Master´s Thesis

The Additionality Effects of Government Subsidies on R&D and Innovation Activities in the Aviation Industry

A Project Level Analysis

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Management Summary

The importance of innovation for organizations and for the economy overall, is commonly accepted by researchers as well as by practitioners. However, conducting innovation and R&D projects is not risk-free and does not necessarily result in the intended findings. As a consequence, many innovation projects suffer from market failures which lead to an underinvestment in R&D and innovation. This underinvestment is not desirable from an economical point of view, since many innovative capacities are unused and do not deliver socially desirable outcomes. In order to increase the private investment, governmental subsidies are used in most western and industrialized countries. The intensified use of governmental subsidies emphasized the need for adequate evaluation tools in order to assess the effectiveness of those subsidies.

This research has been conducted at a major European airline group and is aimed at exploring the particular impact of governmental subsidies on publically-funded R&D and innovation projects. The particular impact of public funding on the projects is assessed by using the concept of additionality, which is a common method to evaluate the effectiveness of public policy programs.

Various R&D and innovation projects are conducted frequently within the airline group in order to stay technologically and economically competitive. The participation in publically-funded innovation programs however, is a rather new venture for the airline. As a consequence, no centralized and synergized knowledge about the impact of public funding on the organization does exist, which can be considered as a knowledge problem. This study is an attempt to contribute to the solution of this knowledge problem by analyzing how the public funding influences the particular projects. To address this knowledge problem, the following research question has been established:

What is the impact of governmental subsidies on the case companies R&D and innovation activities in terms of additionality effects at the project level?

The concept of additionality is designed to assess the difference which is made by governmentally-sponsored programs. Additionality effects are typically evaluated by the use of the traditional concepts of input additionality and output additionality. Input additionality is commonly used to assess the allocation of private and public funding, while output additionality is used to evaluate the innovative output of the subsidized projects. In addition to those two concepts, the concept of behavioral additionality is used to assess how the public funding influences the organizations behavior when receiving governmental support. Various different manifestations of behavioral additionality exist, in order to fully assess the behavioral changes of organizations.

In order to answer this research question and to assess the additionality effects, a qualitative, cross-sectional research has been conducted. A total of 16 interview sessions with 18 project

managers of the airline group, who conducted at least one subsidized R&D project, have been held, in order to assess the additionality effects of a total of 18 projects.

The interview sessions and the subsequent analysis of the interview data revealed several interesting main findings.

First, the results of this study indicate that the participation in publically funded innovation programs had, in the vast majority of projects, a decisive influence on the implementation or non-implementation decision of those projects. In the absence of a governmental support measure, most of the R&D projects would have been cancelled. The projects, which had been conducted in a similar manner anyway, were conducted on a much broader and bigger extent.

Second, the participation in a publically-funded innovation program rather lengthened the duration of the particular projects, which was considered as very beneficial and a positive effect of the funding by the majority of respondents. This finding is in particular interesting since an accelerated project duration is commonly considered a positive effect of public funding. However, a lengthened project duration can only be considered as a positive effect, if the lengthened project duration is in accordance with the overall project objectives. If the overall project duration and the product life cycle is too short, the application for subsidies might take too long and consequently not be beneficial for the overall project.

The third main finding of this research concerns the outputs of the subsidized R&D projects. In literature patents, prototypes and products are commonly considered as regular indicators of R&D output. Certainly, among the outcomes of the projects under study, also patents, prototypes and products were observed. However, in the majority of the analyzed projects, rather intangible outcomes were perceived as the biggest benefits of the participation in a publically-funded program. These intangible outcomes were rather improved processes, services, innovation potential as well as knowledge and know-how.

Another main finding concerns the overall influence of the public funding on the R&D projects. In the majority of cases, the government funding resulted in more complex and challenging projects, created follow-up activities, increased the management capabilities, created more diverse networks and enabled the company to conduct the projects on a bigger scale.

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To Christine Lohmann,

* 19.12.1962 † 01.12.2013

who patiently taught me this wonderful language.

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Preface

This master thesis is the final graduation assignment for the Master of Business Administration program with the specialization International Management of the University of Twente, The Netherlands.

The research has been conducted at a major European airline company and studies the influence of governmental subsidies on R&D and innovation activities at the project level.

First, I would like to express my gratitude to the members of my graduation committee. Dr. Kornelia Konrad and Professor Dr. Stefan Kuhlmann guided me in a very pleasant way during the execution of this thesis, challenged me to continuously improve my research and to scrutinize the topic of policy evaluation from different perspectives. I am grateful that both supervised my research and appreciate their efforts. Further, I would like to thank my external supervisor, for giving me the opportunity to conduct my master thesis at such an interesting environment and for giving me the possibility to gain insights into the exciting aviation industry.

Further, I would like to thank my colleagues of the Innovation Management department for warmly welcoming me and their genuine interest in my research. Also the project managers and other employees of the case company, who invested their time for frequent discussions and interview sessions deserve my appreciation. Without their contribution, this thesis would not have been possible.

I also like to thank my fellow students for proof reading this thesis and for providing valuable comments.

A final appreciation goes out to my family and my girlfriend Nicole who supported my on so many levels during this thesis project as well as during all my other academic years as a student. I would not be the same without you.

Enschede, March 2014

Fabian Lohmann

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1. Introduction

The process of innovation can be considered as the engine of economic growth (Grossman & Helpmann, 1994; Romer, 1990). Already 70 years ago, Schumpeter stated that "(t)he fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates" (1943, p. 83). R&D investment and technological change are the primary force of economic growth (Lööf & Heshmati, 2005). This economic growth is essential to the economic success of nations and an important factor for a nation's wealth (Aerts, Czarnitzki & Frier, 2006).

However, despite the importance of innovation for firms and the entire economy, innovative activities are not risk-free and do not necessarily result in the intended research or development findings. As a consequence of this risk and the involved degree of uncertainty, not all potentially successful innovation projects are conducted. As indicated in literature, innovation project might suffer from market failures (Hussinger, 2003; Clausen, 2009). This market failure leads to an underinvestment in R&D and innovation (Klette, Moen & Griliches, 2000). Some Innovation projects are not implemented because the private benefits do not exceed the private cost (Hussinger, 2003) and because firms "(…) face insufficient incentives to invest in innovation from the point of view of society as a whole" (Hall, 2002a, p. 4-5). Consequently, many R&D projects that have the potential to generate high social benefits are not implemented because they do not cover the investment costs and do not promise private benefits (Hussinger, 2003). This non-implementation of potentially promising innovation projects has certainly a severe impact on the overall performance of the economy, since substantial innovative capacities are left unused. In order to increase private innovation activities and to implement more potentially successful projects, governments generally use the measure of public funding to support the innovating organizations. According to Hussinger (2003), it is the rationale of public R&D funding to reduce private innovation activity cost and to increase the innovation investment volume to a social optimum.

In order to maximize the impact of public funding, the supported R&D programs are generally designed to support commercial R&D projects with large expected social benefits and inadequate expected returns for private investors (Klette et al., 2000). Innovation as well as technology policies are providing positive incentives to companies to preform R&D activities that had not been performed in the absence of such a form of governmental support (Afcha, 2012). Further, Clausen (2009) argued "(t)here is little disagreement today about the desirability of subsidizing private R&D activities among researchers and policymakers" (p. 240). Consequently, it is not surprising that R&D subsidies are believed to be a central part of innovation in industrialized economies (Afcha, 2012). Cunningham, Gök and Laredo (2012) assume that governmental R&D support has an impact on the quality and quantity of R&D overall. Further, R&D policies are believed to stimulate the technological process of the industry (Madsen, Clausen & Ljunggren, 2008).

Despite the broad agreement and growing scholarly attention about the usefulness of governmental support, some issues about the effectiveness of innovation policy remain unclear (Lööf & Heshmati, 2005). Several authors demand to deepen our understanding of how governments interact with the systems they are trying to affect with those innovation programs (Jaffe, 2008; David, Hall & Toole, 2000) and which long-term effects they have (Aerts et al., 2006; Georghiou, 2004). These long term effects are generally assessed on different levels. Previous studies of the discipline of R&D and innovation policy evaluation commonly used four levels of aggregation to assess the influence of the public funding, namely laboratory, firm, industry and country (David et al., 2000).

1.1. Research context

This research has been conducted at a major European airline group. In 2012, the case company was in terms of scheduled passengers carried as well as in passenger kilometers flown one of the ten largest airlines in the world and one of the five largest in Europe[1]. The core business of the airline group is centered around the transportation of flight passengers. However, the passenger transportation is not the exclusive business activity of the group, since other aviation-related activities are performed by the various sub- or affiliated companies of the group. The activities performed the companies of the group are very diverse and multifaceted, varying from airplane maintenance and overhaul services, to freight and cargo services as well as catering for passenger flights and aviation IT system services. These activities however, do not only directly contribute to the air-transportation core business of the group, they are also provided to external clients and private customers.

Within the airline group, R&D projects are performed frequently in order to foster innovation and to ensure the competitiveness within this fierce industry. Several of the R&D and innovation projects performed within the group are supported by government innovation policies, which are used as a point of origin for this research.

1.2. Problem statement

As mentioned above, R&D and innovation projects are conducted frequently within the group. However, the participation in governmental innovation programs is a rather new venture for the entire group. The publically-funded innovation projects which have been conducted were commonly planed, initiated and performed by one of the various technical departments within the group, which resulted in a decentralization of knowledge about publically-sponsored innovation projects. The experience and the know-how gained during those projects is embedded in the particular departments and is only communicated sporadically to other instances which might have a potential interest in this knowledge. An

[1] http://en.wikipedia.org/wiki/World's_largest_airlines, Retrieved: November 22, 2013

effective, centralized communication throughout the organization, which is based on synergized and systematic knowledge about a variety of projects, is largely nonexistent.

The preceding parts underline the importance of innovation and the need of understanding how governmental subsidies and especially R&D policies affect the companies that are receiving them. This understanding is particularly important for evaluators of public policy programs as well as for policy makers, but also the companies, or in particular the projects managers, that are receiving subsidies or which consider applying for such incentives.

In particular, it is important for the various levels of management of the participating company, how the public support affects the organization. Public funding does not only affect the particular project which is being supported but also higher level instances, like the entire organization and also lower level instances, like the individual project managers. Knowledge about how the participation in governmentally sponsored programs affects the organization is not only very value prior to the conduction of the project, when applying for the incentives, but also for decisions arising during and after the project was executed.

For instance, it is very valuable for the management to understand which projects are especially worthwhile to conduct with governmental support and which types of projects might not be advisable for a participation in a publically-funded context. Further, it is of a strategic importance for the management to understand which repercussions they might have to face when receiving subsidies and to adjust their expectations and their actions accordingly.

Knowledge about which impact subsidies have on innovation projects and the company in general are valuable for every organization that is participating in publically funded technology programs and not only for companies of the aviation sector. However, it is of particular interest for airline companies since minor optimizations can result in significant improvements. Removing a tiny olive from the salats served during intercontinental flights for example, which is probably not missed by the majority of passengers, can result in cost savings of a minimum of $40,000 per annum for a major airline company[2].

Even if this example is not about a technological innovation, it underlines the importance as well as the potential impact of innovative activities on the organization and indicates what influence minor changes can have in the aviation industry. Successful innovations are, within the fierce and highly competitive aviation industry, decisive factors for the success of the organizations. Understanding how public subsidies influence innovation projects is one of many steps to improve the innovation performance and to ensure the competitiveness of the organization.

This thesis is contributing to this goal by collecting evidence on how the public incentives influence the supported projects and which particular differences are made by the policy.

[2] http://www.nbcnews.com/id/3073562/#.UpNJzNL2h8E, Retrieved: January 22, 2014

1.3. Research goal

As mentioned earlier, synergized and systematic knowledge about the impact of governmental subsidies on the various R&D and innovation projects of the airline group is largely non-existent. This can be considered as a knowledge problem. The primary goal of this thesis is to contribute to the solution of this knowledge problem and to gain insight about how subsidies change the project behavior of the case company in particular. Therefore, the research goal is formulated as followed:

Develop an understanding of how governmental subsidies affect R&D and innovation projects of the airline case company.

By applying and testing the concept of additionality, which is commonly used to assess the impact of public funding and which will shortly be introduced in the subsequent subchapter, this study does also contribute to the policy evaluation literature and might yield some relevant findings.

1.4. Theory and concepts

This subsection will shortly introduce the theories used in this thesis in order to provide a basic level of understanding for this topic, which is necessary to understand the aim of this study. The theories will be discussed in further detail in Chapter 2. Recent literature considers it as an important issue of policy evaluation to deepen our understanding of how government subsidies influence the systems they are trying to affect (Autio, Kanninen & Gustafsson, 2008; Clarysse, Wright and Mustar, 2009; Cunningham et al., 2012). Government R&D policies are stimulating technological progress and innovation in various complex ways (Madsen et al., 2008).

The question of what difference is made by the governmental-sponsored programs to the recipient firms is commonly addressed by the concept of additionality. This concept compares the situation in which subsidies were granted with the null hypothesis or counterfactual situation, meaning if no intervention would have taken place (Georghiou, 2002). In contemporary literature, three manifestations of additionality are frequently used: input additionality, output additionality and behavioral additionality (Buisseret, Cameron & Georghiou, 1995; Georghiou, 2002; Georghiou, 2004; Clarysse et al., 2009; Madsen et al., 2008; Bayona-Sáez, Cruz-Cázares & García-Marco, 2013; Wanzenböck, Scherngell & Fischer, 2013).

Input additionality is concerned with the financial inputs of the subsided projects and the allocation of private and public funds. It is defined by Cunningham et al. (2012) as the degree of companies' increase of innovation input because of governmental support, while Busom and Fernandez-Ribas (2008) refer to it as "(…) the change in private R&D expenditure

triggered by public support (…)" (p. 241). More generally speaking, the change in financial investment and the allocation of the funds used during the innovative activities is assessed with the concept of input additionality.

Output additionality on the other hand, is concerned with the outputs of the subsidized projects. It is defined by Cunningham et al. (2012) as the amount of innovation outputs that increases because of governmental support, while Busom and Fernandez-Ribas (2008) refer to it as "(…) the change in patents and new products obtained by supported firms (…)" (p. 241).

It is believed that innovation policy is only successful if it creates either input or output additionality or both (Cunningham et al., 2012). If a subsidy does not create either input or output additionality, it is considered a misallocation of public funds. In general, public funds should always complement private funding and not substitute the private investment (David et al., 2000).

A third form concerned with additionality effects is commonly labeled behavioral additionality. The concept of behavioral additionality was first addressed by Buisseret et al. (1995) who coined the terminology of policy evaluation by introducing this concept to compliment the rather traditional concepts of input and output additionality. The authors argued that it is not sufficient to only look at how governmental subsidies change the firms spending (input additionality) and the firms output (output additionality). In addition to those two concepts, Buisseret et al. (1995) argued that it is also important to analyze what happens within the firm during the governmental intervention. Bayona-Sáez et al. (2013) define the concept as the difference in the firms innovation behavior that is taking place after receiving governmental subsidies, while Busom and Fernandez-Ribas (2008) refer to it as the "(…) changes in the type of R&D projects, R&D management capabilities or collaboration strategies that firms may experience as a result of receiving public support " (p.241).

In order to assess the concept of behavioral additionality more specifically, various manifestations of the concept have emerged. A refinement of the behavioral additionality concept has been proposed by Falk (2007) by establishing the following categories: Scope additionality, cognitive capacity additionality, acceleration additionality, challenge additionality, network additionality. The concept of acceleration additionality, for example, is concerned with the change of project speed of innovative projects which are funded and challenge additionality is concerned with the complexity of funded projects. Like the other additionality concepts, it considered a positive effect if the governmental invention leads to an improvement in the particular category. For instance, higher degrees of complexity or a faster execution of the project are considered positive effects of behavioral additionality.

This study will focus on which effects public innovation and R&D policies have on projects of the case company. In particular, it will be investigated if and how the three forms of additionality and their refinements manifest in practice.

1.5. Central research question

This study is a qualitative study. The methodology of this thesis will be discussed in more detail in Chapter 3. In qualitative research "(t)he central question is a broad question that asks for an exploration of the central phenomenon or concept in a study" (Creswell, 2009, p. 129). According to Creswell (2009), the question should be broad in order to not limit the inquiry process. In order to fulfill the research goal of this study, as described in the previous section, the following research question was formulated:

What is the impact of governmental subsidies on the case companies R&D and innovation activities in terms of additionality effects at the project level?

1.5.1. Sub-research questions

The research question was divided into sub-research questions in order to narrow the focus of the research and to provide structure:

(a) How is the effectiveness of public R&D and innovation policies measured?
(b) How do public subsidies affect the case company's R&D input and investment?
(c) How do governmental subsidies affect the case company's R&D output?
(d) How do governmental subsidies affect the case company's project behavior?

1.6. Practical and academic relevance

This research is on the one hand of practical relevance, since it discovers how governmental subsidies practically change the course and the process of innovation projects of the case company. This knowledge provides the reader with useful information about how, not only the input and output sides of R&D projects are influenced, but also how the particular project behavior is affected. It gives insight on how those incentives influence the speed, the scope, the complexity, the collaboration and other project attributes. This knowledge is particularly valuable to project managers of the case company, who are applying for subsidies for the first time, since it supports the managers to better anticipate how their innovation projects are influenced by the policy. Further, the project managers can better estimate the input, output and the behavioral changes the subsidy can potentially have on their project. This is especially of interest for the project managers and also for the general management of the case company, since innovation is naturally an important topic and also since the interest in public funding within the organization has increased significantly over the last years.

On the other hand this research is of scientific relevance, since it independently uncovers the particular effects of governmental subsidies on project performance of a large enterprise in the highly-developed and technically-advanced sector of the aviation industry. Especially from a

policy evaluation point of view this thesis yields relevance, since the particular effects of public-funding are assessed from a point of view, which is independent and not governmentally-influenced. Since the study was conducted within the organization and researches a variety of subsidies projects, a deep and broad evaluation was possible. The issues revealed by this research are typically not assessed by standard evaluations conducted by the funding authorities and are, consequently, valuable insights in terms of policy evaluation. Moreover, this study presents insights on how public funding in particular influences the project behavior of a large enterprise, which is particularly interesting because most policy evaluations are focused on rather small or medium-sized organizations.

Further, the theory about the various additionality concepts is practically applied and might uncover potential mismatches during the practical application. This practical application of the concept might contribute to the theory of additionality and practical issues regarding the application of this policy evaluation concept.

Overall, it has to be noted that the findings of this study are specific to the aviation industry, which certainly also influences the relevance of this research. The narrow focus in particular has a significant influence on the practical relevance, since the study is very specific to the context of the case company and the particular aviation environment the organization is operating in. It is unlikely that the findings of this research yield practical relevance for other organizations than the case company. This narrow focus also has an impact on the scientific relevance since it only represents the case of one particular organization. Other studies, even if conducted in similar environments, might yield different results. In order to increase the scientific relevance and to confirm the results of this study, other studies in either the aviation industry or in large enterprises are required, depending on the objectives of future research.

2. Literature review

This chapter will discuss the innovation and R&D literature as well as the market failure concept and the rationale of governmental subsidies. The evaluation of public policy programs will be introduced, the concept of additionality will be outlined and the various manifestations of the concept will be discussed.

2.1. Innovation

As already mentioned in the introductory chapter, innovation is considered the engine of economic growth (Grossman & Helpmann, 1994; Romer, 1990). Innovation can provide the company with growth regardless the condition of the larger economy it is operating in (Trott, 2005). The concept of innovation can be defined as the introduction of an internally generated or externally purchased device, system, policy, process, product or service which is new to the organization (Damanpour, 1991).

Innovation is considered a necessity for organizations to compete in pervasive, unpredictable and continuous environments (Brown & Eisenhardt, 1995). In a similar vein, Trott (2005) states: "Corporations must be able to adapt and evolve if they wish to survive (…) The ability to change and adapt is essential to survival" (p. 5).

In order to understand the organizations adoption behavior and to identify the determinants of innovation, it is necessary to distinguish between various types of innovation. In the innovation literature, many typologies have been discussed but three in particular have gained broad recognition, namely administrative versus technical innovations, product versus process innovation and radical versus incremental innovations (Damanpour, 1991, Wolfe, 1994, Georghiou, Rigby & Cameron, 2002). Each of those typologies is focused on a different set of generic characteristics (Georghiou et al., 2002) and will briefly be introduced in the following parts:

- First, administrative versus technical innovations. This first dimension refers to a general distinction of technology and social structures (Damanpour, 1991). Technical innovations refer to "(…) product, services and production processes technologies; they are related to basic work activities and can concern either product or process" (Georghiou et al., 2002, p. 45). Administrative innovations on the other hand are focused on the organizational structures and administrative processes, which are only indirectly related to the organizations basic work activities and more directly related to its direct management (Damanpour, 1991).

- Second, product versus process innovations. The product innovation dimension is related to the introduction of new products and services in order to meet external user and market needs, while the process innovation dimension is related to the

implementation of new elements in the production or service operations of the organizations, which can be input materials, task specifications, devices, information and knowledge mechanisms (Georghiou et al., 2002).

- Third and last, radical versus incremental innovations. This last dimension is about the degree of change the adoption of an innovation has on the implementing organization in terms of existing practices. Radical innovations generate fundamental changes in the existing structures of the organization and include major modifications on the existing practices, while incremental innovations are only minor modifications on the existing rules and practices (Damanpour, 1991).

Figure 1 below indicates the economies and most organizations reliance on innovation by visualizing the percentage of firms' total turnover produced from new product innovation, classified by new-to-market and new-to-firm innovations.

Firms' turnover from product innovation, by type of innovator, 2006

As a percentage of total turnover

Figure 1: Turnover by product innovation (OECD, 2010) [3]

The preceding parts underline the importance of innovation and the organizations ability to react on changing circumstances. In order to be innovative and to stay competitive, organizations have to continuously make progress by further developing their products, their competencies, processes, services and other business aspects.

[3] Source: http://dx.doi.org/10.1787/835838585236, Retrieved: December, 18, 2014

2.2. R&D

Industrial research and development is one of the most decisive influences of the concept of innovation introduced above (Trott, 2005). R&D can be defined as the "(…) creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications" (OECD, 2002, p. 30).

As well as innovation, research and development is assumed to be a crucial of the long-term growth of an economy and the national competitiveness (Köhler, Larédo & Rammer, 2012).

Despite the importance of innovation and R&D, as well as their fundamental influence on the bigger economy, organizations do not always sufficiently invest in particular innovation and R&D activities. It is widely accepted that R&D activities are "(…) difficult to finance in a freely competitive market place" (Hall, 2002b, p. 2) and that a suboptimality of R&D expenditures is existing in many organizations (Guellec & Van Pottelsberghe de la Potterie, 1997). The reluctance of many organizations to invest in R&D can partly be explained by the phenomenon of market failure.

2.3. Market failure

Market failure is defined by Datta-Chaudhuri (1990) as "(…) the inability of a market economy to reach certain desirable outcomes in resource use" (p. 25) and by De Janvry, Fafchamps and Sadoulet (1991) as the situation in which "(…) the cost of a transaction through market exchange creates disutility greater than the utility gain" (p. 1401). Expressed more simply, the market failure argument describes a situation in which some innovation projects, which would be very contributing to the overall economy, are not implemented because a number of various reasons prevent the private investment in such projects.

In his classic article, Arrow (1962) identified three prime sources for such a possible failure of perfect competition in resource allocation: Inappropriability, indivisibilities and uncertainty. Falk (2007) described those phenomena as:

- First, inappropriability or knowledge spillovers to the society. Innovating firms face high costs when creating knowledge, but cannot always capture and appropriate the full benefits since the generated knowledge has the nature of a public good, which is referred to as an appropriability problem.

- Second, indivisibilities or scale of effort. The creation of knowledge might require a higher complexity or bigger scales of effort than one individual company can generate.

- Third, uncertainty or information asymmetries. The generation of knowledge always involves risk and uncertainty. No market exists that insures against those risks.

These market imperfections create a divergence between the private and the social benefits of R&D and innovation activities (Arrow, 1962). A long-standing result of the market failure is the suboptimality of innovation and R&D expenditures in many firms (Guellec & Van Pottelsberghe de la Potterie, 1997; Gonzáles & Pazó, 2008). Companies will essentially under-invest in innovation and R&D because of their inability to appropriate all the benefits resulting from those activities (Metcalfe & Georghiou, 1997).

Study	Estimated private rate of return	Estimated social rate of return
Mansfield et al. (1977)	25%	56%
Bernstein-Nadiri (1991)	14-28%	56%
Nadiri (1993)	20-30%	50%

Table 1: Estimated rates of returns of R&D and spillovers

In a similar vein refer Wanzenböck et al. (2013) to the leakages and spill-over effects that lead to a decreased willingness of companies to invest in innovative activities.

Table 1 above visualizes the discrepancies between the estimated private and the estimated social rates of return, whereby the social rate of return describes the anticipated value for the overall economy. The variances between the different rates of return indicate that companies basically invest significantly less in innovation than socially desirable.

A detailed discussion about the problem of under-investment in innovation is given by Peneder (2008), who states that "(i)nnovation requires the commitment of resources, which in turn need to be financed" (p. 518). The author identified two causes for the private under-investment in innovation. First, the lack of incentives to invest, resulting from imperfect markets and second, the lack of means to invest, resulting from imperfect capital markets (Peneder, 2008).

In order to compensate for this under-investment in innovation and R&D in the private sector, governmental intervention is needed. According to Cunningham et al. (2012), the government should implement policies to obtain the "second best" (p.29) social optimum by overcoming the appropriability problem, substitute failing markets by decreasing costs and risks and by reducing uncertainty.

2.4. Government subsidies

In response to the under-investment in R&D and innovation activities resulting from the market failure, it is believed that public intervention can be used as a rationale for market incentives (Sanz-Menendez, 1995) and that governmental intervention stimulates R&D and innovation activities by reducing market failures (Klette et al., 2000).

Various policy instruments are commonly used in developed countries by governments to foster R&D and innovation activities directly or indirectly (Czarnitzki, Hanel & Rosa, 2004). In a very recent study, Edler, Cunningham, Gök and Shapira (2013) mention fiscal instruments, like tax incentives, and direct support measures, like subsidies, as measures to increase private investment in R&D. In addition to those measures, the authors' further state that other, rather indirect measures, like improved access to finance, credit guarantee schemes, immigration schemes, IP management support and innovation management advisory schemes can also have a positive influence on the private R&D activities. All those measures can be used to support the particular companies as well as the overall national economy and should be taken into account by policy makers as well as by evaluators of those programs. This study however, is focused on the impact of direct support measures and only evaluates the impact of direct subsidies.

According to Hussinger (2003), it is the state's rationale to increase the innovation volume to a social optimum by decreasing the company's innovation expenditures. Certainly, it is the interest of policy makers to allocate the financial resources of the funding most effectively and to achieve high levels of impact. Consequently are publically funded R&D and innovation programs designed to allocate resources to projects with high anticipated social benefits (Lööf & Heshmati, 2005). However, it is not the exclusive goal of public innovation funding to reduce the organizations cost. As Guellec and Van Pottelsberghe de la Potterie (2000) state, another goal of public innovation policy is, besides the aforementioned reduction of private cost of innovation, also the introduction of new technological opportunities available.

Because of the broad scholarly consensus about the usefulness and the desirability of subsidies, it is not surprising that government subsidies are used in many industrialized countries since several decades (Hsu, Horng & Huseh, 2009) and that R&D subsidies in particular, are considered a central aspect of the innovation and technology policy in many economies (Afcha, 2012). Bayona-Sáez et al. (2013) further claim that public R&D and innovation policies have an essential role in the long-term development and prosperity of regions.

It is argued that government support will "(…) result in competitive benefits for the firm that will diffuse into economy, creating benefit and ultimately increasing national competitiveness" (Davenport, Grimes & Davies, 1998, p. 55) and that public support will increase R&D and innovation investment, which will in turn lead to an accelerated economic

growth over the long run (Clarysse et al., 2009). This is also in line with Hsu et al. (2009), who argue that the competitive benefits the companies gain from a public subsidy will spill over to the economy, which will consequently lead to an increase of industry competitiveness.

By allocating subsidies to companies, governments attempt to reduce the problems associated with the market failure problem and to encourage firms to conduct more R&D and innovation activities.

Public innovation policies provide organizations with incentives to conduct projects and might also enable companies to conduct innovation activities that had not been conducted in the absence of such a support policy (Madsen et al., 2008). However, public innovation support does not only have an influence on the quantity of the conducted projects, it also has a decisive influence on the quality of R&D overall (Cunningham et al., 2012).

Another interesting particularity is that the beneficiaries of governmental support programs are generally in more technologically advanced sectors and that larger firms tend to participate more frequently in public R&D programs than smaller companies (Hanel, 2003). These findings are in particular of interest for this research since this study was conducted at a large enterprise which is operating in a technologically very advanced and sophisticated sector.

2.5. Evaluation of public policy programs

The increase in public R&D innovation support over the past decades has resulted in a growing interest in the evaluation of public policy programs (Clarysse et al., 2009; Bayona-Sáez et al., 2013). The increased interest in public policy to stimulate innovation and the accompanying evaluation of these measures, also emphasized the need for more advanced and sophisticated measurement tools (Georghiou & Clarysse, 2006).

The central question addressed in the evaluation of public innovation policies is related to the effectiveness of such programs and aims at assessing the effects of the subsidies. In order to measure the effectiveness and to assess the effects of public funding, the concept of additionality has been introduced. The additionality concept has become a key concept in the evaluation of the 'effectiveness' of R&D and innovation policies, on which most assessments are based (Luukkonen, 2000).

2.6. The concept of additionality

In the process of evaluation of public innovation policies, the key question to be asked "(…) must go beyond the level of effects achieved by the beneficiaries of a policy and pursue the issue of the contribution to those effects made by the existence of the public intervention"

(Georghiou, 2002, p. 58). Expressed more simply, the policy evaluation has to focus on the difference which is made by the public intervention instead of only highlighting the success of supported R&D and innovation projects. Consequently, the situation in which a project received public support has to be compared with a situation in which the same project had not received any government support.

In order to capture the differences between those two situations, the concept of additionality has been introduced. This concept traditionally assesses the difference arising from a government intervention (Georghiou, 1998) and describes the 'catalyst' effects of governmental subsidies (Bræin, Hervik, Nesset & Rye, 2002; Rye, 2002).

Additionality is the change in privately financed R&D spending, company behavior and performance which would not have occurred in the absence of a public program or subsidy (Buisseret et al., 1995; Madsen et al., 2008). Georghiou (2002) states that on a conceptual basis "(…) additionality appears relatively simple on superficial examination. It involves comparison with the null hypothesis or counterfactual – what would have happened if no intervention had taken place?" (p.58).

Polt and Streicher (2005) describe the concept as the difference between the 'state-of-the-world' that would have occurred with and without the public policy. The concept is aimed to measure the difference in effects of a company´s under-investment in R&D and the actual investment by the company and the government as a part of the public innovation policy program (Luukkonen, 2000).

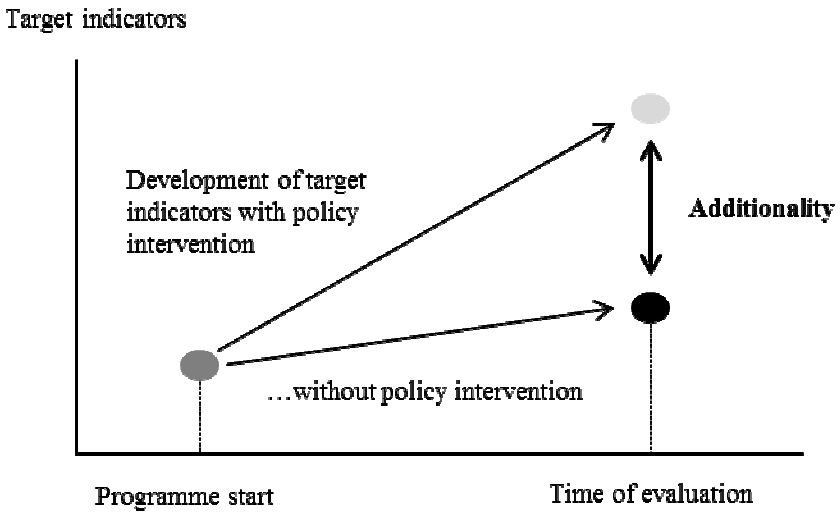

Figure 2: A straightforward concept of additionality (Polt & Streicher, 2005)

Public funds should always be additional to what the supported companies would have invested in R&D and innovation activities in the absence of a subsidy (Madsen et al., 2008). Governmental funding is designed to result in new activities instead of substituting private

funding that would also have occurred in the absence of the intervention (Georghiou & Clarysse, 2006).

The concept received considerable scientific attention over the last decades of policy evaluation (Buisseret et al., 1995; Davenport et al., 1998; Luukkonen, 2000; David et al., 2000; Georghiou, 1998, 2002, 2004; Rye, 2002; Falk, 2004, 2007; Larosse, 2004; Clarysse et al., 2009; Madsen et al., 2008; Georghiou & Clarysse, 2006; Roper & Hewitt-Dundas, 2012) and is widely accepted as the key concept in the evaluation of the effectiveness of public policy programs.

Three main manifestations of the concept of additionality, namely input additionality, output additionality and behavioral additionality have been identified in contemporary literature. These three manifestations assess the effects of pubic polices through different perspectives, namely the impact of the policy on R&D input, the impact on the output achievement and the impact on the innovative behavior (Bayona-Sáez et al., 2013). Falk (2007) classified those three forms of additionality as "(…) resource-based concepts, result-based concepts and concepts that measure the success of policy intervention by examining desirable changes in the process of innovation" (p. 667).

These three manifestations will be introduced and discussed in more detail in the subsequent sections.

2.7. Input additionality

Input additionality can be considered as the first traditional concept of policy evaluation. It is concerned with "(…) whether resources provided to a firm are additional, that is to say whether for every Euro provided in subsidy or other assistance, the firm spends at least an additional Euro on the target activity" (Georghiou, 2004, p. 7). The concept mainly focusses on inputs in the form of financial investment (Gök, 2010) and describes, more generally speaking, the change of private R&D expenditure caused by the public policy program (Busom & Fernandez-Ribas, 2008). It describes the extent to which a certain policy program results in additional innovation investments of the subsidized company (Wanzenböck et al., 2013).

The concept is considered the most popular impact evaluation approach (Gök, 2010) and the most thoroughly investigated aspect of public R&D and innovation policy effects (Bayona-Sáez et al., 2013).

Falk (2007) classifies input additionality as a resource-based concept of additionality.

As stated earlier, Madsen et al. (2008) argued that public funds should always be additional to what the supported companies would have invested in R&D and innovation activities without a subsidy. Consequently, the key question in the evaluation of input additionality is whether

public funding increases the total R&D investment or if it displaces the funding from other sources. Only if the subsidized companies increase their R&D and innovation expenditures and the public investment compliments the private investments, "input additionality effects" occur (Madsen et al., 2008, p. 3). If the public investment is directed towards a project that the subsidized company had also conducted in the absence of a policy intervention, it is considered as misallocated (Clarysse et al., 2009).

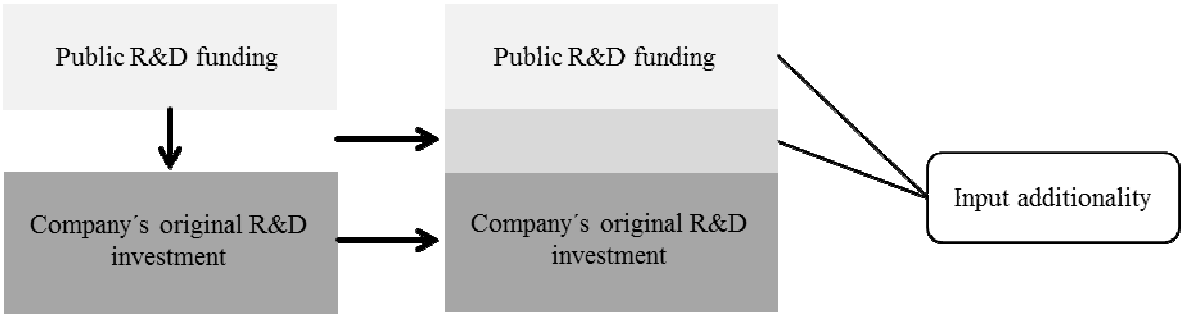

Figure 3: Input additionality (Tekes, 2006, translated by Hyvärinen 2010)

When researching input additionality it is generally important to acknowledge certain assumptions (Bach & Matt, 2002):

- A clear link between input and output innovation activities exist
- Divisibility and a constant rate of return to scale of the innovative activity
- No differences of the nature of output generated by public and private expenditure

Naturally, all companies have an incentive to reduce cost and consequently to apply for governmental subsidies. This leads to an inherent risk of so called crowding out effects (Aerts et al., 2006). Crowding out or substitutive effects occur, when public funds replace the company´s private investment (Rye, 2002) and the public subsidies are allocated to projects which had also been conducted in the absence of an policy intervention. From a policy point of view, it is certainly desirable to avoid allocating funds to projects which had been conducted even in the absence of a subsidy. Lööf and Heshmati (2005) argue that, due to the socially costly revenue mechanisms the overall economy will be "(…) worse off if society´s total R&D investment remains unchanged but public research-grant programs by crowding out, replace privately funded investment" (p. 14).

2.8. Output additionality

Output additionality can be considered as the second traditional concept of policy evaluation. It is concerned with "(…) the proportion of outputs which would not have been achieved without public support" (Georghiou, 2004, p. 7). It basically deals with the most decisive impact of government intervention, namely the effect on the results (Falk, 2007). In the

evaluation of output additionality, the results from subsidized R&D projects are compared to the output that would have resulted from the project without policy support.

Falk (2007) classified output additionality as a result-based concept of additionality.

For evaluators and also for policy makers this kind of additionality is often the most interesting manifestation, since it focusses on the additional commercial effects deriving from a governmental intervention (Rye, 2002). Especially the question "(…) whether the socially desirable innovation has been achieved" is interesting in the evaluation of output additionality (Georghiou, 2002, p. 61).

The above definitions of output additionality raise the question of determining the outputs this concept exactly intends to measure. The problem related with the measurement of the additionality concepts will be discussed in further detail in the later course of this study, namely in section 3.4.

Despite the concerns of measurement, it is assumed that a strong link between the public policy support and the measured results of the intervention exist (Hsu et al., 2009). In general, it has to be acknowledged that the outputs of an innovation project are rarely products, services or processes alone and that even unsuccessful innovation projects produce additionality in the form of experiences and training of the involved personnel (Georghiou & Clarysse, 2006).

While the measurement of input additionality is rather straightforward, it is more complex and problematic to find evidence for output additionality (Davenport et al., 1998). Since the measurable inputs of the input additionality concept are assumed to 'hopefully' produce outputs of the output additionality concept (Buisseret et al., 1995), it is obvious that it is difficult research output additionality while not considering input additionalities. Consequently, it is not surprising that the input additionality concept is more frequently studied than the output additionality concept (Buisseret et al., 1995).

Various ways of accessing output additionality have been proposed in recent literature. It has been proposed to assess concept by direct-firm level innovation outputs, indirect-firm-level outputs and general firm performance indicators (Clarysse et al., 2009). Other authors suggest assessing output additionality by either tangible output, intangible output and patent performance (Hsu et al., 2009) or in terms of marketable or commercial output (Falk, 2007).

In a more specific way, most authors suggest measuring the effects of public policy programs by the number of patents as a result of the downstream effects of R&D (Bach, Conde-Molist, Ledoux, Matt & Schaeffer, 1995; Georghiou, 2004; Czarnitzki & Licht, 2005; Aerts et al., 2006; Busom & Fernandez Ribas, 2008,). Patents are, due to their broad availability and their high standardization, a common measure of innovation output (Griliches, 1991). Thus, not surprisingly, patents are the most frequently used measure of output additionalities.

In the process of policy evaluation it has to be acknowledged that even if the measurement of patents gives an indication about the success of the funded R&D project, it only provides an intermediate picture which does not provide information about the profitability of the project (Salmi, 2012).

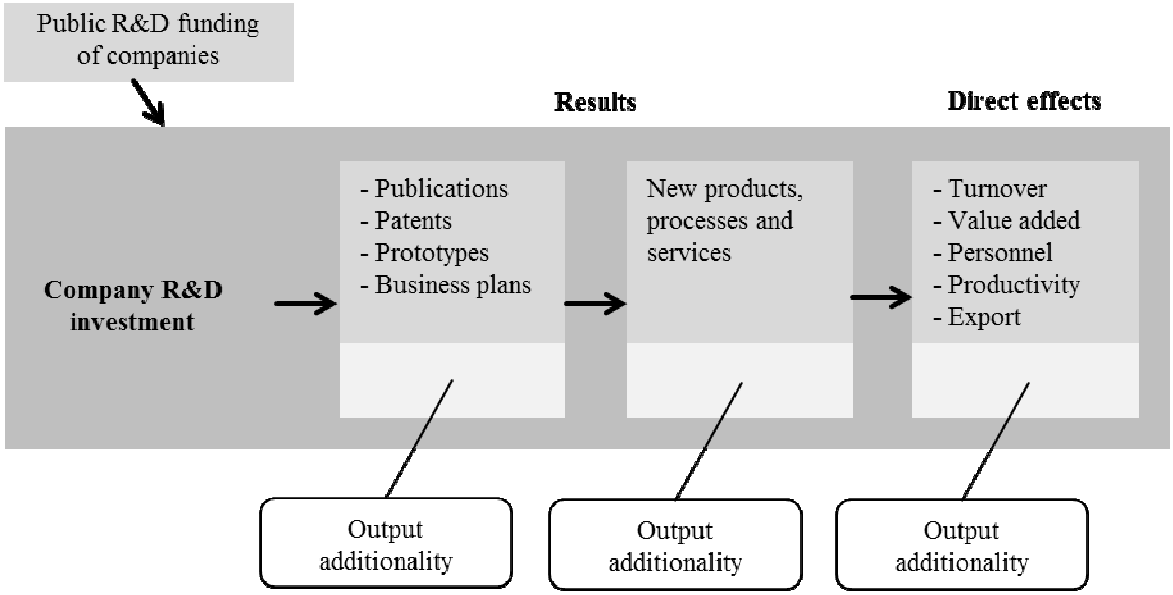

Figure 4: Output additionality (Tekes, 2006, translated by Hyvärinen 2010)

In addition to new patents, new products (Davenport et al., 1998; Georghiou & Clarysse 2006; Falk, 2007; Busom & Fernandez-Ribas, 2008; Gök, 2010), new processes (Bræin et al., 2002; Georghiou, 2004; Clarysse et al., 2009), new applications (Georghiou, 2004), new prototypes (Buisseret et al., 1995; Georghiou, 2002; Clarysse et al., 2009), new services (Bræin et al., 2002; Georghiou, 2004; Clarysse et al., 2009), new papers and publications (Buisseret et al., 1995; Georghiou, 2004; Clarysse et al., 2009), increased sales (Falk, 2007; Clarysse et al., 2009), improved image (Bach et al., 1995), increase market share (Davenport et al., 1998), innovation potential and improved profitability (Clarysse et al., 2009) are frequently mentioned in recent literature as indicators for innovative output. In the course of this thesis, the above mentioned measures are used as indicators of output additionality, which will be discussed in more detail in section 3.

The traditional additionality concepts that focus on the evaluation of input and the output factors of publically-funded innovation projects have generally been criticized because those approaches treat the firm as a black-box and neglect the process that happens within the firm (Gök, 2010). Figure 5 visualizes this black-box behavior. The concept behavioral additionality, which will be introduced in the following chapter, is an attempt to open this black-box and to discover the process that is taken place within the organization while conducting governmentally-funded innovation projects.

As mentioned earlier, public intervention addressed to reduce market failures is generally considered as unsuccessful if it does not create either input additionality or output additionality. This is labeled as the "narrow test of incrementality" by Lipsey and Carlaw (1998), whereas the term "incrementality" is the Canadian terminology for the concept of additionality. The authors state that a technology has to "(…) be developed or installed that would not have been developed or installed in the absence of the policy or program under consideration" (Lipsey & Carlaw, 1998, p. 13). It is acknowledged by the two authors that this assumption is only valid if the neoclassical approach is used to "confine the objectives of technology policy to achieving a targeted technological change" (Lipsey & Carlaw, 1998, p. 13) and that no other changes in the company are valid justification aspects for the policy objectives.

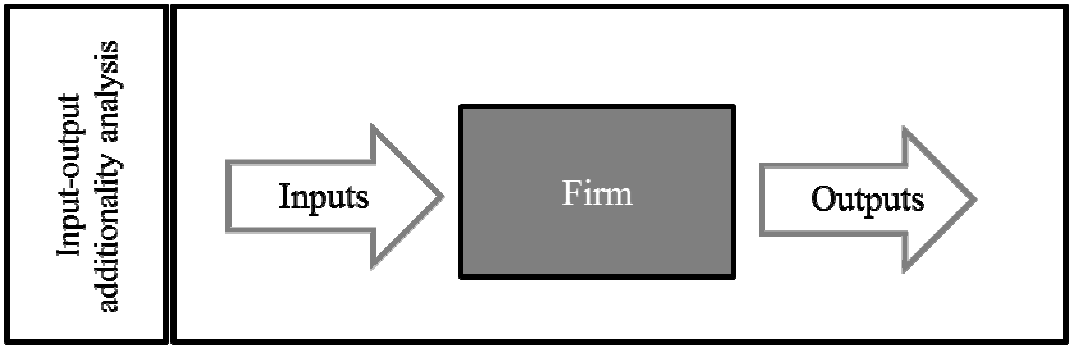

Figure 5: Input and output additionality analysis (Gök, 2010)

2.9. Behavioral additionality

In addition to the rather traditional concepts of additionality, the so called behavioral additionality concept has evolved and received considerable as well as growing scholarly attention over the last years. The traditional concepts of policy evaluation do not provide an adequate picture of the effect of governmental intervention on the process of R&D and innovation itself (Falk, 2007), since they mainly focus on the 'hard effects' of innovation policy programs (Madsen et al., 2008).

This focus on input and output additionalities in the evaluation of public policy programs leads to a situation in which a third and very important dimension is neglected, namely the learning effects that take place within the company while conducting a project funded by the policy program (Georghiou, 2002). Public support is not only intended to merely increase the private financial investment in R&D and innovation projects, it is also intended to improve innovative competencies, create managerial skills, build national knowledge and increase the innovative capacity (Rye, 2002). Further, R&D and innovation policies do not only have an impact on the business practices and processes of the supported company, but also on its external linkages (Salmi, 2012). Consequently are public R&D and innovation programs,

which contribute more to the goal of knowledge acquisition and diffusion, considered as more effective (Falk, 2007).

The behavioral additionality concept has been decisively coined by Buisseret et al. (1995), who introduced this perspective to broaden the additionality policy evaluation concepts by considering other aspects than the measurement of inputs and outputs of subsidized firms or projects. The behavioral additionality perspective is not directed to replace the two traditional concepts of input additionality and output additionality; it is rather directed to complement those two evaluation approaches (Georghiou & Clarysse, 2006) and to capture the effects of policy intervention in a more comprehensive way.

The concept of behavioral additionality can be defined as "(…) the difference in firm behavior resulting from the intervention" (Georghiou, 2004, p. 7) and the "(...) change in a company's way of understanding R&D which can be attributed to policy action" (Buisseret et al., 1995, p.). It is argued that the combination of changed company behavior and an increased importance for technology development might be a potential determinant for the R&D and innovation of the industry (Madsen et al., 2008). Falk (2007) classifies behavioral additionality as a concept of additionality that assesses the success of a government intervention by evaluating the innovative process itself.

Literature indicates that these changes in company behavior increase the competencies of the system and the involved actors, which are considered as the more important additionality effects (Larosse, 2004). These effects and those changes are more persistent since they are not only internalized by the involved actors but also because they might potentially be reproduced in the subsequent behavior of the participants.

Following Davenport et al. (1998), it is further believed that "(…) lasting improvements in a firm´s competitive ability would be highly desirable (…)" (p. 62) outcomes of government support and that these improvements might potentially be the most durable effect of a public policy intervention. Of a similar opinion are Aerts et al. (2006), who consider an increase in firm competence as stimulating for future R&D and innovation activities since an enhancement of the absorptive capacity of the supported organization is taking place.

This is especially of interest for policy makers since knowledge can be considered as an economic good, which is not wearing out in consumption (Larosse, 2004). Knowledge even grows with usage, contributes to cumulative growth and creates dynamic spillover effects for further innovation projects (Larosse, 2004). The persistence and the long-term effects of behavioral additionality are also of particular interest and vary significantly from the effects of input and output additionalities. The behavioral effects of a policy intervention are expected to persist beyond the time of the project, which is in contrast to the case of input and output additionalities, where the effects are expected to be at one certain point of time (Georghiou & Clarysse, 2006).

In an evaluation study of governmental-funded R&D consortia, Sakakibara (1997) found that the perceived benefits of employees who participated in supported projects are rather intangible, like researcher training and an increased awareness for R&D and innovation issues.

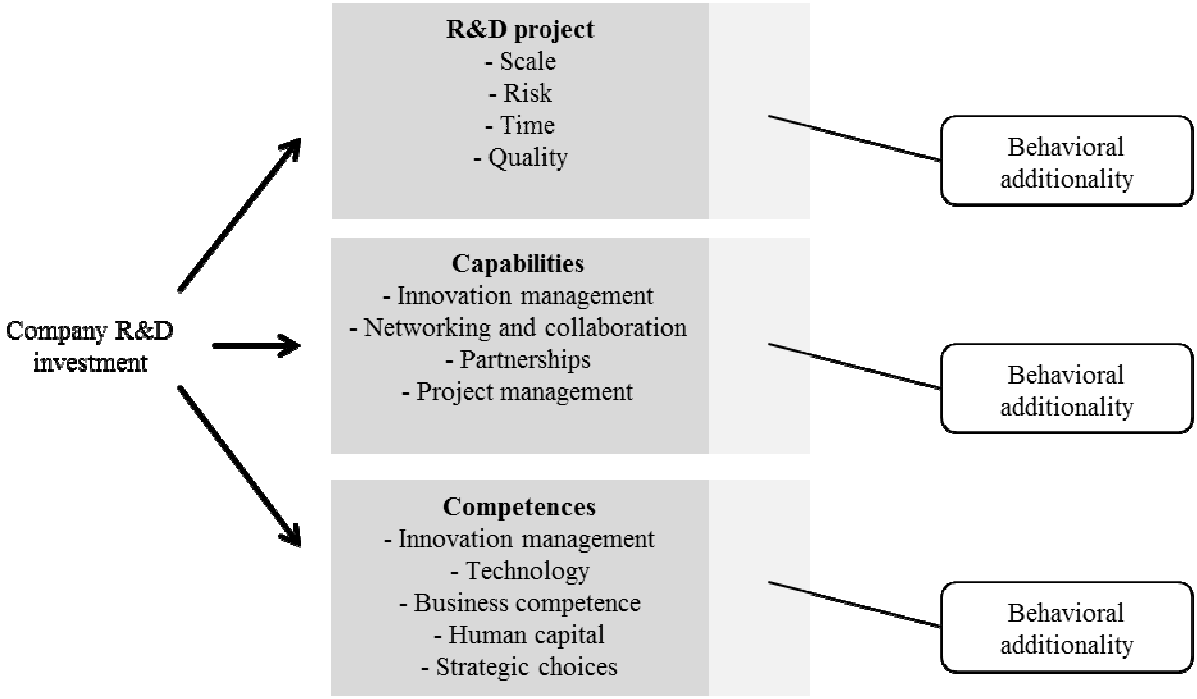

Figure 6: Behavioral additionality (Tekes, 2006, translated by Hyvärinen 2010)

Consequently, changes in company behavior are not only permanent of character, but it is also desirable changes: Changes for the better (Georghiou & Clarysse, 2006; Falk, 2007). Once successfully implemented, those changes in the companies behavior will lead to what Georghiou (2002) referred to as "(…) self-sustaining cycle of investment in innovation" (p. 62). The changes are not restricted to the particular project level, in which the project was conducted, they might also have an impact on the organizational level (Afcha, 2012).

As mentioned in the previous section, a public policy is only considered successful in terms of input and output additionality if it creates at least one of those two additionalities (Lipsey & Carlaw, 1998). The same principle applies to behavioral additionality. Only if the policy increases the innovative capacities of supported firms or their performance, it is considered as successful (Clausen, 2009).

Behavioral additionality is considered a complex concept consisting of several different aspects and should be measured by several different indicators (Rye, 2002). Consequently, the concept has been further refined by various authors in order to enable a more specific and systematic evaluation of the behavioral effects. These refinements of the concept are for example: scope additionality, scale additionality, cognitive capacity additionality, acceleration

additionality, challenge additionality, network additionality, follow-up additionality and management additionality (Bach & Matt, 2002; Larosse, 2004; Falk, 2004, 2007; IDEA Consult, 2006, 2009; Georghiou & Clarysse, 2006; Gök, 2010).

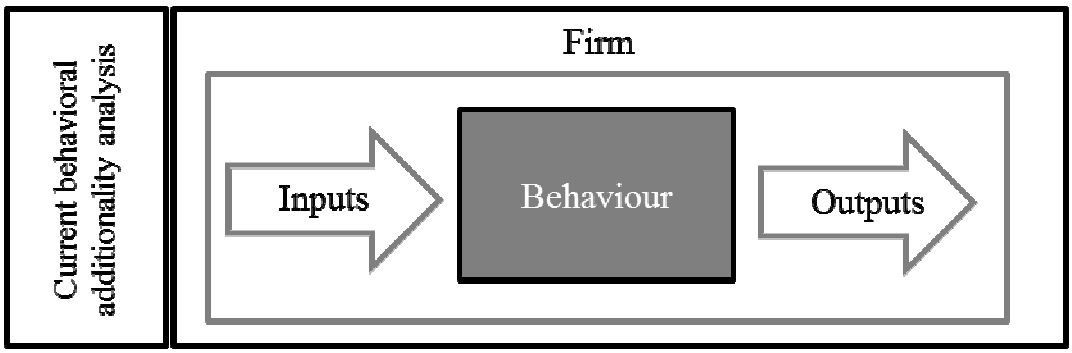

Figure 7: Current behavioral additionality analysis (Gök, 2010)

The various refinements are introduced and discussed in more detail in the following sections. Before the concepts are described, it has to be acknowledged that these different layers and distinctions of behavioral additionality are not always straightforward to separate and not always clear cut (Clarysse et al., 2009).

2.9.1. Project additionality

Project additionality is concerned with the most obvious way to evaluate public policy: Implementation or non-implementation of a project. It addresses the question whether a government incentive has resulted in a R&D or innovation project that would not have been conducted in the absence of a subsidy. This concept is discussed by Davenport et al. (1998), Falk (2004, 2007), Georghiou and Clarysse (2006), IDEA Consult (2009) as well as by Gök (2010). The concept has been defined as "(…) the situation in which a project would have been cancelled or not started, if public support had been rejected" (Wanzenböck et al., 2012, p. 67).

Following Lenihan and Hart´s (2004) conference paper about additionality effects in the Irish industry, the terms "pure project additionality" and "partial project additionality" have been established (Idea Consult, 2009). Pure project additionality describes the situation in which an R&D and innovation project is in the absence of any public support continued without changes, whereas partial project additionality describes the situation in which the presence of a public support changes the size or other characteristics of the project. Lenihan and Hart (2004) however, used the concept of full, partial and zero deadweight to describe the above mentioned concepts and to measure the "degree to which projects would have gone ahead anyway without financial assistance from a development agency" (p.3). The degree of deadweight should be measured in terms of time, location, scale or a combination of those factors.

2.9.2. Acceleration additionality

Acceleration additionality is about whether the participation in a public innovation program has an impact on the timely dimensions of the R&D and innovation projects. Some authors only describe the increased pace of project completion as acceleration additionality (Georghiou, 2002; OECD, 2006; Idea Consult, 2006; Gök, 2010), while others authors mention earlier starting dates, shorter implementation phases and earlier completion times as observable outcomes (Falk, 2007; Idea Consult, 2009). A fastened project duration is assumed to lead to a shortened time-to-market time which has a positive impact on the general competitiveness of the firm (Idea Consult, 2006).

2.9.3. Scale and scope additionality

Scale and scope additionality is basically about two closely related concepts. The first concept, scale additionality is about if government funding enables the company to conduct a project on a larger scale than previously intended (Wanzenböck et al., 2012). This concept is further discussed by Larosse (2004), Falk (2004, 2007), OECD (2006) and Gök, (2010). Idea Consult (2009) states that the scale additionality concept, in a certain way, describes "the gradual variant of binary defined project additionalities" (p. 8). The second concept, scope additionality is about if government funding enables the company to expand a project to a wider range than without the fund. This expansion can, for example, be reflected in a wider range of markets, applications or involved actors (Falk, 2007). The concept of scope additionalities has been discussed by Larosse (2004), Falk (2004, 2007), Georghiou and Clarysse (2006), Idea Consult (2006, 2009), Gök, (2010) and Wanzenböck et al. (2012). Since the close relation of those two concepts it is commonly treated as one manifestation of behavioral additionality.

2.9.4. Challenge additionality

Challenge additionality is about if government funding encourages the company to conduct more risky and challenging projects than previously and in the absence of a support intended. Conducting higher-risk R&D and innovation projects can enable companies to develop new competencies, which can be exploited in future innovation projects (OECD, 2006). The concept of challenge additionality has been discussed by OECD (2006), Idea Consult (2006, 2009) and Gök (2010).

2.9.5. Network additionality

Network additionality refers to the increased cooperation and networking resulting from government funding. It is concerned with the question whether the project would have been conducted in a less collaborative way in the absence of a government fund (Gök, 2010). The

concept has been discussed by Falk (2004, 2007), OECD (2006), Idea Consult (2006, 2009); Gök (2010) and Wanzenböck et al. (2013). Frier, Aschoff and Löhlein (2006) divide the concept into the following two dimensions:

- Diversification of cooperation: Does the government funding stimulate the organization to seek new R&D partnerships and does it change the firm´s cooperative behavior towards a more diversified set of partners?

- Continuation of R&D partnerships: Do the partnerships, which were initiated from a governmental subsidy, continue to exist after the funding ends?

Wanzenböck et al. (2013) did not use the term network additionality to describe this phenomenon, but the term cooperation additionality.

2.9.6. Management additionality

Management additionality is concerned with the improvement of management practices and routines as a result of the participation in publically-funded R&D and innovation projects (OECD, 2006). This concept considers the management capabilities of the subsidized firm separately (Idea Consult, 2009) and especially looks at the changes made by the program. These changes made by the government fund "(…) could result in further participation in government programs, changes in organisational structures for conducting R&D or commercialising results, and different management strategies" (OECD, 2006, p. 31). The concept has been discussed by Georghiou and Clarysse (2006), OECD (2006), Idea Consult (2006, 2009) and Gök (2010).

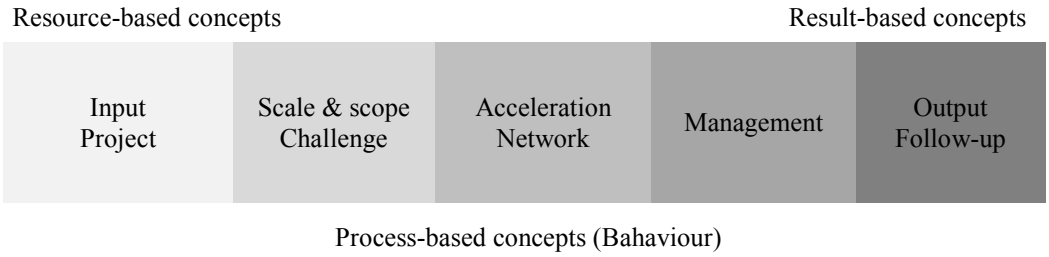

Figure 8: Additionalities in resources, processes and results (based on Falk, 2007)

2.9.7. Follow-Up additionality

Follow-up additionality is related to spin-off projects which are created because of the government support (Gök, 2010). More specifically speaking, it describes the situation in which pubic support increases the probability to establish follow-up projects (OECD, 2006). The concept has further been discussed by Idea Consult (2006, 2009), (Gök, 2010) and

Cunningham et al. (2012). The concept of follow-up additionality is especially important regarding the sustainability of innovation projects (Gök, 2010).

Figure 8 illustrates how the above introduced and discussed manifestations of behavioral additionality are situated between the resource-based and the result-based additionality concepts.

2.9.8. Cognitive capacity additionality

Also the concept of cognitive capacity additionality has been mentioned by several authors. Bach and Matt (2002) define it as the "(…) changes the different dimensions of the cognitive capacity of the agent" (p. 6) and consider it, besides input additionality, output additionality and behavioral additionality, as a fourth main concept of additionality.

In a very recent study, Knockaert, Spithoven and Clarysse (2013) label it as "the positive impact on competencies, expertise and networks" (p.3). The authors consider cognitive additionality as a form of the behavioral additionality concept, which can be further divided into the two sub-categories network additionalities and competence additionalities.

Other authors' view the cognitive capacity dimension as what by many authors has been labeled as behavioral additionality (Clausen, 2009; Gök, 2010; Gök & Edler, 2012). Falk (2007) considers it as one manifestation of behavioral additionality, which is similar to the concept of scale additionality.

Because of the different perceptions of cognitive capacity additionality, the scholarly disagreement about the concept and the close relation to the already existing concepts, it will not be used in this research. Although this study acknowledges the importance of the cognitive capabilities of the agents, it is believed that the existing concepts are broad enough to cover the idea of cognitive capabilities.

During project implementation	After project implementation
- Project additionality	- Network additionality
- Acceleration additionality	- Follow-up additionality
- Scale & scope additionality	- Management additionality
- Challenge additionality	

Table 2: Behavioral additionality in relation to time (Gök, 2010)

As mentioned earlier, one reason for the increased scholarly interest in behavioral additionality is the persistence of the concept, compared to input and output additionality

(Idea Consult, 2009). Davenport et al. (1998) stated that the "modified behavior is likely to strengthen a policy's latent ability to influence the creation of output additionality" (p. 55) and also Georghiou (2002) assumed that behavioral additionality effects persist beyond the R&D project in the form of integrated capabilities of the company. As a consequence, another categorization of the layers of behavioral additionality has been made by Gök (2010). The author categorized the manifestations based on the time period of the behavioral changes within the organization. Gök distinguished between behavioral changes during the project implementation and after the project implementation. See table 2 for an overview.

The current chapter introduced the relevant theoretical aspects for this study, centered around the concept of additionality and its manifestations. In the later course of this reserach, the input additionality and the output additionality concept as well as the behavioral additionality concept, with its various manifestations, will be used to measure in impact of the governmental funding on the R&D and innovation projects of the case company. The introduced concepts will provide the structure for a systematic identification of the particular effects of the public funding. The following chapter will provide insights about the methodology of this research.

3. Method

There are quantitative as well as qualitative approaches to the assessment of the various additionality effects introduced in the previous chapter, each with specific advantages and disadvantages (Idea Consult, 2009).

Quantitative, econometric approaches have in particular been popular to assess of input and output additionalities. Typically, these empirical analyses compare a situation in which government funding was received with a situation in which a public funding was absent. According to Idea Consult (2009), such a comparative analysis:

> *"(...) can be executed inter-temporally for a single company (before, during and after the support), at one single moment comparing information on several projects and companies (cross-section) or inter-temporally comparing information on several projects and companies (panel-data). Concerning the vision on empirical evidence, we can make a distinction between facts (objective approach) and interpretations (subjective approach)"* (p. 76).

However, it is particularly difficult to assess the concept of behavioral additionality by using standard econometric measures, which is why most evaluations of the concept are based on qualitative techniques (Idea Consult, 2009). As a consequence, the additionality effects of governmental funding of the case company in this study are assessed by using qualitative measures. The subsequent parts will outline which research design has been used as well as present issues regarding data selection, collection and analysis, as well as how the findings will be presented in the later course of this study.

3.1. Research design

In order to analyze the additionality effects of the case company, a qualitative, cross-sectional research has been conducted. A cross sectional study "involves observations of a sample, or cross section, of a population or phenomenon that are made at one point of time" (Babbie, 2007, p. 106). Information from various R&D and innovation projects of the case company has been collected at one specific point in time, namely from November till December 2013.

A qualitative analysis has generally the advantage that it is richer in meaning than quantitative data (Babbie, 2007) and it is best suited to deal with complex social situations, since qualitative data is rich and detailed (Denscombe, 2010).

Babbie (2007) defined die concept of qualitative analysis as: "(t)he nonnumerical examination and interpretation of observations, for the purpose of discovering underlying meanings and patterns of relationships" (p. 394). Qualitative research is aimed at exploring complex sets of factors surrounding a central phenomenon and to describe the various perspectives of the

involved participants (Creswell, 2009). Consequently, this approach is particularly suiting to assess the additionality effects of a particular company, as intended in this research.

3.2. Data collection

Qualitative, semi-structured interviews with project managers of the airline group, who executed at least one subsidized R&D or innovation project, have been conducted.

Interviews are best applied to explore rather complex as well as subtle phenomena and when the researcher wants to gain insights into the participant's opinions and experiences (Denscombe, 2010). Further, Denscombe (2010) states that interviews are suited to obtain information about sensitive issues and to receive privileged information from key participants of a phenomenon with high intricacy.

Also in the policy evaluation practice, interviews with participants are considered a suitable data collection method. Polt and Rojo (2002) state that interviews are a quick and low cost method which can not only provide rich information, but can also reveal insights which have originally not been assumed. As limitations they mention the difficulty to code and analyze the data and the difficulty to compare across different interviews. Interviews can in particular be very suitable for evaluating economic micro and economic meso issures (Georghiou, Rigby & Cameron, 2002) and can provide the interviewer with "significant depth and understanding of effects which cannot be known in advance" (Georghiou et al., 2002, p. 208).

In a later work, Georghiou (2004) states regarding the concept of additionality and its evaluation:

> *"The complexity of the additionality issue and the present level of understanding of its manifestation in reality mean that its measurement should be addressed by means of in-depth case studies and interviews which seek to reconstruct the decision-making process around a project and the subsequent behaviour of the firm in comparison with the counterfactual"* (p. 14).

Data method	Strengths	Limitations
Interviews and case studies	Quick implementation and low costs	Difficulty to code and analyze responses to open-ended questions
	Provides rich contextual information	Difficulty to compare across interventions
	Reveal project issues originally not thought	Conduct of interviews requires expert staff

Table 3: Strengths and limitations in data collection (Polt & Rojo, 2002)

Literature further indicates that in particular face-to-face interviews are an excellent method of data collection to reconstruct the innovation process of large companies (Clarysse et al., 2004) and that verbal reports of recipients of government funding are a widely used method to measure additionality (Rye, 2002). Consequently, interviews are a suitable and adequate method to assess the effects of governmental funding and to measure the additionality effects of the case company as well as to gain in-depth knowledge.

3.2.1. Questionnaire guide and interview protocol

Prior to the interview sessions, generally one or two days before the appointment, a general overview of the topic and a rough version of the questionnaire guide have been made available to the participants. These pre-information-documents were designed to give the respondents an impression about the topic and the respective questions. It was particularly indicated that this questionnaire was designed to be used as a reference and not to answer the questions beforehand. This approach has also been used by Clarysse, Bilsen, Steurs, and Larosse (2004), who conducted a similar study about additionality effects and provided their interview partners with a questionnaire guide prior to the interviews as well. Their interview partners indicated afterwards that it was very helpful, due to the complexity of the themes, to have the guide available. The interview guide used for this thesis can be found in appendix 7.1.

A more detailed version of the abovementioned interview guide has been used during the sessions by the researcher as an interview protocol in order to give the interviews a certain structure. During the sessions, in which the topic changed naturally to another direction or in which respondents answered questions straight away without being asked, the interview guide enabled the researcher to keep track and to maintain the contextual overview.

3.2.2. Data recording

Another essential step in the data collection process and a prerequisite for a solid data analysis is an adequate data recording technique. It is commonly accepted that "(…) whenever possible, field observations should be recorded as they are made" (Babbie, 2007, p. 329). Consequently, all in-depth interviews with the project managers have been, with the consent of the respondents, recorded digitally in order to enable the best possible and most precise evaluation of the collected information.

3.2.3. Transcription and anonymization

When a qualitative research is conducted, which involves the collection of recorded in-depth interviews, it is necessary to decide whether the analysis of the data is best supported by using transcripts or by notes derived from the review of the audio files (Patton, 2002).

In order to enable the best possible analysis of the data collected during the interview sessions, all interviews were transcribed shortly after the recording to maintain the research momentum and to provide a permanent document of the qualitative data which is utilizable for further analysis.

In the process of transcribing interview data, the researcher has to decide how detailed the recorded data should be converted into a textual document. As McLellan, MacQueen and Neidig (2003) pointed out "(a)t some point, a researcher must also settle on what is transcribed. The phrase "settle on" has been deliberately selected because despite all best intentions, the textual data will never fully encompass all that takes place during an interview" (p. 65). The researcher's decision about what will be transcribed and what will be left out can be considered as the first step of the data reduction process (Miles & Huberman, 1994). For instance the researcher has to decide whether the textual form of the transcript should include nonlinguistic observations like body language and facial expressions as well (McLellan et al., 2003) or if these observations are not necessarily relevant for the research context.

Due to the timely restraints of this study and the contextual circumstances of the research an intelligent verbatim transcription[4] was used; the informational content of data was given priority, unnecessary filters were cut out and the rest left as it was spoken. The transcription was aimed at capturing what was stated by the respondents and not how the respondents exactly did it. The interviews were transcribed in the native language of the country the case company is situated in and only extracts where translated and used during the later course of this research as quotes to support the discussion.

In the process of transcription, the obtained data was processed anonymously in order to protect the privacy of the participants and to conceal confidential aspects of the case company. These confidential aspects might include aspects like project details, financial details and organizational issues, which do not have relevance for the manifestations of additionality researched in this study.

3.2.4. Case selection and sampling

Sampling procedures are a topic of rigid discussion in quantitative research. In qualitative research on the other hand, the topic has not received broad attention and prescriptions are rather scarce (Coyne, 1997). In quantitative research, the goal generally is to select a representative sample from the population, so that the findings of that sample can be generalized back to the population it was taken from (Marshall, 1996). However, this is not necessarily the case in qualitative research.

In qualitative research the researcher has to be aware of the objective of the study before decisions about which participants to select for inquiry and how to select the sample, are

[4] http://www.transcriptioncity.co.uk/verbatim-transcription, Retrieved: February 06, 2014

made (Onwuegbuzie & Leech, 2007b). Determining the sample in qualitative research is a determining factor since it has a profound impact on the overall quality of the study (Coyne, 1997). The researcher has to be aware whether the objective of the study is to generalize the interpretations or findings back to the population or if the objective is to obtain certain insights into a phenomenon or individuals and not to generalize these findings (Onwuegbuzie & Leech, 2007a). The authors claim that the objective of the study is decisive for the qualitative sampling process, which can either be based on random sampling or on non-random sampling.

Population	All subsidized R&D and innovation projects of the case company of the last five years
Units	Sample of publically supported R&D and innovation projects of the case company
Sample	Managers of publically supported R&D and innovation projects of the case company

Table 4: Population, Units and Sample (based on Folkestad, p. 11)

If the objective is to generalize the findings, Onwuegbuzie and Leech (2007b) recommend using large and random samples. If, on the other hand, the objective is to gain insight into certain phenomena, individuals or events, the authors suggest purposefully selecting cases and settings which yield the maximum understanding of the phenomenon. This method of purposeful sampling is considered the most common method of sampling in qualitative research (Onwuegbuzie & Leech, 2007b). In a purposeful sampling process, instances are selected for analyses which are assumed to be "information rich" (Patton 2002, p.169). Based on Miles and Huberman (1994), Onwuegbuzie and Leech presented an extended list of 24 sampling strategies for qualitative research, which is presented in Table 5 (2007b).

Two factors significantly influenced the sampling process of this study. First, the large organizational size of the case company and the division into several sub-companies on multiple locations significantly complicated the identification of publically-funded R&D projects. Second, the non-centrality of administrative issues concerning governmental-funded R&D projects. As mentioned earlier, on a group level, only very limited efforts concerning the centralization of all publically-funded R&D in the form of administration were present. The preformed projects were mostly initiated and conducted by the particular project managers themselves. No overview of all publically-funded projects was available. Consequently, the researcher had to actively inquire information about innovation projects and potential interview partners. The combination the decentralized structures of the company in combination with a non-existence of centralized knowledge concerning the distribution of subsidized R&D projects, made the identification and the access to the projects a difficult and time-consuming process.

Since no exact and reliable information about the total population of subsidized innovation projects was available, it was not possible to apply a random sampling technique. Consequently, the most common form of qualitative sampling methods (Onwuegbuzie &

Leech, 2007b), a purposeful sampling technique, was used. In particular, a non-random sampling approach, which shows elements of several sampling techniques proposed by Onwuegbuzie and Leech (2007b), was applied.

In practice, the researcher received the names of several of employees involved in innovation and public-funding issues of one of the sub-companies of the airline at the beginning of the study. In several meetings with those experienced employees, a list of approximately 20 potential interview partners and innovation projects was created. These potential project managers were contacted and asked about their willingness to participate in the study. During the first interview sessions, the participants were asked about other project managers who might potentially be participants for the study. As a result, five more project managers were contacted and asked for their willingness to participate in the research. After the positive replies reached a count which promised sufficient data saturation, the researcher stopped actively searching for more potential candidates and conducted the remaining interview sessions.

The approach described above comprises several elements of the different non-probability sampling techniques, introduced by Onwuegbuzie and Leech (2007b):

- *Homogenous sampling*, which "(…) involves sampling individuals, groups, or settings because they all possess similar characteristics or attributes. Participants are selected for the study based on membership in a subgroup or unit that has specific characteristics" (Onwuegbuzie & Leech, 2007b, p. 112). The interview partners selected for this study all process the same characteristics that they are employees of the airline group and that they have conducted a subsidized R&D or innovation project during the last five years. However, and despite the project managers homogeneity in terms of those attributes and characteristics, they are not homogenous in terms of business areas and their specializations. As mentioned earlier, the R&D projects performed by the respondents are very diverse and from a variety of different business fields. Consequently, the sample shows a wide variety of different projects.

- *Snowball sampling*, which is sometimes labeled network sampling, involves asking participants of the study about other potential respondents. This approach was especially useful at the beginning of the study, since not all interview sessions have been scheduled at that point of time and not much information or details haven been known about other projects within the airline group.

- *Convenience sampling*, involves "(…) selecting individuals or groups that happen to be available and are willing to participate at the time" (Onwuegbuzie & Leech, 2007b, p. 114). A certain degree of convenience sampling is apparent in many studies (Marshall, 1996) and also in this study a certain degree of convenience sampling was used. Bound by the timely restraints of this study, not all potential innovation projects, which were conducted during the past five years, have been identified. After the list of

potential participants reached a count which promised a sufficient data saturation, the researcher stopped actively searching for more potential candidates.

Random (probability) sampling	Non-random (purposeful) sampling
Simple random sampling	Maximum variation sampling
Stratified random sampling	Homogeneous sampling
Cluster random sampling	Theory-based sampling
Systematic random sampling	Critical case sampling
Multi-stage random sampling	Snowball sampling
	Extreme case sampling
	Typical case sampling
	Confirming and disconfirming cases sampling
	Intensity sampling
	Politically important sampling
	Random purposeful sampling
	Stratified purposeful sampling
	Criterion sampling
	Opportunistic sampling
	Mixed purposeful sampling
	Convenience sampling
	Quota sampling
	Multi-stage purposeful random sampling
	Multi-stage purposeful sampling

Table 5: 22 sampling schemes for qualitative research (Onwuegbuzie & Leech, 2007b)

The non-identification of the exact population of publically-funded R&D projects has certainly an impact on the representativeness of this study. The knowledge about the overall population and sufficiently large samples significantly increases the representativeness and underlines the results of studies. However, even at the end of the study, no exact and reliable information about the total population of all subsidized innovation projects was available. The time in the case company, however, and the frequent discussions with project managers provided a rough idea about the overall number of publically-funded R&D projects, which probably varies between 40-60 innovation projects over the last 5 years.

In the selection process of the cases, no decisions were made by the researcher based on any particularities of the certain projects. More specifically, no project was considered suitable or not suitable for this study because of the context, the content or issues regarding the success or non-success of the project. Overall, the selected projects cover a broad range of activities preformed in the group. The content of the projects vary from environmental issues to various process-optimizations and from component-modifications to strategy-evaluations.

The described sampling method and the non-identification of the overall population might have several potential influences on this study and might create several biases. It is possible that the consulted innovation employees, who were the starting point of the research and the project managers, only recommended projects which were particularly interesting or successful. Unsuccessful projects or projects which are less interesting might not be very prominent and consequently not known by many employees. This could result in a situation in which only the rather successful projects were sampled and the rather unsuccessful and less interesting projects were neglected. This certainly would have a severe impact on the findings of the study since it would provide a different, more successful picture of the prevailing situation.

Second, the non-identification and the recommendations of the employees might have resulted in a sample which does not adequately reflect the overall content situation of all publically-funded R&D projects. As mentioned above, the selected projects cover a very broad range of different activities. However, it is possible that all the remaining projects, which were not sampled, are, for example, component-modification projects only. Consequently, a selection which only includes a minor part of projects focused on component-modification, does not adequately represent the overall population. Again, this would have significant influences on the results of this study, since the sample would not be comparable with the overall population. These uncertainties, and the fact that potential bias might arise from that, have to be acknowledged.

The sampling method applied in a study certainly has a significant influence on the results of the study and how generalizable those findings are. The concept of generalizability, which is a common evaluation method in quantitative research, is often referred to as transferability in qualitative research, which is discussed in more detail in section 3.2.3.

3.3. Sample size

The question of how many interviews are required during a qualitative research has been discussed in various scholarly works (Marshall, 1996; Guest, Bunce & Johnson, 2006; Onwuegbuzie & Leech, 2007a; Baker & Edwards, 2013). In the simplest terms, the "appropriate sample size for a qualitative study is one that adequately answers the research question" (Marshall, 1996, p. 523). According to Onwuegbuzie and Leech (2007), the sample size should not be too large since it becomes more difficult to extract thick and rich data from it. The term theoretical saturation or data saturation is frequently used in literature to describe the moment of a qualitative study in which no new additional data can be found (Marshall, 1996). In a study involving 60 in-depth interviews, Guest et al. discovered that after twelve interviews, the saturation reached 92% in terms of codes created from the obtained data (2006). In a review paper, Baker and Edwards asked 14 renowned scientists and five early career researchers from different social science disciplines the question of "how many" and found varying recommendations, mostly in the range of 12-20 interviews (2012). In this

research, a total of 16 interview sessions have been held with a total of 18 project managers about a total of 18 projects. After approximately 10-12 interviews, the interviews mostly resulted in similar findings, which is an indicator of a sufficient level of data saturation.

3.4. Problems with measurement

Although the concepts of additionality are rather straightforward concepts in theory, they have some conceptual implications and are not straightforward to identify (Polt & Streicher, 2005). The evaluation and the assessment of the stimulated additional R&D efforts, manifested in the forms of input, output and behavioral additionality, is a difficult process (Rye, 2002).

According to Larosse (2004), the two most known problems of evaluation practice are problem of 'counterfactual' evaluation and problem of 'attribution' of cause and effect.

The problem of counterfactual evidence and the hypothetical question of "what would have happened to the firm, in case of an opposite funding decision" (Peneder, 2008, p. 523) has been discussed by various authors (Klette et al., 2000; Rye, 2002; Larosse, 2004; Lööf & Heshmati, 2005; OECD, 2006; Gök, 2010). Larosse (2004) states that the problem of counterfactual evidence is "inevitable because time is irreversible and conditions are never completely comparable between a situation with and without a subsidy" (p. 66). Consequently, the situation is hypothetical and not straightforward to answer for the interview partners. Further it is possible, that the lack of counterfactual evidence might result in false answers since the respondents do not know what would have happened in the hypothetical situation (Rye, 2002).

The problem of counterfactual evidence, as well as the fact that the respondents cannot know for certain what would have happened without a subsidy, has to be acknowledged. The respondents simply cannot know for certain what would have happened if they had not received government funding. However, this study is a qualitative study and is focused rather on the participant's subjective assessment of the benefits resulting from public funding. Consequently, this research is more an attempt to measure the project manager's experiences as well as the perceived benefits and not necessarily the hard facts. If the goal of this study would have been to measure and evaluate the hard facts and the tangible results of public funding on the innovation projects of the case company, a different research method would have been required. In this case the use of econometric research methods would have been more advisable and suiting to the research purpose.

The second problem mentioned by Larosse (2004), namely the problem of attribution, is concerned with separating one certain impact, in the form of a government fund, in a multi-causal phenomenon. It is not always straightforward to define which effects to measure and how to attribute them to a particular public policy program (Georghiou & Clarysse, 2006). On the one hand, it has to be acknowledged that it is not always possible to directly attribute particular outcomes of innovation projects to potential causes in the form of a subsidy. On the other hand, it also has to be acknowledged that the participation in a publically-sponsored

innovation program might contribute to other R&D projects than originally intended, which might even not be closely related to the initial project.

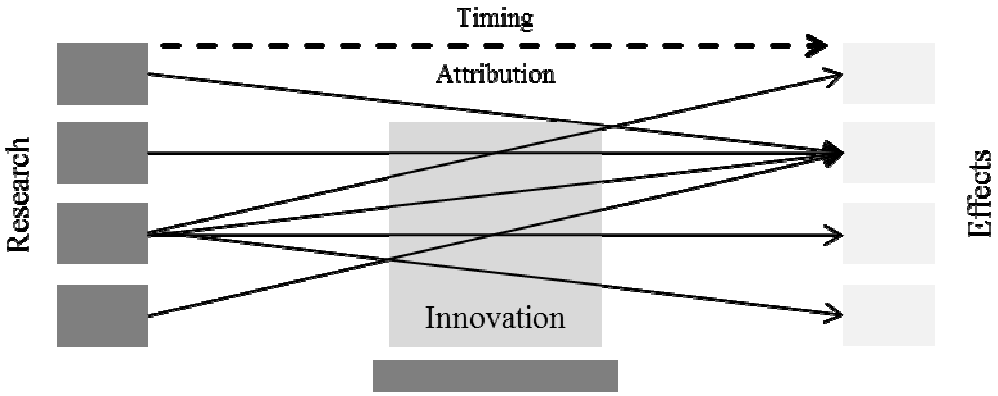

Figure 9: Attributing problems in calculating returns to R&D (Georghiou, 2002)

These issues have to, as the problem of counter-factual evidence, be acknowledged. The effects of R&D projects are not always and necessarily traceable to particular research activities or research budgets. For example, the results of a project, which might be considered very unsuccessful, might yield an important or even decisive contribution to another R&D project which is preformed subsequently at the same department or somewhere else in the subsidized organization.

Other issues in the evaluation procedure are that self-assessment reports have been criticized for various reasons (Clausen, 2009) and that the possibility of upward bias in the assessment of the various levels of additionality has to be considered (Davenport et al., 1998). Davenport et al. (1998) assume that manager's responses are subjective and possibly biased. The first reason for this is that managers might not want to concede that their department was incapable of conducting the innovation project without governmental support (Davenport et al., 1998). The second reason for upward bias is that managers might be inclined to over-estimate the levels of additionality to increase the probability to receive further funding in the future (Davenport et al., 1998; Klette et al., 2000; Clausen, 2009)

This issue has also been addressed by Sakakibara (1997), who conducted a study about publically-funded R&D consortia in Japan and concluded that the potential for biased responses is minimal, since "(t)he respondents, however, are R&D managers who do not necessarily negotiate with the government directly" and since the interview partners do not "(…) expect their questionnaire responses to directly affect governmental decision making" (p. 460). The findings of Sakakibara were also confirmed by Rye (2002), who conducted a study on the reliability of verbal reports to measure additionality using data from 12 evaluation studies from two decades of Norwegian evaluation studies including 2624 interviews. The author concluded that the above described problem of strategic answering is overrated and that verbal reports can provide important evidence and feedback to the efficiency of innovation policy programs.

Since the study is conducted from within the company and not by a governmental-funding authority, the interview partners have no reason to assume that their decisions will directly affect governmental funding decisions of the future. However, their answers might be biased in a similar way because of the researcher's origin in the innovation department. The innovation department does not have a direct influence on the decision-making process of the departments, which are conducting the R&D projects, as well as on any related funding decisions. However, the project managers might be inclined to strategically answer the questions during the interview sessions in order to avoid any potential form of negative repercussions related to their responses. On the other hand, it is also possible that minor problems concerning the public funding process, which are apparent within the organization, are widely overstated in order to obtain a faster solution of those issues.

The issues and potential problems discussed previously are apparent in this study and have, without a doubt, to be acknowledged. The current part is an attempt to identify and reflect about the potential problems and difficulties, as well as to provide the reader with a sufficient level of understanding about those issues. Despite the difficulties discussed above, are qualitative assessments in the form of qualitative interviews, a valid method to assess the effects that government subsidies have on project behavior of the case company.

3.5. Interview content

In order to obtain the required information from the project managers of R&D and innovation projects about how the additional effects manifest in practice in a structured way, Table 6 has been created. The different types of additionality, with their respective indicators are listed and the associated literature is opposed. In addition, the corresponding interview questions listed in the interview guide (see appendix 7.7.1 for the guide) are also included in the table. The subsequent chapter is focused on the data analysis and related issues regarding this process.

3.6. Data analysis

Qualitative data has "(...) to be collected, processed and filed in a way that makes them amenable for analysis" (Denscombe, 2010, p. 274) before it can be used for research purposes.

In the data analysis step, the gathered information has to be prepared for analysis, different analysis have to be conducted, data has to be prepared for presentation and finally the information has to be interpreted (Creswell, 2009).

The analysis phase is considered to be a continuous process, which cannot easily be distinguished into the collection, reduction and analysis phases from one other (Folkestad, 2008). It is rather an ongoing process. According to Folkestad (2008), this is due to the

Type of additionality	Indicators	Corresponding interview questions	Literature
Input additionality			
	Financial investment	A1	Georghiou, 2002, 2004; Davenport et al., 1998; Rye, 2002; Bræin et al., 2002;
Output additionality			
	New patents	B1	Buisseret et al., 1995; Bach et al., 1995; Georghiou, 2002, 2004; Czarnitzki & Licht, 2006; Falk, 2007; Busom & Fernandez Ribas, 2008; Clarysse et al., 2009;
	New products	B2	Buisseret et al., 1995; Bræin et al., 2002; Georghiou, 2004; Clarysse et al., 2009;
	New processes	B3	Bræin et al., 2002; Georghiou, 2004; Clarysse et al., 2009;
	New applications	B4	Georghiou, 2004;
	New prototypes	B5	Buisseret et al., 1995; Georghiou, 2002; Clarysse et al., 2009;
	New services	B6	Bræin et al., 2002; Georghiou, 2004; Clarysse et al., 2009;
	New papers or publications	B7	Buisseret et al., 1995; Georghiou, 2004; Clarysse et al., 2009;
	Increased sales	B8	Falk, 2007; Clarysse et al., 2009;
	Improved image	B9	Bach et al., 1995;
	Increased market share	B10	Davenport et al., 1998;
	Increased competitiveness	B11	Lukkonen, 1998; Davenport et al., 1998;
	Innovation potential	B12	Georghiou & Clarysse, 2006;
	Improved profitability	B13	Clarysse et al., 2009;
Behavioural additionality			
	Project additionality	C1	Buisseret et al., 1995; Davenport et al., 1998; Rye, 2002; Falk, 2004, 2007; Georghiou & Clarysse 2006; Gök, 2010; Wanzenböck et al., 2012; Cunningham et al., 2012;
	Acceleration additionality	C2	Georghiou, 2002; Larosse, 2004; Falk, 2004, 2007; Georghiou & Clarysse; 2006; Idea Consult, 2006, 2009; Gök, 2010; Cunningham et al. 2012;
	Scale & scope additionality	C3 & C4	Georghiou, 2002; Larosse, 2004; Falk, 2004, 2007; Georghiou & Clarysse; 2006; Idea Consult, 2009; Gök, 2010; Wanzenböck et al., 2012; Cunningham et al. 2012;
	Challenge additionality	C5	Falk, 2004, 2007; Georghiou & Clarysse, 2006; Idea Consult, 2006, 2009; Gök, 2010; Cunningham et al., 2012;
	Network additionality	C6	Falk, 2004, 2007; Georghiou & Clarysse, 2006; Idea Consult, 2006, 2009; Gök, 2010; Ropter & Hewitt-Dundas 2012; Wanzenböck et al., 2012, Cunningham et al., 2012;
	Management additionality	C7	OECD, 2006; Idea Consult, 2006, 2009; Gök, 2010; Cunningham et al., 2012;
	Follow-up additionality	C8	Falk, 2004, 2007; Georghiou & Clarysse, 2006; Idea Consult, 2006, 2009; Gök, 2010; Cunningham et al., 2012;

Table 6: Types of additionality, their indicators, responding questions and literature

interaction of the researcher with the participants and with the research tools, which broadens the experience of the researcher and increases his data collecting skills.

The analysis phase is considered to be a continuous process, which cannot easily be distinguished into the collection, reduction and analysis phases from one other (Folkestad, 2008). It is rather an ongoing process. According to Folkestad (2008), this is due to the interaction of the researcher with the participants and with the research tools, which broadens the experience of the researcher and increases his data collecting skills.

In order to ensure a structured analysis of the interview data, the following research process, as suggested by Creswell (2001) has been used:

- Step 1: Data organization and preparation
- Step 2: Reading through the data
- Step 3: Coding of Data
- Step 4: Creation of categories and themes
- Step 5: Presentation of the qualitative narrative
- Step 6: Interpretation

The data analysis process suggested by Creswell is also visualized in Figure 10.

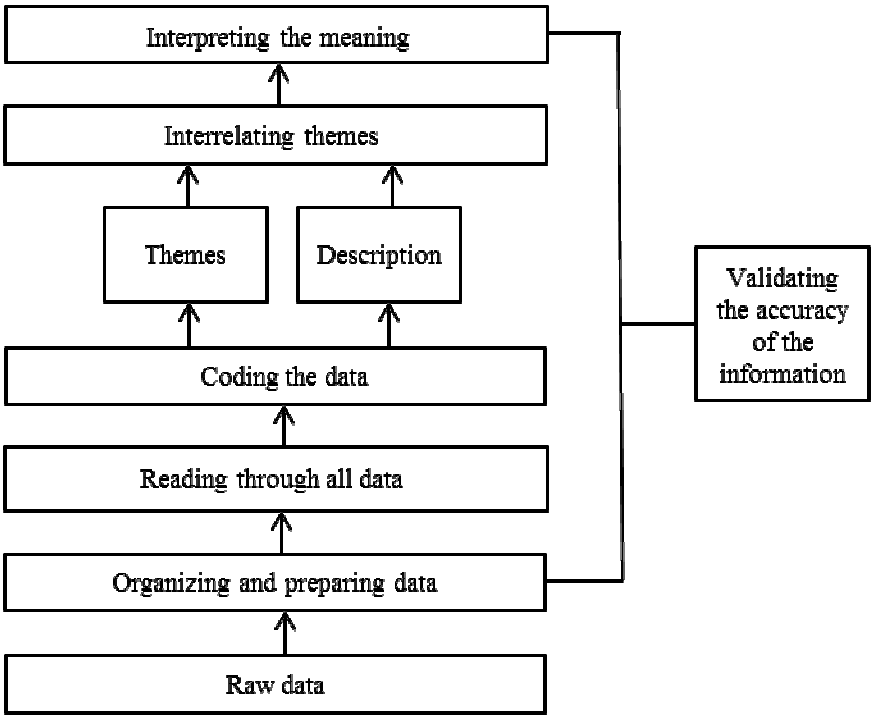

Figure 10: Data analysis in qualitative research (based on Creswell, 2009, p. 185)

Following the recommendation given by Crewsell, the data collected during the interviews in the form of raw audio taped recordings was transcribed, organized and prepared for further

analysis. After the repeated review of the transcripts the actual coding was performed. Some of the codes originate from the studies reviewed during the literature review and the remaining codes emerged during the interviews, as described in more detail in the following section.

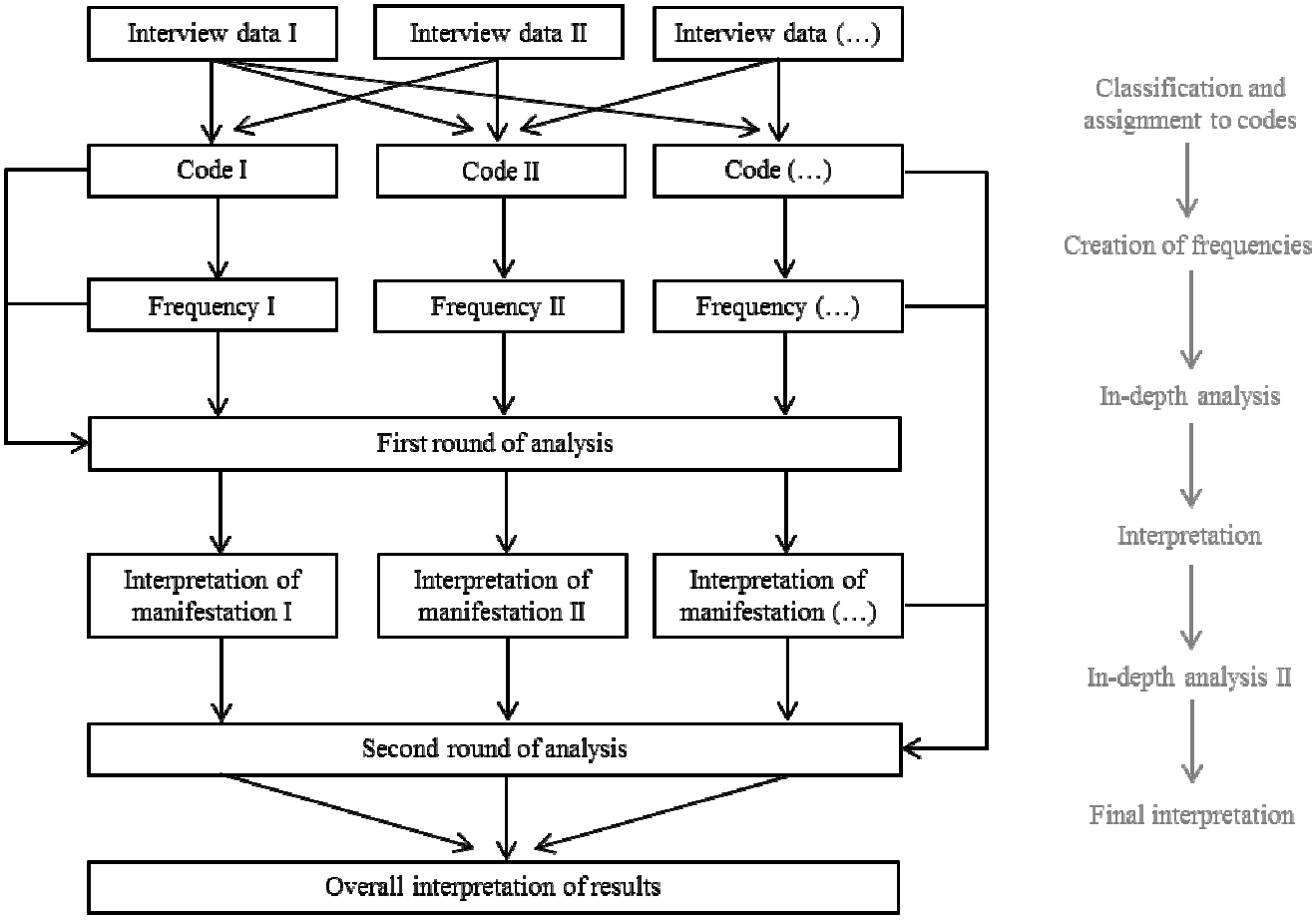

Figure 11: Interpretation process

In the main step of analysis, the interview transcripts were reviewed again and the statements of the respondents were classified and assigned to the codes created for the codebook. The accumulated counts, in the form of frequencies of the particular codes, provided a first impression about the results and served as a starting point for in-depth analysis. This procedure was also recommended by Idea Consult (2009), who state "(b)y means of frequency tables one can easily assess to which extent a certain type of behavioral additionality is realized" (p. 77). After the counts and the simple frequency tables provided a starting point for analysis, the particular categories were observed in more detail. In this first round of analysis, the instances of evidence which appeared in the various interviews were analyzed and first interpretations were drawn. In order to verify the results obtained from this first round of analysis and to evaluate the data in more depth, a second round of analysis was performed. In this second round it was also analyzed whether commonalties and further patterns are existing in the results discovered during the first round of analysis.

3.6.1. Coding

As mentioned in the previous part, the raw data collected during the interview has to be transformed into analyzable data in the form of certain categories and codes in order to facilitate the data analysis process. This process of transforming raw data into a standardized form, by assigning exhaustive and mutually exclusive codes and categories to pieces of data, is commonly referred to as coding (Babbie, 2007). Generally, coding involves several steps, namely the reduction of the data amount in the form of transcripts, the organization of the information by assigning them to certain categories, and the detection of new data within them (Cope, 2005). Basit (2003) describes codes and categories as "(…) tags or labels for allocating units of meaning to the descriptive or inferential information complied during a study" (p. 144).

This coding process is considered as "(…) one of the significant steps taken during analysis to organize and make sense of textual data" (Basit, 2003, p. 143) and as "(t)he key process in the analysis of qualitative social research data (…)" (Babbie, 2007, p. 400). Further, coding is believed to be an ongoing part of the analysis but not as the analysis itself (Gough & Scott, 2000).

These code names can stem from the researchers disciplinary, can be borrowed from technical literature or can arise from the terminology used by the participants of the interviews (Basit, 2003). In a similar vein, Creswell (2009) indicates that coding can be can be based on the following:

- The emerging information collected during the interviews from the participants
- Predetermined codes, to which the collected information will be assigned
- A combination of emerging and predetermined codes

For this study the third of the above mentioned approaches, the combination of emerging and predetermined codes has been used. Many of the codes were already predetermined by the concepts of additionality, introduced in Chapter 2 of this study. Consequently, the codes were derived from the types of additionality and its indicators as presented in Table 6. However, during the interviews several other aspects emerged, which made the creation of several new codes and the adoption some codes necessary in order to fully describe and analyze the interviewee's responses.

As suggested by Creswell (2009), a so called qualitative codebook has been created which contains the predetermined codes from policy evaluation theory as well as emerged codes from the interview sessions, which have been used during the subsequent data analysis process. A qualitative codebook should contain the names of the codes, the definitions of the codes and the instances in which the code can be found in the transcripts (Creswell, 2009).
The author further suggests that the codebook should not be developed or changed based in information collected during the data analysis process, when a distinct theory is tested during

Concept	Indicators	Codes
Input additionality	Financial investment	Complementary effects
		Substitutive effects
Behavioural additionality	Project additionality	
	- *Full project additionality*	Abandoned the project
	- *Partial project additionality*	Reduced scale
	- *Zero project additionality*	Gone ahead unchanged
	Acceleration additionality	
	- *Project start*	Earlier start
		Later start
		No change
	- *Project duration*	Faster conduction
		Slower conduction
		No change
	Scale & scope additionality	
		Increase
		No change
		Other
	Challenge additionality	
		Increase
		Decrease
		No change
	Network additionality	
	- *Diversification of cooperation*	More diverse
		No change
		Other
	- *Continuation of cooperation*	More continued
		No change
		Other
	Management additionality	
		Increase
		No change
		Other
	Follow up additionality	
		Increase
		Decrease
		No change
		Other
Output additionality	New patents	
	New products	
	New prototypes	
	New services	
	New applications	
	New processes	
	Improved image	
	Increased competitiveness	
	Innovation potential	
	Improved profitability	
	Knowledge / Know-How	

Table 7: Qualitative codebook

the research project. This is also in line with Weston (2001), who states that a codebook should be used to ensure consistency of coding throughout the research project. Consequently, the codebook has been developed prior to the interviews and adopted during the process but have not been changed during the actual data analysis process itself.

Based on the above introduced information, a qualitative codebook has been developed, which can be found in Table 7. In the later course of this study, this codebook will be used to transform the interview data into analyzable information and to indicate from which evidence the interpretations are drawn.

3.6.2. Quantitative measures in qualitative research

A controversial issue in the analysis and the presentation of qualitative research is the use of quantitative measures.

This study is following the approach of Sandelowski (2001), Sandelowski, Voils and Knafl (2009) and Maxwell (2010) who are considering the use of numbers a legitimate and relevant measure in qualitative research.

The process of quantitizing is defined as the assessment of numerical values to data which is not conceived as numerical, as for instance words or other qualitative instances (Sandelowski, et al., 2009). In qualitative research "(…) the quantitative conversion of qualitative data is done to facilitate pattern recognition or otherwise to extract meaning from qualitative data, account for all data, document analytic moves, and verify interpretations" (Sandelowski, et al., 2009, p. 210). Numbers are considered powerful rhetorical devices (John, 1992), which can partly be attributed the overall association of numbers with scientific rigor (Sandelowski, et al., 2009).

Especially, the use of so called "quasi-statistics", which are simple counts of the findings and things, are legitimate and important sources of data for qualitative researchers (Maxwell, 2010, p. 476). These "quasi-statistics" provide the reader with information about the frequency and the amount of the results or the observed data. According to Sandelowski (2001), the counting of data is an integral part of the data analysis in qualitative research, especially to recognize patterns and deviations as well as to make "(…) analytic and ideographic generalization form data." (p. 231). Presenting information numerically and displaying it in qualitative measures can make patterns or points (…) emerge with greater clarity" (Dey, 1993, p. 207). However, as Maxwell (2010) states: "they do this at the cost of stripping away everything but the quantitative information and are thus necessarily complementary to qualitative information rather than substituting for it" (p. 478).

In his 2010 article about using numbers in qualitative research, Maxwell identified four advantages of incorporating quantitative measures:

- First, using numbers contributes to what Maxwell (2010) labels "internal generalizability" (p. 478). This concept does not refer to the concept of transferability introduced in the later course of the study, it refers to the generalization within the setting and collection under study and provides information about the degree to which the themes and findings identified are representative for the setting or the individuals under study.

- Second, the usage of quantitative measures contributes to the identification and characterization of the diversity of the actions, perceptions and believes of the set of individuals or the group under study. Using quantitative figures can provide systematic evidence and consequently potential bias can more easily be identified.

- Third, using numbers can enable the researcher to identify patterns which are not apparent in the unquantizied data, which might be overlooked by the researchers as well as by the participants of the study.

- Fourth and finally, quantitative data is an adequate way to present data and to indicate that the interpretations are supported by the data under study. Furthermore, the presentation of numbers can "(…) counter claims that you have simply cherry-picked your data" (Maxwell, 2010, p. 479).

Despite the advantages introduced in the preceding parts and the value quantitative data can add to qualitative research, it also has to be acknowledged that some disadvantages and problems arise when using quantitative figures in qualitative research. Maxwell (2010) did not only identify four advantages of using numbers in qualitative research, he also identified four disadvantages:

- First, using numbers might "lead to the inference (by either the researcher or the audience) of greater generality for the conclusions than is justified (…) A particular setting or sample may be unrepresentative, and a facile reading of quantitative results may lead a reader to ignore this limitation" (Maxwell, 2010, p. 479).

- According to Maxwell (2010), a second disadvantage is that the use of qualitative figures can lead to " (…) a slide into variance ways of thinking (…)" (p. 480), which might undercut the advantages of qualitative research by making causal claims.

- Third, by including numbers in a qualitative research to support the conclusions, there is an apparent danger to reduce the findings of the study to the amount of evidence. However, quantitative measures cannot replace the detailed description of qualitative evidence, it can only supplement it.

- Fourth, as mentioned earlier, numbers can be used as powerful rhetorical devices (John, 1992), which can make a report more precise, rigorous and scientific (Maxwell,

2010). However, those powerful devices can also imply a higher level of accuracy and scientific rigor than justified by the actual study itself.

Also in the assessment of additionality, the use of numbers and frequency tables is considered a way to easily assess the extent to which certain manifestations of additionality are realized (Idea Consult, 2009).

This study is aware of the advantages as well as the disadvantages of using quantitative measures in qualitative research and will cautiously use quantitative measures in the analysis of the data as well as during the presentation of the data following in chapter 4.

3.7. Trustworthiness

The trustworthiness of qualitative research has often been criticized by researchers who follow a conventional positivist research approach, since the concepts of validity, reliably and objectivity, which are common measures to assess the scientific rigor of qualitative work, cannot be used to assess the quality of naturalistic and qualitative work (Shenton, 2004; Zhang & Wildermuth, 2009). However, like quantitative researchers, qualitative researchers need to demonstrate that their studies are credible (Golafshani, 2003).

Criterion	Qualitative approach	Quantitative approach
Consistency	Dependability	Reliability
Truth value	Credibility	Internal validity
Applicability	Transferability	External validity
Neutrality	Confirmabilty	Objectivity

Table 8: Comparison of criteria by research approach (Krefting, 1991)

Consequently, there is a need for alternative models to ensure and demonstrate the scientific rigor of qualitative research. This need for evaluation criteria has been addressed by Lincoln and Guba (1985) by proposing four criteria for assessing the quality of qualitative and interpretive research efforts, namely dependability credibility, transferability, and confirmabilty. In the following parts, the four concepts will briefly be introduced and subsequently connections with this research will be established.

3.7.1. Dependability

In the context of quantitative research, the concept of reliability is commonly addressing the question of whether similar results would be obtained if the work would be repeated in the same context, with the same participants and using the same techniques. The equivalent in qualitative research is referred to as dependability. The concept is concerned with the

question: If another researcher would conduct the same study, would he have the same results and would he arrive at the same conclusions? (Denscombe, 2010). In general it refers to the consistency of the research. Bradley refers to is as "the coherence of the internal process" and "the way the researcher accounts for changing conditions in the phenomena" (Bradley, 1993, p.437).

Peters, Abu-Saad, Vydelingum and Murphy (2002) state that dependability focusses on the "(…) process of inquiry and the researchers' responsibility for ensuring that the research process was consistent, logical, traceable and documented while adapting to the changes of the studied environment and to new inputs during the study" (p. 1053).

In order to validate the dependability of a study, it is recommended that the researcher enables the reader to evaluate the procedures and decisions as well as demonstrates that they constitute a reputable procedure and reasonable decisions (Denscombe, 2010). Providing the reader with detailed information about the procedures enables him to potentially repeat the project and the opportunity to receive the same or similar results.

In order to provide a sufficient understanding of the methods used during a qualitative study, Shenton (2004) proposes including the following sections:

- Research design and its implementation
- Operational detail of data gathering
- Reflective appraisal of the project

According to Shenton (2004), such in-depth coverage does not only enable the reader to understand the research practices but also empowers him to better access the scientific quality of the study.

The current chapter of this study is an attempt to describe the research process as clear, traceable and comprehensible as possible. As proposed by Shenton, the research design and its implementation were introduced in the preceding parts as well as the procedure of data gathering. By demonstrating all the particularities concerning the research design and the implementation of the design in this study, the reader theoretically has the possibility to redo this study and to receive similar results as well.

3.7.2. Credibility

Positivist researchers generally apply the concept of internal validity to assess whether their research measures, what it is actually intended to. In order to assess the qualitative equivalent of internal validity, the concept of credibility has been introduced. The concept of credibility is associated with an "adequate representation of the constructions of the social world under study" (Bradley, 1993, p.436), and about the extent to which the researcher is capable of demonstrating the accuracy and the appropriateness of the data. Generally, it is addressed to deal with the question about to which extent the results are congruent with the reality under

scrutiny. Lincoln and Guba (1985) consider the concept of credibility as one of the most important factors in establishing trustworthiness and propose a set of measures which contribute to ensuring the credibility of research, namely prolonged field-engagement, persistent observation, triangulation, negative case analysis, the checking of interpretations against raw data, peer debriefing, and member checking. These steps are designed to persuade the readers of the study that the information is, to a reasonable extent, accurate and appropriate, as well as that the data has been produced and analyzed according to good scientific practice (Denscombe, 2010).

In order to support the credibility of this study, this research has been conducted at the case company over a timeframe of 7 month, which is corresponding to a prolonged field-engagement as well as a persistent observation suggested by Lincoln and Guba. Further, additional to the interviews analyzed for this study, various discussions with personnel involved in different innovation activities have been held during the research period, in order to gain a deeper understanding of the topic and to receive frequent feedback about this study.

3.7.3. Transferability

In quantitative research, the concept of external validity is concerned with the extent to which the hypothesis or the results of a research can be transferred or applied to another setting or situation. In positivist research external validity is often about demonstrating that the findings of a study can be applied to a wider population (Shenton, 2004). The concept of transferability has been introduced as an equivalent in qualitative research. The concept is concerned with the generalizability of the qualitative results, which are commonly based on the intensive study of a few cases. There is a general agreement in literature that the objective qualitative studies is not to generalize the findings of a sample to a population (Onwuegbuzie & Leech, 2007b).

More specifically, the findings of qualitative research are "specific to a small number of particular environments and individuals, it is impossible to demonstrate that the findings and conclusions are applicable to other situations and populations" (Shenton, 2004, p.69).

Despite the rather broad agreement about the undesirability of generalization of qualitative results, some qualitative researchers cannot resist the temptation to generalize their results (Onwuegbuzie & Daniel, 2003). However, those attempts are "(…) flawed unless a representative sample has been selected" (Onwuegbuzie & Leech, 2007b, p. 115). As discussed in section 3.2., a non-probability sampling method has been used for this study and the overall population is only roughly known. Consequently, no exact assessments about the representativeness of case selection and therefore about the generalizability or transferability can be made.

However, in qualitative research, it is not the researcher's responsibility to provide an assessment about the transferability of his study (Shenton, 2004). It is rather the researcher's responsibility to provide sufficient contextual information about the situation in which the research was conducted in order to enable the reader of the study to judge about the applicability to other specific situations (Lincoln & Guba, 1985). The authors argue that the researcher cannot make any inferences about the transferability since he only knows the "sending context" in which the study has been conducted and not the potential situations to which the findings might be applied to.

Literature further indicates that it is of particular importance to convey the boundaries of the particular research (Shenton, 2004). In particular the author recommends providing rich and detailed information about:

- The number and the locations of the of organizations taking part in the study
- Restrictions in the type of respondents who contributed the data
- The number of researchers involved in the fieldwork
- The data collection methods used in the study
- The number and the duration of the data collection sessions
- The overall time period during which the data of the study was collected

The current chapter is an attempt to provide rich and sufficient contextual information about this research as well as to provide the reader with a possibility to assess the transferability of the results presented in a later part of this study. As already mentioned, the study was conducted by a single researcher at a major European airline group and is focused on the subsidized innovation projects of the organization. The interview sessions conducted during the research varied in length between 21 and 52 minutes and were conducted from November till December 2013. The data collection method was presented in section 3.2. and further, potential sample restrictions and bias have been discussed in detail in section 3.3. and 3.4.

3.7.4. Confirmabilty

The concept of objectivity in quantitative research is concerned with the extent of the researchers influence on the outcome of the concept. Optimally, it is denoted by an absence of the researcher's bias in the particular study. The research should be impartial and neutral on the outcome as well as use fair, even-handed processes of data collection and analysis (Denscombe, 2010). The concept of confirmabilty is commonly considered the qualitative researchers comparable concern (Shenton, 2004) and refers to "the extent to which the characteristics of the data, as posited by the researcher, can be confirmed by others who read or review the research results" (Bradley, 1993, p.437).

In order to ensure a maximum level of confirmabilty, the researcher must take steps to ensure that the results of the qualitative research are based in the respondents experiences and ideas and not the preferences of the researcher (Shenton, 2004). Also Peters et al. (2002) consider it

as crucial, that the findings of a research are not distorted from reality and that those results are not the result of "(…) poorly preformed analysis and preconceived assumptions" (p. 1053).

Confirmabilty is commonly "(…) determined by checking the internal coherence of the research product (..)" (Zhang & Wildermuth, 2009, p. 7). In order to establish confirmabilty for the research process, the findings, the interpretations and the recommendations should be auditable, which can be done by providing raw data, field notes, coding manuals, process notes and other documents relevant for the research (Zhang & Wildermuth, 2009).

In order to ensure the confirmabilty of this study, the research process was developed as open as possible, auditable procedures have been applied and the interview data is provided in a transcribed form in the appendix. As mentioned in the in the discussion about transferability above, the current chapter is an attempt to provide rich and sufficient contextual information about the study. All those measures were designed to provide the reader with an understanding of how the findings and interpretations of this study were derived and to enable him to check the internal coherence of the research.

3.8. Data presentation

When conducting a qualitative study, the basic procedure in the reporting of the results is to provide: "(…) descriptions and themes that convey multiple perspectives form participants and detailed descriptions of the setting or individuals" (Creswell, 2009, p.193).

In order to provide a suitable description of theses perspectives and to appropriately describe them, the presentation of the results in the subsequent chapter is based and in accordance with the following recommendations by Creswell (2009):

- Use quotes and vary their length form short to long embedded passages
- Present text information in tabular form (comparison tables of different codes)
- Use the wording from participants to form codes and theme labels
- Intertwine quotations with the authors interpretations

The discussions and the interpretations will be accompanied by quotes and statements retrieved from the respondents during the interviews, in order to provide the reader with context-specific and in-depth information as well as to support the overall argumentation. The designations following the quotes refer to the number of the transcripts and the respective line number the quote was taken and translated form.

As already mentioned earlier in this study, numbers can be powerful rhetorical devices in qualitative research (John, 1992) and can provide the reader with information about the frequency and the amount of the results or the observed data. In the succeeding discussion,

frequency tables and numbers will be used cautiously to display and visualize the findings of the interview sessions as well as to summarize the overall results. These quantitative measures are considered adjuncts to the discussions. As mentioned earlier, the frequency tables contribute to what Maxwell (2010) labels “internal generalizability” (p. 478) and provide an overview of the patterns within the data as well as underline the interpretations drawn from the interview data.

4. Results

As mentioned earlier, in a total of 16 interview sessions, 18 project managers have been interviewed about 18 innovation projects within the organization. The interviews lasted between a minimum of 21 minutes and a maximum of 52 minutes depending on the interview partner and the context of the project(s). 15 of those interview sessions were recorded digitally and transcribed shortly afterwards, while one of the respondents requested not to audiotape the session. One interview about one particular project was not suitable and cannot be used for analysis. Consequently, the information about 17 projects will be used for further analysis.

The interviews were conducted from November to December 2013 on multiple locations of the case company. As mentioned earlier, the interviews were, if possible, conducted face-to-face in order to observe the respondents non-verbal communication as well and to provide a more personal and confident environment to the interview partners. Due to aspects of timing and distance two interview sessions had to be conducted via telephone.

Bound by timely restraints, as well as by the availability of "hard facts", the analysis was drawn from a set of indicators describing the particular behavioral patterns of the earlier introduced additionality effects. From these indicators direct and indirect conclusions were drawn about the additionality effects of innovation projects carried out in a publically-sponsored context.

The use of quantitative measures in qualitative research has been discussed in detail in the preceding section. In the presentation of the qualitative findings of this study, counts and approximate percentages will be used to provide the reader with an impression about the frequency, will facilitate pattern recognition and support the interpretation process. As suggested by literature, those qualitative measures are used to compliment the qualitative argumentation and not to substitute for it (Maxwell, 2010). As mentioned earlier, those quantitative measures are used cautiously in order to provide a more meaningful presentation of the results.

It has to be noted that in some instance the overall percentages of the particular categories result in the overall count of 101%, which is due to the fact that the figures have been rounded to zero decimal places.

Subsequently, the qualitative narrative will be presented by describing the findings and by visualizing the results. Further, final interpretations of the collected information will be drawn, which can be found in the later course of this chapter.

Concept	Indicators	Codes	Frequency	Percent
Input additionality	Financial investment	Complementary effects	12	71%
		Substitutive effects	5	29%
Behavioural additionality	Project additionality			
	- *Full project additionality*	Abandoned the project	12	71%
	- *Partial project additionality*	Reduced scale	5	29%
	- *Zero project additionality*	Gone ahead unchanged	0	0%
	Acceleration additionality			
	- *Project start*	Earlier start	2	12%
		Later start	3	18%
		No change	12	71%
	- *Project duration*	Faster conduction	1	6%
		Slower conduction	10	59%
		No change	6	35%
	Scale & scope additionality			
		Increase	12	71%
		No change	4	24%
		Other	1	6%
	Challenge additionality			
		Increase	14	82%
		Decrease	1	6%
		No change	2	12%
	Network additionality			
	- *Diversification of cooperation*	More diverse	8	47%
		No change	7	41%
		Other	2	12%
	- *Continuation of cooperation*	More continued	7	41%
		No change	2	12%
		Other	8	47%
	Management additionality			
		Increase	12	71%
		No change	3	18%
		Other	2	12%
	Follow up additionality			
		Increase	12	71%
		Decrease	1	6%
		No change	2	12%
		Other	1	6%
Output additionality	New patents		4	
	New products		7	
	New prototypes		5	
	New services		7	
	New applications		10	
	New processes		13	
	Improved image		6	
	Increased competitiveness		14	
	Innovation potential		16	
	Improved profitability		12	
	Knowledge / Know-How		17	

Table 9: Overview of findings

4.1. Evidence on input additionality

Input additionality, which is considered as one of the traditional concepts of policy evaluation, is concerned with the substitutive or complementary character of the financial investment of publically-supported R&D projects. The questionnaire of this study was not developed in order to address the topic of input additionality in particular, which is commonly analyzed by using econometric research techniques. Nevertheless, some of the questions are closely related to this traditional concept of policy evaluation and can provide some valuable insight into the organizations funding behavior and existing or non-existing input additionality effects.

Concept	Indicators	Codes	Frequency	Percent
Input additionality	Financial investment	Complementary effects	12	71%
		Partially substitutive effects	5	29%

Table 10: Frequency of evidence on input additionality

It has to be noted, that the indicators of input additionality are closely related to the indicators of project additionality, which are presented and further discussed in the later course of this study. However, project additionality is concerned with the more fundamental issue of implementation and non-implementation of the project, while input additionality is concerned with the allocation of private and public financial resources of subsidized innovation projects. Because of the indicators close relation, the results are rather similar since they were drawn from the same responses. Nevertheless, the project manager's responses often also provided, directly or indirectly, some information about the funding behavior of the particular project.

The existing literature on input additionality largely reports positive effects of public funding on R&D expenditures or rejects the reject full crowding out effects (Busom, 2000; Czarnitzki, 2001; Almus & Czarnitzki, 2003; Gonzáles & Pazó, 2008). In a meta-analysis, Garcia-Quevedo summarized the findings of a total of 74 studies and found that 38 studies showed complementary effects and 17 showed substitutive effects (2004). 19 of the analyzed studies showed insignificant results. However, there are also studies which conclude that public-funding is crowding out private investment (Wallsten, 2000) and that governmental support is especially crowding out the R&D investment in large organizations (Lach, 2000).

For the majority of the respondents in this study, the governmental support was considered a prerequisite for the viability of the entire project(s), while some of the managers indicated that the project(s), most likely, would have been conducted in a reduced manner even without the participation in a publically-funded context.

In terms of input additionality effects of the particular projects this means that, in the majority of the cases, the company or the department in particular had not invested any financial

resources and that the project would have been abandoned. As one of the project managers noted:

> *„Well…I already noticed that question…I think it is a quite interesting one. We could speculate about this…but I think…we had not pushed the entire topic so far and suggested it to the board…we expected from the beginning the outcome to be …[Project details]…and since this is something you cannot calculate by the means of a standard economic efficiency calculation…you don´t start the project at all."* [T5:52-57]

In the majority of projects, the government support was considered the decisive factor for the company´s involvement in the research venture by the respondents. Without the funding, no research would have been conducted. As one of the project managers stated:

> *„So, according to our calculation the project is barely economical and the decisive factor in this case clearly is the subsidy…we would never take the risk…we would never get the go-ahead from our owners to spend that much money for a…[Project details]…without the possibility to proof that this procedure is in fact economical."* [T12:131-135]

Consequently, without the subsidy, no financial investment of the company would have taken place. However, with a subsidy, about 71% of the projects were conducted which had not been executed in the absence of such a support. In all those cases it is safe to assume that the funding increased the company's financial investment as well and logically constitutes a form of input additionality. Another respondent confirmed the increased financial commitment of the company by stating:

> *„So, one of your most important questions was:"Would you have continitued the project without the subsidy?" Absolutely not! Company X already addressed us last year…or even one year before that and asked: "Are you interested in doing a project like this with us?" Our specialists were excited…but we could not do it, since such a…[Project details]…is just too expensive. Such a…[Project details]…costs…[Project details]…and there was absolutely no way to consider that project as economically feasible."* [T12:48-53]

For the remaining 29% of the projects, the respondents indicated that the project(s) they conducted, would probably also have been conducted in the absence of a subsidy but in a reduced and smaller form. Consequently, a certain form of substitutive effect had taken place, since the public funds replace private funds to a certain degree. The phenomenon is labeled partial substitutability in literature (Rye, 2002) and is commonly considered a partial misallocation of public funds.

> *"We had conducted parts of that project anyway…but certainly not everything"* [T12:205]

However, it has to be acknowledged that the projects, which show instances of this substitutive behavior, were, de facto, conducted in a much broader extent because a public support was granted. Although some of the respondents indicated that they probably had conducted the project in a similar manner without a government support, they also stated that the funding enabled them to conduct the particular project(s) on a significantly bigger extent. Without the funding, most of the projects would have been conducted on a minimal scale. Most of those respondents indicated that these projects would have never yielded in comparable results and that the enlargement of the project had significantly positive results on the respective outcomes of the venture.

From a policy maker's point of view, it is understandable to consider partial substitutability effects as an undesirable outcome of government-funding, since the public funds partially crowd-out and replace the private investment. Although the findings of this study indicate that there are some instances of substitutive behavior, it has to be noted that the projects which would have been conducted anyway, would have probably been executed in a very limited form. Nearly all of the respondents, who stated that their project would have been conducted anyway, also indicated that it was very beneficial to conduct the project with the financial means of the subsidy and not in such a limited way. The majority of those projects would have been a minimal solution or a compromise without the public support, which might not even had resulted in a satisfactory outcome.

Consequently, and even if partial substitutability is considered an undesirable outcome of public funding, it has to be noted that the participation resulted in significantly bigger projects and also in higher investments of the case company.

These findings are in line with a priori expectations. The results of this study indicate positive effects of governmental support on R&D investment and reject full crowding-out effects like most studies on input additionality (Czarnitzki, 2001; Almus & Czarnitzki, 2003; Gonzales & Pazo, 2008). However, the results of Lach (2002), who concluded that public funding especially crowds out R&D investment in large companies, are not confirmed. It is rather the case that in large companies the "qualitative impact" of public funding higher than merely the impact on the percentage-share of the support measure on the R&D budget, which is in line with the findings of IDEA Consult (2006).

4.2. Evidence on output additionality

Output additionality is the second traditional concept of additionality and it is, like input additionality, typically assessed by using econometric research methods. As in the case of input additionalities, this research was not developed to research output additionalities in particular. Nevertheless, some questions are directed towards the concept of output additionality and provide some valuable insight about how the output side of the projects was affected by the public funding.

The respondents were therefore asked how the participation in a governmentally-funded program influenced the actual outputs of the particular project. Indicators of output additionality are for example new patents, new products, new prototypes, improved profitability, increased competitiveness and know-how. An overview of the observed outcomes of output additionalities can be found in Table 11.

Concept	Indicators	Evidence (Count)
Output additionality	New patents	4
	New products	8
	New prototypes	5
	New services	7
	New applications	10
	New processes	13
	Improved image	6
	Increased competitiveness	14
	Innovation potential	16
	Improved profitability	12
	Knowledge / Know-How	17

Table 11: Frequency of evidence on output additionality

As mentioned earlier, output additionality is commonly evaluated by using econometric evaluation methods and by assessing the output of R&D projects by the number of patents which can be attributed to the particular project. Previous studies have found positive effects on the output of publically-funding R&D projects in terms of patents (Czarnitzki & Frier; Ebersberger, 2004). In a comprehensive overview of micro-economic evidence Klette et al. (2000) conducted a meta-analysis of five specific output additionality studies and found that four out of those five studies showed positive forms of output additionality. Sakakibara (1997) also found that the "perceived benefits of projects are rather intangible, such as researcher training and increased awareness of R&D in general" (p. 447).

In general, the interview findings indicate that the majority of projects rather produced intangible benefits than "hard" results. Certainly, new products, patents and prototypes were the also among the results but the majority rather considered intangible results like new services, processes, increased innovation potential and internal know-how as the results of the publically-sponsored projects. Nearly all respondents emphasized the strong positive impact of the participation in a sponsored project on their knowledge and their know-how. As one of the project managers noted:

> *„The other thing is…we know today that if a component…[Project details]…then it is clear to us that…[Project details]…and this is something we would not know without project X. This is because we allowed ourselves to…[Project details]…and we certainly learned from this experience...our daily doing benefited massively from these things…[Project details]…A lot of things directly changed our routines… it was not*

about developing a particular technology, it was rather directed to producing knowledge. Knowledge is not tangible and if I do have the knowledge, it helps you to solve so many issues." [T4:202-207]

Most managers had similar perceptions about the outcomes and also emphasized the importance of intangible outcomes as a result of the participation in a governmentally-funded project, as shown in the following statement:

„The knowledge about how it works and also the organization…this is internal knowledge now. Well, let´s put it like this…it is not patentable or so…but rather…the results are in the form of changed processes, procedures, instructions, communication concepts…[project details]…and so on." [T12:244-248]

In particular, the importance of the knowledge gained from the subsidized projects was underlined by many managers. Asked about the results of participating in a governmentally-funded project, one of the managers stated:

„(…)simply the know-how exchange, knowledge of the industry, knowledge about the technology and so on…accompanying to what we intentionally wanted to do, this brought great benefits…" [T13:217-219]

In some other instances the participation in publically financed innovation projects, which had a focus on environmental issues, also had considerable publicity effects for the organization. Asked about those publicity effects of the project he conducted, one of the project managers claimed:

„Interestingly, it did. That was something we certainly did not expect. We knew that we would have some communication work do to, but we certainly did not do the project because of PR-reasons. We were very surprised by the intensity but also of the positive tone of the media coverage." [T14:178-181]

In general, the traditional econometric evaluation of output additionality is rather focused on quantifiable numbers than on qualitative assessment. Consequently, such studies commonly assess the quantifiable indicators of output additionality, like the number of patents, the number of products or the sales or profits which can directly or indirectly be attributed to a publically financed innovation program. As mentioned earlier, this study is not an econometric research and is consequently not designed to evaluate those hard facts. This study is rather designed to demonstrate the soft aspects. It is not surprising that the traditional econometric studies of output additionality are so heavily focused on quantifiable measures like the number of patents or the number of prototypes. Output indicators as for instance knowledge, know-how, improved processes, new services or an increase innovation potential are much more difficult to measure and to quantify. Those results are nevertheless important,

especially in an industry which intangibles services, knowledge and know-how are decisive factors.

The importance of knowledge and know-how gained during the governmentally-supported R&D project has to be underlined in particular, since it was perceived as one of the most valuable outcome of the participation in a publically-funded innovation program by nearly all respondents. As mentioned earlier, knowledge grows with usage, contributes to cumulative growth and creates dynamic spillover effects for further innovation projects (Larosse, 2004). Consequently, the results and the benefits of the supported R&D projects can be considered as long-term and sustainable effects, which have the possibility to positively influence the future R&D and innovation activities of the organization.

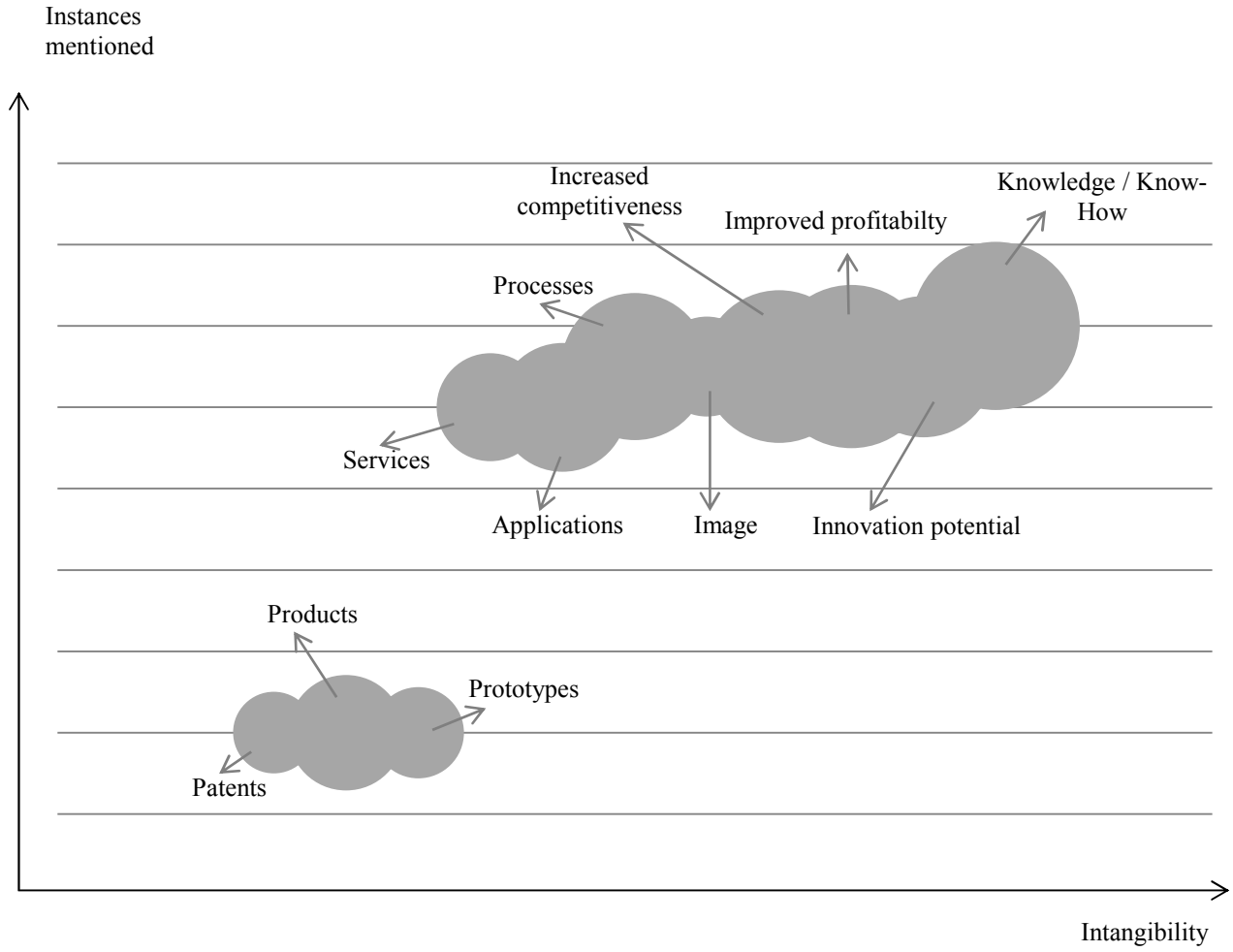

Figure 12: Tangibility of innovative outcomes and the number of instances mentioned

Figure 12 displays the tangibility of the outcomes and the number of the instances it was mentioned by the respondents. The table provides an impression about the distribution of those outcomes and confirms that the majority of perceived outcomes are rather intangible.

4.3. Evidence on behavioral additionality

After providing some insight about the rather traditional concepts of policy evaluation, input and output additionality, the subsequent part will present evidence on behavioral additionality and the associated manifestations of the concept.

4.3.1. Evidence on project additionality

Discovering whether publically-funded innovation projects would have been conducted in the absence of a subsidy is a prime objective and the most obvious way in the evaluation of public innovation policy. It is certainly the policy maker's interest to report high levels of project additionality in order to argue for the value of the program and a meaningful allocation of the financial resources. Consequently, evaluations which show low levels of additionality are not very desirable for policy makers as well as for government representatives.

Concept	Indicators	Codes	Frequency	Percent
	Project additionality			
Behavioural additionality	- *Full project additionality*	Abandoned the project	12	71%
	- *Partial project additionality*	Reduced scale	5	29%
	- *Zero project additionality*	Gone ahead unchanged	0	0%

Table 12: Frequency of evidence on project additionality

Earlier studies of policy evaluation have found rather diverse results on project additionality. In an OECD pilot project (2006), five studies found varying percentages for the number of projects which would have been cancelled in the absence of a subsidy. The Australian results of this study showed that 37% would have been cancelled, the Austrian 28%, the Finnish 20%, the Norwegian 53% and the results from the United States indicated that 93% of the projects would have been abandoned. These findings confirm the results of Davenport et al. (1998), who concluded that partial project additionality is present in most of the cases and the results of Falk (2007). In her study, Falk observed full project additionality effects in 31% of the cases, partial project additionality in 47% and no project additionality in 22% of the cases. Further, literature indicates that governmental support is less important for the realization of R&D projects in larger firms than in small or medium-sized organizations (Rye, 2002).

In order to discover the effects of project additionality, the interview partners were asked what would have happened with the innovation project(s) if they had not received public funding.

The interview results provided some valuable insight about the conditions under which the innovation projects had been completely or partially abandoned. It is possible to assign the

project managers responses into the two categories full additionality and partial additionality. Overall, no instances of zero additionality have been examined in the interview sessions.

The vast majority of project manager's responses indicated that an absence of a subsidy would have led to a non-implementation of the project, which is evidence for full project additionality. In this case, the participation in the publically-funded program was a prerequisite for the viability of the entire venture. The two subsequent statements underline the respondent's conviction that the innovation projects they conducted would have been cancelled if they were not granted governmental support:

> *„Without the subsidy…the project would have died in it´s child shoes…we had not carried out the project at all."* [T12:72-73]

> *„Yes, indeed. It is not the case that any kind of extension or something like that has taken place. One can say quite clearly… without a subsidy the project had not taken place."* [T1:83-85]

Another respondent also implied his doubts about an implementation of the project he was conducting if the support measure would have been absent:

> *„Well the project was planned like a regular research project…but what I strongly believe is…we had not conducted the project without the subsidy."* [T4:59-61]

Overall, full project additionality was found in approximately 71% of all the analyzed projects.

The residual findings can be assigned to the partial additionality category. For these remaining 29% of the researched projects, the project managers indicated that they probably had conducted their project(s) even in the absence of a subsidy on a reduced scale - for example with less depth or with a narrower scope. Consequently, those projects show partial project additionally effects. As one of the project managers claimed:

> *„…well let me phrase it like this…the project would certainly have been conducted in a different way…to a much smaller extent, much more down to earth and probably it had not been done in this broad and extensive way."* [T7:77-81]

Other respondents shared the opinion that their project(s) would have been conducted in a reduced form without the subsidy, as shown in the following statement:

> *„Certainly the project would have been done in a different form, much smaller. We would have looked less to the left and the right, especially concerning the configuration and the diversity of the system."* [T3:53-55]

This is not in line with a priori expectations. As mentioned earlier, in her 1998 New Zealand study, Davenport found that partial additionality was present in most cases and that most of the researched projects would have been conducted in a different way. The findings of this study do not confirm the results of Davenports study and the results of other studies shortly introduced above, since most of the projects would not have been implemented without governmental support (71%) and only a minority of the researched projects would have been done on a different manner (29%). Consequently, full additionality was present in most of the cases and partial additionality was only found in a minority of the researched projects.

Surprisingly, none of the project managers reported zero additionality for any of the 17 projects, meaning that the project would have been conducted in the same manner without a government incentive. The fact that none of the respondents indicated that they had conducted the project(s) in the same manner, raises the question if the managers were answering the questions strategically. As discussed earlier, the possibility of strategic answering and the potential for biased responses does exist. The absence of zero additionality effects might be a potential indicator for biased and distorted results. However, the broad and vast body of qualitative evidence, as well as the large number of positive instances mentioned by the respondents gives reason to assume that the results nevertheless provide a good impression about the positive effect of public-funding on the project additionality dimension of the case company. If those results are actually as positive as indicated by the respondents, or if the public-funding actually had such a significant impact, cannot be answered with certainty.

The results further indicate that, also in large and financially stable companies, governmental subsides can be quite decisive for not only the size of the innovation project but also for the more essential question of implementation and non-implementation of entire projects. These findings are not in line with the results of Rye (2002), who concluded that government support is more important for the realization of innovation projects of small and medium sized organizations, than for projects conducted by larger firms and with the results of Buisseret et al. (1995), who concluded that larger enterprises have logically lower levels of additionality because they have other resources available to continue without support. However, the results do confirm the findings of Idea Consult (2006), who concluded that no significant relationship between the project additionality and the organizational size exist.

4.3.2. Evidence on acceleration additionality

Public funding can also have an impact on the elaboration process in terms of timing, which is usually referred to as acceleration additionality. Commonly, it is regarded as a positive consequence of government funding if a subsidy speeds up the project development time. This shortened time to market is assumed to positively influence the competitiveness of the organization (Georghiou, 2002; Idea Consult, 2006).

In this study, the researched projects were observed concerning two dimensions of acceleration additionality, the project start and the project duration. Therefore, the

respondents were asked how the subsidy affected the timely constraints of the project compared to the situation in which the project would have been conducted internally.

The respondent's answers indicate that the subsidy had no influence on the project start dimension of about 71% of all projects. 12% of the projects started earlier because of the governmental support, while the project start was postponed in 18% of the projects. One of the project managers reported about his project, which started later because of the subsidy:

> *"Well, on the timely constraints it had the effect that we did not start with the project until we had the promise to receive funding. If we had have had the money available internally, we would have started right away."* [T16:98-100]

Concept	Indicators	Codes	Frequency	Percent
Behavioural additionality	Acceleration additionality			
	- *Project start*	Earlier start	2	12%
		Later start	3	18%
		No change	12	71%
	- *Project duration*	Faster conduction	1	6%
		Slower conduction	10	59%
		No change	6	35%

Table 13: Frequency of evidence on acceleration additionality

However, the second dimension, the project duration, delivered the more interesting results. As the term acceleration additionality already implies and as previously outlined, an accelerated project duration is often considered as a favorable outcome of public intervention. The results of the interviews are not in line with these expectations. The respondents indicated that only 6% of the projects were conducted faster because of the government support, while 60% of the projects showed a longer project duration. Asked about the impact of the subsidy on the project duration, one of the interview managers stated:

> *„I think indeed that the project duration has prolonged because of the subsidy… this is also because we deliberately invested more time and resources…we worked more thorough because of the research…if we had conducted the whole thing as a pure internal project, without subsidy and without scientific partners…in many cases we would have chosen the first solution to come along, which would have been available first…but since it was a research we were able to deliberately look for the best solution…not the one which came to mind first."* [T7:90-97]

Surprisingly, the longer project duration in particular was considered a positive effect of participating in a publically-funded innovation project by the majority of respondents. As one of the interviewees claimed:

> *„Yes, I think rather slower. The subsidized budget was rather generous, which gave us the possibility to take some time to look more to the left and to the right. During the*

project course we included some more aspects into the research…so it rather prolonged the project time." [T2:22-25]

Another project manager also confirmed this perception by stating:

„On the other hand, if you do a research project you…at that time we had no exact idea about what to do with the second two years of the project. From the beginning we were told: "Do a four year project because of the subsidy"…in the end it was great that we did the project in four years because we were able to cope with a lot of topics in the last two years…during the first two years we finished our technical homework and during the second half we laid the foundation for the practical application. I think if we only had have had two years, the chance that the project would have turned out a disaster would have been high, since we would only have been finished in theory and without any practical relevance…so in this case it was extremely beneficial that the project time was four years and that we had a budged which enabled us to say: "Now lets try this and that… and since we have a fixed and supported budged for this it is not a problem to do this". In this respect…the support probably prolonged the project duration about two years compared to the situation if we had done it on our own…content-wise this really was a blessing." [T6:162-178]

Several other responses also confirmed those statements and indicated that a longer project time is considered as something rather positive than something negative by the informants.

These findings are not in line with the expectations, since a shortened project duration is considered as something positive in literature (Georghiou, 2002; Idea Consult, 2006). All in all, it is surprisingly that nearly of all of the project managers, who indicated that the duration of their projects prolonged because of the government incentive, also considered this prolongation a positive effect of the funding. The public funding provided them with the possibility to find the best solution and had the opportunity to preform analyses which are generally outside the regular doing of the organization. In particular, it was mentioned by many respondents that they appreciated the context the innovation policy provided them with. The fact that they had the possibility to elaborate on out-of-the-box solutions, that they had the possibility to include aspects into the research which were discovered during the project duration, and that they had a fixed financial and timely budget are aspects which were highly valued by the respondents. According to the project managers, the government support positively influenced the content as well as the results of the project.

Nevertheless, it also has to be acknowledged that a prolonged project duration was also considered as a negative influence in the case of one project, in which the time to market was especially important and essential for the success of the venture. The project manager of this particular project indicated:

„What I´m about to say is very specific for our department…it is only valid for our department, which is concerned with…[Project details]…in the field of highly qualitative…[Project details]…The pace of technology development is extremely fast in this area…such a…[Project details]…at least once a year some new product is released…or even every half year. So if you develop or conceptualize products in this field…you are quickly being cut off by our competitors, this happens really fast. During the project duration we were simply left behind by the market...not only this particular project, all subsidized projects. So, our conclusion is that subsidies are for our technology…or the research in general in our field…an unusable method to conduct R&D." [T3:62-72]

These findings indicate that the different impacts of public innovation programs on the timely constraints of the particular project are always highly context-dependent and cannot per se be labeled as positive or negative. In the vast majority of cases, a prolonged project time was considered a positive effect of public funding. However, these effects were only considered as positive if the product-life-cycle was not too short. If the product-life-cycle and the product development duration were short, or more general, when time was an essential aspect, the participation in governmentally-sponsored programs might have had negative impacts. Solely the time to apply for subsidies in these instances was too long in those instances and a purely internal conduction of the project would have been preferable.

For the remaining six projects (35%) the respondents indicated that the subsidy had no noticeable impact on the project duration.

4.3.3. Evidence on scale and scope additionality

If a public support measure has an effect on the extent of the project it is commonly referred to as scale and scope additionality. In particular, this concept describes the situation in which the government incentive enables the organization to conduct a project on a larger scale or to broaden the scope of the venture.

Concept	Indicators	Codes	Frequency	Percent
	Scale & scope additionality			
Behavioural additionality		Increase	12	71%
		No change	4	24%
		Other	1	6%

Table 14: Frequency of evidence on scale and scope additionality

In order to evaluate the scale and scope additionalities of the public-funded R&D projects, the participants were asked how the support affected the extent of their project(s).

Earlier studies have shown that 46% - 92% of the supported innovation projects under study would have been conducted on a smaller scale or scope if the support measure would have been absent (OECD, 2006).

The vast majority of the respondents indicated that the funding enabled them to conduct the project in a more extended way because of the subsidy. Of the researched projects, approximately 71% were conducted on a broader scale because of the funding, while 24% of the projects showed no change.

One of the project managers highlighted the positive influence of the public funding on the project he conducted by stating:

> *„In this respect it broadened our perspective compared to the situation in which we had done the project on our own…and this was really worth its weight in gold, since this helped us do understand some important aspects. So…the subsidy certainly enabled us to have a broader perspective on the issue."* [T7:52-57]

This perception is confirmed by another respondent, who also indicated the positive effect of the subsidy on the project extent, by stating the following:

> *„What we certainly did was that we examined topics in detail, which we…if we had to fully finance it out of our own pocket…certainly had not done in this depth and to this extent."* [T8:134-137]

Asked about the effect of the support measure on the project size, one project manager pointed out in a quite representative way:

> *"After all, it is the possibility to increase the project scope significantly."* [T10:63-64]

The cases, in which the governmental incentive had no influence on the scale and the scope of the project, can mostly be explained by the context-specific conditions of the project. In these instances the context or respectively the content of the project(s) was already predetermined by the goal or the objectives of the venture. In these cases it simply was not be possible to change or adjust extent the scale or the scope of a project, since the conditions of the project were simply predetermined. These projects had to be conducted in a certain way in order to be feasible, which is not influenced by any funding decision. As one of the project managers confirmed:

> *"The scope is certainly the same. This is because…this product does not exist yet and it is very unique. Basically, the effort that we have in order to…[Project details]…that effort is certainly not affected."* [T12:95-97]

Overall, the results for the scope and scale additionalities are in line with a priori expectations. In the vast majority of cases the public funding enabled the organization to conduct the projects on a broader scale and with a wider scope than in the absence of a support measure. Many respondents indicated that the government support encouraged them to conduct the project(s) in a much broader way and also include aspects into their research which they had not been able to include in an internally financed project. In only the minority of cases the scale and the scope was not affected by the funding. In most cases this can be, to a

considerable degree, be attributed to the particular circumstances of the project, which simply could not be changed or extended.

4.3.4. Evidence on challenge additionality

Another positive effect government subsides can have on innovation projects is that the funding can encourage the organization to conduct higher-risk and more challenging R&D projects as in the absence of the subsidy intended. The phenomenon is commonly referred to as challenge additionality.

Concept	Indicators	Codes	Frequency	Percent
	Challenge additionality			
Behavioural additionality		Increase	14	82%
		Decrease	1	6%
		No change	2	12%

Table 15: Frequency of evidence on challenge additionality

In order to assess the challenge additionality effects of the projects under study, the respondents were asked how the participation in a publically-funded innovation program changed the complexity of and the risk-attitude towards the particular project.

Previous studies have shown that between 48% and 78% of subsidized innovation projects would have been less challenging in the absence of a subsidy (OECD, 2006).

Nearly all project managers recognized the strong positive impact of subsides on the risk-taking and challenge-seeking behavior. Of the 17 projects under study, 82% showed higher levels of challenge additionality, 6% showed less and 12% were apparently not influenced in terms of challenge additionality. Consequently, the vast majority of the respondents indicated that the projects they conducted were more challenging and comprised higher levels of risk because a subsidy was available. This perception is reflected by the following statement:

> *„What we certainly did was that we examined topics in detail, which we…if we had to fully finance it out of our own pocket…certainly we had not done in this depth and to this extent. So it legit to say that that the project was certainly a higher-risk project than a regular project. Also that we included certain things of which we said: "We do not know which direction this will lead us to"."* [T8:134-137]

Another respondent indicated that the project he conducted was highly disputed internally and that the subsidy enabled them to conduct this controversial project nonetheless:

> *„Well, the entire project was quite controversial, it still is today to a certain extent. If you look at the execution of the…[Project details]…it was somewhat similar to a suicide*

mission. Most people did not believe that we would be able to master the technology and also did not believe in the results…if the results could really fulfill the task. In this case the subsidy was of course highly welcome since we were able to take a higher risk as without support." [T6:61-66]

The results indicate that most of the projects were also conducted with a higher technical demand and consequently comprised a higher degree of uncertainty. As one of the project managers stated:

„And the second aspect was that the project was content-wise but also result-wise of a very uncertain nature…if it really…if the result will be something usable…"[T2: 8-11]

Another issue that is quite noticeable in the project managers responses is that some highly-complex projects were conducted even if the project managers believed that they organization was too inexperienced at the time of the project start and that the project had, under regular circumstances, no real chance of success. As one of the project managers outlined in the following statement:

„I think at his point in time…we were not able to do this. Let me phrase it like this, it is for sure that we started the project at a time at which we were quite inexperienced in the field of…[Project details]…The entire topic was completely new for us…[…]…and to start with such a complex subject…I think we had not been capable of handling it. If we had not had the external partnerships, who know how it works, who know which approach to follow and so on…and who helped us to get through it all…the whole thing had not had any real chances of success." [T4:129-139]

Overall, the results for challenge additionalities are in with the expectations, since the subsidies significantly encouraged the company to conduct projects which they had not conducted in the absence of a funding. The subsidies did not only encourage the organization to conduct higher-risk projects, they also helped to overcome the uncertainty of those projects. As mentioned earlier, reducing uncertainly and lowering the chances of market failure are some of the prime objectives of innovation policy, which took place in the vast majority of the projects.

The higher levels of risk, complexity and challenge mentioned by the majority of respondents raise the question to which extent the public funding increased those attributes. Did the subsidy increase the risk to a degree which is stimulating and which resulted in successful projects? Or did the governmental support increase the company´s risk-seeking behavior too much, so that the projects turned out to be unsuccessful? This study is not designed to evaluate those questions in detail, but the results nevertheless provide some insights into those issues. Of the 14 projects, for which the interview partners reported higher levels of challenge additionality, 13 turned out to be "successful" and only one was "not successful". The terms "successful" and "not successful" are based on the project managers overall assessment of the publically-funded project(s) he conducted and the impression gained during the interviews

about the particular project(s). Overall, it can be concluded that the government support increase the challenge and risk-seeking behavior of the company, but in a positive and adequate manner.

4.3.5. Evidence on network additionality

One of the major goals of current innovation policies is to foster cooperation and networking. The impact of public funding on a company's collaboration is commonly referred to as network additionality. As suggested by Frier et al. (2006), the concept has been divided into the dimensions diversification of cooperation, which is concerned with the corporate behavior towards the diversity of the partners and continuation of collaboration, which is concerned with the collaboration after the finalization of the project.

Concept	Indicators	Codes	Frequency	Percent
Behavioural additionality	Network additionality			
	- *Diversification of cooperation*	More diverse	8	47%
		No change	7	41%
		Other	2	12%
	- *Continuation of cooperation*	More continued	7	41%
		No change	2	12%
		Other	8	47%

Table 16: Frequency of evidence on network additionality

The respondents were asked to assess how the governmental support measure affected network related issues of the project(s) they conducted, in terms of collaboration with research institutes or external companies.

Previous studies found that 42% - 78% of the projects observed during the 2006 OECD study would have been conducted in a less collaborative way if they had not received public support.

In terms of diversification of collaboration, the responses indicate that in 47% of the projects the cooperation with external partners increased because of the subsidy, while in 41% of the projects the collaborative behavior was not influenced by the funding. As it is one of the prime objectives of current innovation policy to foster collaboration between members of the industry, it is not surprisingly that none of the responses indicates a decrease of collaboration.

Many of the project managers, who stated that the subsidy increased the collaboration of their research project(s), also indicated that this increase in cooperation was very valuable and beneficial for not only the project but also for the know-how of the entire company. The following statement indicates that the collaboration of the particular project increased because of the subsidy:

> *"It is quite similar with the universities…I think we had not searched for this many universities if we had conducted the project internally. In retrospect one has to acknowledge that this brought much expertise, external know-how and also interdisciplinary know-how into our company."* [T6:83-86]

Another respondent indicated that the depth of collaboration was also positively influenced by the subsidy. As the project manager claimed in this statement:

> *„What probably had not happened without the subsidy is that we cooperated with company X in a collaborative project and I think that this in particular is a massive enrichment… company X thought us in the course of the project how to handle their software…which would not have happened if the project had been a classical customer-service provider relationship… in this case the relationship of the two project partners reached a depth which had not been possible otherwise I think. I further believe that we had not collaborated with research facility X and research institution Y on such a level."* [T4:101-109]

Other respondents indicated that the collaboration was not influenced by the subsidy and that they had cooperated with the very same external partners also in the absence of a subsidy:

> *„(…) especially because we worked with partners with whom we collaborate in other projects or product developments on a daily basis anyway."* [T3: 125-126]

As mentioned earlier, the governmental funding had no influence on the diversity of collaboration of approximately 41% of the researched projects. In these cases the collaboration with the external partners was already existing or the probability that the collaboration was already predetermined or highly probable. This rather high percentage might be explained by the high degree of specialization in the airline industry. Depending on the topic of the research project, there might only be a limited set of external partners available to select form.

In terms of continuation of collaboration, the responses indicate that in 41% of the projects the cooperation with external partners continued after the subsidized project or that a further collaboration is desired by the project managers, while in 12% of the projects the continuation of collaboration was not influenced by the funding. In 47% of the cases no evidence for a continuation of collaboration was found, which can largely be explained by the high number of projects, which did not show any impact on the diversification of cooperation dimension. Logically, if no change in cooperation of a project can be detected it can also not be continued. As one of the project managers stated:

> *„Well, we are in loose contact…currently there is no research project in the pipe so to say…in which we would collaborate with them again. But we are still in contact."* [T7:136-138]

Another respondent emphasized the circumstantial disparities of the established contact and the advantages of collaboration in general:

> *„There still is some contact and in the future we also will maintain this contact. Of course this contact will be more or less intensive depending on the circumstances…but through the project our relationship certainly became closer…in particular the relationships with the people you work together with on various working levels…that is definitely an enormous advantage of collaboration."* [T8:126-130]

In one other case the collaboration with the external partners was not continued after the finalization of the project:

> *"(...) but the partnership with the research institute has petered out by now. We had some staff changes in decisive positions and with those changes other research institutes were just preferred."* [T2: 49-52]

In general, the findings are in line with a priori expectations. In many cases, the diversification of collaboration was increased because of the subsidy. In particular, the collaboration with universities and research institutes was initiated by the public funding and had otherwise, in a regular project setting, not taken place. In some other cases the collaboration was not affected by the subsidies and the collaboration with particular partners had quite likely also taken place in the absence of a support measure. Overall, the tendency that many project managers indicated, that the collaboration would have also have been quite likely without a support measure, is not very surprising. This can, to a considerable extent, be explained by the specific, prevailing conditions of the aviation industry, which is highly specialized and only offers a rather limited or even predetermined set of potential external partners.

Some interviewees also indicated that another advantage of publically-sponsored innovation programs is that the organization receives efforts of the collaboration partners without direct monetary payment. By collaborating in a governmentally-funded project the organization only has to partially reimburse their own operational costs, while they do also have access to the output deliverables and knowledge of the collaborating partners. In this case they do not have to directly remunerate them, since they share the research results among the involved partners. In a project which is conducted internally, they must bear the costs of the entire research, meaning that they have to pay for their own expenditures but also have to pay for external services.

4.3.6. Evidence on management additionality

The improvement of management practices, capabilities and routines as a result of the participation in governmentally-sponsored projects is considered another positive effect of public funding. The effect of public funding on management routines and capabilities is generally referred to as management additionality.

Previous studies indicated that governmental-funding typically leads to increased management capabilities on various levels (OECD, 2006).

Concept	Indicators	Codes	Frequency	Percent
	Management additionality			
Behavioural additionality		Increase	12	71%
		No change	3	18%
		Other	2	12%

Table 17: Frequency of evidence on management additionality

In order to explore the impact of the support measures on management behavior and capacity, the respondents were asked how the subsidy affected their management routines and their departmental practices on various levels.

Most of the project managers had a positive appraisal of the impact of the governmental support measure on their internal organization and the management capabilities (71%). The results indicate that the government incentives influenced the management behavior on three distinct levels, namely on the manager level, the department level and on the organizational level. Firstly, it changed the behavior and capabilities of the project managers who conducted the particular project, since the conduction improved their understanding of the procedure and also their increased their awareness for R&D in general. This change of attitude is reflected in the following statement:

> *„Well it certainly is the case that I, as a project manager, of course learned a lot of things…about how the…[Project details]…works, what the funding authorities want and so on…this means that…at the moment at which we will start a new subsidized project…I know exactly how it will go down now…what the funding authority expects from us…what we have to deliver to them…in which form and so on…I know what works and what not…so the experience on this field is certainly of value to handle the topic in a more confident manner."* [T4:150-156]

Secondly, the participation in a subsidized project also influenced some departmental routines and the way the departments conducted the particular projects. As one of the project managers claimed:

> *„We worked noticeably more systematic as we might do it in other projects…just because the government wants certain things to be calculated in a particular way and also wants everything accounted for…"* [T7:159-161]

Another manager confirmed this by also emphasizing the impact of the incentive on their departmental structures:

„So, okay. This means that the structure of our department has changed significantly…and also the organization for…[Project details]…was set up." [T12:310-311]

In general, the accounting and controlling procedures required by the funding authorities were considered as a very time-consuming and difficult issue by the majority of respondents. In particular it was considered as problematic that the project managers had to cope with a wide variety of administrative issues on their own, which usually had been outside their own scope.

The participation in a variety of subsidized innovation projects also stimulated modifications on the organizational level. In particular the establishment of a centralized function, which is responsible for consulting and support in administrative issues, was requested by many of the respondents. This demand for a centralized function was recognized by the project managers as well as by the organizations higher level management as a result of the participation in public policy programs. As one project manager stated:

„This also led to a certain change, which is not completed in my option…there is still the need for clarification. The next step will be the implementation of the…[project details]…and an organizational change or the establishment of an organizational unit to cope with this issue." [T1:215-220]

This centralization and concentration of activities is already in conception and considered as a result as well as a benefit of a variety of subsidized projects. As one of the respondents noted:

„This means…we didn´t have those structures at the beginning but we created them by conducting those projects…we recognized that…there is demand and by dealing with that we discovered what we need exactly. That was certainly one benefit that the company had of conducting those projects." [T16:152-156]

The third and last level, which was influenced by the public funding, is the organizational level. Some of the project led to high level discussions and changes in the strategic direction of the company, as reflected by the following statement:

„This manifested in a certain change of attitude, in very fruitful discussions among the middle and senior management…which all led to guiding and directional decisions. For example… in my subjective perception…responsibilities were created and also the strategic direction of the company can directly be traced back to this particular project." [T10:123-129]

Finally, of the 17 projects, 18% showed no evidence of management additionality and 12% of the projects could not be assigned to any category and were labeled as "Other".

These findings of management additionality are also in line with the prior expectations. The management routines and practices of the organization have significantly been influenced on various levels by the participation in innovation policy programs. These enhanced

management capabilities and procedures improved the organizations future R&D and innovation capacity, which is another prime objective of publically-sponsored R&D policies.

4.3.7. Evidence on follow-up additionality

If the participation in a government-funded project enables the organization to develop a capacity that it can exploit in further R&D and innovation projects, it is commonly referred to as follow-up additionality. As mentioned earlier, the concept of follow-up additionality is particularly related to the sustainability of innovation projects (Gök, 2010).

Previous studies indicate an increase in the number of projects which were conducted after a project has been conducted in a publically-funded context (OECD, 2006).

In order to assess the follow-up additionalities, the interview partners were asked whether the participation in the publically-funded program increased their follow-up activities in this field.

Concept	Indicators	Codes	Frequency	Percent
	Follow up additionality			
Behavioural additionality		Increase	12	71%
		Decrease	1	6%
		No change	3	18%
		Other	1	6%

Table 18: Frequency of evidence on follow-up additionality

The presence of follow-up additionalities was confirmed by the majority of the respondents. Of the 17 projects under study, approximately 71% resulted in spin-off or follow-up activities. As one of the project managers noted:

> *„Certainly. A lot. In particular all the knowledge we gained during the project, especially since we had time to look more left and right of the regular way…this certainly led to many follow-up projects, in which we now develop or follow-up on things which we have only briefly examined in the past."* [T2:80-84]

Due to the case company's large organizational size, not all follow-up R&D activities were or are necessarily conducted in the same department in which the original R&D project was conducted. As one of the project managers outlined:

> *„There are some projects that revolve around the topic. But those projects are not conducted in our unit X. Unit Y is quite active on that field now, especially…[Project details]…in which they are only coping with this topic."* [T1:182-185]

Another respondent confirmed the presence of follow-up additionalities by stating:

"Yes, it did. We discovered some aspects in the course of the project, especially concerning…[Project details] …which led to follow-up activities, yes." [T14:158-159]

Surprisingly, one of the project managers indicated that the subsidized innovation project he conducted had a negative influence on follow-up projects. Asked about whether the funded project led to follow-up activities the project manager claimed:

„No, in this case it was rather counterproductive. I strengthened our opinion to never conduct such a project again. Since then we have never applied for another subsidized project. In this case this is very particular for our department…we are of the opinion that subsidized innovation projects are not applicable for our needs, simply because of the timely constraints." [T3:173-177]

However, it has to be noted that the project was very specific since the product life cycles of this particular department are very short, which complicates the participation in the rather time-consuming process of public funding application.

Figure 12 provides an overview of the distribution of all behavioral additionality results.

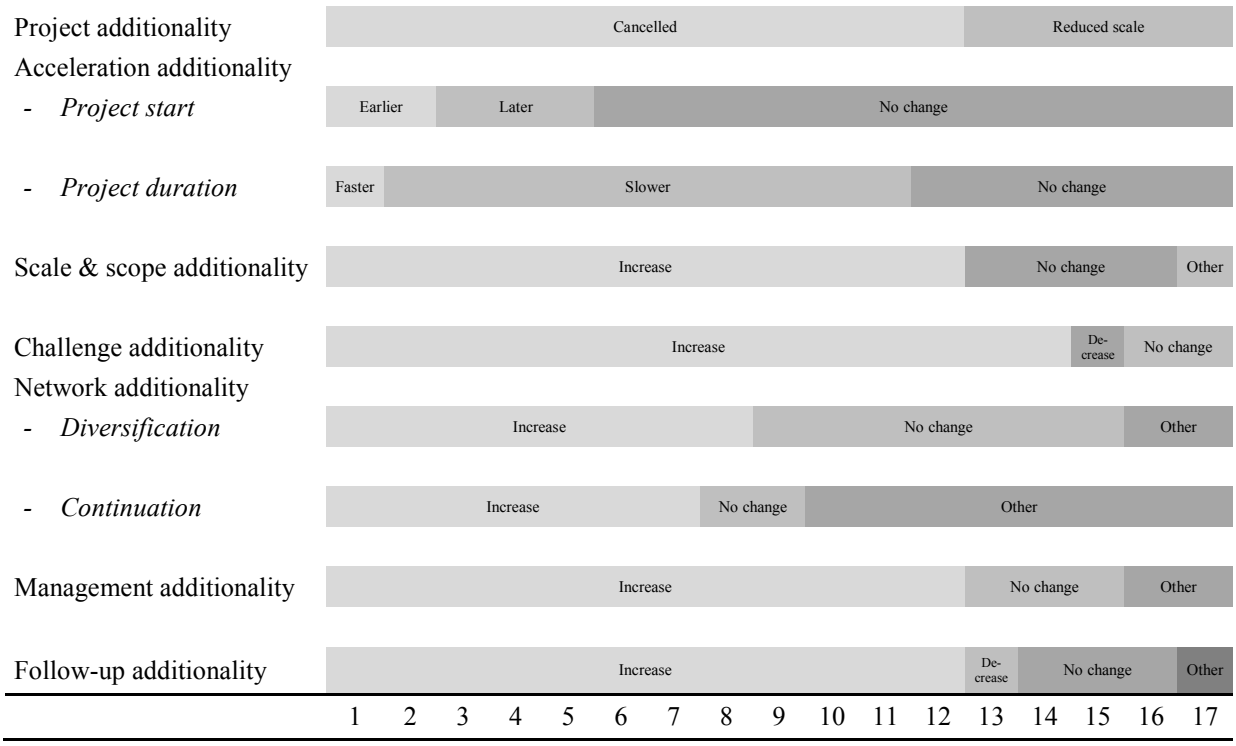

Figure 13: Distribution of the behavioral additionality results

Overall, the results are in line with the prior expectations. The participation in governmentally-funded R&D and innovation projects led to various follow-up activities within the organization. These follow-up activities consist of internally-funded projects as well as further publically-sponsored ventures. In general, these follow-up activities have a

positive influence on the sustainability of innovation of the organization in general. Once successfully implemented, those changes in the company's behavior will lead to what Georghiou referred to as "(…) self-sustaining cycle of investment in innovation" (2002, p. 62).

5. Summary, conclusion, limitations and relevance

This study is an effort to deepen our understanding about how governmental subsidies affect the organizations that are receiving the support measures. This study is focused on the aviation industry and was conducted at a major European airline company. The two traditional concepts of additionality, input and output additionality, as well as the rather new concept of behavioral additionality, which are commonly applied to assess the influence of public funding on the receiving organization, were tested in the setting of the case company.

Consequently, the central research question addressed in this study is aimed at exploring the impact of governmental subsidies on the project level of the case company:

What is the impact of governmental subsidies on the case companies R&D and innovation activities in terms of additionality effects at the project level?

This issue has been addressed by conducting multiple qualitative interviews with project managers of the case company involved in publically-funded innovation activities.

This final chapter gives a general overview of the most important results of this study, addresses some questions for further research and provides some recommendations for the case company.

5.1. Summary of results

This research evaluated the influence of public innovation funding on the particular R&D projects by analyzing various manifestations of the concept of additionality.

A first result concerns the **input additionality** effects observed during the qualitative interviews. The project managers indicated that the majority of the R&D projects, which were conducted in the context of a public innovation program, showed complementary funding behavior (71%). In those cases, the financial investment of the case company increased because of the support measure. The remaining cases, which are the minority of all projects, show some kind of partially substitutive effects (29%). In those cases, the respondents reported that they had conducted the project even without a support measure, which is an indicator that the public-funding partially crowded-out the private investment. However, the respondents also indicated that the projects would have been significantly smaller without a public support measure and that the funding was very valuable for the projects.

A further important finding concerns the **output additionality** of the projects. Commonly, tangible outcomes like patents, products and prototypes are considered frequent outputs of publically-sponsored innovation projects and certainly those outcomes were also found in the project manager's responses about the outcomes of their project(s). However, it was apparent that the vast majority of respondents reported rather intangible outcomes more frequently as

the outputs of the subsidized R&D projects. These project managers mentioned aspects like new services, applications, processes, improved image, increased competitiveness, innovation potential and knowledge far more often than the above mentioned tangible outputs as the outcomes of their project(s).

Another very important result concerns the **project additionality** observed in the governmentally funded innovation projects of the case company. According to the respondents, the vast majority of projects had been completely cancelled if no support would have been granted (71%). In these cases, the public support was the decisive factor that led to the implementation of these projects. Further, the project managers indicated that the remaining projects would have been conducted in much reduced manner if a subsidy would have been absent (29%). Overall, it quite surprising that none of the projects would have been conducted in the same manner if no support would have been granted.

The in-depth interviews also provided some valuable evidence on **acceleration additionality**. Only a few instances were detected in which the public funding had an impact on the first dimension, the project start. The second dimension, the project duration, delivered the more interesting results. The majority of respondents indicated that the participation in a governmentally-funded technology program prolonged the duration of their project(s) (59%) and a majority of those respondents indicated that this extended conduction time was very beneficial for the project. The remaining responses indicated that the public-funding had no influence on the project duration of the projects (35%) or that the project was actually conducted in a faster manner (6%). These findings are not in line with the expectations, since an accelerated project duration is considered, as the term acceleration additionality already implies, a positive result of the participation in public technology programs. However, a prolonged project duration was only considered as a positive effect when the development time and the project-life-cycle of the particular outcome had a certain minimum length, since it is usually a rather time consuming process to apply for subsidies and generally to conduct a project which is publically-funded. If the overall project duration was generally short, the governmental support resulted in rather negative effects, since the application and the participation unnecessarily lengthened the development time.

A majority of respondents also indicated that the project(s) they conducted showed positive effects of **scale and scope additionality**. Most project managers stated that the participation in a publically funded innovation program enabled them to conduct their project(s) on a larger scale and with a broader scope (71%), as intended by policy makers. In the instances, in which no scale and scope extension was observed (24%), most the project managers indicated that the scale and the scope of the project was already technically predetermined and was not influenced by any funding decisions.

Also in terms of **challenge additionality**, positive results were observed. The majority of projects were conducted in a more challenging way (82%). In those instances the risk-taking behavior and the challenge-seeking behavior was positively influenced by the participation in publically-funded innovation programs. It further enabled some departments to conduct

projects which were much disputed internally, because they were content-wise as well as result-wise of a very uncertain nature.

Fostering collaboration is one of the prime goals of current publically-sponsored innovation programs. Consequently, it is not surprising that positive effects of **network additionality** were observed during the in-depth interviews. About half of the projects were conducted with a more diversified collaboration than without a subsidy (47%). In the majority of those cases, the respondents also indicated that the collaboration was continued after the finalization of the project or that such a continuation was desired. However, it was also apparent that the public support measures had no influence on the diversity of the collaboration of roughly the same number of projects (41%). In these cases, the respondents indicated that the support had no influence on the external partners they collaborated with and that those partners would probably also have been preferred partners if the project would have been conducted without a subsidy. As mentioned earlier, this might be explained by the particular conditions and the high-specialization of the aviation industry, which naturally limits the set of potential partners to collaborate with.

In terms of **management additionality**, three distinct levels of policy impact have been observed: The project manager level, the department level and the organizational level. First, it was indicted by some the project managers, that they personally learned from the experience and that they shaped their project skills as well as their competence in terms of public funding. Second, the support measures also had an impact on the departmental levels. Most respondents indicated that it was difficult to cope with all the administrative issues involved in the participation in publically-sponsored programs and they demanded a more centralized and systematic approach for those projects. On a third and last level, effects of the subsidies on the organizational level have been observed, which influenced the strategic direction of the company. The influence of the public funding was indicated for a majority of project(s) (71%), while a few showed no influence (18%) or could not be assigned to a category (12%).

A last, although expected, finding concerns the **follow-up additionality**. As the majority of project managers indicted, the participation in publically-sponsored technology programs led to various follow-up projects or activities (71%). However, due to the big organizational size of the case company, it has to be noted that those activities were not necessarily performed by the same department, but that they sometimes yielded in activities in other organizational areas.

5.2. Conclusions

The results of this study underline the importance and the impact of governmental subsidies on the companies that are receiving them. In conclusion, this study yields four important main findings.

First, the public funding had, in particular, a very decisive influence on the question relating the implementation or the non-implementation of the vast majority of the researched R&D projects. Without the intervention, most projects had been cancelled and only a very few projects would have been conducted in a different, smaller form anyway. However, the projects that would also have been conducted in the absence of a subsidy were conducted in a much bigger extent because of the intervention.

Second, the participation in a publically-funded innovation program rather lengthened the duration of the particular projects, which was considered as very beneficial and a positive effect of the funding by the majority of respondents. This finding is in particular interesting since an accelerated project duration is commonly considered a positive effect of public funding. However, a lengthened project duration can only be considered a positive effect, if the lengthened project duration is in accordance with the overall project objectives. If the overall project duration and the product life cycle is too short, the application for subsidies might take too long and consequently not be beneficial for the overall project.

The third main finding of this research concerns the outputs of the subsidized R&D projects. In literature patents, prototypes and products are commonly considered as regular indicators as R&D output. Certainly, among the outcomes of the projects under study, also patents, prototypes and products were observed. However, in the majority of the analyzed projects, rather intangible outcomes were perceived as the biggest benefits of the participation in a publically-funded program. These intangible outcomes were rather improved processes, services, innovation potential as well as knowledge and know-how. In the earlier parts of this study, the different determinants of innovation have been introduced (p. 19). These determinants are used in order to distinguish various types of innovation. The typology distinguishes between administrative or technical innovations, project or process innovations and radical or incremental innovations. In conclusion, the findings of this study can broadly be assigned to those determinants in order to provide a general overview. Overall, the funding appeared to have the most impact on projects which were rather of a technical nature, were rather process related and incremental innovations.

Another main finding concerns the overall influence of the public funding on the R&D projects. In the majority of cases, the government funding resulted in more complex and challenging projects, created follow-up activities, increased the management capabilities, created more diverse networks and enabled the company to conduct the projects on a bigger scale.

5.3. Limitations

This research has several limitations which potentially influenced the overall results. These limitations have to be acknowledged and have to be remembered when assessing the results of this study.

First, the selection of cases and the sample under study. The big organizational size of the case company, the decentral structures concerning publically funded R&D activities and the timely restraints of this study, prevented the identification of the overall population of all publically-funded R&D projects of the case company. As a consequence, it was not possible to apply a random sampling approach and a purposeful sampling approach was used to select the sample from the population. The sampling approach used might have resulted in a sample, which is biased and which does not adequately represent the overall situation of R&D projects of the case company.

Second, the lack of counter-factual evidence and attribution. During the interviews, the project managers were asked what would have happened with the project(s) if they had not received public support. By using this approach the respondents had to describe and evaluate a hypothetical situation, which is not always straightforward, since the respondents cannot know for certain what would have happened in this scenario. Consequently are the project manager's responses subjective assessments of the hypothetical situation and do not necessarily provide a correct picture of the situation that would have happened without a subsidy. Further, it is not always possible to assign certain particularities or outcomes of a R&D project to particular stimuli in the form of governmental subsidies.

Third, the use of self-assessment reports. The information about the projects has been obtained by using self-assessment reports, which inherits the risk of an upward bias. The respondent's answers might be biased because they might expect negative repercussions based on their responses. Even if the study is not conducted from an official funding authority, the respondents might a have answered strategically because of the researchers origin in the innovation department.

5.4. Practical implications and recommendations

As mentioned in an earlier part of this study, the sample selection as well as the overall nature of the qualitative research approach prevents the researcher from making generalizations about the findings of a sample to a general population. It has to be acknowledged that the findings are specific to a small number of projects (17) and their particular environment. However, the findings presented in the previous parts yield various implications for practice and might enable the case company to improve its behavior in public funding issues.

The most important practical finding is that the participation in publically funded innovation programs can be a decisive influence on the implementation or non-implementation decisions of the organization. In the majority of cases, the governmental support was even considered a prerequisite for the overall viability of the projects by most respondents and even if the projects would have been conducted anyway, the support enabled the company to conduct the project on a much bigger scale. These findings indicate that subsidies are an effective way to increase the innovativeness of the case company, since the participation in public innovation programs enabled the organization to conduct projects which could not have been conducted

in the absence of a subsidy. The public funding can provide the company, or in particular the departments, with the possibility to conduct projects which usually would not be conducted because of economical or other internal issues.

Also the results of the various other manifestation of additionality are of practical relevance, since those results provide the case company with an overview of the changes in project attributes. In particular, the results concerning the influence of the public funding on the timely constraints of the projects are interesting and of practical relevance. These results uncover the inappropriability of applying for subsidies in projects in which timely issues are essential and a fast conduction is relevant.

In general, the case company should intensify the participation in publically-funded innovation programs. However, this intensification should be conducted carefully in order to not establish a reliance on public support measures. Truly innovate companies do not base the decision do conduct or not to conduct R&D projects on the external factors like the receipt of public funding.

In order to improve the internal innovation process regarding public funding, the company should centralize this process more and should provide the particular departments with more support. As mentioned earlier, it was indicated by many project managers, that the administrative issues regarding the participation in public innovation programs was a difficult and time-consuming process. This process should be centralized more in order to optimize the application and administrative procedures. Further, this centralized department should also actively analyze which funding possibilities exist and should attempt to allocate those possibilities to potential research projects within the organization by using a more systematic approach.

5.5. Policy evaluation implications and future research recommendations

This study does not only yield practical implications and contributions, it also contributes in various ways to the theory of policy evaluation.

In general, this research supports the increasing importance of the behavioral additionality concept. The concept of behavioral additionality has been introduced in order to compliment the rather traditional policy evaluation concepts of input and output additionality, in order to analyze what happens inside the recipient firms during the public support (Buisseret et al., 1995). This study strengthened this approach by discovering and analyzing the various impacts of governmental funding on the case companies innovation related behavior as well as by confirming that it is not sufficient to only consider the firm's financial investment and the firms output factors in innovation policy evaluation. In particular, the findings of this study confirm the perception that innovation policies should increase the organizations innovative competence and the innovative capacity (Rye, 2002), as well as the external linkages (Salmi, 2012) and that these policies should ultimately contribute to the goal of

knowledge acquisition and diffusion (Falk, 2007). This study also confirms that the participation in a governmentally-funded innovation program increases the innovative competence of the organization and creates a innovative capacity which can be exploited during future projects.

The new insights gained during this research indicate that governmental subsidies can also have a decisive influence on the implementation or non-implementation decisions of large and financially stable companies, which does not confirm the results of Rye (2002), who concluded that public funding is less important for the realization of projects in large firms.

A further and rather specific finding of this research is that accelerated product duration should not per se be labeled as a positive outcome of the subsidized projects, since a lengthened project duration was commonly considered a very positive and beneficial effect of the public funding procedure. This finding is not in line with Idea Consult (2006), who conclude that an accelerated project duration is considered a positive outcome of public funding, since the time-to-market time is shorted.

Despite the usefulness of the behavioral additionality approach, the concept also has several limitations which should be further elaborated on. The concept successfully opens the black-box behavior that is created between the concept of input and output additionality by evaluating the companies behavior that happens during the participation in a publically-funded innovation program. However, the evaluation in terms of behavioral additionality creates another variety of smaller black-boxes in terms of the particular manifestations of the concept. These particular manifestations, like management additionality or network additionality, fail to open the smaller black-boxes and treat them in a similar way as the traditional input and output relationship. This approach has also been criticized by Gök (2010) who particularly lookd at the concept of network additionality and stated that it fails "to open the black-box of collaboration by focusing on the change in the dynamics of the collaboration or the building blocks that create collaboration behavior" (p. 153). Future research should attempt to open these smaller black-boxes and should also evaluate the particular behavior of the different behavioral additionality manifestations in more detail.

These future studies should also evaluate and analyze the correlations of the amount of public investment on the effects within the company resulting from the intervention. The relationship of the subsidies financial amount on the particular effects should be analyzed and optimal impact levels should be discovered. Expressed more simply, do big subsidies lead to big effects? And which amounts of public funding result in the optimal outcomes? These questions should be addressed in order to provide a more meaningful allocation of public funds.

Future research should further evaluate the nature of the publically funded R&D projects and should evaluate which projects yield the most impact as well as which projects create the largest social benefits. The results of this study indicated that public funding was in particular

valuable for projects which are of a rather technical nature, process related and incremental innovations. Future research should analyze this approach in more detail and should evaluate which projects yield the largest social benefits. By identifying the projects with the largest social benefits, policy evaluators could increase the impact of their funding and could increase the overall utility gain. These evaluations could also provide a more meaningful allocation of public funds and could increase the impact of the funding.

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7. Appendix

7.1. Detailed interview guide in English

Proposed interview guide for measuring additionality effects

This interview guide will be applied during interviews with R&D management and managers of funded projects. The goal of the data collection in the form of interviews is to get an impression of how governmental funding manifests in the case company in the form of additionality effects on a project level.

Important points to consider during the interview:

- The interview is expected to last within one hour
- The interview data will be recorded and transcribed afterwards

Direct and indirect questions will be used in the course of this interview to assess the additionality effects. The qualitative interviews will be held in hypothetical conditions, emphasizing the subjective impressions of managers involved in at least one publically-funded R&D process.

The interview will be divided into effects of the public-funding before the time of the project, during of project implementation, after project implementation and outcomes of the project.

Note that the parts in *italics* are meant for the interviewer only and that interviews were conducted in the national language of the case company and not in English.

First of all, the interviewee will be asked to give a short introduction about the funded project.

Before the project:

How has the behavior changed before the project? Typical questions will involve:

- What would you have done if the R&D project had not received a government funding? Why? *(Project additionality, C1)*
    - *Continued as originally planned?*
    - *Continued with changes in the project? Downsized?*
        - *Would you have realized the same results as today?*
    - *Discontinued the project?*

- Do you think the subsidy has changed your investment in the project? How? *(Input additionality)*
    - *Increased, decreased or no changes in monetary investment?(A1)*

During the Project:

How has the behavior changed during the project? Typical questions will involve:

- Do you think the subsidy has changed the timing of the R&D project? How? *(Acceleration additionality, C2)*
    - *Earlier or later starting date?*
    - *Shorter or longer execution time?*
    - *Earlier or later finishing date?*
    - *Would you have needed more time for the project without a subsidy?*
    - *If not, why?*

- Do you think the incentive has changed the scale of the project? How? *(Scale additionality, C3)*
    - *Smaller or bigger scale?*
    - *If not, why?*

- Do you think the incentive has changed the scope of the project? How? *(Scope additionality, C4)*
    - *More markets?*
    - *More actors involved?*
    - *More applications?*
    - *If not, why?*

- Do you think the funding has changed the complexity of the project? How? *(Challenge additionality, C5)*
    - *Increased complexity because of the subsidy?*
    - *Increased risk?*
    - *If not, why?*

After the project:

How has the behavior changed during and after the project? Typical questions will involve:

- Do you think the funding has increased the professional network during the project? How? *(Network additionality, C6)*
    - *More actors involved during the R&D project phase?*
    - *More collaboration?*
    - *More diverse partners? Partners which usually had not been involved?*
    - *Are those networks/contacts persistent and are they beneficial for current projects?*
    - *If not, why?*

- Do you think the subsidy has changed the management behavior? How? *(Management additionality, C7)*

- *Improvement of management capabilities?*
- *Improvement of management routines?*
- *Improvement of management practices?*
- *Are those changes persistent and are beneficial for current projects?*
- *If not, why?*

- Do you think the funded project has led to or resulted in spin-off projects? What exactly? (Follow-up additionality, C8)
  - *Do you think you were able to use the capabilities and knowledge from the funded project for other, subsequent projects?*
  - *Do you think you could have done those projects without the succeeding funded project?*
  - *Are the developed capabilities persistent and do you think you could not have obtained them without a subsidy?*
  - *If not, why?*

Outcomes of the project:

How has the subsidy changed the outcome of the project? Typical questions will involve:

- Do you think the public funding has changed the outcome of the project? (Output additionality)
  - *Resulted in new patents? (B1)*
  - *Resulted in new products? (B2)*
  - *Resulted in new processes? (B3)*
  - *Resulted in new applications? (B4)*
  - *Resulted in new prototypes? (B5)*
  - *Resulted in new services? (B6)*
  - *Resulted in new papers or publications? (B7)*
  - *Resulted in increased sales? (B8)*
  - *Resulted in improved image? (B9)*
  - *Resulted in increased market share? (B10)*
  - *Resulted in increased competitiveness? (B11)*
  - *Resulted in increased innovation potential? (B12)*
  - *Resulted in improved profitability? (B13)*
  - *Do you think the outcomes without funding would have been better?*
  - *Do you think the outcomes without funding would have been better?*

Additional questions:

Has the subsidy had other effects on your project?

Negative effects of participation in publically funded projects?