National research funding opportunities in our country…

	strongly disagree				strongly agree	
…increase our participation in EU funded research projects	1	2	3	4	5	don't know
…decreases our participation in EU funded research projects	1	2	3	4	5	don't know

Dear participant,

this is the last question of this survey. If you press 'next', your answers will be submitted.

Thank you very much for your effort to complete my questionnaire.

In case you are interested in the final thesis, I will distribute it with pleasure. Please contact the intermediary from whom you received the link, and I will send it to you as soon as the thesis is completed.

In case you have comments, please find a box below, in which you can place them.

Thank you.

25 Comments (text field)

Thank you very much. Your answers were transmitted, you may close the browser window or tab now!

Stephanie Schulz, Management and Governance, University of Twente
s.a.schulz@student.utwente.nl

Table 14: Conceptualization, operationalization, and coding of questionnaire variables

Please note that in case a question was not answered, the answer is coded with (-9).

Statement	Variable	Conceptualization	Operationalization & Coding	Author(s)
1	Firm size	The number of employees a firm has	(1) = 0-9 (2) = 10-19 (3) = 20-99 (4) = 100-199 (5) = 200-249 (6) = >250 Scale adapted from OECD, modified to EU SME classification as of code category (4)	Barajas & Huergo, 2010; Blanes & Busom, 2004; Busom&Fernández-Ribas, 2008; Tether, 2002; Spithoven & Teirlinck, 2013; Duysters & Lokshin, 2011; Narula, 2004; Sakakibara, 2002
2	Position of respondent	----	Open text field Coding: (1) CEO/General Manager (2) Head/Manager R&D (3) Head/Manager Sales (4) Other	
3	Presence of internal R&D department	A department within the firm which exclusively deals with R&D related issues	(1) = no (2) = yes	Hitt et al., 2002
4	R&D employees	Number of employees who work in R&D functions	(1) = 0%-20% (2) = 21%-40% (3) = 41%-60% (4) = 61%-80% (5) = 81%-100%	
5	R&D budget	The money a firm dedicates towards R&D	% of turnover allocated to R&D budget in 2012 (1) = 0.00%-3.00% (2) = 3.01%-8.00% (3) = 8.01%-15% (4) = > 15% Scale from Canadian Government[7]	Spithoven & Teirlinck, 2013; Belkhodja & Landry, 2007; Becker & Dietz, 2004
6	Country of the firm	A nation with its own government, comprising a certain territory marked by national borders in which the firm is located.	(1) = Germany (2) = Spain	Adapted from Oxford Dictionary[8]

[7] http://www.ic.gc.ca/eic/site/061.nsf/eng/00592.html

[8] http://www.oxforddictionaries.com/definition/english/country

7	Industry	A certain branch of economic or commercial activity	(1) = Agriculture, hunting and forestry (2) = Mining and quarrying (3) = Food products and beverages manufacturing (4) =Textile manufacturing (5) = Paper and paper products manufacturing (6) = Coke, refined petroleum products and nuclear fuel manufacturing (7) = Chemicals and chemical product manufacturing (8) = Rubber and plastic products manufacturing (9) = Basic metals manufacturing (10) = Machinery and equipment manufacturing (11) = Office, accounting and computing machinery manufacturing (12) = Electrical machinery and apparatus manufacturing (13) = Motor vehicles, trailers and semi-trailers manufacturing (14) = Other transport equipment manufacturing (15) = Furniture manufacturing (16) = Recycling (17) = Electricity gas and water supply (18) = Construction (19) = Transport, storage and communications (20) = Education (21) = Other Categories from United Nations	Sakakibara, 2002; Blanes & Busom, 2004; Busom & Fernández-Ribas, 2008; Barajas & Huergo, 2010
8	Turnover 2012	----	(1) = 0€-5.000€ (2) = 5.001€-50.000€ (3) = 50.001€-500.000€ (4) = 500.001€-5.000.000€ (5) = 5.000.001€-50.000.000€ (6) = 50.000.001€-500.000.000€ (7) = >500.000.000€	
9	Change in turnover	Development of turnover 2012 compared to 2011	(1) = strong decrease (2) = decrease (3) = equal (4) = increase (5) = strong increase	
10	Profitability 2012	----	(1) = large loss (2) = loss (3) = breakeven (4) = profit (5) = large profit	(Czarnitzki et al., 2007; Becker & Dietz, 2004)

11	Change in Profitability	Development of firm results 2012 compared to 2011	(1) = sharp decrease (2) = decrease (3) = equal (4) = increase (5) = sharp increase	(Czarnitzki et al., 2007; Becker & Dietz, 2004)
12	Experience in research collaboration	Whether the firm did R&D collaboration before participating in EU funded research projects	(1) = no (2) = yes (3) = don't know	Sakakibara, 2002; Blanes & Busom, 2004; Busom & Fernández-Ribas, 2008
13	Experience in EU funded research projects	Number of EU funded research projects in which the firm participated	(1) = 1 (2) = 2-4 (3) = 5-7 (4) = 8-10 (5) = > 10 Scale based on the fact that 72% participated only once, and only 1.1. % more than ten times (Sixth FP7 Monitoring Report, 2013, p. 17)	Paier & Scherngell, 2011
14	Product/market introduction	Whether the firm (a) Introduced a new product in a new market (b) Introduced a new product in an existing market (c) Introduced an existing product in a new market (d) Introduced an existing product in an existing market (e)None of the above	Open selection (tags) (1) = not chosen (2) = chosen	Spithoven & Teirlinck, 2013; Johnson, 2008;
15	Product innovation	How many customers consider product or service new and unfamiliar	(1) = all (2) = some (3) = none	
16	Dominance in market	Number of competitors	(1) = many others (2) = few others (3) = no others	
17/18	Availability of product or service in market	Availability of product or service (17) > five years (18) > one year	(1) = no (2) = yes	
19-1 / 21-1	R&D costs	The money which has to be invested by a firm to conduct R&D projects	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Narula, 2004; Sithoven & Teirlinck, 2013; Blanes & Busom, 2004

19-2 /21-2	Risk of uncertainty	The risk whether R&D projects fail	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Spithoven & Teirlinck, 2013; Duysters & Lokshin, 2011; Tether, 2002, Hagedoorn et al., 2000, Tether, 2002; Alexander et al., 2000; Johnson, 2008; Luukkonen, 1998; Narula, 2004;
19-3 /21-3	Learning of new skills	The acquisition of previously unknown skills within the firm	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Spithoven & Teirlinck, 2013; Luukkonen, 1998; Alexander et al., 2000; Bougrain & Haudeville, 2002; Dyer & Singh, 1998; Sakakibara, 2002; Tether, 2002; Bayona Sáez et al., 2002; Barajas & Huergo, 2010
19-4 / 21-4	Enlarging firm's existing network	Getting to know new partners to which the firm connects	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Spithoven & Teirlinck, 2013
19-5 / 21-5	Increasing competitiveness	Becoming better than or as good as other players in the market	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Arnold et al., 2005; Bougrain & Haudeville, 2002; Sakakibara, 2002; Hagedoorn et al., 2000; Barajas & Huergo, 2010
19-6 / 21-6	Increasing visibility	The firms receives more attention from others (e.g. newspapers, (potential) partners, market players etc.)	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Katz & Martin, 1997
19-7 / 21-7	Access to complementary resources	The access to resources from others, which the firm does not possess itself, which are then combined	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Sakakibara, 2002; Narula, 2004; Hagedoorn et al., 2000; Hitt et al., 2002; Barajas & Huergo, 2010; Deazio et al., 2009; Alexander et al., 2000;

				Dyer, Kale & Singh, 2001; Bougrain & Haudeville, 2002; Spithoven & Teirlinck, 2013; Becker & Dietz, 2004
19-8 / 21-8	Finding of new partners for future research	Getting to know new contacts which fulfill requirements for a future project	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Barajas & Huergo, 2010
19-9 / 21-9	Access to specialized skills from universities and research institutes	Acquisition of basic and applied research skills in the required field	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Alexander et al., 2000
19-10 / 21-10	Facilitates development of prototypes and pilot lines	The construction and assembly of examples is more likely	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Bayona Sáez et al., 2002; Arnold et al., 2005
20-1 / 22-1	Difficult access to information on funding opportunities	The acquisition of information on calls, budgets and project contents from the EU	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Barajas & Huergo, 2010
20-2 / 22-2	Too far from commercialization	The introduction to the market is a long-term objective of the project	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Luukkonen, 2000
20-3 / 22-3	Costs of management	The cost for coordinating the assigning of tasks, timing of contributions, meetings, communications, and travelling	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Busom & Fernández Ribas, 2008; Duysters & Lokshin, 2011; Hitt et al., 2002; Arnold et al., 2005; Spithoven & Teirlinck, 2013; Luukkonen, 1998
20-4 / 22-4	Bureaucratic complexity; additional costs	The rules for participation of EU projects are difficult	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Gulati, 1995; Duysters & Lokshin, 2011; Hitt et al., 2002; Luukkonen, 1998; Arnold et al., 2005; Barajas & Huergo, 2010

20-5 / 22-5	Time negotiation of grant agreement	The time until the Commission and the consortium agreed on the amount of funding contributions of the EU	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Johnson, 2008; Barajas & Huergo, 2010
20-6 / 22-6	Cultural differences	Business cultures as well as national cultures of partners are not the same	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Katz & Martin, 1997; Bayona Sáez et al., 2002; Hitt et al., 2002
20-7 / 22-7	Language barriers	Partners speak different languages and English is mostly not their maternity language, which can lead to complicated communication	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Spithoven & Teirlinck, 2013; Tsang, 1998; Mahnke & Overby, 2008
20-8 / 22-8	Free-riding	Partners do not deliver inputs but benefit from the contributions of others	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Czarnitzki, 2007; Spithoven & Teirlinck, 2013
20-9 / 22-9	Drop out of partners	The decision of partners to exit the consortium	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Mahnke & Overby, 2008
20-10 / 22-10	Knowledge leakages	The loss of important competitive knowledge to partners	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree	Czarnitzki, 2007; Luukkonen, 1998; 2000; Alexander et al., 2000
23	National funding opportunities	The projects and funds national governments offer within their territories	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree (-1)= don't know	Pavitt, 1998; Bayona Sáez et al., 2002
24	Effect of national funding opportunities on respondents' decision to participate in EU funded research projects	(a) increase in EU funded research project participation (b) decrease in EU funded research project participation	(1) = strongly disagree (2) = disagree (3) = neutral/undecided (4) = agree (5) = strongly agree (-1)= don't know	

Coding scheme respondents' position

Category 1: CEO/General Manager (N=23)

Brewmaster (talked to him over the phone he is CEO/Owner of brewery) (1)
CEO (10)
CCO (1)
CFO (1)
Co-owner (1)
General Manager (2)
Managing Director (7)

No separation between CCO, CFO and CEO in different categories, because in SMEs all have general management function

Category 2: Head/Manager R&D (N=4)

Head of department R&D projects (1)
Head of research (1)
Manager Innovation & Entwicklung (1)
Project manager (survey only dealt with R&D projects) (1)

Category 3: Head/Manager sales (N=3)

Sales (1)
Sales Manager (1)
Technical sales manager (1)

Category 4: Other (N=6)

Engineer (2)
Manager (1)
Managing Shareholder (1)
Technical manager (1)
Regional Director (1)

Figure 1: Histogram multiple regression sub-question 4

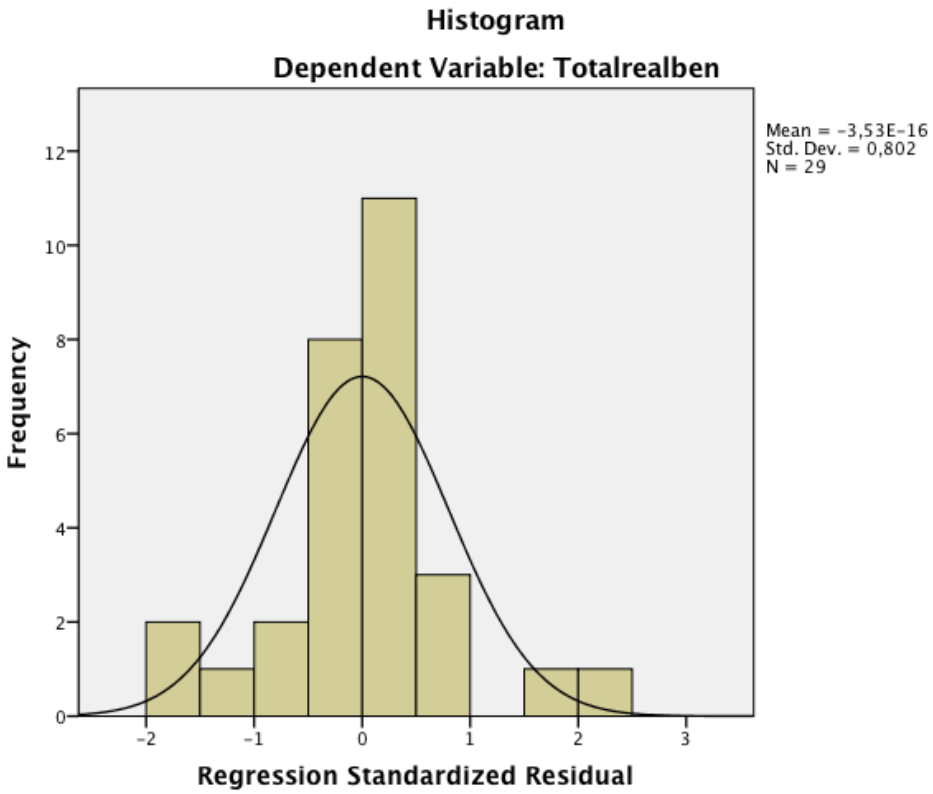

Table 15: Model summary multiple regression sub-question 4

Model summary

					Change statistics					
Model	R	R Square	Adjusted R Square	Standard Error	R Square Change	F Change	df 1	df 2	Sig. F Change	Durbin-Watson
1	0.385	0.148	0.117	0.653	0.148	4.709	1	27	0.039	
2	0.654	0.427	0.359	0.557	0.279	6.090	2	25	0.007	
3	0.703	0.495	0.411	0.534	0.067	3.202	1	24	0.086	
4	0.707	0.500	0.364	0.555	0.005	0.114	2	22	0.892	
5	0.731	0.534	0.378	0.548	0.034	1.520	1	21	0.231	
6	0.731	0.534	0.348	0.561	0.000	0.014	1	20	0.906	
7	0.733	0.537	0.318	0.574	0.003	0.128	1	19	0.725	
8	0.735	0.540	0.284	0.588	0.540	2.113	10	18	0.800	2.100

Table 16: ANOVA multiple regression sub-question 4

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.009	1	2.009	4.709	.039
	Residual	11.521	27	0.427		
	Total	13.530	28			
2	Regression	5.783	3	1.928	6.221	.003
	Residual	7.747	25	0.310		
	Total	13.530	28			
3	Regression	6.695	4	1.674	5.877	.002
	Residual	6.835	24	0.285		
	Total	13.530	28			
4	Regression	6.766	6	1.128	3.667	.011
	Residual	6.765	22	0.307		
	Total	13.530	28			
5	Regression	7.222	7	1.032	3.435	.013
	Residual	6.308	21	0.300		
	Total	13.530	28			
6	Regression	7.227	8	0.903	2.866	.027
	Residual	6.304	20	0.315		
	Total	13.530	28			
7	Regression	7.269	9	0.808	2.451	.048
	Residual	6.262	19	0.330		
	Total	13.530	28			
8	Regression	7.306	10	0.731	2.113	0.080
	Residual	6.225	18	0.346		
	Total	13.530	28			

Table 17: Coefficients multiple regression sub-question 4

Model		Unstandardized Coefficients		Standardized Coefficients			95% Confidence Intervals		Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	2.944	0.308		9.562	0.000	2.313	3.576		
	Reduced costs	0.212	0.098	0.385	2.170	0.039	0.012	0.012	1.000	1.000
2	(Constant)	1.577	0.472		3.342	0.003	0.605	2.548		
	Reduced costs	0.023	0.125	0.042	0.184	0.855	-0.235	0.281	0.442	2.263
	Reduced uncertainty	0.100	0.127	0.183	0.790	0.437	-0.161	0.361	0.428	2.334
	Learning of new skills	0.399	0.127	0.531	3.150	0.004	-0.138	0.661	0.807	1.239
3	(Constant)	0.941	0.575		1.636	0.115	-0.246	2.128		
	Reduced costs	0.074	0.123	0.135	0.602	0.553	-0.180	0.329	0.418	2.392
	Reduced uncertainty	0.088	0.121	0.161	0.727	0.474	-0.162	0.339	0.427	2.341
	Learning of new skills	0.273	0.141	0.362	1.938	0.064	-0.018	0.563	0.603	1.659
	Enlarge existing network	0.240	0.134	0.304	1.789	0.086	-0.037	0.517	0.727	1.375
4	(Constant)	1.033	0.659		1.568	0.131	-0.333	2.399		
	Reduced costs	0.054	0.137	0.098	0.395	0.696	-0.230	0.338	0.367	2.727
	Reduced uncertainty	0.110	0.135	0.202	0.815	0.424	-0.171	0.391	0.371	2.695
	Learning of new skills	0.281	0.163	0.373	1.729	0.098	-0.056	0.618	0.487	2.052
	Enlarge existing network	0.240	0.141	0.304	1.700	0.103	-0.053	0.533	0.708	1.412
	Increased competitiveness	0.029	0.138	0.041	0.208	0.837	-0.258	0.315	0.598	1.673
	Increased visibility	-0.068	0.144	-0.086	-0.473	0.641	-0.368	0.231	0.692	1.446
5	(Constant)	0.827	0.672		1.230	0.232	-0.571	2.224		
	Reduced costs	0.040	0.136	0.072	0.293	0.773	-0.243	0.322	0.364	2.747
	Reduced uncertainty	0.085	0.135	0.156	0.630	0.535	-0.196	0.367	0.363	2.757
	Learning of new skills	0.295	0.161	0.391	1.830	0.082	-0.040	0.630	0.485	2.062
	Enlarge existing network	0.210	0.142	0.266	1.479	0.154	-0.085	0.504	0.687	1.456
	Increased competitiveness	0.033	0.137	0.046	0.239	0.814	-0.251	0.317	0.597	1.674
	Increased visibility	-0.091	0.144	-0.114	-0.630	0.535	-0.390	0.209	0.681	1.469
	Access to complementary resources	0.136	0.111	0.200	1.233	0.231	-0.094	0.366	0.840	1.190
6	(Constant)	0.852	0.721		1.182	0.251	-0.652	2.356		
	Reduced costs	0.033	0.151	0.060	0.218	0.830	-0.282	0.348	0.310	3.227

	Reduced uncertainty	0.086	0.139	0.157	0.618	0.543	-0.204	0.375	0.363	3.759
	Learning of new skills	0.301	0.172	0.399	1.745	0.096	-0.059	0.660	0.445	2.247
	Enlarge existing network	0.221	0.174	0.280	1.270	0.219	-0.142	0.584	0.477	2.095
	Increased competitiveness	0.029	0.144	0.041	0.200	0.844	-0.271	0.328	0.566	1.766
	Increased visibility	-0.092	0.148	-0.116	-0.624	0.540	-0.402	0.217	0.674	1.485
	Access to complementary resources	0.145	0.133	0.213	1.088	0.289	-0.133	0.422	0.611	1.638
	Finding new partners	-0.023	0.192	-0.030	-0.119	0.906	-0.423	0.377	0.368	2.720
7	(Constant)	0.766	0.766		0.987	0.336	-0.858	2.389		
	Reduced costs	0.024	0.156	0.044	0.154	0.879	-0.030	0.351	0.302	3.309
	Reduced uncertainty	0.080	0.143	0.146	0.560	0.582	-0.219	0.379	0.358	2.794
	Learning of new skills	0.289	0.179	0.384	1.614	0.123	0.086	0.664	0.430	2.323
	Enlarge existing network	0.238	0.184	0.302	1.292	0.212	-0.148	0.624	0.444	2.250
	Increased competitiveness	0.026	0.147	0.037	0.178	0.860	-0.282	0.334	0.565	1.770
	Increased visibility	-0.075	0.159	-0.095	-0.474	0.641	-0.408	0.257	0.613	1.632
	Access to complementary resources	0.122	0.150	0.179	0.808	0.429	-0.193	0.436	0.498	2.007
	Finding new partners	-0.038	0.200	-0.050	-0.188	0.853	-0.457	0.382	0.352	2.842
	Access to specialized knowledge from academia	0.051	0.142	0.079	0.357	0.725	-0.247	0.349	0.500	2.000
8	(Constant)	0.793	0.799		0.993	0.334	-0.885	2.427		
	Reduced costs	0.030	0.161	0.054	0.185	0.855	-0.308	0.368	0.299	3.348
	Reduced uncertainty	0.078	0.146	0.142	0.530	0.603	-0.230	0.385	0.357	2.801
	Learning of new skills	0.305	0.190	0.404	1.607	0.125	-0.094	0.703	0.403	2.479
	Enlarge existing network	0.240	0.189	0.304	1.269	0.221	-0.157	0.637	0.444	2.251
	Increased competitiveness	0.015	0.155	0.021	0.097	0.924	-0.310	0.340	0.537	1.862
	Increased visibility	-0.082	0.164	-0.103	-0.499	0.624	-0.426	0.263	0.604	1.656
	Access to complementary resources	0.133	0.158	0.195	0.842	0.411	-0.199	0.465	0.474	2.109
	Finding new partners	-0.036	0.205	-0.047	-0.173	0.864	-0.467	0.396	0.352	2.845
	Access to specialized knowledge from academia	0.065	0.152	0.101	0.428	0.674	-0.254	0.385	0.459	2.178
	Development of prototypes and pilot lines	-0.038	0.116	-0.069	-0.327	0.747	-0.282	0.206	0.569	1.757

Table 18: Casewise diagnostics multiple regression sub-question 4

Casewise Diagnostics

Case Number	Std. Residual	Total realized benefits	Predicted Value	Residual
26	2.008	4.50	3.319	1.181

Table 19: Residuals statistics multiple regression sub-question 4

Residuals Statistics

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.074	4.131	3.559	0.511	29
Residual	-1.164	1.181	0.000	0.472	29
Std. Predicted Value	-2.906	1.121	0.000	1.000	29
Std. Residual	-1.980	2.008	0.000	0.802	29

Tables 20 and 21: ANOVA H_2

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Realized benefits	2.397	2	28	0.109

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Realized benefits	Between Groups	1.236	2	0.618	1.300	0.289
	Within Groups	13.312	28	0.475		
	Total	14.548	30			

Tables 22 and 23: ANOVA H_3

Test of Homogeneity of Variances

Realized benefits

Levene Statistic	df1	df2	Sig.
2.499	2	28	0.100

ANOVA

Realized benefits

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.369	2	0.185	0.365	0.698
Within Groups	14.178	28	0.506		
Total	14.548	30			