KU LEUVEN

FACULTY OF ECONOMICS
AND BUSINESS
CAMPUS BRUSSELS

Internally Organised Master's Thesis

Additionality of R&D support for Young Innovative Companies

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Master's Thesis Submitted for the Degree of
Master in Business Engineering

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Academic Year: 2014–2015

Defended in: June 2015

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Summary

Young Innovative Companies (YICs) play a crucial role in today's innovation landscape. Because these companies spend at least 15 percent of their budget on R&D, they are considered to be highly innovative. Moreover, these companies are also very young, small and often lack financial resources. Therefore, they face so-called innovation boundaries that prevent them from intensifying their innovation and R&D activities. This research is an assessment of some of the current innovation and R&D support programs offered by the IWT (the central innovation support agency in Flanders), and their impact on YICs. This report does not address all the support programs, but mainly focusses on those programs that facilitate R&D partnerships or target innovative SMEs. The central research question of this research is "***What is the additional impact of IWT support for innovation and R&D on YICs?"***. To make sure that the effects of R&D are "additional", we adopted the concepts of input-output and behavioral additionality. Furthermore, we focused on both the similarities and differences in additionality amongst YICs. In order to analyze the differences amongst YICs, we used a classification scheme, based on Clarysse et al. (1998).

In this research, we interviewed eight YICs from different industries, such as chemistry, engineering and textiles. For the interviews, we asked four series of questions. The first series encompass basic questions regarding their main products, services and activities, the size of the company etc. Because most companies did not have a formal R&D budget, we performed an innovation audit in the second series of questions, as an alternative to measure the innovativeness according to one of the YIC criteria. In the third and fourth series of questions, we addressed the participation in the IWT programs and the additionality of IWT support (the main topic of this research). Several important aspects were taken into account for measuring additionality. Firstly, additionality effects are strongly interrelated and can occur on both the short and long run. Secondly, most interview questions are also hypothetical (*What would the company have done if it did not receive R&D support?*). Moreover, company statements may have a subject bias, meaning that some companies could over-estimate additionality effects. Each of these issues will be further discussed in the methodological chapter.

Based on the interview results we were able to formulate several **key findings**. With regards to input additionality, we addressed two topics: employment effects and general R&D spending. In relation to employment effects, we found that short term support for R&D does mostly not provide a sound basis for long term employment in research related roles. In relation to R&D spending, we found that for most of the interviewed companies, government **support for R&D does not impact the decision of companies to engage in specific R&D projects**. However, it does impact the way that companies carry out their R&D projects. Another key finding is that for most of the interviewed companies, **output (outcome) additionality** occurs only in the **long run**, and typically **results from behavioral additionality**. These behavioural effects comprise that some companies were able to increase the scope of their projects (scope additionality), by engaging new project partners, or by exploring new trends such as sustainability. This also gave these companies the ability to become more ambitious in their projects (risk additionality). For example, some companies would more likely engage university partners. Thereby, they could focus more on research and fundamental issues, instead of solely development.

Another key finding is that, according to some of the interviewed companies, R&D support also affects **project priority** and thereby leads to **project acceleration**. For example, some companies would delay their innovation and R&D projects if they did not have the support from the IWT programs. Furthermore, by engaging in IWT projects, some companies were able to **build** new **competences** regarding innovation management and gain more product knowledge. This also allows companies to improve their innovation strategy and develop new business opportunities (strategy additionality). Finally, the results from the interviews also show that the IWT programs allowed some of the companies to **intensify** their **relationships with university partners** and make new contacts with other companies that have similar interests (networking additionality).

The results from the interviews also show that there are several **key differences** amongst companies. By making use of the classification scheme of Clarysse et al. (1998), we find that, for the sample of eight interviewed companies, input-output and behavioral additionality is highest for the companies that were classified as Schumpeterian Pioneers. As discussed in the literature review, Schumpeterian Pioneers are YICs that focus on innovation based on new (breakthrough) technologies. The results from the interviews show that, because these companies focus on developing breakthrough innovations, risk and scope additionality is particularly high. Because of the importance of partnering with other companies and universities in developing breakthrough innovations, networking additionality is also particularly high. This seems in line with research by Monjon and Waelbroeck (2003) that suggests that highly innovative firms appear to derive most benefit from collaborative research with (foreign) universities. Moreover, because these companies also focus on gaining more control over the supply chain, knowledge and strategy additionality is typically also very high. In contrast, input-output and behavioral additionality is typically very low for the interviewed companies that were classified as Resource Based Innovators. As discussed in the literature review, Resource Based Innovators are YICs that typically focus on client-specific projects (short term development) instead of developing breakthrough innovations.

The results from the interviews may have several **implications** for future innovation policy, as well as for future additionality research. The current IWT program portfolio does a very good job in addressing the needs of different types of companies, by offering a broad range of support services. However, the results from the interviews suggest that there should be more focus on the **alignment between companies' (strategic) objectives and the objectives of the IWT programs**. Some IWT programs such as TETRA and SBO are better suited for companies that fit the Schumpeterian Pioneers criteria from Clarysse et al. For Resource Based Innovators, it is especially important that the programs have a light overhead structure. The results from the interviews have important implications for **future additionality research**. With regards to the time horizon of effects, we found that, for most of the interviewed companies, scope additionality typically results in risk additionality (more ambitious projects) and input additionality. Scope additionality and knowledge additionality typically result in output additionality in the long run etc. It is very important that future additionality research takes into account this interrelation and the time horizon of additionality effects. Moreover, as input-and output additionality are mainly long term (consequential) effects, policy research should focus more on behavioral effects, instead of input-output additionality.

Preface

Firstly, I would like to express my sincere gratitude towards my **supervisor** (promotor), **Stijn Kelchtermans**, for his assistance in writing this Master Thesis, and his ideas for conducting this research.

Secondly, I would like to thank the staff from the **IWT**, for their support in finding contacts and providing information about the interviewed companies. In particular the following persons:

Dirk Otte, Advisor and Coordinator IWT
Magali Parent, Scientific Advisor IWT
Jeroen Fiers, Advisor IWT
Els Schelfout, Advisor IWT

Finally, I would also like to thank the managers from the eight **interviewed companies**. Without them, it would have been impossible to conduct this research. For confidentiality reasons, the names of the companies and the company managers are not disclosed.

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List of abbreviations

SME	Small and Medium Enterprise
YIC	Young Innovative Company
EEN	Enterprise Europe Network
IWT	Agentschap voor Innovatie door Wetenschap en Technologie
FIT	Flanders Investment and Trade
AO	Agentschap Ondernemen
TETRA	Technology Transfer
SBO	Strategisch Basisonderzoek
SBIR	Small Business Innovation Research

Introduction

For decades, there has been a long debate on which market structure is the most appealing when it comes to stimulating innovation. The 'small versus large' debate has been very prominent in innovation literature; examples include Baumol (2004) and Kamien and Schwarz (1982). In the earlier innovation studies, the prominent work of Schumpeter provided several arguments in favour of large firms. Schumpeter's contributions to the 'small versus large' debate are outlined in two key hypotheses. The first Schumpeterian hypothesis illustrates that there is a positive relationship between innovation and monopoly power. The second hypothesis points out that large firms are, proportionally, more innovative than small firms (Schumpeter, 1939). Contrary to the second Schumpeterian hypothesis in favour of large firms, some studies have actually favoured the role of small firms as sources of innovation. The research of Baumol (2004) clarifies that, even though the gross R&D spending originates from large firms, most revolutionary breakthroughs in history have been realized by small enterprises. This is evidenced by the finding that small firm patents are more likely to be among the top cited patents than large firm patents.

Arguments in favour of the Schumpeterian hypothesis on large firms and monopoly power, as well as arguments in favour of small firms, have both shown their relevance. Since both large and small firms play a crucial distinct role in our economy, researchers and policymakers soon realized that innovation ideally should be a mix of both large and small firms, complementing each other in their innovative performance (Kamien & Schwarz, 1982). Thereby, policymakers also started to realize that innovation should be more open. It was until the late 20th century that the idea of Open Innovation became widely adopted. Large companies began to see the benefits of Open Innovation. By implementing external innovations, they could create synergies, and moreover also reduce the cost of R&D. Entrepreneurs also started to realize that R&D is not something that should solely be done by large companies with sophisticated R&D labs. This created a new wave of high tech start-ups: Young Innovative Companies (YICs). These high-tech start-ups were typically small, young and very R&D intensive. Moreover, these companies adopted the idea of Open Innovation by focussing on specific niche markets for advanced technologies (e.g. robotics), providing R&D and process improvement services (e.g. Information Technology and specialized machinery) or developing high performance subcomponents (Clarysse et al., 1998).

Because of their unique characteristics, YICs also face several innovation boundaries, that prevent them from intensifying their R&D activities. Compared to large companies, they often do not have the financial resources available to engage in risky (early stage) R&D (Czarnitzki & Hottenrott, 2011). Moreover, they often do not have enough knowledge and capabilities to engage in these kind of activities (Schneider & Veugelers, 2010). This also explains why Open Innovation is particularly important for YICs. By collaborating with other partner companies, knowledge institutions, universities and government agencies, they can share knowledge and resources for R&D. Moreover, collaborations can reduce the risk of R&D by generating scope economies (Czarnitzki & Hottenrott, 2012). These collaborations or "R&D partnerships" can take many forms, ranging from simple contractual agreements to long term strategic alliances. The number of partners that are involved in the partnerships can also vary greatly, ranging from simple company-university collaborations to collaborations with ten to fifteen partners including universities or research institutions.

Over the last two decades, policymakers have become more aware of the innovation boundaries of YICs and their crucial role in the innovation landscape. Consequently, they

have taken several measures to stimulate R&D and Open Innovation, with a particular focus on YICs and innovative SMEs. For example, the European Commission has launched the Enterprise Europe Network (EEN), especially designed to support European SMEs (and YICs) in a broad range of services, such as innovation, access to finance and internationalization. In Flanders, the IWT (Agentschap voor Innovatie door Wetenschap en Technologie) has launched several programs to stimulate R&D and Open Innovation. Some of these programs are also particularly designed for (innovative) SMEs and YICs. In this research we will make an assessment of R&D support for YICs. This research will focus on R&D support for YICs in Belgium, in particular Flanders. Therefore, we will mainly focus on R&D support by the IWT. Likewise, we will further investigate the relevance of the IWT programs and their particular significance for YICs.

For this research, we conducted eight depth interviews with Flemish YICs that have relied on IWT support services in the past. In these interviews we addressed several questions regarding the impact of IWT support on innovation and R&D. In order to evaluate the relevance of the R&D support measures offered by the IWT (the IWT programs) for YICs, two important factors were taken into account. Firstly, it is essential to take into account the heterogeneity of YICs. YICs are a very diverse group of companies that share the same boundaries towards innovation. Therefore, we adopted the classification scheme of Clarysse et al. (1998) to identify key differences amongst YICs. Secondly, it is important to take into account the total impact for evaluating the significance of R&D support for YICs. Even when R&D support does not lead to certain (technological) advances, it could lead to other additional effects, such as knowledge creation, behavioural change etc. Moreover, in order to evaluate the impact of R&D, it is important to understand to what extend these effects are additional. This implies that the effects would not have taken place without R&D support (in this case from the IWT programs). In order to evaluate these additional effects, we will make use of the concept of "additionality" as suggested by Georghiou (2002). This will further be explained in the literature overview of this report.

1 Problem definition and research questions

Over the last decade, YICs have drawn the attention of policymakers and innovation intermediaries. Because of their high innovative performance and their role in breakthrough innovations, they have a crucial role in today's innovation landscape (Schneider & Veugelers, 2010; Baumol, 2004). Moreover, because of their special characteristics (*2.1.1 Definition and common characteristics*), these companies also face several innovation boundaries (*2.1.2 Common innovation barriers*). For example, YICs often lack experience and financial resources to support their innovation strategy. Therefore, the question arises to what extend the current innovation policy (in Flanders) is addressing the special needs of these companies. Is the government doing too little or too much (crowding-out)? For this reason, we will assess some of the current innovation and R&D support mechanisms offered by the central innovation support agency in Flanders, namely the IWT. In *2.2.3 The IWT programs*, we will give an overview of these innovation support mechanisms. We will especially focus on some of the IWT programs that facilitate R&D partnerships and Open Innovation.

In this research we will assess the (additional) impact of some of the IWT support programs on YICs. The central research question of this research is therefore: ***What is the additional impact of these IWT programs on YICs?*** To answer this question, we will make a clear distinction between key **similarities** and key **differences** amongst YICs. To classify the key differences, we will adopt the classification scheme by Clarysse et al. (1998), as presented in *2.1.3 Classification of YICs*. Furthermore, the central research question also emphasizes the fact that the impact of R&D support should be additional. By "additional" we mean that the effects would not have taken place without the R&D support. It is important that the effects of R&D are additional, because otherwise there is no surplus effect (added value) from the R&D support. In order to address this question, we will make use of the concept of additionality.

Additionality is a key concept in the context of evaluating R&D support measures that aim at addressing market failures and crowding-out effects (Wallsten, 2000; Aerts & Czarnitzki, 2004). Additionality studies have been conducted by several public agencies, such as the IWT in Flanders (Larosse, 2004) and the UK Department of Trade and Industry (Georghiou, 2002). Most traditional studies only take into account **input-and output additionality**. These studies often create a rather narrow view, since they do not take into account behavioral changes. Therefore, we will also adopt the concept of **behavioral additionality** as suggested by Georghiou (2002). In *2.3.2 Introducing the concept of additionality*, we will give an overview of all the additionality effects that will be further analyzed in this research. In general we will focus on the following additionality effects: input, output, networking, scope, building up competence and expertise, acceleration, risk and strategy.

This report is especially relevant to policymakers, in particular the IWT. Moreover, this report also contributes to the existing additionality literature. This research is also unique in several ways. Firstly, it provides an insight into the additionality effects of a broad portfolio of R&D support programs, beyond the traditional focus on subsidies (for example: Clarysse, Wright, & Mustar, 2009; Fier, Aschhoff, & Löhlein, 2006; Meeusen & Janssens, 2000), and with a particular focus on Open Innovation and R&D partnerships. The policy note 2014-2019 by minister Muyters highlights Open Innovation as a key issue for stimulating innovation in Flanders. According to the policy note, future innovation policy should focus on stimulating partnerships between companies and academic institutions (Vlaanderen, 2014). Secondly,

this report focusses on the effect of these programs on one specific type of companies, namely YICs.

2 Literature review

This section will give an overview of the existing literature regarding some the key concepts in this report. Firstly, we will introduce the concept of YICs and identify what makes these companies so special (*2.1 Young Innovative Companies*). Secondly, we will explain why R&D partnerships are so relevant for these companies, and how the government in Flanders stimulates YICs to engage in these partnerships by using the "IWT programs" (*2.2 R&D partnerships and the role of innovation intermediaries*). Finally, we will introduce the concept of "additionality" to assess the impact of these programs on YICs (*2.3 Additionality of R&D support*).

2.1 Young Innovative Companies

2.1.1 Definition and common characteristics

The term Young Innovative Company is a relatively new concept, which has only recently been adopted by several authors in the academic literature (Schneider & Veugelers, 2010; Czarnitzki & Delanote, 2013). In general, these companies combine three common properties: age, innovativeness and size. However, most countries have set up their own rules and restrictions with respect to what they define as a YIC. In this report we will address two YIC definitions: the definition adopted by the Belgian government (Belspo, the Belgian Science Policy) and the definition adopted by the European Commission.

According to definition adopted by **Belspo**, YICs are SMEs that are relatively new to the market, meaning they should not be more than **10 years old**. In addition, they should spend at least **15% of their budget on R&D**, which distinguishes them from regular non-innovative SMEs. It is also important that the company has **not been established through** the **restructuring** of another company. In addition, in order to fulfil the **criteria** of a **SME**, the company should not exceed more than one of the following criteria: have a total staff of maximum 50 persons, have at most 7.300.000 EUR annual revenue (VAT excluded), and have a maximum balance total of 3.650.000 EUR if the company has a yearly average total staff of more than 100 persons (Belspo, 2013). The definition adopted by the **European Commission**, which is also used by Schneider and Veugelers (2010) and Czarnitzki and Delanote (2013), is somewhat less restrictive. According to the European Commission's definition, YICs should be young (less than **6 years old**), small (less than **250 employees**) and have at least **15%** of their **budget spent on R&D**.

Some countries have recently implemented several support measures to address YICs. For example, some EU countries have adopted a specific fiscal regime for YICs. The main reason why EU Member States have allowed companies to gain fiscal benefits by adopting a YIC status, is to allow small firms from typical domains as life sciences and biotech, to boost their innovation activities and to intensify R&D expenditures (YIC Status, 2013). Facts and figures from the European Commission show that, in Europe, over 99% of all businesses are SMEs, but only a small percentage of these SMEs are classified as YICs (European Commission, 2013a). In order to avoid the misusage of concepts such as R&D and innovation in the context of the average SME, a clear distinction should be drawn between regular SMEs and YICs. Moreover, the average bookstore or bakery of course has little to do with innovation. The next subsection (*2.2.2 Common innovation barriers*), we will go deeper into the specific common innovation barriers for YICs, that result from the characteristics presented above.

2.1.2 Common innovation barriers

Since, according to the definition by the European Commission and Belspo, YICs spend at least 15% of their budget on R&D, they are considered as highly innovative compared to regular SMEs. As a result of their high level of innovation, YICs are often considered to be risky businesses, having to place huge bets without having much **financial resources** available. Financial institutions such as banks are often reluctant to grant loans to businesses of which they consider projects to be too risky. Therefore, YICs typically have to rely on venture funds or business angels to attract external financial resources. This also explains why Venture Capital is typically very popular amongst certain YICs and highly innovative companies, for example in biotechnology (Schneider & Veugelers, 2010). Research by Czarnitzki and Hottenrott (2011) shows that young and small firms are often (financially) restricted to invest in R&D. Moreover, the research also shows that the size of a company is negatively correlated to its restriction in financial resources for R&D. This implies that small companies are more financially restricted than large companies.

Research by Schneider and Veugelers (2010) shows that, since YICs face so-called financial barriers for R&D, they not only are restricted to invest in R&D, but also find it more difficult to engage partners in collaboration projects. The authors also emphasize both the importance of YICs because of their highly innovative powers and the disadvantages that these companies have to face. These disadvantages include the fact that YICs generally operate at a **small scale**, meaning that they often cannot benefit from economies of scale. Secondly, YICs also have a very **short operating history**, which implies that they often have less accumulated **knowledge, know-how and expertise** than other companies. Finally, YICs also have less **capital and financial reserves** than large firms, simply due to the fact that they are young and small. On top of these structural disadvantages, YICs also face the challenge of having to invest in **risky innovative projects**, making them even more vulnerable.

In general, the abovementioned disadvantages create so-called **innovation boundaries** for YICs, which prevent them from intensifying their innovation and R&D activities. The research conducted by Romijn and Albaladejo (2002) gives more detail on the specific causes that relate to some of the abovementioned YIC disadvantages. Based on a sample of small high tech companies in the UK, the authors show that the most prominent innovation boundaries for small high-tech firms are the lack of prior experience within a scientific environment and the lack of staff holding a science and engineering degree. In addition, the research also confirms that innovation boundaries for high tech firms include the lack of financial resources, which is especially relevant during the start-up phase of the company. Table 1 gives an overview of the most prominent innovation boundaries and their relation to common YIC characteristics.

Table 1: Innovation boundaries of YICs (Romijn & Albaladejo, 2002; Czarnitzki & Hottenrott, 2011; Schneider & Veugelers, 2010)

Characteristics	Innovation boundaries
Young (<6 years)	Lack of prior experience in a scientific environment
	Lack of (innovation) management capabilities
Small (<250 employees)	Lack of staff holding a science and engineering degree
	Lack of staff with relevant experience
Innovative (>15%	Risky (early stage) research projects

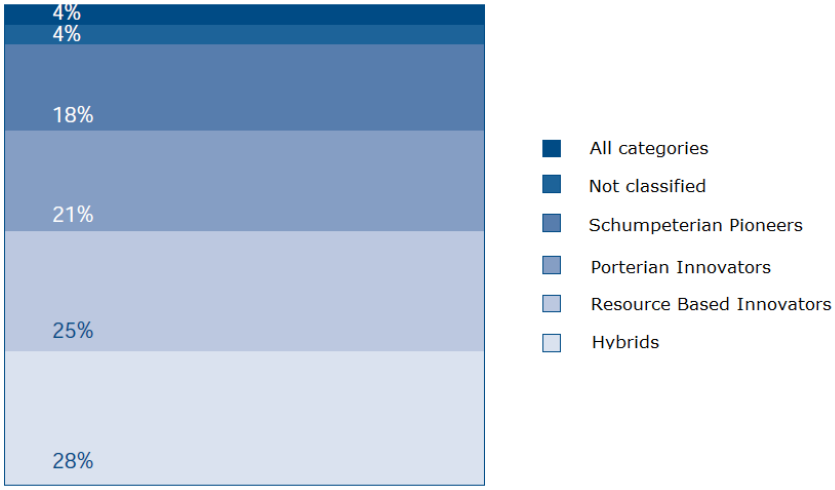
R&D)
Lack of financial resources

2.1.3 Classification of YICs

On the one hand, YICs combine several innovation boundaries which distinct them from other SMEs (Schneider & Veugelers, 2010; Romijn & Albaladejo, 2002). However, on the other hand, research by Clarysse et al. (1998) shows that YICs are also a very heterogeneous group of companies. Therefore, we need to take differences amongst YICs into account. Based on a list of **18 strategic success factors**, Clarysse et al. (1998) classify YICs (in Flanders) into three groups: Schumpeterian Pioneers, Resource Based Innovators and Porterian Innovators. For their classification of YICs, the authors conducted 32 depth interviews. By making use of an interview technique called "repertory grid[1]", they came up with a list of 18 strategic success factors (innovation characteristics) that characterize **strategic positioning, core competences and market positioning**.

The first group of YICs, that are classified as **Schumpeterian Pioneers**, typically combine the following innovation characteristics: innovation based on new (breakthrough) technologies, a strong desire to have more control over the supply chain, technological know-how and a keen strategy for growth. The second group of YICs, that are classified as **Resource Based Innovators**, typically combine the following innovation characteristics: formal quality systems (ISO certificates etc.), formalized R&D, focus on service delivery and client-specific projects. Finally, the third group of YICs, that are classified as **Porterian Innovators**, typically combine the following innovation characteristics: innovations based on niche markets and industry leadership. Based on a total sample of 32 Flemish YICs, Figure 1 shows the heterogeneous distribution of YICs according to Clarysse et al. (1998). The figure indicates that, one the one hand, the number of YICs in all groups are more or less evenly distributed. On the other hand, the figure also shows that there are also a lot of hybrid YICs, that do not just fit within one group.

Figure 1: Distribution of heterogeneous YICs (Clarysse et al., 1998)



[1] The "repertory grid" technique is a well known interview technique that uses psychological reasoning as a measurement tool, based on George Kelly's psychological theory of personal constructs (Kelly, 2003).

The first category of YICs (Schumpeterian Pioneers), refers the Schumpeterian idea of creative destruction[2]. These YICs have a culture of innovation that is inspired by a visionary leader and create products from a new breakthrough technology. Furthermore, they choose to have control over the value chain, for example by buying licenses to certain technologies. The companies are also very IP oriented because they want to protect their technologies from other competitors. They also have a strong growth strategy, but are hard to reach by government programs since their activities are mostly informal. These companies tend to create high employment by vertical expansion across the value chain. The second category of YICs is referred to as Resource Based Innovators. These YICs try to differentiate themselves from other competitors by offering a unique service. Instead of selling a product to a client, they try to offer a total concept that includes product and service, for example logistical support. They offer this service in order not to compete with other companies that offer standardized or 'one size fits all' products. The R&D activity of these companies is generally more formalized, and is client-oriented. The resource based innovators tend to engage in small client-oriented projects and tend to create employment by expanding their services.

The third category of YICs (Porterian Innovators), refer to Michael Porter's model of the five market forces of competition[3]. These companies are leaders in a specific market segment, because they have acquired technical expertise in a certain domain. They tend to create low employment because they already operate in a specific niche segment. Some of these firms choose to stay small research units, because they do not want to become a large production unit. Out of all three categories, the Porterian Innovators find it most easy to get subsidies or other government support.

2.2 R&D partnerships and the role of innovation intermediaries

2.2.1 The advantages of R&D partnerships and the role of innovation intermediaries

As presented in *2.1.2 Common innovation barriers*, YICs face so-called **innovation boundaries**, such as a lack of experience and resources, that prevent them from intensifying their innovation activities. For this reason, Open Innovation is particularly important for YICs. By collaborating with other partner companies, knowledge institutions, universities and government agencies, they can **share knowledge and resources** for R&D. Moreover, collaborations can also **reduce the risk of R&D** by generating scope economies (Czarnitzki & Hottenrott, 2012). In this research we will evaluate the impact of R&D support for YICs. However, because of the particular importance of Open Innovation for YICs, we will mainly focus on R&D support for Open Innovation. Therefore we will first briefly address the topic of R&D partnerships and R&D alliances in this part of the literature review.

Research by Arvanitis, Kubli, & Wörter (2005) shows that, two key motives for firms to collaborate with partner companies and knowledge institutions for R&D are: **insufficient R&D resources** and **time-saving in R&D**. Since YICs often do not have enough financial resources available, they find it difficult to invest in R&D, prototyping equipment or staff (specialized researchers and engineers). Time-saving in R&D implies that companies (YICs)

[2] Creative destruction refers to the process where a new product or process innovation replaces an product or business process (Schumpeter, 1942).

[3] Porter's five forces model represents the five competitive forces that shape the competitive environment of a firm: industry rivalry amongst firms, bargaining power of buyers and suppliers and threats from potential new entrants and substitute products (Porter, 2008).

can more efficiently engage in R&D because if these complementary R&D resources (prototyping equipment, staff etc.). Despite the fact that R&D partnerships offer a good solution for YICs to deal with innovation boundaries, there are also some practical challenges for companies (YICs) to engage in R&D partnerships. Research by Lokshin, Hagedoorn, & Letterie (2011) shows that companies often face difficulties in gaining access to **R&D project funding** and **finding the right R&D partner**. Not finding the right R&D partner and conflicts of interest are in fact the most prominent reasons why most R&D partnerships fail. By increasing companies' chances to find good partners and by stimulating R&D partnerships in general, public agencies can offer a solution. Project funding is important to carry the costs of university researchers in R&D partnerships with universities.

How can the government address the special needs of YICs and facilitate R&D, and R&D partnerships in particular? Over the last couple of years, progress has been made on the provision of support measures for stimulating R&D and R&D partnerships for SMEs. The **European Commission** has launched the Enterprise Europe Network (EEN), to support SMEs operating in Europe, not only regarding R&D partnering, but also with respect to internationalization, innovation, access to finance and funding, contract law, e-signature and e-identification (European Commission, 2013b). The EEN is a large network of over 600 already existing organizations. They all act individually, but are connected as they are part of the network. The organizations are subsidized by the European Commission and receive additional support from the Executive Agency for SME (EASME), with the aim of helping SMEs within the European Union (European Commission, 2013b). One of these organizations is the **IWT (Agentschap voor Innovatie door Wetenschap en Technologie)**, the Flemish branch of the EEN. The IWT provides support for innovation and R&D through subsidies and advisory via the so-called **"IWT programs"**. The IWT also plays an important role in providing support for R&D and R&D partnerships (Open Innovation) in particular. Moreover, it also provides support for companies in finding the right R&D partners. In this research we will solely focus on R&D support offered by the IWT. The next section, *2.2.3 The IWT programs*, will give more detail on the IWT programs. Other Belgian organizations, that are part of the EEN, are FIT [4](Flanders Investment & Trade, support of SME's toward globalization) and AO[5] (Agentschap Ondernemen). These organizations will not be discussed in this research.

2.2.2 Definition and classification of R&D partnerships

Hagedoorn (1993) defines R&D partnerships as a specific form of inter-firm partnership where companies agree to voluntarily exchange technology and knowledge regarding R&D. Companies can agree to exchange knowledge and technology for different reasons. A distinction between production, distribution, and R&D alliances can be made based on the particular motives of companies to form such alliances. We will mainly focus on R&D alliances for Open Innovation.

In the case of R&D alliances, motives are typically cost- and risk sharing of R&D, sharing of know-how and access to new technologies (Hagedoorn, 1993). The type of R&D partnership can also differ according to the **scope** and **length** of the partnership and on the **type of collaboration** (collaboration objectives) between the partners participating in the R&D partnership. Within the category of R&D partnerships, a distinction can be made between short (simple) contractual arrangements and long-term strategic alliances. Furthermore,

[4] FIT provides subsidies to support Flemish companies and SMEs in internationalization and international trade.
[5] AO is the central point of contact for Flemish entrepreneurs. Services by AO include subsidy support, administrative support, financing and innovation.

Hagedoorn (1993) categorizes six types of R&D partnerships, namely: joint ventures, joint R&D, technology exchange, direct investment, customer-supplier relationships and uni-directional technology flows. Table 2 gives an overview of the different types of inter-firm alliances according to Hagedoorn (1993).

Table 2: Typology of inter-firm alliances according to Hagedoorn (1993).

Inter-firm partnerships	Knowledge/service flow	Capital flow
Joint Venture	Shared	Shared
Joint R&D	Bi-directional	Bi-directional
Technology Exchange	Bi-directional	Bi-directional
Direct Investment	Uni-directional	Uni-directional
Customer-Supplier relationship	Uni-directional	Uni-directional
One-directional technology flow (also known as technology transfer (TETRA))	Uni-directional	Uni-directional

This research will mainly focus on inter-firm cooperation that engages a bi-directional flow of knowledge and capital and that is, most-of-all, R&D related. As Table 2 indicates, only joint R&D and technology exchange have a bi-directional flow of knowledge and capital, therefore we will focus on these two R&D collaboration types.

2.2.3 The IWT programs

In this research we will assess the impact of some IWT programs. Under the aim of stimulating innovation in Flanders, the IWT provides several incentives for SMEs and large companies to engage in innovation activities and R&D. These incentives can be divided into two groups: financial support through subsidies and advisory (coordination) support. Per annum, there is a total provision of around 300 million euros for financial support (subsidies) for companies, knowledge centers and non-profit organizations. A small proportion of the IWT budget goes to advisory support and coordination activities (IWT, 2013b). In this chapter, we will briefly discuss some of the IWT programs and advisory support mechanisms.

The financial support (subsidies) portfolio can be subdivided into the following categories or programs presented in Table 3.

Table 3: The IWT financial support portfolio (IWT, 2013b).

IWT financial support portfolio	
R&D company projects and feasibility studies (R&D Program)	Agricultural research (LA Program)
SME feasibility studies and innovation projects (SME Program)	**Strategic fundamental research (SBO Program)**
SPRINT projects (non SME)	**TETRA-fund**
Baekeland-mandates (doctorate)	Applied biomedical research (TBM Program)
Doctoral grants for strategic fundamental research	Flemish Innovation Network (VIS Program)
Innovation mandates (post-doc)	

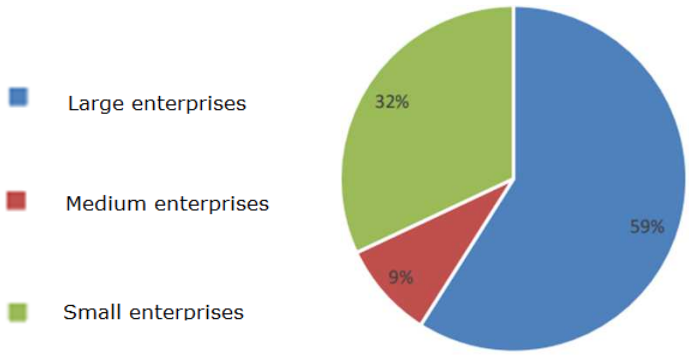
As previously mentioned, we will mainly assess R&D programs that focus on R&D (project) collaboration with other companies and universities. However, we will also assess other innovation-and R&D support programs that might be relevant for YICs. In general, we will focus on the following IWT programs: R&D company projects and feasibility studies, SME feasibility studies and innovation projects, strategic fundamental research and TETRA-fund. Table 4 briefly summarizes the annual budget distribution for financial support concerning these programs. The table shows that R&D projects represent the vast majority of the IWT budget. The TETRA program for example only represents a small proportion of the total budget.

Table 4: IWT budget evolution 2010-2013 (in mln euro) (IWT, 2013b)

	2010	2011	2012	2013
TETRA	7,941	8,298	8,451	8,595
Strategic fundamental research (SBO)	34,840	36,674	39,174	42,441
R&D projects (incl. SME program)	126,298	138,306	147,386	143,49
Total budget	243.346	292,457	302,962	323,389

Figure 2 shows that financial support mostly reaches large companies, since only 41 percent of total financial support from the IWT addresses SMEs. Some IWT programs, such as the SME program, have a specific focus on SMEs and YICs. Programs such as SBO and R&D, do not have a specific focus on SMEs (YICs). However, SMEs (YICs) can also choose to participate in these programs.

Figure 2: Financial support distribution (IWT, 2013b)



Besides financial support, the IWT also offers advisory (coordination) support to companies and SMEs. The IWT advisory support only represents a small proportion of the total support budget, but plays a crucial role in improving access to R&D and innovation. The IWT advisory support can be subdivided into the programs and categories as presented in Table 5.

Table 5: The IWT advisory support portfolio (IWT, 2013b).

IWT advisory support portfolio	
Innovation network	Knowledge acquisition
EEN	Starting innovation
VCEP	**Networking**
Innovative procurement	Project application support

Partner search (IWT newsletters)

In this research, we will briefly assess the advisory support mechanisms regarding networking and project partnering (see *7.1 Networking additionality by making new contacts*). These advisory support mechanisms include: EEN, Partner search and networking.

Tables 6-10 give a brief description of each of the focal IWT subsidy programs and advisory support mechanisms that will be assessed in this research (IWT, 2013b). The SME program and R&D program are both individual company projects by means that they address a specific company problem or opportunity. However, companies can partner with other companies, research organizations or universities. These can be both national or international partners. The partner companies, research organizations and universities are all treated as subcontracting parties, as the project originates from a specific company problem.

Table 6: The SME program.

Program:	Target group
SME Program	SMEs
	Description
SME feasibility studies	*SME feasibility studies aim at providing a better insight into the possibilities and feasibility of an innovation project.*
SME innovation projects	*SME innovation projects contribute to developing product, process or service innovations. Innovation refers to any activity that is new to the company and has an impact on business activities.*

An initiative that is similar to the IWT's SME program is the **SME Instrument**. The SME instrument is an initiative by the European Commission and is part of its Horizon 2020[6] framework. The SME Instrument is an international program as it operates on the European level, while SME program is only applicable in Flanders.

Table 7: The R&D program.

Program:	Target group
R&D Program	SMEs and large enterprises
	Description
R&D company projects	*R&D company projects provide direct support to companies that engage in R&D projects for innovative solutions.*
R&D feasibility studies	*R&D company projects provide direct support to companies that engage in R&D projects for innovative solutions.*

The SBO and TETRA program are both university (academy) based programs, as they start from a specific university research project. Companies, in particular YICs, that are interested in the potential application benefits of this research, can subscribe to these programs and become part of a user committee. This allows them to apply the results from the research to their own products and services. Companies need to make a financial contribution to the university partners to become part of a user committee. The financial support from the IWT

[6] Horizon 2020 is a framework by the European Commission. The aim of this framework is to stimulate innovation and R&D in the European Union (European Commission, 2015b).

in these programs is directed towards the academic partners, and not the companies of the user committee.

Table 8: The SBO program.

Program:	Target group
SBO Program	Companies, research organizations, non-profit
Description	
Strategisch Basis Onderzoek (SBO) is a program that aims at investigating new applications for innovative research. Besides the goal of economic valorisation (economical goal), the program also aims at making a positive impact on society (social goal).	

Table 9: The TETRA program.

Program:	Target group
TETRA Program	SMEs, research organizations, non-profit
Description	
The TETRA program is a project collaboration program for applied research, between companies, organizations and universities. The TETRA project is mainly conducted by a university. Afterwards, the results and IPRs from the project are distributed amongst the TETRA partners (user committee). The TETRA program has two main objectives. The first objective is to stimulate innovation in SMEs, (large enterprises) and non-profit organizations. The second objective is to stimulate knowledge transfer for applied research between universities, companies and other organizations.	

Table 10: The EEN program.

Program:	Target group
EEN	SMEs, research organizations
Description	
*As a partner of the Enterprise Europe Network (EEN), the IWT offers support in **networking** and **partner search** via an international database of technology offers and requests. These contacts form the basis for TETRA, R&D and SBO projects. Apart from the IWT, other organizations such as Agentschap Ondernemen (AO) and Flanders Investment and Trade (FIT) are also members of the EEN. These organizations mainly focus on the commercialization of innovations and other business-related areas, such as international trade.*	

Apart from the programs offered by the IWT, there are also other programs, for example by Agentschap Ondernemen (AO), that are specifically designed for startups. For instance, **KMO-portefeuille** is a program by Agentschap Ondernemen (AO) that allows companies to gain subsidies from the Flemish government for internationalization and innovation. Moreover, KMO-portefeuille also has generally low administrative requirements compared to other subsidy programs for business and innovation. Because of the lower administrative requirements, this program also addresses needs of innovative startups and YICs. Subsidy amounts are relatively low as companies can apply for an annual subsidy up to 40.000 EUR (AO, 2011).

2.3 Additionality of R&D support

2.3.1 R&D partnerships and R&D partnership success

In order to evaluate (assess) the impact of government support for R&D and R&D partnerships, we first need to make a clear distinction between project impact and project

outcomes. Not all R&D (collaboration) projects lead to successful outcomes in terms of (technological) advances. However, even when projects do not lead to certain advances, they can lead to other additional effects, such as knowledge creation, behavioural change etc. R&D projects and partnerships can end for different reasons, but this does not mean that the R&D partnership has been a complete failure. In other words, a pure black or white point-of-view seems somewhat simplistic to categorize R&D partnership success. Therefore, a clear conceptual framework is needed to define what R&D partnership success really means. Besides, how can we define if a R&D (collaboration) project was successful? To answer this question, we will first give an overview of some prominent factors that impact R&D (collaboration) projects.

According to Lhuillery and Pfister (2009), the success of an R&D collaboration project is affected by several factors. These factors lead to certain **unplanned outcomes such as stoppage, delay or abandonment of the project**. Based on data from the French Community Innovation Survey (CIS), the authors show that R&D project cooperation has a higher degree of failure when companies collaborate with other competitors, research organizations, suppliers or foreign partners. The reason for this is that these partnerships typically pose so-called **cooperation problems**. For example, companies could be reluctant to collaborate with suppliers because they might leak confidential information. As a consequence, (dominant) suppliers could use this information against the company. Moreover, the research shows that company **size** and **previous experience** in R&D collaboration projects also have an impact on the previously mentioned cooperation outcomes. SMEs typically have a higher chance of cooperation failure than large companies. Young companies typically also have a higher chance of cooperation failure, because they often lack previous experience in R&D collaboration projects.

Research by Lokshin, Hagedoorn and Letterie (2011) shows the main cause of R&D partnership failure is the formulation of **unclear objectives at the beginning of the partnership**: in nearly 53% of all cases, changes in the priority and strategy of firms lead to project failure. Moreover, the research also shows that companies with a broad R&D partnership portfolio have a higher **absorptive capacity (ACAP)**. This means that they have more competence in absorbing external information (knowledge transfer) from other partners. With regards to R&D cooperation projects, Cassiman & Veugelers (2002) have conducted research on two main aspects of **knowledge spillovers**: incoming spillovers[7] and knowledge appropriability[8]. Based on data from the Community Innovation Survey (CIS) for a sample of Belgian companies, they confirm that companies with higher incoming knowledge spillovers and a better knowledge appropriability, more likely collaborate on R&D with other companies and research institutions. Furthermore, in the research of Easterby-Smith, Lyles, and Tsang (2008), a conceptual model for knowledge transfer is used to describe some of the prominent factors that influence knowledge transfer. This model suggests that the nature (tacitness) of the transferred knowledge, as well as inter-organizational dynamics, influence knowledge transfer. Moreover, the research by Easterby-Smith, Lyles, and Tsang (2008) also shows that the success of knowledge spillover largely depends on the cultural differences between firms, but also on partner trust.

[7] "Incoming spillovers" means external knowledge that is transferred from the partner to the companyduring the partnership.

[8] "Knowledge appropriability" means the ability to capture and protect knowledge, for example by patenting or strategic protectioning.

2.3.2 Introducing the concept of additionality

As presented in *2.3.1 R&D partnerships and R&D partnership success*, it is important to evaluate the total impact when it comes to evaluating R&D support. Moreover, it is also important that the effects of government support are additional. This means that the effects would not have taken place without the R&D support (in this case from the IWT programs). For example, if a company would not have partnered with a university for one of its R&D projects without R&D support from the IWT programs, than this effect is additional. In the academic literature, this concept is referred to as additionality. The **additionality** concept first originated as a tool for the evaluation of government support measures in response to market failures (examples include Wallsten, 2000; Falk, 2007; Aerts & Czarnitzki, 2004). For the evaluation of government support measures, the traditional input/output view of additionality has been a prominent tool. However, this traditional view is considered to be too restricted as it does not give a total view of all the additional effects of a government support measure (Georghiou, 2002). Therefore, we will also make use of the concept of behavioral additionality, as proposed by Georghiou (2002) and Falk (2007). The classification that is used is based on the IWT guide for measuring effects (IWT, 2011) and is represented in Table 11.

Traditional additionality research has prominently focused on input additionality. In a traditional subsidy context, the central question regarding input additionality would be: *"How much additional input is invested by companies for each euro of public input through subsidies?"* In the case of IWT support, **input additionality** corresponds to the question whether a company would have made the same innovative efforts without the support mechanisms offered by the IWT. The input additionality concept is also closely linked to the concept of crowding out effects of government support measures (Wallsten, 2000; Aerts & Czarnitzki, 2004). Previous research on Flemish companies (both large and small companies) by Aerts and Czarnitzki (2004) shows that there is no crowding-out effect of R&D subsidies. Research by Wallsten (2000) illustrates the case of SBIR[9], an initiative by the American government to support small enterprises in R&D. The SBIR case demonstrates that there can be a crowding-out effect among firms in which grants may not have any additional impact on private R&D spending. Another concept that has been very prominent in additionality literature and that is closely linked to input additionality, is output (outcome) additionality. **Output (outcome) additionality** refers to the amount of additional output that a firm generates in relation to the governmental support it receives. This additional output can take on many forms. Previous additionality research by Georghiou (2002) encompasses the following forms of output: increased sales, number of functional applications and incremental innovations, increased patent citation etc. In general, the central question regarding output additionality should be: *"How much output is generated for every euro of R&D support input?"*

Besides the traditional input/output additionality, a third type of additionality, namely **'behavioral' additionality**, has drawn attention in recent additionality studies. Behavioral additionality refers to the effect of governmental support on a firms (strategic) behavior. In other words: do companies behave differently as a result of governmental support (Buisseret, Cameron, & Georghiou, 1995; Georghiou, 2002)? Bach and Matt (2002) identify the **exploration of new business areas** and the **changes in business processes** as two key elements of behavioural additionality. Georghiou (2002) shows that the UK Departement of Trade and Industry uses a three-category approach for the evaluation of behavioral

[9] SBIR (Small Business Innovation Research) is part of SBA (Small Business Administration).

additionality of governmental support. These three main categories are scale, acceleration and scope additionality. For example, R&D partnership support could stimulate companies to participate in larger projects (**scale additionality**), because the companies can operate at a larger scale by collaborating with other companies and universities. This can also lead to a diversification and an horizontal expansion of the existing technology or product range (**scope additionality**). In other words, scope additionality causes a company to target new markets or to explore new research areas (Falk, 2007). Scope additionality is also closely linked to another additionality type, namely **risk additionality**. By increasing the scope of a project, companies can also engage in more ambitious projects and invest in early stage research (Schneider & Veugelers, 2010). Finally, **acceleration additionality** refers to the fact that a company can speed up its innovation process by collaborating with other companies or organizations (Georghiou, 2002). This could be due to access to complementary resources, financial resources etc.

Other key elements that comprise the concept of behavioral additionality are learning effects (Nielsen & Nielsen, 2009) and an improved absorption of external information through experience (Lokshin, Hagedoorn, & Letterie, 2011). As previously discussed in *2.3.1 R&D partnerships and R&D partnership success*, research by Lokshin, Hagedoorn, and Letterie (2011) shows that participation in previous inter-firm partnerships has a positive effect on a firm's absorption capacity of external information, as well as the firm's intention to participate in future collaborations. Research by Nielsen and Nielsen (2009) shows that there is a positive relationship between knowledge transfer and partner trust. Furthermore, knowledge transfer can lead to new **competences, expertise and know-how**. Another important additionality effect that should be taken into account is **networking additionality**. Research by BarNir and Smith (2002) has shown that there is a positive correlation between the size of a small firm executives' social network and the likelihood of establishing future R&D partnerships and alliances. In their research, the authors also emphasize the important role and the strength of the personal ties between executives and members in their personal network. Strong ties lead to a certain level of trust and willingness to take risks (**risk additionality**). Networking additionality can also lead to an increased credibility rating amongst external investors, such as venture capitalists (Romijn & Albaladejo, 2002). A final concept related to behavioral additionality is **strategy additionality**. Strategy additionality comprises all sorts of additionality that reflect the strategic change of a company. For example, has the company improved its strategic goals, did it develop new business opportunities etc.? Table 11 gives an overview of the previous discussed literature studies with regards to input, output and behavioral additionality.

Table 11: Overview of additionality effects, categories based on IWT (2011)

Additionality type	
Input	Crowding out effects (Wallsten, 2000; Aerts, & Czarnitzki, 2004)
Networking and cooperation	Making of new contacts (BarNir & Smith, 2002)
	Increase of the executive's social network (BarNir & Smith, 2002)
	Increased credibility amongst investors (Romijn & Albaladejo, 2002)
Scale and scope	Exploration of new markets and new research areas (Falk, 2007)
Building up competence and expertise	Improved absorption of external information (Lokshin, Hagedoorn, & Letterie, 2011)

	Learning effects (Nielsen & Nielsen, 2009)
Acceleration	Time-saving in R&D or financial benefits (Arvanitis, Kubli, & Wörter, 2005)
	Speeding up of the R&D process (Georghiou, 2002)
Risk	Sharing of the risk involved in the project (Schneider & Veugelers, 2010; Hagedoorn, 1993)
Strategy	Higher intention to participate in future collaborations (Lokshin, Hagedoorn, & Letterie, 2011)
Output	Exploration of new business areas and the changes in business processes
	Increased sales and citation index of a patent (Georghiou, 2002)

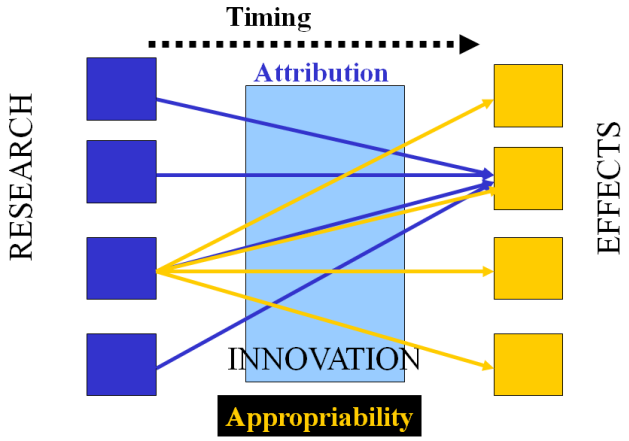
Each of these additionality concepts are addressed in the interviews. The results will be discussed in the sections 7-14.

3 Methodology and interview design

3.1 Challenges for measuring additionality effects

Several studies have measured the additionality effects of government support for R&D by using large scale surveys or by using quantitative measures, such as the increase in the citation index of a patent (Georghiou, 2002). The success of these approaches is ambiguous because they often do not succeed in finding a good causal relationship between additionality effects and do not succeed in identifying additionality causes (Falk, 2007). Measuring additionality effects of R&D support poses two main challenges. Firstly, **additionality effects are strongly related with each other**. For example, input additionality from hiring a new researcher also results in the building up of new competences for R&D, but could also lead to acceleration of the development phase or an increase in the number of R&D projects. Another example would be that networking additionality leads to increased knowledge transfer, which could lead to increased competences and expertise (Nielsen & Nielsen). A second challenges is the **timing of events**, since additionality effects can occur on the short, medium or long term (IWT, 2011). Most of the additionality effects, especially output additionality are long term effects. Figure 3 gives a good representation on the problem with measuring and assigning additionality effects of R&D support.

Figure 3: A simple schematic representation of the challenges for measuring the additionality effects of R&D support (Georghiou, 2002)



Because the timing and interconnection of additionality effects is very complex, it is also very challenging to measure effects by the use of a standard econometric model, taking into account the constant interactions between additionality effects (Falk, 2007). Especially for behavioural additionality measurement, it is difficult to use an econometric measurement approach. This is because behavioural additionality measurement is also very complex because of the highly **intangible nature of behaviour**. Moreover, in order to measure behavioural changes in firm behaviour, companies are asked what their behaviour would be, if it would not benefit from R&D support. For example: "*Would the company engage new partners, such as universities, **if** it did not receive R&D support?*". Of course, these questions are all **hypothetical**. Therefore, there is no guarantee that company managers know what they would do under a certain (hypothetical) scenario, which could create a certain bias. The abovementioned reasons explain why few studies have really attempted in measuring behavioural additionality on a large scale.

There are two other important aspects that should be taken into account. Firstly, because we only interviewed eight companies, the research results are not representative for the whole population of YICs. Secondly, it is also important to take into account the "**subject bias**". Some of the interviewed companies could over-estimate additionality effects intentionally or subconscious, for example because they are afraid to send out negative signals to the IWT. We dealt with this challenge by being very critical in our observations and the statements made by the companies. For example, when a company stated that it could take extra project risks, increase the scope of the projects etc., we asked the company to specify why this is exactly the case and to give an example.

3.2 Interview design

In total, eight Flemish companies were interviewed. The companies were chosen from different sectors (see also *4 Overview of the companies*), and selected with the help of the IWT. All company names have been anonymized upon request of several companies. In general, all of the companies were aware of the programs and services offered by the IWT, and also participated in one or multiple programs or relied on IWT services in the past. All the interviews were held face-to-face. The persons that were interviewed were mostly the CEOs of the companies. For some of the larger companies, the interviews were held with research representatives or head scientists of R&D.

For each of the companies, a series of interview questions were asked regarding their innovation activities. The interview questions can be subdivided into four parts. The first series of interview questions are some basic questions regarding the main products and activities, the size of the company and the overall corporate structure. These questions aim at getting a general view of the interviewed company, but are also relevant to see if the company fits the YIC criteria regarding age and size (see *2.1.1 Definition and common characteristics*). The second series of the interview questions measure the innovation capacity or innovation efforts of the interviewed company. These questions are particularly important to see if the interviewed company fits the YIC criteria regarding innovativeness. Some companies do not have a formalized R&D budget, which makes it difficult to measure innovativeness as the proportion of R&D related costs to total costs (or revenues). Table 12 gives an overview of the different indicators that were used to measure innovation capacity. These indicators, as well as the questions that were asked in the interviews regarding innovation capacity, are based on the instrumental approach for measuring innovation, that is suggested by Clarysse and Uytterhaegen (1999). This approach is based on four innovation criteria: the implementation of innovation, innovation strategies, the organizational context and the participation in innovation networks.

The innovation criteria can be subdivided into several performance indicators. For example, an indicator for the *"innovation implementation"* criterion is "*the following up of technology trends"*. Companies can follow up technology trends by visiting technology fairs or by screening a patent database or scientific literature. This allows them to keep track on recent advanced technology developments so that they can easily implement external innovations into their products or business processes. Another example of a performance indicator is "*the participation in (local) innovation networks"*. Companies that are highly networked in so-called innovation networks can easily interact with other innovative companies or

universities, which are also part of the innovation network. Examples of innovation networks in Flanders are the Inter-university Centre for Micro-electronics (IMEC)[10] and Agoria[11].

Table 12: Indicators for measuring innovative capacity

Innovation criteria	Innovation capacity indicator
Innovation implementation mechanisms	Following up technology trends
	Project structure for R&D
	Recent business process innovations
	Internal communication and brainstorming sessions
Innovation strategies	Assimilation between innovation strategy and corporate strategy
	Innovation management and benchmarking
	Recent product innovations
	Formalized R&D budget
Organizational context	Willingness to innovate and take project risks
	Organizational flexibility
	Internal mechanisms for stimulating innovation
Innovation networks	Screening of new project partners
	Participation in (local) innovation networks
	Awareness of innovation support mechanisms

In the third series of interview questions, the companies are being asked for which IWT projects or programs they have applied in the past. The companies are also being asked what their specific role was in these projects, and how they overall experienced and appreciated the course of the projects. These questions aim at getting a clear view and a broader understanding of the companies' previous experiences with the IWT. In order to get a clear view of the scope of the projects, the companies are also being asked if there were other companies or universities involved in the projects. Finally, the companies are also being asked for which projects they received subsidies from the IWT.

The final series of interview questions focus on the central subject of this report, namely the additionality effects of the IWT support programs. The additionality study will not only focus input – and output additionality, but also on behavioral additionality. As previously discussed in the literature review (*2.3.2 Introducing the concept of additionality*), behavioral additionality can be subdivided into six categories: networking and cooperation, scale and scope, building up competence and expertise, acceleration, risk and strategy. For each additionality type, several indicators can be formulated, as shown in Table 13. The indicators in Table 13 are based on *Study 68: Measuring effects of the series of IWT studies (IWT, 2011)*. The additionality indicators measure the effects regarding a certain additionality type. For example, in relation to input additionality, a question to the company could be: *"Did the company make any additional R&D investments that were not covered by the IWT*

[10] The Inter-university Institute for Micro-electronics (IMEC) is one of the largest independent research centres for research on micro-electronics (Imec, 2015)

[11] Agoria is the federation of Belgian technology companies (Agoria, 2015)

programs?" or *"Did the company hire a new staff member in relation to one of the IWT projects?"* Another example, in relation to risk additionality could be: *"Is the company able to engage in more ambitious R&D projects because of the IWT support?"*

Table 13: Key indicators in measuring additionality (based on IWT Studies, Study 68: Measuring effects) (IWT, 2011)

Additionality type	Indicator
Input	Additional investments in technology and R&D
	Hiring new employees (researchers and non-research related roles)
	Increased number of research projects
	Would the company have carried out the project independently in terms of financial and/or non-financial resources? (crowding-out effect)
Networking and cooperation	Ability to expand the network with other firms, universities or governmental institutions
	Intensified contact with other firms, universities or governmental institutions and increased likelihood of future collaborations
Scale and scope	Exploration of new markets
	Exploration of new trends (sustainability etc.)
	Engaging new partners in the project
Building up competence and expertise	Better understanding of products and materials (know-how and expertise)
	Better understanding of the production process
	Innovation management competences
Acceleration	Acceleration of research and product development
	Are the project acceleration barriers for research and product development?
Risk	More radical and ambitious innovation projects
	Would the company have carried the risk alone?
Strategy	Impact on innovation strategy
	Did the company change its business model or general strategy?
	Increased credibility among external investors and other stakeholders
Output	Increased number of product applications and incremental innovations
	Revenues and sales growth
	Number of follow-up research projects

4 Overview of the companies

4.1 A brief introduction to the companies

What will follow is an overview of each of the interviewed companies. Based on the interviews and information on the company websites, Table 14 gives an overview of the following company figures: the year in which the company was established, the product distribution channels (business-to-business versus business-to-consumer), the products or business solutions that the company offers to its customers, the sectors in which the company operates, and the number of employees in the company (up to December 2014).

All of the companies fit the European Commission's SME criteria and have less than 250 employees. However, *Companies B, E and H* have recently been acquired by a larger group which does not fit the SME criteria. In these cases, the interviews only focussed on the pre-acquisition period. *Companies D, E, C and G* do not fit the 'young' criterion of a YIC, according to the definition by the European Commission, because the companies are more than 6 years old. In these cases, the interviews also mainly focussed on the start-up phase of the company. Only three companies out of eight, namely *Companies C, E and G*, have a formalized R&D budget. The other companies did not have a formalized R&D budget but the innovation audit during the interviews showed that innovation is a crucial part of their strategy. The paradox with the European Commission's YIC definition[12] is that most young companies do not have a formalized R&D budget (Clarysse et al., 1998; Schneider & Veugelers, 2010). Therefore, the YIC 'innovative' criterion from the European Commission is not fully adopted. Instead, an innovation audit has been adopted in the interviews (see *3.2 Interview design*).

Table 14: General information about the interviewed companies

Company	Year of establishment	B2B/B2C	Business solutions	Sector	Number of employees
Company A	2008	B2C	Optics & accessories - Eyewear	Optics & accessories	3 FTE
Company B	2009	B2B	Engineering - Special machine construction	Agriculture and food processing	7 FTE
Company C	1996	B2B	Chemistry - coating materials	Paper & cardboard	12 FTE
Company D	1990	B2B	Engineering - Special machine construction	Food processing, electronics, automobile	15 FTE
Company E	1960	B2B	Thermal insulation materials	Construction	220 FTE
Company F	2011	B2B	Software for data mining and analytics	Social media, research, forensics	5 FTE + 3 Freelance

[12] According to the definition adopted by the European Commission, YICs are young (less than 6 years old), small (less than 250 employees) and spend at least 15% of their budget on R&D. (See *2.1.1 Definition and common characteristics*)

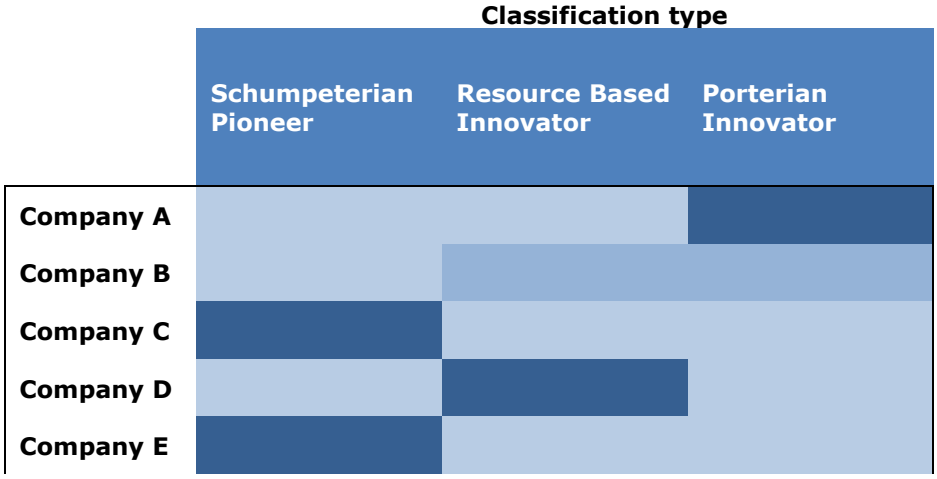
Company G	1977	B2B	Chemistry - fibre coatings	Textile industry	49 FTE
Company H	2008	B2B	UAV (unmanned aerial vehicle) technology	UAV (unmanned aerial vehicle) technology	30 FTE

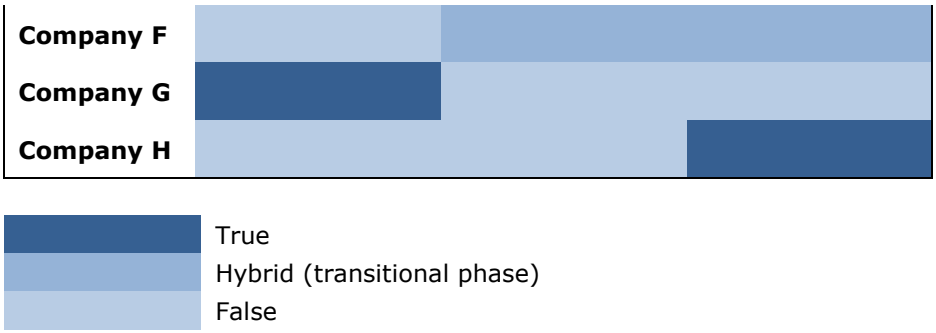
*FTE: Full time employees

Based in the classification scheme proposed by Clarysse et al. (1998), the companies can be classified into three groups: Schumpeterian Pioneers, Resource Based Innovators and Porterian Innovators (see *2.1.3 Classification of YICs*). *Companies D, B and F* can be classified as Resource Based Innovators, because they mostly engage in single client projects and offer customer-made innovative solutions. *Companies B and D* construct specialized machinery on demand, and *Company F* develops specialized software on-demand. Their business model is based on a demand-pull for specialized machinery or software. This means that they do not push new innovations in the market but avoid competition from other companies by offering a unique solution to each of their clients, which allows their clients to build up a competitive advantage.

Companies A and H are typical examples of Porterian Innovators, because they push new technologies, such as UAV technology and eyewear accessories, into the market. They avoid competition by focusing on a new niche market where competition is low. Unmanned Aerial Vehicle (UAV) technology and (special) eyewear accessories are examples of such niche markets. Finally, *Companies G, E and C* can best be classified as Schumpeterian Pioneers, because they try to differentiate themselves by focusing on a particular part of the supply chain. For example, *Company G* focusses on one particular aspect of textile manufacturing, namely textile coatings. Some companies are currently in a transitional phase. Two of the interviewed companies that can be classified as Resource Based Innovators (client specific projects), have the ambition to develop their own product portfolio in the future by focusing a new niche market (Porterian Innovators). *Companies B and F*, which are currently classified as Resource Based Innovators, also try to find a niche market for some of their specialized technologies. For example, *Company B* is currently developing a special agricultural tool for measuring cracks in eggs, for which it received IWT support. Table 15 gives an overview of the classification of the interviewed companies according to the typology used by Clarysse et al. (1998).

Table 15: Classification of the interviewed companies

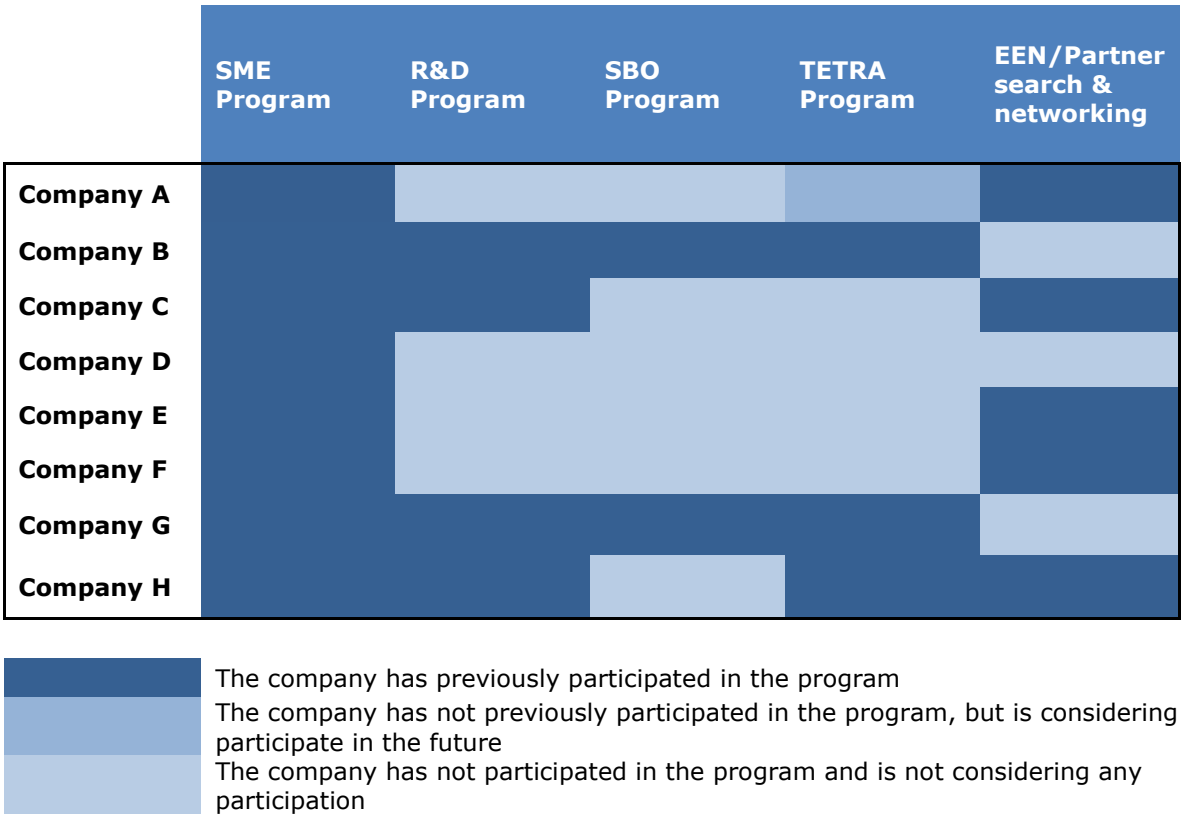




4.2 Participation in IWT programs

All the interviewed companies participated in one or more IWT innovation support programs. As mentioned in *2.2.3 The IWT programs*, the interviews mainly focused on the following programs: SME Program, R&D Program, SBO, TETRA and the EEN services for partner search and networking. Table 16 gives an overview of the participation of the interviewed companies in each of these programs. The table is based on the results from the interviews and the IWT annual reports between 2000 and 2013 (IWT, 2013b).

Table 16: Participation of the interviewed companies in the IWT programs



The company has previously participated in the program
The company has not previously participated in the program, but is considering to participate in the future
The company has not participated in the program and is not considering any participation

Most of the interviewed companies have participated in several IWT collaboration projects. *Company A* has previously participated in several IWT collaboration projects. For example, the company participated in a collaboration project for the development of 3D printed titanium spectacle frames. The company has also done an IWT collaboration project with the University of Liège (ULg). For all of its projects, it did not receive any subsidy. There have also been several successful R&D project collaborations because of the IWT partner search support. *Company B* has done several IWT collaboration projects in the past. For most of

these projects, the company has a role of subcontractor. For the R&D projects, there have been collaborations with universities, such as the KU Leuven (faculty of bio-engineering), in the past. The company has also done a TETRA project with the KU Leuven (faculty of bio-engineering). *Company C* has previously engaged in several IWT collaboration projects with universities and other partners. For example, the company has done an R&D project with the University of Ghent (Centre for Material studies and Engineering) for the production of styrene-maleic acid nano-particles.

For *Company D,* the IWT collaboration projects are solely focused on product development. The company has previously engaged in some (development) projects with other partners, such as Flanders Mechatronics Technology Centre (FMTC) and SIRRIS, and with financial support from the IWT. However, the company has not previously engaged in research collaboration projects such as R&D Program, TETRA or SBO. *Company E* has previously engaged in an IWT collaboration project with the University of Ghent (faculty of engineering) and other partners, for the development and application of one of its isolation material products. The project was classified under the SME Program, but focused on both (material) research and development. For *Company F*, the IWT programs are an important channel for business development. The company has done previous IWT collaboration projects as a project subcontractor, and is currently engaged in a European collaboration project for its own product development. For this project, the company recently also received an IWT subsidy. The company has done several development projects with universities, but has not engaged in research (collaboration) projects. The management staff is also aware and has relied on the partner search mechanisms offered by the IWT. The partner search support has led to successful contacts with two Finnish companies.

Company G has previously engaged in several IWT collaboration projects for both development and fundamental research. For example, the company engaged in a R&D project with the University of Ghent (faculty of organic and polymer chemistry) for research and applications of polyurethane foams and elastomers. The company has also engaged in a similar TETRA project by the University of Ghent. Also *Company H* has previously engaged in a TETRA project and other R&D collaboration projects with universities and other partners. For example, the company participated in the user committee of a TETRA project by the KU Leuven (photometry faculty), for the development of a new camera technology.

What will follow is an overview of the results from the interviews with regards to the additionality of R&D support by the IWT (IWT programs). For each additionality type, an overview is given at the end of the chapter.

5 Input additionality

5.1 Input additionality by increased investments in Human Capital

The input additionality effect of R&D subsidies on local job creation and R&D spending has already extensively been studied in the scientific literature and the results are ambiguous. The central question regarding input additionality for government agencies should be: *"How much additional input is invested by companies for each euro of public input through subsidies?"* Subsidies can increase R&D spending in companies in two ways. Firstly, companies could increase the number of new participations in R&D projects. Secondly, while subsidies in some cases may not increase R&D spending by engaging in new research projects, they could also support companies in continuing and allocating more resources to ongoing projects (Aerts, & Czarnitzki, 2004).

The issue of crowding-out effects of public funding for R&D has already broadly been addressed in the academic literature. On the one hand, there is research that suggests that there is a crowding-out effect of public R&D. For example, research by Wallsten (2000) on the crowding-out effect of the Small Business Innovation Research Program (SBIR)[13], shows that R&D subsidies do not lead to a direct increase in R&D spending or employment in the short run. On the other hand, recent research by Hottenrott et al. (2014) has shown that public grants do increase private R&D spending. In other words, there is no crowding-out effect on R&D spending. The research also shows that, on average, input additionality for research is higher than for development. There are also cross input additionality effects, between research and development funding. This implies that research subsidies also stimulate development spending and vice versa. Moreover, the research findings also suggest that subsidy size matters. Larger subsidy grants typically result in larger input additionality effects. Other research by Koski and Pajarinen (2013) suggests that R&D subsidies are, on the one hand, positively related to direct employment growth. One the other hand, there is no after-subsidy employment effect. This could be explained by the fact that R&D subsidies only create temporarily subsidized R&D jobs, which implies that there is no long-term job creation effect. Moreover, research by Falk (2007) has shown that a large proportion of companies find it difficult to hire new researchers for innovation projects due to several structural barriers, such as high labour costs and commercial-and technologic risks.

The results from the interviewed companies suggest that job creation mostly occurs on the long term, which is compliant with the research of Wallsten (2000) and Aerts and Czarnitzki (2004). Most of the companies also hired new staff members for non-research related roles. The interview results also suggest that most companies only hire new staff members for research related roles if the cost of the researchers can be subsidized. *Company A* hired a new IT professional for a 3D printing collaboration project for which it did not receive any subsidies. In *Company B*, one of the senior managers was responsible for an IWT supported research project and was partly financed by the IWT. In one year time, the number of employees in the company also increased from four to seven. *Company C* just started hiring new staff two to three years after the IWT project, mostly for **commercial-and sales roles**. These new staff members were hired **after the project, without IWT subsidy support**. This year, the company hired four new employees and will continue to hire new employees in the next years. It would also hire new researchers if they could recover some of the costs by subsidies.

[13] Small Business Innovation Research Program (SBIR) is a US government initiative with the aim of stimulating SMEs to engage in R&D related activities. SBIR also provides incentives to stimulate the commercialization of new technologies and innovations (SBIR, 2015).

Also *Company D* did **not hire new employees on a single project basis**. The company did not hire new staff members for most (or all) of its IWT projects. However, it did manage to grow from five to fifteen employees in ten years. Most of the staff are engineers that design and construct specialized machinery. In general, the company hires new staff if there is a structural shortage of engineers. *Company E* recently hired a new researcher for a feasibility study. However, for all the other projects, it did also not hire a new researcher on a single project basis. Most of the projects led to **employment in the long run in commercial roles, as well as production roles** on the production site.

For *Company F,* the IWT projects alone cannot provide a sound basis for direct employment because of the **high level of uncertainty** and the short duration of the projects. The company did not hire any researchers recently. It is very cautious in hiring new researchers because the IWT projects for customers are typically very **short in duration**. The company also wants to keep a flexible cost structure to track volatility in project demand. Therefore, it also chooses to hire freelance developers for some of its projects. According to one of the managers, the subsidy approval for a recent European collaboration project would lead to direct recruitment of new researchers. Because the project has a long duration, it can provide a sound basis for long term employment. Moreover, the company could also use the extra capacity. Without the subsidy approval, the consequences of project failure would be higher because they could not recover costs. The company would also like to hire a doctoral researcher for *Innovation mandate*, if the cost would be partly (>50%) covered by the IWT. It would be impossible to finance the cost of a doctoral researcher without subsidy, firstly because the cost of hiring a doctoral researcher to do purely fundamental research is too high in relation to the benefit. Secondly, the research is also **too theoretical** and not solely in benefit of the company, but **also in benefit of research and publications**.

For *Company G*, the direct impact of subsidies on employment is rather low. However, subsidies allow the company to invest in new products and make profit, which can be reinvested into hiring new employees. The subsidies also provide a financial buffer. Because of this buffer, the company did not have to layoff researchers during periods of economic downturn and during the financial crisis. In other words, the subsidy can also lead to input additionality by **project continuation**. The company recently hired staff for non-research related functions, such as product management, sales and marketing. The company would also hire a new staff member if it gets the approval for a new European cooperation project. According to one of the managers, the European R&D cooperation projects provide a better basis for employment than the IWT projects, because the projects have a longer duration. Often, the company's assigned work package exceeds resource capacity, which makes it necessary to hire new researchers and engineers. Also *Company H* recently hired a software developer because of a shortage of staff. The company also finds it difficult to hire new staff members on a single project basis. Most of the new staff members are hired when there is a **structural shortage of staff**.

5.2 Input additionality by increased number of R&D projects and prototyping technology investments

Most of the interviewed companies would, on the one hand, invest less in R&D prototyping technology without subsidy support. On the other hand, they would less likely collaborate with academic partners in IWT collaboration projects, if they would not receive subsidy support from the IWT. The subsidy allows them to recover some of the costs for the work done by universities and external partners. However, most of them were willing to finance a (small) proportion of the research costs of universities themselves.

Because of the IWT collaboration project for 3D printing, *Company A* recently invested in new 3D printing technologies for prototyping. In general, technology investments are rather low, because the company wants to keep its cost structure low and flexible. For most of its other projects, it does not have to make large capital investments, because most of its business activities focus on design, and not on production. For *Company B*, collaborating with partners in **IWT projects allows co-financing and sharing of (technology) costs**. Each of the partners develops applications in a different domain, but all the costs are mainly shared by all of them. For example, the company develops a software algorithm, and the partner company develops a correspondent image processing tool. By co-sharing the project costs, the projects can evenly get financed amongst the partners. According to *Company C*, **financial reserves are often not available on the right time**. Therefore, financial support from the IWT for R&D collaboration projects is very important. It allows the company to invest in new projects, even when financial reserves are not available. Moreover, according to one of the managers, there is not a lack of research ideas, but solely a lack of margin and financial reserve for future R&D projects. If the company could have more financial reserve available from subsidies, it would do two to three times more research collaboration projects with universities and partners (see also *10.1 Acceleration additionality by speeding up the R&D process*).

For *Company D and E,* **R&D projects go on with or without a project subsidy**. The financial support from the IWT does not impact the decision on investing in a certain project or not. *Company E* would never participate in an R&D collaboration project with other partners, only because it is subsidized. However, the company would allocate **fewer resources in the early stage of the project,** because these projects have a higher market risk and have no direct business relevance (see *11.2 Risk additionality by early stage financing and the IWT as a Venture Capital provider*). The company recently invested in a new pilot machine for one of their IWT collaboration projects (*SME program*). The company bought a new pilot machine for the production of isolation panels and adapted the machine to comply with the European safety norms. For some other IWT projects, the company bought a license to use a certain technique or technology. The IWT collaboration projects allow the company to share technology costs for prototyping and R&D. Before the company got acquired, it was not able to invest in certain analytical devices such as microscopes. Therefore, the company could not do many analytical tests itself.

Because of the high initial cost of certain pilot research technologies, *Company G* looks for alternatives by sharing these capital costs with universities and partners. The company also recently participated in the investment of a new pilot machine together with another company because it did not have enough financial resources to invest and store the new pilot machine. By partly participating in the new pilot machine together with a partner, the company was on the one hand able to share the technology -and storage cost for the new machine. On the other hand, this also resulted in a higher utilization rate and price-to-value of the new pilot machine. The company also does not have enough financial resources to set up fundamental research projects by itself. The IWT programs allow it to engage in these kinds of projects without having to make large private (capital) investments. **Without the possibilities of the IWT programs, most of the projects would be more short-term and development related.** If the company could not collaborate with (academic) partners in IWT collaboration projects and receive subsidies, they would also less likely engage in these activities.

For *Company F*, the IWT programs do not lead to new technology investments or project engagements. However, because the company is a supplier of R&D activities, the projects

often do result in new R&D project investments for partners and clients. For example, **two customers would not have participated in one of the projects, without the initial 5.000 euro subsidy from *the SME feasibility study* (*SME Program*)** (see also *11.2 Risk additionality by early stage financing and the IWT as a Venture capital provider*). For *Company H*, there are now more financial resources available to invest in certain new technologies for prototyping and R&D, than before the company got acquired. **Before it got acquired, the company was not able to invest in a prototyping technology for environmental testing.** The IWT project collaborations allowed the company to share certain prototyping technologies with other partners, such as the University of Ghent. After the acquisition, the company was able to invest in new prototyping and environmental testing equipment, such as a 3D-printing device for prototyping and other technology setups including vibration benches and specialized antennas. Without subsidy, the company would only participate in R&D projects that have a direct market potential. The problem for many (fundamental) research projects is that there is no direct market relevance.

5.3 Input additionality: overview

To conclude, we will give an overview of the results from the interviews, with regards to input additionality. Based on the company interviews, we can formulate several **main findings (similarities)**, with regards to ***Human Capital investments***:

- For most of the interviewed companies, the direct impact of subsidies on employment is rather low. However, the indirect effects can be much larger.
- Most of the interviewed companies only hire new employees if there is a structural shortage of staff.
- IWT projects alone cannot provide a sound basis for direct employment because of the high level of uncertainty and short project duration.
- Employment is mainly a consequence of structural shortages in staff.
- Most companies are not willing to fully finance the costs of researchers, because the cost of hiring a doctoral researcher to do purely fundamental research is too high in relation to the benefit. However, some companies are willing to finance a (small) proportion of this cost.

The interview results show that companies that focus on a specific supply chain segment[14] typically generate employment in many different roles, such as production, sales, marketing etc. These employment effects mostly take place in the long term, several years after the IWT project is finished. The reason for this is that the company cannot hire marketing, sales or production staff, if the product (material solution) has not been developed yet. The interview results also show that companies that focus on client-specific development projects[15], mostly operate new staff in project development roles. These roles include software development, engineering etc. Because of the volatility in project demand, these companies are very cautious when hiring new project development staff.

With regards to ***the number of R&D projects and prototyping technology investments***, we can formulate the following main findings:

- Financial resources are often not available at the right time. The subsidies from the IWT programs can allow companies to engage sooner into new projects (see also *10.1 Acceleration additionality by speeding up the R&D process*).
- The IWT programs allow companies to cover costs of university partners.

[14] These companies can best be classified as Schumpeterian Pioneers (Clarysse et al., 1998).
[15] These companies can best be classified as Resource Based Innovators (Clarysse et al., 1998).

- Without the possibilities of the IWT programs, most of the projects would be more short-term and development related. This implies that there would be an underinvestment for fundamental research.
- R&D projects go on with or without IWT subsidies. However, subsidies allow companies to go further in their projects.

Based on the company interviews, we see that companies that focus on a specific supply chain segment, often operate in capital intensive industries. The production and prototyping of new materials requires companies to make investments in new machinery, which are often hard to make. The interview results also show that companies that focus on client-specific development projects, are less confronted with production and prototyping technology investments.

There were also some recommendations made by the interviewed companies:

- Since short term projects have a high level of uncertainty, longer project durations could give more certainty for hiring researchers.
- In order to evaluate the employment effects of R&D support, policymakers should take into account that most of the employment effects take place in the long term.

6 Output (outcome) additionality

6.1 Direct output (outcome) additionality by increased sales and number of incremental innovations

While input additionality is an important measurement tool to analyse the effect of R&D programs on private spending for R&D, it does not say anything about the effectiveness or R&D output that is generated. Therefore, it is also important to analyse R&D output through output or outcome additionality (Georghiou, 1998). Moreover, it is also important to take into account output additionality, because many subsidized R&D projects have a high failure rate, and have lower private net returns than average development projects (Aerts et al., 2006). The central question for policymakers regarding output additionality should be: *"How much output is generated for every euro of input from public subsidies?"* It is often difficult to answer this question, because output additionality is a very indirect effect and mostly happens in the long run. Therefore, it is important to keep into account the time horizon of the output effects (Georghiou, 1998). Furthermore, a classification can be made between direct and indirect additionality effects. Direct output additionality effects reflect the end-results of government support on company performance. Indirect output additionality effects reflect the intermediary impact of government support on company performance.

For *Company A*, the IWT collaboration projects lead to new (breakthrough) product innovations which lead to the development of new designs (incremental innovations). The production of the design spectacles is outsourced and the spectacles are later sold to different clients and end-users. The IWT project collaborations are mainly focused on implementing new materials such as wood or titanium into the existing spectacle frames portfolio. **Based on one breakthrough innovation**, such as the usage of titanium for developing spectacle frames, **the company can develop many different incremental innovations** (designs). For example, because of the strong titanium properties, the frames can be made thinner, leading to a new product design (see also *8.1 Scope additionality by exploring new markets and engaging new project partners*).

For most of the companies, direct output additionality by **increased sales takes place several years after the R&D project is finished**. For example, for *Company B and F*, most of the non-client-specific projects are still in the development phase. Therefore, there is not any proof yet if these projects will lead to commercial success in the future. Most of the other projects are client-specific. Therefore, these projects do not lead to large scale sales or the development of new incremental innovations in the future. For *Company C*, the long term output effects of one of their R&D projects with the university of Ghent are significant. The company is still able to reap the returns from the project. The project led to a fundamental innovation on which the company could develop many different incremental innovations and paper coating applications. Therefore, the company can still continue to launch new products based on the same fundamental innovation. To date, the revenues generated by the **different product applications** continue to rise over time, and **one fundamental innovation could easily generate revenue for more than fifteen years.** The reason why the company can still benefit from the project is because the product was up-scalable. Once the product had an initial success in the market, the rewards could easily be magnified. The product could be up-scaled because the developed material had stable mechanical properties, which allowed the firm to manufacture the product on a large scale at a reasonable cost. Without the collaboration with the University of Ghent, it would have been much more difficult to develop a stable solution.

For *Company D*, the collaboration project with the University of Ghent did not lead to significant outcome additionality in terms of sales growth compared to the overhead costs and administrative burden. The subsidy gave the company the ability to develop several **additional product features**. However, the project did not lead to product scale-ability and the development of incremental innovations, because the company does not have the ambition to setup its own product portfolio. Contrary, for *Company E*, the IWT collaboration projects did lead to scale-able growth and product portfolio enlargement. The IWT collaboration project with the University of Ghent, led to one basic product solution for isolation panels. Based on this basic product, the company developed several incremental innovations and created a portfolio of new products. Some examples include product solutions for timbre frame constructions, refrigerators, roof-and floor insulation systems etc.

According to *Company G*, collaboration projects with university partners, in general, only lead to commercialization several years after the completion of the project. Most of the research projects have a long duration, and after the project, product development has not even started yet. However, in general, **the projects lead to sales growth in the long run** and have a positive return on investment for the company. The IWT project collaborations with the University of Ghent and the Free University of Brussels (VUB) have led to several breakthrough innovations, such as the development of self-repairing coatings. Based on these breakthrough innovations, the company was able to develop several incremental innovations and product applications, such as: strain release coating solutions, shrink resistant coatings, stretch recovery coatings etc. For *Company H*, the IWT projects (*SME Program*) are an important channel for developing new product applications or incremental innovations that can be integrated within the UAV product technology. For example, for one of the projects, the aim was to develop a software pipeline for automated image processing, and to integrate this software into the UAV mapping system. **By developing additional product features, the company can come to a better product, and increased customer fit** (see also *8.1 Scope additionality by exploring new markets and engaging new project partners*). The IWT collaboration products do not lead to many different future incremental innovations or product applications, because the company just has one UAV product instead of a product portfolio.

6.2 Indirect output (outcome) additionality by technological expertise and sleeper technologies

As mentioned earlier, only part of the research projects lead to direct output in terms of sales and incremental innovations (Georghiou, 1998). However, output-additionality can also be indirect. These indirect output additionality effects include knowledge creation and increased technological expertise in certain domains by so-called "sleeper technologies". Sleeper technologies are technologies that are not ready for the market, but can lead to commercialization in the future (Georghiou, 2002).

The results from the interviewed companies show that the IWT collaboration projects often lead to sleeper technologies. For example, for *Company A*, new ideas are often not ready for the market, and it is therefore important to find the right market timing. In general, **ideas are often being put on a hold and lead to new product development in the future**. An example to illustrate this, is again the IWT project for the development of titanium glasses frames. The project led to a new design for the development of titanium glasses. However, the production of the titanium spectacle frames was put on a hold, because the product was not ready for the market yet. Therefore, the production of the glasses only started several years later. Previous projects (project failures) that do not lead to

development in the future, can often also be useful to the company, because these failures allow them to **learn from mistakes**. By learning from mistakes, the company can avoid making the same mistakes in the future. For example, previous projects have shown that some materials are not suited for developing spectacle frames. In general, most of the R&D projects lead to the development of a prototype, but only half of them result in commercialization, because most of them are being put on a hold. As mentioned in the previous chapter, for *Company B*, most of the non-client-specific products are still in the development phase, and it is difficult to know whether these products will lead to commercialization in the future. The development and production of these product technologies is often being put on a hold. For example, the development of an agricultural tool (product) for measuring cracks in eggs is currently getting restyled. One of the software solutions for measuring agricultural field data is also still partly in the development phase. The projects for clients are, in general, mainly short term. Because these **projects** operate **under strict deadlines**, they mostly **lead to direct development** and do not lead to sleeper technologies.

For *Company C*, the IWT projects do not only lead to the development of new competences and knowledge during the partnership, but also lead to new competences and know-how after the partnership. The partnership often leads to a solution that is already mostly finished, but is not fine-tuned yet. The fine-tuning aspect, which is only a small part of the solution, is often harder than the rest of the project, because of the attention for detail and the required customer fit. In general, many **R&D projects also lead to sleeper technologies, when there is a lack of financial margin to develop new products** (see also *5.2 Input additionality by increased number of R&D projects and prototyping technology investments*). For *Company D and F*, most of the development projects are single client projects. Therefore, these projects do not lead to sleeper technologies, because they are short term and operate under strict deadlines[16]. However, for *Company D*, one of the IWT collaboration **projects led to a certain competence which allowed the company to improve accuracy for building future technologies**. Also for *Company E*, the IWT project collaborations have also led to certain product guidelines (competence), which can later be adopted in other products (see also *9.1 Building up know-how and expertise by knowledge transfer*).

According to *Company G*, many projects are being put on hold because of additional complications that cannot be solved with the current level of know-how. If there would be enough financial resources available, these additional complications can offer opportunities for new **follow-up research projects**. In general, the IWT projects lead to a certain technological expertise, which is transferred during the collaborations with universities and other partners. The company learned a lot from project failures. Even for some of the projects where the end result was not accomplished, the technological expertise lead to a **better understanding of the products and materials**. Because of the technological expertise, the company also gained **more control**, negotiation power and a **better view on market opportunities** in the supply chain (see also *9.1 Building up know-how and expertise by knowledge transfer* and *12.1 Strategy additionality by improving strategic goals*). For *Company H*, the image processing project with the University of Ghent also led to certain software developments, which can be integrated into future UAV products.

[16] By definition, sleeper technologies are technologies that are not ready for the market yet. This idea only holds for technology push innovations, and not for demand pull innovations (client-specific projects) (Georghiou, 2002).

6.3 Output (outcome) additionality: overview

To conclude, we will give an overview of the results from the interviews, with regards to output (outcome) additionality. Based on the company interviews, we can formulate several **main findings (similarities)**, for ***sales growth and incremental innovations***:

- The IWT collaboration projects mostly lead to output (outcome) additionality by sales growth in the long run. Therefore, it is difficult to analyse these effects in the short run.
- For some companies, one fundamental (breakthrough) innovation can results in many different product applications.
- In general, IWT collaboration projects allow companies to develop additional incremental innovations.

The interview results show that for companies that focus on a specific supply chain segment[17], one fundamental (breakthrough) innovation can result in many different product applications. R&D projects allow these companies to broaden their existing product portfolio. Moreover, because these companies are very much focused on production, they can easily upscale sales and production (output). This is not the case for those focusing on client-specific development projects[18], as they are more service (instead of production) oriented.

With regards to ***technological expertise and sleeper technologies***, we can formulate the following main findings:

- Ideas are often being put on hold (sleeper technologies) and can lead to product development in the future.
- Ideas can be put on hold for many reasons, for example because of a lack of time (deadlines for other projects) or financial resources.
- Even if projects lead to unknown outcomes such as early stoppage, they can be useful to companies because it allows them to learn from mistakes. Moreover, they can also result in other knowledge effects (see *9 Building up competences, know-how and expertise (additionality)*)
- Project complications can also lead to follow-up research projects.

The interview results show that projects most often lead to follow-up research, sleeper technologies and technological expertise, for companies that focus on a specific supply chain segment.

[17] These companies can best be classified as Schumpeterian Pioneers (Clarysse et al., 1998).
[18] These companies can best be classified as Resource Based Innovators (Clarysse et al., 1998).

7 Networking additionality

7.1 Networking additionality by making new contacts (partner search)

Networking is of central importance in the establishment of new collaborations for R&D. Moreover, research has shown that technology based SMEs that are highly networked in local research clusters, perform significantly better than other SMEs with regards to innovation output (Romijn & Albaladejo, 2002). Research by BarNir & Smith (2002) has shown that on average 11-22 percent of the alliances in SMEs are based on social networking. Not only the number of social ties, but also the strength of the ties of senior managers and executives in SMEs are positively related to the likelihood of forming a strategic alliance. The IWT supports managers from Flemish companies in establishing new ties with other companies and universities, in order to stimulate open innovation. To increase awareness about R&D projects and partnership requests, the IWT financially supports seminars and fairs, but also publishes newsletters for partnership proposals for R&D. Companies can also access the IWT database to screen project proposals for technology offers and requests. In order to evaluate the networking additionality effect of public support for R&D, policymakers should address the following questions: "*Does government support for R&D increase the likelihood of establishing new ties between companies and other institutions, such as universities?*" and "*Does government support for R&D strengthen the existing ties between companies and other institutions, such as universities?"*

Based on the experience from the interviews, companies often find it difficult to find the right R&D project partners. Moreover, companies are often not aware of other interesting partnership opportunities. Some of the interviewed companies screened the **IWT newsletter (partner search)** for partner requests, but the success of these requests is ambiguous. All the interviewed companies were member of one or multiple strategic research centres or innovation networks, such as IMEC, VITO, SIM, FMTC, Flanders DRIVE or AMICA. These networks allow the companies to participate in specialized **fairs and seminars,** but also offer the possibility to create project consortia for R&D. Most of the interviewed companies actively participated in technology fairs because these events are a great opportunity to meet potential new partners.

In order to find the right partners to engage with in future R&D collaboration projects, *Company A* is a member of several networks, including Agoria. The company finds it very important to find the right partners for innovation projects, because it does not have the (engineering) competences to develop new products on its own. Therefore, it also actively participates in **technology fairs and seminars**, for example on the practice of 3D printing, the usage of new materials etc. (see also *8.2 Scope additionality by exploring new trends*). The company is aware of the partner search support initiatives offered by the IWT and has previously relied on these services (mainly technology requests). However, up to date, there has not been much response from IWT newsletters or the partner database offers, because of the **long response times and low response rates**. The **most important channel for finding new contacts is via fairs**. The company also receives subsidies from the IWT for visiting fairs. Without the subsidy, the company would still participate in fairs, however with a slightly lower frequency. Hypothetically, the company would annually visit three fairs instead of four.

For *Company B and D*, the most prominent channels for making contact with potential new project partners, are **industry networks**[19](Flanders DRIVE, FTMC etc.) and technology fairs (MoTec, EuroBLECH etc.). Through these networks, the company tries to find new project partners for development (technology offer). Both companies are not familiar with the IWT newsletters or partner search services offered support by the IWT. Also for *Company C*, the main channels for finding new partners is via (international) industry networks, such as the paper industry federation in Grenoble or Munich. The company has relied several times of the IWT partner search services in the past. However, based on previous experiences, **projects are often not well defined, or are too difficult and unrealistic**. Moreover, some companies do not respond to the advertisements or do not give enough feedback. Because no financial contribution has to be made and the contacts are anonymous, according to one of the managers, many companies post offers and requests without really having a specific demand.

For *Company E*, industry networks, such as the WTCB (Wetenschappelijk en Technisch Centrum voor de Bouw), are an important channel to find new project partners. However, the IWT newsletters and partner search support are also important channels for finding new project partners. Based on previous experiences, there were some successful partnership contacts via the EEN database. However, the **response from technology offers and requests has declined over the last years**. Moreover, for some of the projects, the financial contributions that were requested by the partner were also too high, and were not clearly communicated through the database. For *Company F*, having a strong network with research centres and universities is a crucial part of their innovation strategy. The network with specialized research centres and industry networks (such as DSP Valley and AMICA) is very important to find partners for new research projects. Most of the new contacts for collaboration projects are found through networking events that are organized by these organizations[20]. Moreover, the company is also registered for the IWT newsletters. Likewise, staff members regularly screen the partner database for opportunities. Based on previous experiences, the company has had several positive contacts from the partner search support services. Furthermore, the company has recently also got in contact with two other Finnish partners for a European collaboration project.

For *Company G*, the **network with research centres** is particularly important because the company operates in a specific industry domain, and most of the companies in this domain already know each other directly or indirectly. Most of the networking events and project proposals are organized via SIM(Strategic Initiative Materials). The companies participating in the networking events are mostly also very innovative and high tech oriented. In general, most of the contacts for R&D collaboration projects are also established via SIM. Before its acquisition, *Company H* could less easily find collaboration projects for new projects. Since the company got acquired, this process has been facilitated, as many partners within the group are also good development partners for IWT projects. The company regularly receives calls for European collaboration projects via the EEN, and the partner search support has been a good channel for finding previous project partners. A more important channel for making new contacts is via **industry federations**. Some of the university partners are also member of UAV associations. Moreover, the company also makes new contacts via IMEC, VITO etc.

[19] The IWT also gives financial support (subsidies) to industry networks, such as Flanders DRIVE and FMTC (IWT, 2013b)

[20] The networking events organized by DSP Valley etc. are also partly subsidized by the IWT (IWT, 2013b)

7.2 Networking additionality by intensifying contacts with universities and partners

Most of the interviewed companies find it important to establish long term relationships with partners and universities. Intense collaboration projects, allow them to establish long term relationships with these partners, which cannot be established by simply exchanging business cards.

For *Company A*, it is important to maintain relationships with partners. Moreover, some partners from previous projects will be contacted again in the future for new projects. **Previous project collaborations with partners often lead to new collaborations**, because there is a certain bond of trust with the partners. Trust is important, as some of the project partners are also important suppliers or are responsible for the manufacturing of the spectacle frames. Because it is important that contacts last, *Company B* also encourages partner companies to remain in contact. The company has strong historical roots within the university, as the company started as a university spin-off. The IWT collaboration projects allow the company to **preserve** its **relationship with university** partners, as the subsidies allow it to cover the university costs. By collaborating with other companies in a TETRA project, the company can also establish strong contacts (instead of weak contacts via fairs or networking events) with many new partners. In general, the **collaboration projects** allow the company to **get to know other companies better** and intensify its relationship with universities.

For *Company C*, the IWT programs are also a great opportunity to intensify the relationships with universities. The company would like to engage in more collaboration projects with universities in the future. By having done **previous successful projects with universities**, it will **more likely engage in new projects with universities** in the future. Based on previous experiences, it is much easier to engage in new R&D projects with partners from previous partnerships than with potential new partners, because there is **less uncertainty and more clarity about the partner's strategic objectives** and the scope of the project. In other words, it is important that all project partners are on the same line and have the same objectives. *Company D* is the only company that does not have any intentions to collaborate and intensify the network with universities. According to one of the managers, the client projects typically have a short duration. However, collaboration projects with universities have a long duration and are often too theoretical. Therefore, university collaborations projects are not suited for this kind of projects.

For *Company E*, it is important to maintain contacts with **partners and universities**, because most of them also **operate in the same niche** and have complementary strategies. Moreover, the university teams that are involved in the IWT collaboration projects also have a specialized knowledge in these niche domains. The relationships with the universities are likely to last because of the personal contacts between their staff and the university staff. However, the IWT programs (and subsidies) allow the company to preserve and facilitate the relationship with university partners. For *Company F*, the IWT programs also facilitate new engagements in projects with universities in the future. All of the projects with the universities are ad-hoc, but the **accumulation and the number of interactions between the company and the university leads to a long-term relationship**. Moreover, it often happens that a complication in one of their projects with the universities leads to a new follow-up research project with the university (see also *6.2 Indirect output (outcome) additionality by technological expertise and sleeper technologies*).

For *Company G*, the story also goes beyond the IWT projects. The managers **never go for a quick 'hit and run'** and want to focus on developing more long term relationships with partners. Solely by knowing other companies from networking events, seminars and fairs, the chances are low that they would engage in a new R&D project with these companies. However, by having done previous collaboration projects, the managers get to know the other companies better and develop long term relationships for the future. The success of the previous partnership also determines the likelihood of new collaborations in the future. If the partnership was a success, the contact with the partner lasts as the product still has to be produced and launched on the market. **By intensifying its relations with universities** in IWT projects, the company can also **meet new potential employees**. The company also finds it difficult to recruit specialized staff (engineers with a background in chemistry and textiles). Most of the profiles that it is looking for are already highly demanded on the labour market. Because the company is very small, it is also difficult to offer salaries to engineers and scientists, which are competitive to the salaries in large corporations. Moreover, it is also difficult for the company to recruit Belgian employees because there aren't enough specialized profiles for the sector that the company operates in. By intensifying its relations with universities, the company can more easily reach engineering graduates.

According to *Company G and H*, the IWT projects are also an important channel to establish long term relationships with universities and partners. By being part of a large user committee in **TETRA** projects, the company has the **opportunity to network with other companies that have similar interests and needs**, but operate in a different sector. Because the companies operate in a different sector, the company would less likely cooperate with these partners without the possibility of TETRA. *Company H* also has personal relationships with some of the university professors, as well as doctoral researchers. According to one of the managers, the collaborations with universities are long term collaborations without a specific long term programming.

7.3 Networking additionality: overview

To conclude, we will give an overview of the results from the interviews, with regards to networking additionality. Based on the company interviews, we can formulate several **main findings (similarities)**, with regards to ***making new contacts***:

- Companies often find it difficult to find the right R&D project partners. Therefore, it is important to make new contacts via networking channels.
- The main networking channels for finding new partners are technology fairs, seminars and industry networks.
- The results from the interviews suggest that *partner search* support does not lead to substantial networking additionality.
- According to some of the managers, the response rate from the IWT newsletters (partner search) is rather low. Sometimes projects are also not well defined or have unrealistic requirements.

With regards to ***intensifying contacts with universities and partners***, we can formulate the following main findings:

- Most of the interviewed companies do not go for a quick hit and run. Moreover, they also find it important to establish long term relationships with other companies and universities that operate in the same niche or have similar interests.
- For most of the interviewed companies, the IWT projects are an important channel for intensifying relationships with universities.

- By having done previous successful partnerships with universities, chances are high that companies also engage in future partnerships. One reason to explain this is that there is more clearness of (project) objectives.
- For some companies, intensifying relationships with universities can also be important to meet new potential employees.

The results from the interviews suggest that, especially for companies that focus on a specific niche market[21] or supply chain segment[22], it is important to network with other companies that have similar interests or needs. Therefore, IWT programs such as TETRA offer many (additional) networking possibilities.

[21] These companies can best be classified as Porterian Innovators (Clarysse et al., 1998).
[22] These companies can best be classified as Schumpeterian Pioneers (Clarysse et al., 1998).

8 Scope additionality

8.1 Scope additionality by exploring new markets and engaging new project partners

Policymakers can encourage innovation, by motivating companies to prospect new markets (market innovation). Financial support (subsidies) from the IWT programs can stimulate companies to explore new markets, because it allows them to go further in their projects. Moreover, IWT programs such as TETRA, allow companies to explore new markets by offering them the possibility to collaborate with other companies that operate in a different sector. Similarly, IWT projects can also offer the possibility to look at new markets for materials and technologies, for example by collaborating with universities for fundamental research on new materials. Most behavioural additionality studies define scope additionality as the effect of policy intervention on the efforts of companies to explore new markets and engage new partners in innovation projects (Falk, 2007; Hyvärinen & Rautiainen, 2007; Shipp, 2004). For policymakers, the central question regarding scope additionality would be: *"Does government support increase the scope of R&D projects by engaging companies to explore new markets, new trends etc.?"* Research by Falk (2007) has shown that, for Austrian firms, innovation support has led to scope additionalities. For more than 40 percent of the Austrian firms, innovation support has led to larger projects by increased number of partners, the exploration of new markets etc.

For some of the companies, R&D support has indeed led to an increased project scope. For *Company A,* it is important to explore new markets to **implement external innovations into** their **products**. The projects with other companies allow them to explore new possibilities such as 3D printing. *Company B* also explores external innovations for innovative technologies by collaborating with universities and other partners. Examples of external innovations include data mining algorithms, advanced measurement techniques etc. However, since the company mostly focusses on a specific niche market for its (future) product developments, the IWT collaboration projects in general do not lead to the exploration of new markets. For example, one of its projects focusses on developing a tool for measuring data for agricultural field tests. Because the product solely focusses on one niche (agricultural field testing), it cannot easily be implemented in other non-related sectors. On the contrary, for *Company C*, IWT projects are an important channel for **bringing existing products into new markets**. For example, for one of the IWT collaborations with the University of Ghent and another chemical manufacturing company, the company explored the possibility of integrating one of its existing nanomaterial products into chipboards. The IWT projects are the privileged way of exploring new markets such as detergents and wood processing, because the projects allow them to collaborate with partners that know the market better than they do.

For *Company D*, IWT subsidies do not lead to the exploration of new (niche) markets, because the company only has an ambition to develop customer-specific solutions. *Company E* would **more likely engage academic partners** if there is a subsidy involved, and in general the company would also more likely engage new partners in the beginning of the project if the initial budget is augmented by a subsidy. The IWT project allowed them to **think out of the box**. Their current product portfolio is over-explored because it is entirely based on the same technology. By engaging in fundamental research projects, the company can explore new markets and new technologies to broaden its product portfolio, which allows them to grow in the long run. It is also important that all the partners that should be involved, are also involved in the project. The reason why one of their fundamental research

projects was very successful is because there was also an architect agency involved in the project. The architect agency played an important role as an integrator for their product. The company was able to collaborate with the agency because of their collaboration with the IWT and the university. Without the possibility of the IWT program, the company would less likely collaborate with universities, and would therefore not be able to collaborate with the agency.

For *Company F,* subsidies are important to create a **technology push**. The company has recently engaged in a European project where it plans to bring a new product to the market. The company already had a strong desire to bring the product to the market, but did not have enough resources and capacity to setup a new project itself. The IWT support made it possible to develop new products and **enter new niche markets**. Also for *Company H*, the IWT program also gives the opportunity to explore new markets, which they would otherwise not explore. The number of partners is already decided beforehand. Before the company applies for a subsidy, they have already decided which partners will be involved in the project. To introduce a product in a new sector, it is important that there is a good customer fit. This is often neglected. It is therefore **often necessary to make slight product modifications and incremental innovations to ensure that the products and product prices become more accessible**. An example is the IWT project for the development of automated image processing software (see also *6.1 Direct output (outcome) additionality by increased sales and number of incremental innovations*). This development improved the functionality of the product, and allowed the product to become more accessible for (new) customers. Furthermore, it is also important that the production process can support scale-ability of the product. Therefore, there should also be a severe screening of the production process.

For *Company G*, R&D subsidies give more time to look at new markets and develop additional features. By **looking at other markets**, the company can **come to a better sales-and business model**. The company also prefers to collaborate with the IWT to explore new markets, because it allows them to meet other partners that they would otherwise not think about (see *7 Networking additionality*). Previous experiences have learned that it is important that all parties are involved in the project. Recently, the commercialization of one of their project failed because one partner, an industrial laundry, was not involved in the project. In this case, additional partner screening by the IWT could have led to more commercial success. According to one of the managers, it is important that there is a severe screening of the supply chain to make sure that all members that should be involved, are also involved. On the one hand, the **IWT projects allow the company to engage many supply chain partners**. On the other hand, the **screening of the supply chain** is often neglected by the IWT. It is important to understand the project environment at the beginning of the project, particularly when the goal is to launch a product into a new market. There should also be a more severe screening by the IWT on how a new product innovation can be produced on a large scale. For the European cooperation projects, there needs to be a business plan, but in general there is not enough focus on the commercialization part[23].

8.2 Scope additionality by exploring new trends

For some of the interviewed companies, it is important to explore new trends, such as sustainability, nanomaterials and Product Lifecycle Assessment (PLCA). Most of the companies follow up recent trends and (technological) developments by screening scientific

[23] The new SME instrument in Horizon 2020 puts however special attention on the commercialization phase for projects to be granted (European Commission, 2015)

literature or participating at technology fairs. However, participating in IWT projects allow companies to follow-up technological developments more closely. *Company A* is definitely an example of a trendsetter. The company wants to go its own way and set new trends in for optics and eyewear. As mentioned in the previous chapter, the IWT collaboration projects allow the company to explore trends in new external technologies, such as **fibre optics** and **3D printing** to set new industry trends. Also *Companies B and D* follow up technology trends, in order to implement these new technologies into their automated machinery products. IWT collaboration projects are mainly an important channel for them to implement new technologies into machinery applications for clients.

For *Company C*, the IWT collaboration projects are an important channel for following up trends such as **sustainability**, **recyclability** and **Product Lifecycle Assessment (PLCA)**. The company also tries to lift on trends such as **nano-materials** and **bio-materials**. The IWT collaboration projects are the preferred way of exploring new radical product innovations that lift on these trends. For example, when the company wants to explore a new concept, such as paper cups that are plastic free, then it is important that all the supply chain partners (end-users, convertors, paper manufacturers) are involved in the project. The **IWT collaboration programs offer the opportunity to engage all parties together to explore new trends and concepts**. For *Company E*, IWT project collaborations also allow the company to increase the scope of their project by lifting on certain sustainability trends. For example, the company was able to incorporate a Product Life Cycle Assessment (PLCA) section in one of its R&D collaboration projects. By collaborating with other partners and universities, the company was able to explore the possibility of raw materials recycling and energy yield improvements for one of its insulation material innovations. Because the company operates in highly regulated industries, it is important to follow up **regulation** trends. The IWT projects facilitate project collaborations with regulating agencies, and allow them to engage these partners in new projects. Moreover, the company is also a member of several committees for standards and regulations (ISO norms).

For *Company F*, the IWT collaboration projects are an important channel to follow up **technology trends** such as **sensor camera technologies**. By collaborating with partners in IWT projects for clients, the company can implement new technologies for the development of client-based solutions. For *Company G*, the IWT collaboration projects are very important to be able to lift on certain trends. According to one of the managers, the company is too small to create a certain market demand. Therefore, it is important to be able to lift on market trends. The IWT collaboration projects allow the company to lift on certain trends such as product sustainablilty, antimicrobial textiles etc. By lifting on these trends, the company can also create its unique value proposition. For *Company H*, the IWT collaboration projects are an important channel for lifting on certain technology and material trends. For example, for one of its IWT collaboration projects, the company explored the possibility of adopting new **composite materials** in its UAV technologies. The company also has a strong network with regulating agencies in order to follow up regulation norms and standards. For example, the company is member and cofounder of the Belgian regulation agency for UAV technologies.

8.3 Scope additionality: overview

To conclude, we will give an overview of the results from the interviews, with regards to scope additionality. Based on the company interviews, we can formulate several **main findings (similarities)**, with regards to ***exploring new markets and engaging new project partners***:

- R&D collaboration projects with universities and other partners are important, because they allow companies to implement external innovations.
- For some of the interviewed companies, the IWT projects are also an important channel for bringing existing products into new markets.
- Some companies indicated that they more likely engage academic partners if there is a project subsidy involved.
- The IWT collaboration projects allow some companies to think out of the box.

The results from the interviews suggest that for companies that focus on a specific supply chain segment[24], it is important that all the supply chain partners that should be involved in the project, are also involved (screening of the supply chain). Moreover, the results show that IWT projects can also offer opportunities for companies that want to explore a new niche market[25].

With regards to ***exploring new trends***, we can formulate the following main findings:

- Legislation and customer requirements require companies to lift on certain trends.
- The IWT collaboration projects allow companies to explore new trends and concepts, such as sustainability, Product Lifecycle Assessment (PLCA) and fiber optics.
- IWT collaboration projects allow some companies to collaborate with partners for exploring new trends and concepts, which they would otherwise not explore alone.

The results from the interviews suggest that for companies that focus on a specific supply chain segment, it is particularly important to be able to lift on trends to create a certain value proposition. For example, by creating a material solution that has certain innovative properties, such as biodegradability.

There was also a recommendation made by one of the interviewed companies, that there should be a more severe project feasibility screening of the supply chain.

[24] These companies can best be classified as Schumpeterian Pioneers (Clarysse et al., 1998).
[25] These companies can best be classified as Porterian Innovators (Clarysse et al., 1998).

9 Building up competences, know-how and expertise (additionality)

9.1 Building up know-how and expertise by knowledge transfer

One of the goals of public policy for innovation is to stimulate knowledge transfer between companies and knowledge centres (universities). The central question for policy makers regarding knowledge additionality would be: "*Does government support stimulate knowledge transfer?*" and "*Does it increase expertise and know-how for companies?*" In many strategic R&D alliances or collaborations, there is a positive relationship between knowledge transfer and innovative performance[26]. Research by Monjon and Waelbroeck (2003) shows university-company collaborations are especially relevant to companies to fill up a technology (knowledge) gap. Moreover, research shows that when knowledge becomes more accessible for project partners, the likelihood of knowledge transfer increases (Spender, 1996; Grant & Baden-Fuller, 2004). It should also be taken into account that knowledge transfer and building up competences are closely linked to the networking additionality. The reason for this is that there is a positive relationship between partner trust and knowledge transfer. If there is more partner trust during the collaboration, partners are more likely to share information with each other, which has a positive effect on knowledge transfer (Nielsen & Nielsen, 2009). There are also many channels where knowledge transfer can lead to an increase of competences and expertise. Based on the interview results we were able to identify some of these channels and how they can lead to increased know-how and expertise within firms.

For *Company A*, the IWT collaboration project with a 3D printing manufacturing company led to the development of new competences regarding 3D printing (**prototyping**). Moreover, the company also built up competences (3D printing) by hiring a new developer for the project (see *5.1 Input additionality by increased investments in Human Capital*). Because most of its non-client specific projects are still in the development phase, *Company B* is still developing new competences together with university partners. For example, the (TETRA) project collaboration with the Lessius Hogeschool has led to a better understanding of several specific image-processing techniques (**technical knowledge**). These techniques have important applications for developing new agricultural tools (plucking robots). For example, the techniques have important applications for detecting if fruit and vegetables are ripe.

For *Company C and E*, the collaboration with universities in the IWT projects led to the acquisition of new knowledge and a better understanding of product materials. For example, for *Company C*, the IWT projects with universities gave the opportunity to achieve two main goals. Firstly, the company gained a **better understanding of their products and the materials** they use. Secondly, they gained an understanding on how these materials can be produced and which physical and chemical factors can complicate the production process (**production process knowledge**). Because the material tends to form a gel and block the reactor, it is important to understand how the material is formed and how it behaves under specific conditions. The second goal achievement was of crucial importance for the company to ensure that the product is upscale-able. This also gave the company the possibility to steer the production process and produce in a consistent and controlled way. For *Company E*, the IWT projects were particularly useful to gain a fundamental understanding of the behaviour of materials in building physics and to perform analytical tests on materials in

[26] Innovative performance can be defined as the ease of exploiting, or use-ability, of knowledge assets (Spender, 1996; Grant & Baden-Fuller, 2004).

building applications. The collaboration with the architecture agency gave them a better understanding of practical building and installation guidelines and material regulations. This knowledge is very important for future product development to ensure that the product can be successfully integrated (**market knowledge**). The IWT project also led to several ideas that were later implemented in the design of a new process innovation for the design of a new automated production line. This new production line allowed the company to produce in a more cost-efficient way.

For *Companies D and F*, the IWT projects often lead to an innovative solution, which is later implemented in the business processes of the client. Afterwards, the integrated solution leads to a certain business **process improvement or competitive advantage for the client**. There is no direct knowledge transfer from the university to the client. There is a **knowledge transfer from the university to the companies, and from the companies to the client**. The knowledge from the university is very theoretical, and the companies act as an innovation intermediary to integrate this knowledge in a new product or solution. For *Company D*, one of the IWT projects led to an innovative technology solution to increase the accuracy of a certain machine. The accuracy-improvement technology was later implemented in some other products (automated machines) for clients. Because the technology is implemented in the production process of the client, the process improvements are created externally (at the client). Similarly, for *Company F*, one of the IWT projects led to development of an artificial intelligence software, which was later implemented in the business processes of the client. The aim of the software was to facilitate research; in this case the client was a university.

For Company G, the collaboration projects with the university have also led to a better **understanding of product material requirements**. This is especially the case for the collaboration projects related to textile micro-encapsulation[27]. Micro-encapsulation has its roots in organic chemistry. By collaborating with universities (UGent, VUB), the fundamental knowledge (chemistry) can be applied into textile applications (see also *8.1 Scope additionality by exploring new markets and engaging new project partners*). Similarly, for *Company H*, one of the IWT projects with the university led to the better understanding of some of the composite materials that they use for building UAVs. This allowed the company to build better and lighter products (UAVs). For the IWT collaboration with the University of Ghent (see also *6.1 Direct output (outcome) additionality by increased sales and number of incremental innovations* and *8.1 Scope additionality by exploring new trends and engaging new project partners*), the company wanted to integrate an image processing software into its product, but did not have the competences to build this software. By collaborating with the university, the company gained a better understanding of how camera images are formed and processed, and how large image data can be transferred. This knowledge allows the company to build better future products.

9.2 Building up innovation management competences by project feasibility screenings

As previously discussed in this report, YICs face internal boundaries regarding innovation (see 2.1.2 *Common innovation boundaries*). The increased complexity of the innovation environment, and the rise of the concept of Open Innovation, has posed several opportunities and challenges for SMEs regarding innovation management (Van de Vrande et al., 2009). In comparison to larger firms, R&D activities in SMEs are less formalized. Therefore, SMEs face several challenges during their growth phase as the need for more

[27] Micro-encapsulation implies binding molecules to textiles, without the usage of a binding material.

formalized R&D measurement and management arises (Clarysse et al., 1998). The administrative requirements and feasibility screenings by the IWT guide SMEs in monitoring R&D projects. Moreover, an important question for the IWT could be: *"Do the IWT programs lead to the development of new competences regarding R&D (project) management?"* and *"Do the programs address the rising need of YICs to measure and monitor R&D performance?"*

In general, the interviewed companies did mostly not formally manage or monitor R&D activities. *Company A* did not have a formal R&D budget because most of its R&D expenditures were booked as (regular) overhead costs. The management staff did not really know if R&D project efforts actually had a positive return on investment in the long run. The company does not monitor its R&D budget or performance because in general, project costs are relatively low. The IWT collaboration projects did not lead to better innovation management, because (according to one of the managers) there is not really a need for it. *Company B* also does not have a formalized budget for most of its R&D projects. In the past the company did not need to monitor its innovation activities because it was too small. However, for the **R&D projects for which the company has received subsidies from the IWT, there is now also a formal project budget**. By having a formal budget plan for its R&D projects, the company is now looking for ways to **measure** its **innovative performance** and the return on investment of its projects in the future. The project proposal requirements by the IWT have definitely contributed to better innovation management and the development of competences regarding **R&D project management**.

Contrary to most of the other companies, *Company C* is currently already in an advanced stage of formal innovation management. Therefore, the subsidy approval requirements and feasibility screenings by the IWT did not lead to better innovation management or the development of new project management competences. The company also protects most of its innovations and currently has seven patents in total. Around 50 percent of the revenue growth in 2014 is related to IP-based innovations. There is also a formal budget for R&D, which yearly account for about 20 percent of total revenues. *Company D* does not have a formal R&D budget and does not measure its innovative performance. The reason for this is that its business activities are all project driven. Therefore, it does not have a specific innovation target. However, similar to *Company B*, the company does have a budget plan for each of its R&D projects. The subsidy requirements and budget plan for the IWT projects did not lead to better innovation management or R&D project management, because most of the projects are short-term and single customer based.

For *Company E*, the IWT programs led to better innovation management because they pushed the project management staff into setting **deadlines** and making up a formal **business plan**. The company already tried to introduce several formalizations in the past, and recently succeeded in adopting a Stage-Gate process[28] for the commercialization of new product innovations. **In comparison to the past, the need for more formalized and systematic R&D management control is now higher**. The IWT programs definitely address this need. Apart from budget plan and feasibility screenings by the IWT, there is also a **feasibility screening** of the project by the project partners. The feasibility screenings are also important to better understand the market potential of the projects. Moreover, because of the possibility of collaborating with regulating agencies in the projects (see *8.1 Scope*

[28] The Stage-Gate process is a five step process model for launching new product innovations. At each of the five steps, the project is either stopped or continues (Stage-Gate, 2015).

additionality by exploring new markets and engaging new project partners), there is also an extra regulatory audit.

Company F does not have a formal R&D budget, nor does it benchmark its innovation activities. According to one of the managers, the company is currently too small, and not ready yet, to use these kinds of techniques. Furthermore, the company wants to stay flexible because of the cyclical and project-driven nature of its business activities. For these reasons, the feasibility screening by the IWT did not lead to better innovation management. On the one hand, innovation management is not an important criterion at the current stage of the company. However, on the other hand, **innovation management could become more important in the future**. For *Company G*, it is also very important to be able to measure and monitor innovation. At the moment, the company does not have a budget for R&D, but would like to formalize this in the future. There certainly is a strong need for better innovation management. For example, the company has recently implemented several structural changes to stimulate communication between different business units. This led to a better integration of all parties and business units of the company in the innovation process, and better definition of project responsibilities. Experience has shown, that in the past, many researchers in the company were very euphoric regarding R&D, and market valorization was often underestimated. The subsidy approval requirements and **feasibility screenings by the IWT addressed the need for better innovation management**, firstly because they led to a clearer **specification** and **formalization** of the **project objectives**. Secondly, the presence of the IWT is also important to **coordinate and manage project responsibilities**.

Thirdly, the benefit of the administrative requirements for the IWT projects is that they enforce the company to think about certain issues such as **patenting**. Previous experiences also learned that by writing down several issues in a formal agreement, there is a clearer understanding about the rights and responsibilities and a better protection of the property rights after the partnership. This also **prevents potential disagreements and conflicts** after the partnership. Sometimes researchers at the company are not sure if they can use certain knowledge internally or externally after the project. By writing down a formal agreement, these issues can be prevented. Moreover, writing down several aspects can address the issue of **tacit knowledge management**. A large part of the knowledge does not lead to direct commercialization or development. Previous experiences from the past have shown that when researchers leave the company, most of the knowledge also disappears. Therefore it is important to capture and store this knowledge. The IWT projects force the company to write down most of the knowledge artefacts and create a sort of **project directory**. This makes it possible to store the knowledge, which may be of use for later research, and could otherwise become lost.

Similarly to *Company E, Company H* has also recently adopted a Stage-Gate Process for the commercialization of new product innovations, because it got acquired by another company (group). The acquisition also led to a formal budget for R&D. The IWT projects in the past (before the acquisition) did not significantly impact innovation management. However, since the acquisition, the company product has become part of a larger product portfolio. Therefore, there now is a stricter need for product innovation management.

9.3 Building up competences, know-how and expertise (additionality): overview

To conclude, we will give an overview of the results from the interviews, with regards to building up competences, know-how and expertise (additionality). Based on the company

interviews, we can formulate several **main findings (similarities)**, with regards to ***building up know-how and expertise by knowledge transfer***:

- For most of the interviewed companies, IWT collaboration projects lead to knowledge transfer from the university (and other partners) to the company. However, there can also be a knowledge transfer from the company to its clients.
- Based on the interviews, we can categorize three main categories of knowledge transfer: product (material) knowledge, process (production) knowledge and market (requirements) knowledge.
- Collaborations with universities are important for some companies to gain a fundamental understanding how products and materials are formed.

The results from the interviews suggest that for companies that focus on material innovations[29], it is important to gain a fundamental understanding of products and materials. For these companies, collaborations with universities are particularly important to create knowledge transfer. Moreover, process (production) knowledge is also particularly important for these companies to be able to upscale production or produce materials in a consistent manner. In general, this may be less important for companies that focus on client projects[30] or niche markets[31].

With regards to ***innovation management and project feasibility screenings***, we can formulate the following main findings:

- For some of the interviewed companies, the IWT projects lead to better innovation management.
- The IWT projects can assist companies in establishing a project budget and can lead to new (operational) competences for R&D project management.
- The projects also push companies to set project deadlines, and write a formal business plan. This enables companies to specify project objectives.
- Moreover, the IWT projects can also address the need of capturing tacit knowledge by creating some sort of project directory. This may also be important to prevent (patenting) conflicts after the project is finished.

The results from the interviews suggest that during the start-up phase, there is less need for innovation management. Innovation additionality is rather low during this stage. However, as companies grow, the need for formal innovation management also rises. Innovation management additionality is also particularly relevant for companies that are currently in a transitional phase. For example, for companies shifting from client-specific development projects to niche markets.

[29] These companies can best be classified as Schumpeterian Pioneers (Clarysse et al., 1998).
[30] These companies can best be classified as Resource Based Innovators (Clarysse et al., 1998).
[31] These companies can best be classified as Porterian Innovators (Clarysse et al., 1998).

10 Acceleration additionality

10.1 Acceleration additionality by speeding up the R&D process

Research by Arvanitis, Kubli, & Wörter (2005) has shown that, two of the most important (financial) motives for firms to collaborate with knowledge institutions for R&D are insufficient R&D resources and time-saving in R&D. SMEs do often not have enough R&D resources, such as prototyping equipment and specialized staff, available to engage in R&D activities. Therefore, most R&D activities are done in a deficient way, leading to longer product development cycles. Falk (2007) defines acceleration additionality as the general effect of R&D support on the timing of the R&D project. According to this research, the acceleration additionality outcomes could be that: projects are started earlier, have shorter project lead times, or are completed earlier. The central question for policymakers regarding acceleration additionality would therefore be: *"Does R&D support impact these outcomes?"* or *"Does R&D support accelerate the product development phase?"* Research by Falk (2007) also shows that, for the vast majority of Austrian firms that receive R&D support, subsidies accelerate R&D projects. Without R&D support, many companies (more than 35 percent) would postpone the starting date of their R&D projects. Moreover, the vast majority (more than 55 percent) of companies also agreed that the projects would last longer.

The results of the interviews confirm the findings of Falk (2007). Most of the interviewed companies agreed that (one of) the most important reason for collaborating with universities and other companies is the lack of expertise, know-how and equipment. For *Company A*, the most important reason for engaging in R&D projects with universities and partners is the lack of technical expertise. The company designs most of its accessories (products), but outsources production. The collaboration with universities and other partners does not accelerate R&D, but due to the nature of some of the R&D projects it is **necessary to collaborate** with these partners. For example, for the design of wooden or titanium spectacles frames, it is necessary to collaborate with universities for prototyping. For *Company B* the collaborations with universities accelerate R&D development cycles, because of the **complementary resources**. When more researchers and engineers are involved in the project, the **projects can be completed faster**.

For *Company C*, the collaboration with the University of Ghent and the IWT allowed the company to accelerate the research project cycle. **Without subsidy support** from the IWT, the company would not collaborate with the university and would **try to conduct part of the research itself**. According the one of the R&D managers, this would result in a more pragmatic research approach. If the company would have conducted the project itself by **trial-and-error**, the research results would maybe be the same, but the **project would take much longer**. Moreover, the company researchers would understand less what they were doing and how the process worked. **Some R&D projects are currently being put on a hold because of a lack of financial resources.** If the company could have more financial resources available, these projects would be much more ahead now. Subsidies can definitely address this problem, because financial reserve from other business activities is not always available at the right time.

Contrary to the other companies, for *Company D*, the R&D collaboration projects with the universities do not lead to project acceleration. Moreover, the intervention from the IWT only decelerates the R&D process, because of the administrative burden (see *10.2 Acceleration additionality barriers: administrative burden*). For *Company E*, it is impossible to develop certain features without the possibility of partnering with other companies and universities. Some analytical tests can only be done at the University of Ghent or Leuven. Before the

company got acquired, it did not have **specialized prototyping equipment** such as electron microscopes. Therefore, most of the fundamental research was done in a pragmatic way by trial-and-error (similar to *Company C*). In general, collaborating with partners also accelerates the product development phase because of the complementary resources.

According to *Company F*, collaborating with universities in general accelerates R&D projects, because of the complementary resources and know-how. **If the company had to do most of the research itself, it would be done less efficient and it would also take longer**. For most of the projects, the company has the know-how and expertise, but does not have enough project staff (software developers) available. Some client projects also have strict deadlines. In order to achieve client satisfaction, it is important to complete these projects as fast as possible. The IWT collaboration projects are mostly projects for clients. The possibility of collaborating with partners and universities in these IWT projects accelerates the project development process because of the **extra capacity and project staff**. For the development of its own product portfolio, the company is currently involved in a European project. The project is currently on a hold, because of resource capacity restrictions and the strict time limits for some of the client projects. If the company could receive an IWT subsidy for the project, it would hire new freelancers, which would accelerate the project.

For *Company G*, the collaborations with university partners and the IWT do not directly lead to project acceleration. However, by collaborating with universities and knowledge centres, the company can gain access to certain prototyping technologies. For example, by collaborating with knowledge centres, the company does not have to invest in expensive micro-encapsulation reactors, which cost approximately 40.000-50.000 euro. The IWT collaboration projects with universities make it possible to engage in fundamental research. Without the possibility of collaborating with universities, it would be almost impossible to conduct long term fundamental research because the resources would not be available.

For *Company H*, the most important reason to collaborate with partners and universities in IWT projects, is the lack of knowledge and expertise in one or more domains of the project. For example, for the image processing project with the University of Ghent (see also *9.1 Building up know-how and expertise by knowledge transfer*), the complementary knowledge and expertise from the university accelerated the design of the software. The IWT program gave the company the possibility to bundle its knowledge from UAV technology with the image processing knowledge at the university. By collaborating with partners in IWT projects, **the company could accelerate the R&D project, and focus on its core activities** (UAV technology). Moreover, collaborations with universities, in general, also accelerate the **prototyping** phase. The company does not have the time or software to make weather simulations for environmental testing. Therefore, these prototyping tests are mainly conducted by the university. Especially before the acquisition, the access to certain prototyping technologies, such as weather simulations, was very limited. Without the collaboration with universities partners, these simulations would be done less efficiently because of time-intensive (and less precise) field trials. Subsidies could also lead to project acceleration. For example, one of the (European) R&D collaboration projects is currently being put on a hold because of a lack of financial resources. If the company could receive a subsidy from the IWT, they would continue with the project. Because the project has currently been put on hold, the company risks **entering late on the market**.

10.2 Acceleration additionality barriers: administrative burden

Besides research acceleration, some factors can also decelerate research. Research by Falk (2007) shows that administrative burden is an important obstacle for companies to engage in

public R&D programs. Recent figures from the European Commission also show that administrative burden, in particular, is also an obstacle for SMEs. Therefore, the European Commission has launched an ambitious action plan to reduce administrative burden by 25% for the upcoming years (European Commission, 2015b). For most of interviewed companies, administrative burden or 'red tape' is one of the main challenges for engaging into new IWT collaboration projects. While human and financial resources are two main drivers of R&D project acceleration (see *10.1 Acceleration additionality by speeding up the R&D process*), administrative burden can be an important project decelerator. For *Company A*, IWT intervention makes project collaborations very burdensome. According to one of the managers, the **administrative burden** for the IWT projects is very high. Therefore, the **cost-benefit** for applying for the R&D programs is also low.

For *Company D*, the benefits from the IWT programs do often not exceed the downsides (administrative burden). Moreover, administrative burden also slows down the project. Firstly, the initial project proposal requirements slow down the **start of the project**, and secondly the administrative requirements also extend the total **project duration**. Since the client projects often operate under strict deadlines, the company often cannot afford the long development times. In general, IWT intervention slows down the total project duration and does not lead to project acceleration. Administrative burden clearly forms a **barrier for engaging into new IWT projects**. According to *Company E*, the IWT subsidy proposals require a lot of time and administrative efforts. However, the benefits exceed the effort, and the company is currently applying for a subsidy for a new IWT project. Because of the large administrative efforts for writing a subsidy request, some **projects (requests)** are often being put on a hold or get **delayed**. For *Company F*, administrative burden also decelerates R&D projects. For most of its projects the subsidy amounts are low, and the overhead costs of the subsidy requests are often high compared to the total benefit. According to one of the managers, the benefit of the IWT's *SME Program*, is that it has a lower overhead cost (administrative burden) than the other IWT programs. The company prefers this program over the other IWT programs, because it has a lower overhead cost and the fact that there is a lower application barrier.

According to Company G, administrative requirements also partly decelerate the R&D process. On the one hand, it is important that projects do not become too bureaucratic. On the other hand, the administrative requirements help the company in writing down several aspects (see 9*.2 Building up innovation management competences by project feasibility screenings*). According to one of the managers, it is important that **administrative burden** is **adapted to the capabilities of young SMEs**. During the early days and the start-up phase of the company it was much more difficult to track the project costs because there was no analytical accounting system. Therefore, it was much more difficult to deal with the requirements of writing **financial reports** for the IWT projects. This is still difficult for some of the larger projects within European consortia[32]. Because the company now uses an analytical accounting system, it can estimate the project costs at the start of each project. During the project, it can also easily track and control project costs. For *Company H*, project subsidies are only useful if the administrative burden and overhead costs are not too large. Most projects imply high overhead costs and administrative requirements. Moreover, the company also finds it is also difficult to meet the IWT project deadlines. Similarly to *Company*

[32] In order to reduce red tape (administrative burden), the European Commission has recently launched the Regulatory Fitness and Performance Programme (REFIT) program within the Smart Regulation agenda. The aim of this program is to simplify regulations for SMEs (European Commission, 2015b)

F, *Company H* also believes in the benefit of *SME program (feasibility studies)*, because the program has a smaller overhead cost and has less administrative burden.

10.3 Acceleration additionality: overview

To conclude, we will give an overview of the results from the interviews, with regards to acceleration additionality. Based on the company interviews, we can formulate several **main findings (similarities)**, with regards to ***speeding up the R&D process***:

- Most of the interviewed companies collaborate with universities and other partners because they have a lack of expertise, know-how and equipment to engage in certain activities.
- For some companies, the complementary use of (human) resources is an important R&D project accelerator.
- Without the possibility of collaborating with universities and other partners in IWT projects, some companies would conduct research themselves, in a more pragmatic (trial-and-error) way.
- Without subsidy from the IWT programs, some companies would postpone R&D projects. R&D projects are often being put on a hold because of a lack of financial resources.

The results from the interviews suggest that for companies that focus on niche markets[33], it is particularly important to be able to focus on core activities. Collaboration projects with universities accelerate research, because they allow the companies to focus on their core competences.

With regards to ***administrative burden***, we can formulate the following main findings:

- Administrative burden is an important R&D project decelerator, which should not be neglected.
- For some companies, administrative burden forms a barrier for engaging into new projects.
- Because of administrative burden, projects often get delayed.
- It is important that administrative requirements are adapted to the capabilities of young companies, especially with regards to analytical accounting.

The results from the interviews suggest that, especially for companies that focus on client development projects[34], administrative burden is an important barrier. The reason for this is that these companies often operate under strict deadlines opposed by clients.

[33] These companies can best be classified as Porterian Innovators (Clarysse et al., 1998).
[34] These companies can best be classified as Resource Based Innovators (Clarysse et al., 1998).

11 Risk additionality

11.1 Risk additionality by engaging in more radical innovation projects

Compared to other SMEs, YICs face several internal and external barriers towards engaging into (radical) innovation projects (Schneider & Veugelers, 2010; see also *2.2 Downsides of being a YIC and R&D partnerships as a solution for dealing with internal and external boundaries*). It is therefore important to analyse how government support for R&D (the IWT programs) can help YICs into engaging in "radical" innovation projects. In general, these radical innovation projects include all types of projects that engage companies to think out of the box, for example by exploration of new technologies and materials (Pekkanen et al, 2004; Shipp, 2004; Vaihekoski et al, 2003). An important channel of these radical innovation projects, is the collaboration with universities and knowledge institutions. Moreover, the risk additionality concept is also closely linked to the concept of scope additionality (see *8.1 scope additionality by exploring new markets and engaging new partners*). The difference between both concepts is that, on the one hand, scope additionality mainly focusses on the manner in which the project is organized. Whilst on the other hand, risk additionality focusses on addressing barriers to innovation. Overall, the question for policymakers should be: "*Does R&D support stimulate companies into engaging in radical innovation projects (with universities etc.)?*" or "*Does R&D support lower barriers for engaging in radical innovation projects?*" Previous behavioural additionality studies have shown that subsidies support SMEs in engaging in more radical R&D projects. By collaborating with other partners, companies can also share project risks and lower R&D project barriers (Hagedoorn, 1993).

The ability to collaborate with partners and universities for R&D has engaged *Company A* into larger and **more ambitious projects**. For example, the company would not have participated in the 3D-printing project (see also *8.1 Scope additionality by exploring new markets and engaging new project partners*), without the possibility of collaborating with glasses frames manufacturing companies. However, in general, project risk is not a determining factor, since the designing activities do not require the company to make large investments (with exception for the 3D printing project) (see *5.2 Input additionality by increased number of R&D projects and prototyping technology investments*). The subsidy from the IWT programs (SME program) allowed *Company B* to become more ambitious and engage in non-client specific projects (see *6.2 Indirect output (outcome) additionality by technological expertise and sleeper technologies*). According to one of the managers, the company would most likely not have set up its own **product portfolio**, without subsidy support from the IWT.

For *Company C*, the IWT subsidy allowed the company to collaborate with universities for fundamental research (see also *8.1 Scope additionality by exploring new markets and engaging new project partners*). According to one of the managers, the **risks of fundamental research projects are higher**, and in general, research objectives less defined than (non-radical) development projects. Therefore, **the company would less likely engage in these kind of projects, without IWT support (IWT programs)**. By means of exception, *Company D* did not become more ambitious into setting up its own product portfolio. In general, the company also focusses on developing incremental (instead of radical) innovations, such as the accuracy improvement project with the IWT (see *6.2 Indirect output (outcome) additionality by technological expertise and sleeper technologies*). Since the bottleneck in the company is time and capacity, and not financial margin, it would not (significantly) invest more in radical research if it had more financial margin (for example by an IWT subsidy). For *Company E*, the IWT support, in general, does not directly lead to

larger or more radical R&D projects. However, without the possibility of collaborating with **universities** and other partners, it would be impossible for the company to engage in certain **(radical) innovation projects** (see also *8.1 Scope additionality by exploring new markets and engaging new project partners*). By bundling **complementary knowledge and expertise** with partners, the company can engage in more ambitious projects.

Also for *Company F*, the possibility of collaboration with universities and other partners makes it possible for the company to engage in certain (radical) innovation projects. Each of the project partners has a certain expertise: mechanical engineering, embedded electronics, electronical engineering etc. By collaborating with other companies in an IWT project, the company can bundle this knowledge with its software knowledge and engage in more radical innovation projects. Moreover, the IWT project subsidies lead to more ambitious projects because they give more certainty for long-term project engagement. The company is able to engage in more radical innovation projects when it can cover most of the costs by the subsidy. **The subsidy also lowers the initial project risk barrier and the cost of university associates**, which gives the opportunity for the company to engage with these partners.

Company G is **too small to explore radical innovations without the possibility of collaboration with knowledge institutions and universities**. Because the subsidies from the IWT programs allow the company to cover university costs, it also gives the ability to invest in new products and engage in radical innovation projects. From a strategic perspective it is important to engage in risky projects for fundamental research. For projects where there the company already has several products in the market, there is more certainty. However, for radical innovation projects where the aim is to explore **new research areas**, such as micro-encapsulation, this is not the case. For *Company H*, IWT subsidies play an important role in reducing project risks for fundamental research. The company does not engage in a project just because it is subsidized. However, the subsidy is an extra stimulant to engage in a new project and take more project risks.

11.2 Risk additionality by early stage financing and the IWT as a Venture Capital provider

Relatively to other neighbor countries such as the Netherlands and the United Kingdom, the Belgian Venture Capital industry is rather premature (Manigart & Van Hyfte, 1999). In Belgium, and especially Flanders, the government has made several efforts to stimulate Venture Capital and early stage investments in risky R&D (see Manigart & Van Hyfte, 1999). The IWT plays a central role in the Venture Capital landscape in Flanders by improving access to finance for R&D. For some of the interviewed companies, the IWT support even substitutes the need for Venture Capital by the provision of subsidies.

For Company A, the risk of early stage financing is relatively low, because in general, the company does not have to make large capital investments (see 5.2 *Input additionality by increased number of R&D projects and prototyping technology investments*). The company solely focusses on the design of its accessories, and has no problem in financing its design activities by own means (without subsidy). However, for *Company B*, financing does play an important role. The company started as a subcontractor for a multinational manufacturer of agricultural and construction equipment. For the development of its first product, the subsidy from the IWT allowed the company to **avoid looking for an external investor and ensured to keep its financial independency**. With the subsidy support from the IWT, the company was also able to avoid a capital increase later-on. The subsidy also played an important role for the early stage financing of the first product of the company.

For *Company C*, the project subsidy at the start-up phase also played a **crucial role for the establishment of the company and the development of its first product**. The subsidy allowed the company to leverage its activities and be more ambitious during the start-up phase. According to one of the managers, there are currently more financial resources available than at the start-up phase of the company. Therefore, there are now more opportunities to engage in R&D. However the company prefers to allocate its financial resources to development projects instead of fundamental research (see *11.1 Risk additionality by engaging in more radical innovation projects*), because development projects lead to a direct increase in revenue. Moreover, fundamental research only results in an increase in revenue in the long run. In other words, the company would **underinvest in early stage research without IWT support**. Since IWT support did not engage *Company D* into investing in more radical innovation projects (see *11.1 Risk additionality by engaging in more radical innovation projects*), it did also not lead to additional early stage investments. On the one hand, there were some IWT collaboration projects for clients, where the initial project risk was too high. On the other hand, in most of the cases it is already clear at the early stage of the project whether the project is feasible or not.

For *Company E and G*, IWT support does not directly lead to additional project investments in early stage R&D (see also *5.2 Input additionality by increased number of R&D projects and prototyping technology investments*). This is because the early stage R&D financing fully depends on the market potential and business plan of the project. However, as discussed in the previous chapter (*11.1 Risk additionality by engaging in more radical innovation projects*), it would lead to more ambitious projects by the engagement of academic partners. For *Company F*, the financial support from the IWT programs definitely has an important role for the early stage financing of R&D projects. For one of its recent projects, the support from *SME program feasibility study* was very important, because it addressed the financial needs at the early stage of the project, where the risk was the highest. The *SME program feasibility study* also allowed the company to get early-stage financing for its project. **Without the early stage financing, it would have been impossible to attract initial clients and partners to participate in the project**. The subsidy resulted in risk additionality across different partners, because it also triggered them to engage in early stage R&D. For *Company H*, the subsidy was crucial at the start-up phase, otherwise the company would not exist today. The first subsidy also resulted in the first product of the company. The initial subsidies at the start-up phase also played a crucial role for early financing, because it allowed the company to rely less on Venture Capital. According to one of the managers, **subsidies become less important as the company grows** or gets acquired by another company. In general, early stage financing also mostly depends on the project business plan. IWT support does not directly impact early stage financing, since the company has enough financial resources available to finance new projects.

11.3 Risk additionality: overview

To conclude, we will give an overview of the results from the interviews, with regards to risk additionality. Based on the company interviews, we can formulate several **main findings (similarities)**, with regards to ***engaging in more radical innovation projects***:

- IWT collaboration projects allow companies to engage in more ambitious projects, when the risks would otherwise be too high.
- Some companies are too small to engage in radical R&D projects.
- By collaborating with universities, companies can engage in radical R&D projects.
- The IWT programs and subsidies allow companies to engage university partners, because they can cover most of the university costs (see also *8.1 Scope additionality*

by exploring new markets and engaging new project partners). This results in more ambitious projects.

The results from the interviews suggest that, the IWT collaboration projects are particularly important for companies that mostly engage in client development projects, and want to create a product portfolio. Moreover, for companies that focus on breakthrough innovations[35], the IWT programs also lower the initial project risk barrier for fundamental research on new products.

With regards to ***early stage financing and Venture Capital***, we can formulate the following main findings:

- For some of the interviewed companies, the IWT programs and subsidies partially substitute Venture Capital.
- According to some of the managers, it is difficult to attract Venture Capital and early stage financing, especially during the start-up phase of the company. The subsidies from the IWT programs provide a good alternative.
- The results from the interviews suggest that the IWT programs and subsidies during the start-up phase, can lead to the development of the first product of a company. Early stage financing is particularly important in this stage, since there are no direct alternatives.

For companies that focus on client development projects[36], the IWT programs and subsidies mostly lead to risk additionality across different partners and clients. Without early stage support from the IWT, clients (partners) are sometimes not willing to collaborate in a project. In other words, the IWT programs and subsidies do not necessarily lead to risk additionality for the company, but lead to risk additionality for the clients.

[35] These companies can best be classified as Schumpeterian Pioneers (Clarysse et al., 1998).
[36] These companies can best be classified as Resource Based Innovators (Clarysse et al., 1998).

12 Strategy additionality

12.1 Strategy additionality by improving strategic goals

By participating in a large portfolio of R&D partnerships, companies can improve the chances of success for future R&D partnerships (Lokshin, Hagedoorn, & Letterie, 2011). The experiences that companies build up from previous partnerships help them in defining their open innovation business model and strategic objectives. These outcomes results in lower chances of project failure[37] in the future, because of clearer project- and strategic scope definitions. This strategic learning effect is also known as strategy additionality. In general, strategy additionality can be defined as the additionality effect of R&D support on a company's strategic objectives and innovation management strategy (IWT, 2011). Therefore, the central question for policymakers regarding strategy additionality would be: *"Does government support improve companies' strategic goal setting?"* With regards to strategic learning effects (Lokshin, Hagedoorn, & Letterie, 2011) and slightly reformulated under the case of the IWT programs, we can also reformulate this question as: *"Do previous IWT project experiences improve the chances of success for new IWT projects by improving (strategic)(project) objectives?"*

For *Companies A and B*, the previous experiences with IWT projects have led to strategic reorientation and clearer **innovation strategy** objectives. Moreover, for *Company B*, the IWT projects allowed the company to become more ambitious to develop its own product line in the future (see *6.2 Indirect output (outcome) additionality by technological expertise and sleeper technologies*) and therefore supported the company's objectives for **strategic change**. For *Company C*, knowledge acquisition (see *9.1 Building up know-how and expertise by knowledge transfer*) from previous collaboration projects with universities and partners, on the one hand, has led to a **better understanding of end-user requirements**. For example, if a specific target group of customers has special requirements regarding biodegradability, special plastics etc., than the knowledge gained from previous partnerships can help the company to better address these needs. On the other hand, the company can also **strategically protect itself from other dominant suppliers**[38] by patenting knowledge from its R&D projects.

By means of exception, for *Company D*, the IWT projects did not have any impact on the company's strategy. As previously mentioned, the reason for this is that business activities are all short-term and project based. There is also no long-term innovation strategy. Contrary to some of the other companies, the company does also not have the ambition to develop its own product portfolio. For *Company E*, the knowledge gained from previous partnerships (see *9.1 Building up know-how and expertise by knowledge transfer*) has also led to a better **strategic positioning and value proposition towards end-users**. For example, for the collaboration project with the architect agency, the building-and installation guidelines (see *9.1 Building up know-how and expertise by knowledge transfer*) can be adopted in future projects. The construction sector is very conservative, and there is a strong lobby by traditional isolation material manufacturers. The understanding and the adaptation of the construction guidelines improves the chances of success for future projects and product innovations. For *Company F*, the IWT collaboration projects have an important strategic impact in two ways. Firstly, the collaboration projects with partners allow the company to meet new **market opportunities**. For example, a partner reference can enable

[37] Project faillures can be defined as unplanned project outcomes, such as abandonment, delay, or stoppage of the project (Lokshin, Hagedoorn, & Letterie, 2011).

[38] These dominant suppliers include large paper-and carton manufacturers.

the company to enter a new sector. Secondly, the collaboration projects also enable the company to develop its own product portfolio in the future (see *8.1 Scope additionality by exploring new markets and engaging new project partners*).

For *Company G*, the experience from previous IWT collaboration projects has had a positive indirect impact on the strategic value objectives and business model of the company. In the past, the company did not have a clear strategic vision. By collaborating with different partners in IWT projects, the company now has a **better vision on how its technology can be integrated in the value chain of different markets**. This also enabled the company to specialize and develop their current product portfolio into more detail. It is important to screen the market to analyse in which new markets existing products can be integrated (see also *8.1 Scope additionality by exploring new markets and engaging new project partners*). Therefore, the existing products and the current business model sometimes have to be slightly adapted. For example, in the past, the number of chemicals used in textiles was rather limited. The IWT collaboration projects enabled the company to change its business model to **integrate new product requirements** such as sleeping comfort. The company currently has several fundamental research projects running. In the future, the company wants to limit the number of projects and become selective, because some of the projects diverge too much from the company's strategic objectives. The **quality and strategic fit** of the projects is more important than the number of projects.

For *Company H*, IWT collaboration projects do not significantly impact strategy. For most of its R&D collaboration projects, the company already has its own business plan and knows its market objectives. There are some IWT projects where the scope of the project diverges from the company's strategic objectives. These projects can sometimes also be very interesting (partly because they are also subsidized) and have strong (market) potential. However, because the scope of the project and project objectives do not fit the company's objectives, these projects often have to be neglected.

12.2 Strategy additionality by developing business opportunities with clients, partners and other stakeholders

IWT projects can also increase credibility amongst investors, potential new partners and clients (business opportunities). For *Company A*, **the success of previous partnerships increases the likelihood of new future collaborations**. By having done previous partnerships with large companies, the company finds it easier to engage **new potential partners for R&D collaboration projects**. Because the company is very small, other companies are often reluctant to collaborate (under fair financial agreements). This is especially the case during the start-up phase of the company. For *Company B*, the IWT collaboration projects create new market and **business opportunities for innovation projects with clients** (see also *12.1 Strategy additionality by improving strategic goals*). This is because the expertise and know-how created in the IWT project can be transferred to other short-term development projects for clients. The IWT projects are important because they allow the company to meet partners that have similar problems and needs than some of their clients. This also gives a better understanding of the needs of the clients, which helps defining their strategy. By collaborating with industry leaders, the company can easily identify market opportunities for its (currently being developed) product portfolio. Because the company generates most of its revenue from subcontracting, IWT projects are an important revenue channel for the company. The **IWT projects generate a demand-pull** leading to business opportunities.

For *Company C*, the IWT projects also play an important role for creating business opportunities with clients. One the one hand, most of the partners (universities and knowledge institutions excluded) in the IWT collaboration projects are also clients. Therefore, by collaborating with these partners, the company can better understand client requirements (see *12.1 Strategy additionality by improving strategic goals*). On the other hand, by engaging with universities, the company can acquire (fundamental) **knowledge** (see *9.1 Building up know-how and expertise by knowledge transfer*), which also **leads to product development and business development opportunities in the long run**. For *Company D*, the IWT projects also led to business opportunities with clients. The accuracy-improvement technology from one of the IWT projects was later implemented in some other products for clients. This also opened many opportunities for business development by attracting new clients with a special demand for high accuracy. According to *Company E*, IWT support gives a better **'project image' to universities**, because it is the (normal) privileged course of business for developing partnerships with universities. Some universities also prefer collaborating with the IWT when partnering with companies for fundamental research. For short-term projects or analytical tests, this is less the case because there is no IWT subsidy involved.

For most of its client projects, *Company F* indirectly benefits from the subsidies received by their clients. Moreover, the company even supports its clients in writing a subsidy inquiry. In general, the IWT programs create a larger market for the company, because its core activity is innovation (providing). Because the early stage financing from *SME program* allowed the company to attract two clients (see *11.2 Risk additionality by early stage financing and the IWT as a Venture Capital provider*), it also allowed the company to develop business opportunities. **These clients would not have participated in the project without the 5.000 EUR initial subsidy**. The university is also an important client. As mentioned previously, the company developed a software tool for the university to increase its research efficiency. Moreover, the company also did a feasibility study for the university for the redesign of existing software (see *9.1 Building up know-how and expertise by knowledge transfer*). Therefore, the collaborations with universities can also lead to business opportunities. The project subsidy during the **start-up phase** of the company was very important because it proved that there was a reality check for the feasibility of project by the IWT. This **enabled the company to attract Venture Capital** from external investors during the financial crisis.

As mentioned in the previous chapter, for *Company G*, the IWT collaboration projects, on the one hand, lead to a better sales model (see *12.1 Strategy additionality by improving strategic goals*). On the other hand, by better understanding product requirements, such as sleeping comfort, the company can also increase credibility towards clients and project partners. For *Company H*, the IWT support also gave more project credibility during the start-up phase of the company. According to one of the managers, the IWT subsidy approval also shows that there is a credibility check by the IWT. This is important to attract new project partners and potential **external investors**.

12.3 Strategy additionality: overview

To conclude, we will give an overview of the results from the interviews, with regards to strategy additionality. Based on the company interviews, we can formulate several **main findings (similarities)**, with regards to ***improving strategic goals***:

- According to some of the managers, IWT collaboration projects have an indirect impact on corporate strategy.

- For some companies, the experiences from the IWT collaboration projects lead to a better understanding of end-user requirements for future projects.
- The experiences from the IWT collaboration projects allow some companies to improve their value proposition and market positioning.
- Moreover, according to some of the companies, it is important that there is a clear alignment between business and R&D. Moreover, it is not the number of R&D projects that counts, but the quality of these projects.

For companies that focus on a specific supply chain segment, the IWT collaboration projects are particularly important to understand product requirements and end-user requirements. For these companies, strategy additionality effects tend to be very high, because of the importance to be able to offer a unique value proposition. Moreover, these companies also often face market threats from dominant suppliers.

With regards to ***developing business opportunities with clients, partners and other stakeholders***, we can formulate the following main findings:

- By having done previous successful partnerships, companies are in general also more inclined to engage in new partnerships.
- According to some companies, the IWT collaboration projects with universities and other companies give a positive image towards new potential partners.
- Partnership can also generate business opportunities with clients, for example by creating a demand-pull.
- According to some companies, the IWT projects and subsidies are a proof-of-concept towards external investors, especially during the start-up phase of the company.

13 General conclusion of the research

13.1 Main findings and similarities

In this report we focused on the input-output and behavioural additionality effects of R&D support. The first, and probably most straightforward topic that we addressed in this report, was **input additionality**. The main findings from the interviews comply with research by Wallsten (2000) and Aerts and Czarnitzki (2004), which suggest that input additionality is mainly a long term effect. The main findings also suggest that government support for R&D does not directly impact the decision of companies to engage in specific R&D activities. At the same time, government support for R&D impacts the way that companies carry out their R&D projects. For example, some companies were able to speed up their R&D projects, or to explore new markets or functionalities. These are mostly 'behavioural effects'. These results confirm our beliefs that focusing solely on input- and output additionality is rather simplistic, and that it is necessary to also analyze changes in company behaviour. Moreover, the main findings also show that most companies only hire new employees when there is a structural shortage of staff. According to most companies, IWT projects alone cannot provide a sound basis for direct employment because of the high level of uncertainty and short project duration. These findings comply with and add to the research results of Hottenrott et al. (2014), that show that larger subsidy grants typically result in larger input additionality effects. Since larger subsidy grants provide a better basis for long-term employment, they could lead to input additionality effects.

The second topic we addressed in this report was **output (outcome) additionality**. Output (outcome) effects such as sales growth and incremental innovations typically occur in the long run. The main findings from the interviews suggest that, because these are long term effects, companies often find it difficult to relate them to the IWT programs. Some companies however were were able to link these two concepts. According to them, the IWT projects lead to more incremental innovations and functional applications, which in the long run leads to sales growth. In other words, we see that the IWT programs lead to direct additionality effects such as scope additionality, which lead to output additionality in the long run. This explains, on the one hand, why it is difficult to measure output (outcome) additionality directly. On the other hand, this also has some practical implications with regards to interview design for measuring additionality effects (see *14.2 Implications for future additionality research*).

In the latter part of this research, we also addressed the topic of behavioural additionality effects of R&D support. Firstly, the main findings with regards to **networking additionality** suggest that partner search support could address the need of companies to find good R&D partners. However, according to some of the interviewed companies, there are some problems with the application of the current partner search support mechanisms. Secondly, the IWT programs support companies in developing long term relationships with universities and other partners. Moreover, according to some of the managers, the IWT programs allow companies to meet other companies with similar interests. With regards to **scope additionality**, we can conclude that, by engaging new project partners, companies can more easily explore new trends and think out of the box. Popular trends include sustainability, Product Lifecycle Assessment (PLCA) and recyclability. It may be interesting for future research to also analyse whether there are other trends that companies can more easily explore by engaging new project partners.

The results from the interviews suggest that, on the one hand, government support can accelerate R&D projects, by giving access to complementary knowledge and resources. On

the other hand, it can also create barriers for R&D. With regards to **acceleration additionality**, we found that, for most of the interviewed companies, administrative burden is an important barrier for R&D. Therefore, government programs for R&D support should attempt to limit administrative burden. Moreover, the results from the interviews show that, in relation to **risk additionality**, R&D support is particularly important for early stage financing. In general, companies can take part in more ambitious R&D projects by engaging new project partners, such as universities. Therefore, risk and scope additionality are related to each other (see also *14.2 Implications for future additionality research*). Some companies explicitly referred to the role of the IWT as a Venture Capital provider, which may not directly fit with the objectives of the IWT. Nevertheless, government support should address the financial needs of companies during the start-up phase. Finally, R&D support can also lead to **strategy additionality**. By engaging in R&D collaboration projects with partners and clients, companies can gain knowledge (**knowledge additionality**), which can improve their products and processes. For example, by gaining certain material knowledge, companies can build new products with new materials or improve existing products by making use of certain material innovations. This allows them to improve their product portfolio (strategic goals) and their value proposition towards customers.

13.2 Differences amongst YICs

The main findings from the interviews suggest that there are also several core differences in additionality effects between YICs. By using the classification scheme proposed by Clarysse et al. (1998) (see also *2.1.3 Classification of YICs*), we can identify some of these core differences. The results from the interviews suggest that the classification scheme suggested by Clarysse et al. is indeed a good one, as it succeeds in explaining differences in additionality amongst YICs. However, the interviews also show that some innovation characteristics are more prevalent than others.

For most of the interviewed companies that fitted the criteria of Schumpeterian Pioneers, two innovation characteristics were most relevant: innovation based on new (breakthrough) technologies and a strong desire to have more control over the supply chain. Moreover, the results from the interviews suggest that, in general, these YICs offer innovative alternative solutions to existing products and materials (for example: biodegradable carton coatings, functional textiles etc.), based on breakthrough innovations. Also, these companies anticipate on opportunities in the supply chain, by replacing traditional products and materials (for example: regular carton coatings, traditional textiles etc.), by new (innovative) solutions, or by adding new product (material) functionalities. It would be better to classify these YICs under a new name that highlights these characteristics, hence our suggestion for relabeling them as "***Supply Chain Opportunists***".

The innovation characteristics most relevant for those companies that fitted the criteria of Resource Based Innovators were a focus on service delivery and client-specific projects. Because these YICs are very client-oriented and typically offer innovative solutions to other companies as a service provider, they could also better be classified under a new label that highlights these characteristics. Therefore, we suggest a relabeling for this group of YICs, under the label "***Innovation Providers***". Finally, since most companies that fit the criteria of Porterian Innovators, typically operate in a niche market where they strive for industry leadership, we could also relabel this group of YICs under the label "***Niche Market Innovators***". The results from the interviews suggest that companies can also be in a transitional phase. Two of the interviewed companies were classified as Resource Based Innovators (client specific projects), but had the ambition to develop their own product portfolio in the future by penetrating a new niche market (Porterian Innovators).

The main findings from the interviews suggest that companies that best fit the criteria of Schumpeterian Pioneers create high employment in different roles, such as production, sales and marketing. Moreover, these companies typically also operate in capital intensive industries. For these reasons, it seems that **input additionality** is highest amongst these YICs. Most of the interviewed companies that fit the criteria of Resource Based Innovators typically only create employment in project (development) roles, such as software development and engineering. Based on the experience of the interviews, these companies also operate in less capital intensive industries. For these reasons, additional technology investments and input additionality is rather low. Finally, for most of the interviewed companies that fit the criteria of Porterian Innovators, input additionality was very low, because of the small production and sales volumes (niche market).

The main findings from the interviews also suggest that **output additionality** is typically high for companies that fit the criteria of Schumpeterian Pioneers. For these companies, R&D projects often lead to breakthrough innovations which result in different product applications later on. Moreover, know-how and technological expertise is very important for these companies, to gain a fundamental understanding of products and materials. Therefore **knowledge additionality** from R&D support is high as well. Because these companies focus more on long term (fundamental) R&D, **risk additionality** of early stage financing is typically also high. For some of these companies, the IWT support during the start-up phase resulted in the first product of the company. In general, this is also true for companies that fit the criteria of Porterian Innovators, but (in general) it is least true for Resource Based Innovators. This is because Resource Based Innovators typically only engage in client specific projects (no product portfolio).

Finally, **networking additionality** is also particularly high for Schumpeterian Pioneers, because these companies focus on gaining more control over the supply chain. By engaging in R&D collaboration projects, they can network with other companies. These companies have similar interests and needs, but do not necessarily operate in the same sector[39]. The results from the interviews suggest that, for the same reason, **scope and strategy additionality** is very high. Moreover, the results show that companies that fit the criteria of Schumpeterian Pioneers find it important to explore new trends such as sustainability and bio-degradability. By lifting on these trends, companies can improve their products and their value proposition (uniqueness) towards other supply chain players. This also holds for Porterian Innovators, but is least true for Resource Based Innovators, since these YICs typically only engage in client specific projects (no product portfolio). With regards to **acceleration additionality**, the results from the interviews suggest that administrative burden mostly affects companies that fit the criteria of Resource Based Innovators. Since these companies mostly engage in (short term) client (development) projects, they do not have the time nor the resources to engage in long term R&D.

[39] The 2014-2019 policy note by minister Muyters highlights industry cluster support as a central issue for innovation policy. However, as the results from the interviews suggest, companies can also have similar needs, even when they do not operate in the same industry.

14 Implications for future innovation policy by the IWT

14.1 Implications for future innovation policy and the IWT programs

This report has given an extensive overview of the different input, output- and behavioral additionality effects of R&D support for YICs, but what could the government learn from this? Moreover, how does the existing government support portfolio (see *2.2.3 The IWT programs*) fit the needs and objectives of different types of YICs? The main findings from the interviews suggest that government support for R&D (the "IWT programs") has a key impact on innovation by YICs in Flanders. According to most of the company managers, **innovation projects would be carried out differently without the existence of the IWT programs**. Of course, on the one hand, it could be argued that some additionality effects are inherent to the IWT programs. In other words, it is not evident to distinguish additionality effects from the design of the program. For example, the TETRA program requires companies to collaborate with a university, so networking and scope additionality from engaging university partners is actually required by the program. However, on the other hand, because companies take the initiative to participate in these specific programs, it could also be argued that there is some incentive from the companies. This is also shown by the interview results, as some companies want to collaborate with universities (so there is an incentive), but do not have the time or financial resources available to do so.

First of all, the current IWT program portfolio does a very good job in addressing the needs of different types of companies, by offering a broad range of support services. Therefore, the current portfolio should not drastically be modified. However, the results from the interviews suggest that the behavioral impact of each of the programs differs amongst different types of YICs. Firstly, the results from **the interviews suggest that additionality effects tend to be higher for Schumpeterian Pioneers and Porterian Innovators**, than for Resource Based Innovators. Therefore, it may, on the one hand, be more appealing for policymakers to address these two categories of YICs. On the other hand, it is also important that the government does not hold a discriminatory policy by solely focusing its R&D support on this category of YICs. Moreover, it should be taken into account that YICs can also be in a transitional phase. The IWT programs can definitely address the needs of these hybrid YICs by providing extra guidance and support. However, we understand that, from a practical point-of-view, it may be difficult to identify companies that are currently in a transitional phase.

Secondly, some IWT programs are better suited for specific types of YICs, because they better fit the YIC's (strategic) objectives. The results also show that it is important that there is an **alignment between the companies' (strategic) objectives and the objectives of the IWT programs**. Of course, there are some practical drawbacks, as a strategic screening[40] of companies may be difficult, time-intensive or costly to implement. Based on the interviews, a better alignment could also lead to behavioral additionality effects in the long run. As mentioned above, this could especially be the case for YICs that are currently in a strategic transition, such as *Companies B and F*. For example, *Company B's* core business activities include performing feasibility studies and agricultural measurements. However, it currently wants to develop its own product portfolio. Therefore, it is currently developing a

[40] The IWT innovation centres already provide support for companies willing to engage in one of the IWT programs. The innovation centres are the local point-of-contact for most companies and SMEs and serve as the front office of the IWT. In total there are five innovation centres located in Flanders, in Kortrijk, Ghent, Antwerp, Leuven and Hasselt. The innovation centres support companies and SMEs in finding innovation partners and guide them through administrative requirements (D. Otte, personal communication, April 23, 2015).

new product, namely an agricultural tool for measuring cracks in eggs. *Company F* currently designs and develops custom made software, but wants to develop its own portfolio of (specialized) software products for data mining and artificial intelligence. These companies are currently classified as *Resource Based Innovators*, but try to find a niche market for some of their technologies. In other words, the companies are in a transition phase from *Resource Based Innovators* to *Porterian Innovators*.

The results from the interviews suggest that companies that best fit the criteria of ***Resource Based Innovators***, typically operate under strict client-project deadlines. Moreover, these companies are often not interested in engaging in long term R&D, and are more interested in short term development projects. Therefore, they are also very averse to administrative burden. Based on the experiences from the interviews, ***KMO Programma (SME Program)*** best fits the needs of these YICs, because it has a light overhead structure[41]. Moreover, *KMO Programma* also focusses more on development and less on research. Therefore, other programs such as *R&D Program* and *Strategisch Basisonderzoek (SBO)*, are less suited for this type of YICs. For companies that are currently in a transitional phase, the *TETRA Program* can also offer the possibility of penetrating new niche markets.

Since ***Schumpeterian Pioneers*** often operate in a complex supply chain, they try to differentiate themselves from other companies by offering innovative (high performance) components and solutions. As previously mentioned, these YICs try to come up with new innovative solutions by focusing on new trends such as sustainability or Product Lifecycle Assessment (PLCA). Because these companies try to come up with new breakthrough innovations, they find it important to think out of the box, explore new research areas etc. Based on the experiences from the interviews, these companies are mostly interested in programs such as ***R&D Program, Strategisch Basisonderzoek (SBO) and TETRA*.** The possibility to collaborate with other partner companies that face specific material needs gives them a better understanding of the supply chain. This allows them to identify new market opportunities. For example, for *Company C*, TETRA gives the opportunity to look at new markets such as detergents and wood processing. Moreover, the program makes it easier for them, because the university and company partners already know these markets.

For *Schumpeterian Pioneers* the collaborations with universities also give the opportunity to explore **new research areas**. These research areas include organic chemistry, nano-electronics etc. Moreover, the possibility of collaborating with universities also allows them to gain more fundamental understanding about their products. This enables them to gain more control over their production process and play a pioneering role in the supply chain. Based on the interviews, the *SBO, TETRA and R&D Program* projects also stimulate **knowledge transfer** from (academic) partners to the company. The transferred knowledge can help them **to gain a unique competitive advantage**. Moreover, these YICs find it important to stay independent and gain control over the supply chain, otherwise they could easily get absorbed by dominant suppliers. For example, *Company G* used to be in a weak supply chain position because it could not produce carpets on its own. Therefore, the company was very dependent on other textile producers. Also *Company C* has a weak supply chain position, because most of its suppliers are large paper manufacturing companies with more negotiation power. By engaging in R&D projects with universities, the company can create breakthrough innovations which it can patent. These radical innovations can give a certain

[41] According to the 2014-2019 policy note by minister Muyters, one of the key issues is to reduce administrative burden. The results from the interviews indicate that this will mostly effect companies that fit the criteria of of Resource Based Innovators (Vlaanderen, 2014).

uniqueness to the company and create entry barriers for the absorption by dominant suppliers.

In line with the fusion between Agentschap Ondernemen (AO) and the IWT, some former IWT programs such as SBO will be transferred to the Fonds Wetenschappelijk Onderzoek (FWO). This could of course have some severe implications. If the design of these programs would change, it could impact the way these Schumpeterian Pioneers carry out their innovation projects. Therefore, an important question would be: *"Will additionality effects, such as knowledge and networking, still be created under the policy of the FWO?"* However, as indicated in the newsletter of April 2015, the FWO, as well as the IWT have clearly indicated that they do not plan on changing the current programs (FWO, 2015).

14.2 Implications for future additionality research

As previously shown in *3.1 Challenges for measuring additionality effects*, there are three **main challenges for measuring additionality**. The first main challenge for measuring additionality is the time horizon of events. Most additionality effects are long-term effects. Therefore, it is difficult to allocate these long term effects to (short term) R&D support. Secondly, additionality effects also strongly interact. This makes it particularly challenging to identify causal relationships between additionality effects. Finally, it is also very difficult to measure behavioural additionality, because of the intangible nature of behaviour and the fact that most of the interview questions are hypothetical. Despite these challenges, we were able to identify some relationships between additionality effects, which should be taken into account by researchers and policymakers.

The results from the interviews indicate that input additionality is closely related to the concept of risk additionality. On the one hand, input additionality is mainly a long term consequence of the behavioural change in risk additionality. On the other hand, risk additionality itself is mainly a consequence of scope additionality. Therefore, we suggest future additionality research to focus on risk and scope additionality effects which could lead to input additionality. For example, interviews should focus first on identifying **scope additionality** effects (e.g. "*Would the company engage new partners, such as universities?*"). Secondly, a follow-up question, related to **risk additionality** would be: "*Can the company engage in more ambitious (radical) innovation projects by engaging with these new partners?*". A third follow-up question, related to **input additionality** could then be: "*Does the company also engage in more R&D projects, because it can be more ambitious?*" or "*Does the company allocate more resources to R&D projects, because it can be more ambitious?*".

Because it is often difficult to relate R&D support to output (outcome) additionality effects, we suggest future additionality research to **focus on behavioural additionality effects which could lead to output (outcome) additionality**. Changes in firm behaviour with regards to scope additionality and building up competences, know-how and expertise (additionality), typically result in output additionality in the long run. For example, interviews should focus firstly on identifying scope additionality effects (e.g. "*Would the company engage new partners, such as universities?*" or "*Does R&D support allow the company to explore new markets or trends?*"). Secondly, a follow-up question, related to output additionality, could be: "*Can the company develop more incremental innovations and functionalities, by engaging new partners, exploring new markets etc.?*". A third follow-up question could then be: "*Do these incremental innovations and new product functionalities lead to increased sales and long term growth?*". Similarly, interview questions can also address the question whether R&D support leads to new competences, know-how and

expertise, which typically also depends on scope additionality. Again, the first question with regards to scope additionality could be "*Would the company engage new partners, such as universities?*". A follow-up question, with regards to building new competences, know-how and expertise (additionality), could then be: "*Can the company gain a better understanding about its products, processes or the market that it operates in, by engaging new partners, exploring new markets etc.?*".

Based on the main findings from the interviews, Table 17 gives an overview on the **time horizon of additionality effects**. The experience from the interviews shows, that in general short term effects are most straightforward for companies to address. As explained in the abovementioned examples, medium term effects are mainly a consequence of these short term effects, the same holds for long term effects. It should be noted that the table is mainly a "suggested" approach for the timing of additionality effects. For instance, input additionality could also be classified as a short term effect, for example when there is a direct (not long term) employment effect. However, based on the experience from the interviews, it can best be classified as a long term effect.

Table 17: "Suggested" time horizon for measuring additionality effects.

Additionality effects	Example
Short term effects	
Scope additionality	*Would the company engage new partners, such as universities?*
Risk additionality	*Does the company engage in more ambitious (radical) innovation projects?*
Acceleration additionality	*Does the company speed up its R&D process?*
Medium term effects	
Competences, know-how and expertise (additionality)	*Does the company gain a better understanding about its products, processes or the market that it operates in?*
Networking additionality	*Does the company intensify its contacts with other firms, universities or governmental institutions?*
Long term effects	
Input additionality	*Does the company also engage in more R&D projects or does it allocate more resources to R&D?*
Output additionality	*Does the company develop more incremental innovations and product functionalities?*
Strategy additionality	*Does the company improve its (innovation) strategy, strategic objectives, value proposition etc.?*

To conclude, several challenges for measuring additionality effects can be addressed by **making use of follow-up questions**, which take into account the time horizon of effects. By using follow-up questions, company managers can more easily relate long term effects to short term effects. By making use of follow-up questions, researchers and policymakers can also more easily address the interrelation of effects. For future research we suggest further exploration on this subject. The experience from the interviews suggests that face-to-face interviews are most appropriate for measuring additionality effects. Furthermore, it could be that for YICs, which are typically very small and young, hypothetical reasoning and cause-relation effects can more easily be addressed in interviews, than for large companies. Therefore, we would also suggest research to be conducted on whether this is indeed the case or not.

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16 Appendices

16.1 Appendix 1: Interview questions innovation capacity

De vragenlijst is opgesteld a.d.h.v. **IWT Studies, Study 22: Benchmarken en meten van innovatie in KMO's.**

1. IMPLEMENTATIEMECHANISMEN

1.1. In welke mate worden technologische ontwikkelingen in de markt opgevolgd?

1.2. Doet het bedrijf een poging om mensen van marketing, ontwikkeling en productie samen rond de tafel te krijgen?

1.3. Denken jullie in termen van projecten, hebben jullie projectleiders?

1.4. Zijn er de voorbije 3 jaar belangrijke veranderingen aangebracht in het bedrijfsproces?

1.5. Investeert het bedrijf in het stimuleren van groepsdynamiek (specifiek voor innovatieprojecten)? (bvb. brainstormsessies, team building activiteiten)

2. INNOVATIESTRATEGIEËN

2.1. Is er een innovatiestrategie en maakt innovatie deel uit van de strategie van de onderneming? Is het bedrijf actief bezig met innovatie, het opvolgen van trends in de markt etc.? Indien ja, geef enkele concrete voorbeelden uit het recente verleden.

2.2. Doen jullie een beroep op andere innovatienetwerken buiten het IWT?

2.3. Vergelijken jullie soms jullie producten met die van de concurrentie en wordt die informatie systematisch opgevolgd en bijgehouden?

2.4. Heeft het bedrijf de laatste drie jaar nieuwe (of verbeterde) producten of diensten geïntroduceerd op de markt?

2.5. Heeft het bedrijf een budget voor innovatie en O&O?

Worden de R&D kosten verwerkt als R&D kost of gewone bedrijfskost?

3. ORGANISATIECONTEXT

3.1. Staat het topmanagement in de onderneming open voor risico's?

3.2. Is er een flexibele structuur, of projectstructuur aanwezig in de organisatie?

3.3. Heeft de organisatie een verloningsstructuur die innovatief gedrag aanmoedigt? (bvb. bonus voor ideeën uit ideeënbus die worden uitgevoerd, prijzen…). Op welke manier wordt innovatie in de onderneming gestimuleerd? Hebben jullie soms brainstormsessies?

3.4. Is leren en training een onderdeel van de organisatie?

4. INNOVATIENETWERKEN

4.1. In hoeverre zoeken jullie naar externe samenwerking en welke criteria hanteren jullie om (eventuele) partners te evalueren en te kiezen?

4.2. Zijn jullie actief in bepaalde netwerken (lokale politiek, beroepsfederatie)?

4.3. Zijn jullie continu op de hoogte van de overheidsinitiatieven die de omgeving reguleren en netwerken stimuleren? Zijn jullie op de hoogte van subsidies voor innovatie, exportsubsidies etc.?

16.2 Appendix 2: Interview questions IWT programs

1. Voor welke steunmechanismes (IWT programma's) deed het bedrijf in het verleden beroep op het IWT?

Welke partners waren er nog betrokken bij de programma's en wat was jullie specifieke rol tijdens deze samenwerking?

2. Met welk bedrijven of universiteiten werd hiervoor samengewerkt (bedrijf binnen dezelfde sector of andere)? Wat was het doel van deze samenwerking?

3. Wat waren de belangrijkste motieven voor deze samenwerking? Verminderen van kosten en risico's, het delen van know-how, toegang tot nieuwe technologieën, andere.?

4. Verliep de samenwerking voornamelijk eenzijdig (investering) of is er sprake van een wederzijdse kennisuitwisseling?

5. Vindt u dat de samenwerking goed verliep en de objectieven van beide partijen duidelijk waren?

6. Was er sprake van ongeplande hindernissen tijdens het verloop van de samenwerking die hebben geleid tot een vroegtijdige stopzetting of vertraging van het project?

7. Kan u de samenwerking best beschrijven als een korte (ééntijdige) samenwerking of een lange termijn (strategische) alliantie? Indien het gaat om een korte samenwerking, wat zijn dan de redenen waarom de samenwerking niet verlengd/herhaald werd?

8. Heeft het bedrijf buiten de IWT steunmaatregelen ook beroep gedaan op andere steunmaatregelen voor innovatie en R&D? Indien ja, dewelke?

16.3 Appendix 3: Interview questions additionality

De vragenlijst is opgesteld a.d.h.v. **IWT Studies, Study 68: Measuring effects**.

1. INPUT

1.1 Heeft de samenwerking ertoe aangezet om meer ruimte vrij te maken voor innovatie en extra kapitaal- of tijdsinvesteringen te maken in O&O? Heeft het bedrijf een subsidie of andere financiële steun gekregen waarmee het extra investeringen heeft gedaan (vb. subsidie van 100.000 EUR waarmee een tijdelijke extra werkkracht werd aangenomen). Indien ja, heeft het bedrijf meer geïnvesteerd dan de verkregen financiële steun (m.a.w. is er een 'surplus' effect)?

1.2. Heeft de samenwerking geleid tot nieuwe ideeën voor mogelijke product-of marktinnovaties?

2. OUTPUT

2.1. Heeft de samenwerking bijgedragen tot de ontwikkeling van enkele prototypes? Indien ja, hoeveel prototypes werden er ontwikkeld?

2.2. Heeft de samenwerking geleid tot de ontwikkeling van nieuwe producten in een bestaande markt (incrementele innovatie, vb. nieuw productdesign) of tot de ontwikkeling nieuwe producten in een nieuwe markt (doorbraak-innovatie)?

2.3. Heeft de samenwerking geleid tot procesinnovaties of een betere manier van werken?

3. NETWORKING AND COOPERATION

3.1. Heeft de samenwerking geleid tot nieuwe netwerkopportuniteiten met andere ondernemingen of organisaties? Is het bedrijf bijvoorbeeld door de samenwerking in contact gekomen met mogelijke klanten of investeerders, universiteiten, overheidsinstellingen?

Als jullie in contact komen met een partner, gebeurt het dan achteraf dat er nog een nieuwe partner bijkomt?

Worden sommige partners achteraf opnieuw gecontacteerd?

Hoeveel gevallen zijn er waarbij opnieuw contact wordt opgenomen achteraf?

3.2. Welke opportuniteiten hebben daadwerkelijk geleid tot een nieuwe samenwerking?

3.3. Heeft de samenwerking geleid tot doorverwijzingen naar andere organisaties die oplossingen konden bieden?

3.4. Heeft de samenwerking een positieve invloed gehad op de geloofwaardigheid bij externe kredietverschaffers zoals banken? Zou het zonder de samenwerking moeilijker zijn geweest om extern krediet te krijgen voor de betreffende investeringen in O&O?

4. SCALE AND SCOPE

4.1. Hoeveel bedrijven en instellingen waren betrokken bij de partnership? Zijn dit voornamelijk grote of kleine bedrijven? Zijn de betrokken bedrijven ook actief met innovatie bezig?

4.2. Zou het bedrijf het project ook uitgevoerd hebben zonder samenwerking met andere bedrijven? Zou het bedrijf ook actief op zoek gegaan zijn naar partners zonder hulp van het IWT?

4.3. Beschikt het bedrijf over voldoende capaciteit en financiële middelen om het project onafhankelijk uit te voeren?

4.4. Heeft de steun van het IWT geleid tot nieuwe of grootschaligere projecten met partners of onafhankelijke projecten?

5. BUILDING UP COMPETENCE AND EXPERTISE

5.1. Heeft de samenwerking bijgedragen tot een betere kennis of nieuwe competenties op vlak van innovatie, productontwikkeling etc.? bvb. nieuwe competenties kunnen leiden tot aanwervingen van kandidaten met andere diploma's dan diegene die het bedrijf normaal gezien had vooropgesteld (bvb. iemand met een doctoraat in engineering)

5.2. Geef concrete voorbeelden van maatstaven waaruit blijkt dat er inderdaad een toename in competenties is.

6. ACCELERATION

6.1. Heeft de samenwerking bijgedragen tot een sneller en efficiënter innovatieproces en/of productontwikkeling?

7. RISK

7.1. Zou het bedrijf op eigen risico het project uitgevoerd hebben zonder samenwerking met andere bedrijven?

7.2. Is het risico om bepaalde redenen te groot, waardoor het onmogelijk is om het project zelf uit te voeren?

7.3. Heeft het bedrijf dankzij de steun meer risicovolle R&D projecten opgezet?

8. STRATEGY

8.1. In welke mate beïnvloedt de samenwerking de bedrijfsstrategie? Wat is de impact van de samenwerking op de bedrijfsstrategie? Impact op de bestaande innovatiestrategie en innovation management?

Zouden jullie extra werkkrachten aannemen of nieuwe technologie in huis halen voor een bepaald project indien dit nodig is?

8.2. Heeft de samenwerking geleid tot het toepassen van nieuwe innovatie-management tools of technieken voor innovatie-management?