What are the possibilities of Research and Development Cooperation between Textile Supplier and Apparel Company?
Declaration of Authorship

I hereby certify that this thesis has been composed by me and is based on my own work, unless stated otherwise. No other person’s work has been used without due acknowledgement in this thesis. All references have been quoted, and all sources of information, including graphs and data sets, have been specifically acknowledged.

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Executive Summary

The immense growth of the world population leads to the request of new sources and solutions for the consumer. The textile and clothing industry (t/c industry) is responding by investing in the field of research and development (R&D) to further grow the knowledge base of the sector. Although the t/c sector is often seen as a low-tech industry, innovation is present on different intensity levels. The report identifies the framework of R&D cooperation and identifies if there are possibilities of joint activities between textile supplier and clothing company.

There are successful ways of cooperative working environments in the field of R&D. Most importantly, cooperative companies have to set standards and rules when working together and decide how tasks are being divided. Vertical cooperation is said to be one of the most successful ways of cooperative R&D due to short communication ways and the most accessible way of entering new knowledge areas. Nevertheless, it also appears that R&D is an area many industries indulge in and therefore cooperative ways of working can differ immensely per industry.

Interviews with four different experts in the area of R&D (textile supplier, research institute, trade association, scientist) and broad literature research lead to an in-depth analysis of the t/c industry regarding their R&D efforts. It shows a picture of an industry that is trying to engage in innovation but has two different business players with an individual interest regarding its end product. The research and development of textile suppliers strongly focuses on chemical and technical applications and processes where experts are invited to participate in finding new technological advancements and textile application. A clothing company, on the other hand, is very different. Their R&D activities are often directed towards non-technological innovations. The reason for this is that, next to its functional properties, the end product also has an emotional meaning to its consumer. The clothing company wants to meet this customer demand and tries to achieve this through extensive market and consumer research.

The research has led to the conclusion that there are currently no formal ways of cooperative activities in R&D that would both benefit the textile suppliers as well as the garment companies. They strongly focus on doing what they are doing best and this should not be seen as a negative outcome. However, industry-wise there are immense efforts happening in thriving innovation and an informal way of sharing knowledge along the way by engaging in non-formal project group activities. These areas all imply a project-based cooperation where informal knowledge exchange is made possible. These areas are: custom-made-orders at textile suppliers by clothing companies, participation in local, national and international research platforms and engagement in the area of smart textiles.
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1 Introduction

This research report is structured in a way to invite the reader to explore the breadth and depth of research and development by providing a detailed theoretical framework before elaborating on the specific research question. The introductory chapter provides the reader with the necessary theoretical background to fully comprehend the origin of the research topic, to display the relevance and rationale of the field of research and to state the methodology. Sub-questions have been formulated to guide the research and structure it accordingly. The introduction further covers the statement of limitations of the object of research and methods used. Furthermore, two hypotheses have been formulated to describe the developments referred to in the rationale and relevance of the chapter. Chapters two and three explore the scope of the research and the relevant industry mentioned in the main research question. They form collection of related literature, primary and secondary data including sectional conclusions to sum up the findings and recap important information for the reader. Chapter 4 forms the conclusion of the findings and states possible future research areas.

1.1 Relevance

The world population has passed 7 billion and according to the author of the book “The global textile and clothing industry- technological advances and future challenges”, R. Shishoo. This will increase by a further 4 billion by 2050 (Shishoo, 2012). This requires new and more sources and solutions to cover the needs of the consumers. The European Commission states that research and innovation are “crucial elements to further develop the knowledge base of the sector […]” (Shishoo, 2012).

According to Olaf Schmidt, Vice President Textiles and Textile Technologies, Messe Frankfurt, the market for technical textiles […] is growing rapidly (Schmidt, 2015). Companies of the textile and clothing industry in various European countries invest heavily in the development of advanced materials like technical textiles or finding ways of improving traditional production technologies. There are businesses figuring out new ways of how to put new products on the market by interacting with clients and suppliers (Dachs et al, 2011).

The reason for this can be identified in the change of perception and use of clothing in general. Taking the trend advice of the highly recognized trend forecaster, Lidewij Edelkoort, into account, fashion does not exist anymore like it used to. She emphasizes the current change of society in appreciating the product, the garment. More and more consumers do not wish to have an exponential wardrobe on their own but start to appreciate fewer, long-lasting items. Therefore, the demand for functional characteristics of a piece of clothing is rising (Edelkoort, 2015). Another evident factor that
aligns with the statement of Edelkoort is the development of new textile applications in the field of smart textiles, where textiles start to have technological or medical functions (Rossi, 2015).

It is evident that important developments are taking place within the textile industry as well as the apparel industry. Knowledge is being acquired, technologies are being found and tested, and new strategic measures are being taken. Companies start to open up their innovation process due to the rise of global competition (Backer and Cervantes, 2008). According to the OECD publication “Open Innovation in Global Networks”, more and more businesses collaborate with different stakeholders (suppliers, clients, universities, institutions) to leverage the wisdom of different parties and share the risk and cost of innovation. (Backer and Cervantes, 2008).

This research report investigates further into these movements with regards to the current position of R&D departments within apparel companies and textile suppliers. It furthermore evaluates the possibilities of knowledge exchange between these two parties. The report identifies if and how synergies are being generated and used between both business partners regarding their investments in Research & Development.

1.1.1 Personal Interest

During my study at the Amsterdam Fashion Institute I participated in the specialization International Production where I conducted a research assignment for the lingerie company Triumph International Hong Kong. This is where I came in contact with their Global Head of Innovation, Tony Herbert. When talking to him, I realized that next to the regular calendar of an apparel company (which mostly consists out of two or more seasons and is immensely time-bound), there is a department that dedicates their time in researching materials, trying to find new advancements in science, chemistry and new technological applications in order to create innovative ideas for their products. These searches, experiments and developments are not subject to the regular seasons of a clothing brand. They are being introduced when the brand decides the consumer is ready for them. I was fascinated by their cooperative spirit to work together with all different kinds of specialists all over the world in the field of R&D. My interest for multidisciplinary ways of working grew and it led me to choose this research topic for the thesis I am writing to receive the Bachelor of Arts in Fashion and Textile Technologies.
1.2 Research Question and Sub Questions

I research current developments in the R&D sector and evaluate activities regarding open innovation. It is my aim to find out the possibilities of R&D cooperation between apparel companies and textile suppliers. The main research question is the following:

What are the possibilities of Research and Development Cooperation between apparel companies and textile suppliers?

In order to be able to answer the main research question, detailed sub-questions have been formulated.

1. What are the current activities of Research and Development Cooperation in general?
2. What are the advantages and disadvantages of joint R&D activities between different business partners/stakeholders?
3. What effects does a possible Research and Development cooperation have on the buyer/supplier relationship?
4. What are the future developments and demands of Research and Development within the apparel and textile industry?

The main question focuses on the cooperative activities between both parties. It sets its emphasis on evaluating possible links between textile suppliers and clothing companies regarding their research and development departments. The sub-questions emphasize different aspects when two companies decide to cooperate within this field. Within the scope of the research, the term textile supplier refers to the construction of cloth when mentioning the term textile. The definition therefore refers to a textile material supplier. When mentioning the term apparel company, it is often referred to as clothing company and stands for small, medium and large clothing brands. It excludes department stores or retail stores.

The research report is structured in a way to invite the reader to learn more about the field of research and development in general and to display how it has affected the textile and clothing industry in the past and what future challenges and possibilities may be. The introductory chapter includes a theoretical framework section to explain relevant terms and abbreviations as well as the methods used to be able to answer the main research question. Within the second chapter “R&D Cooperation” general findings on joint activities in the area of R&D are displayed, followed by a chapter conclusion to evaluate the general findings and to guide the reader on to the next chapter. The third chapter “R&D within the Textile and Clothing Industry” therefore, presents the findings on how R&D is established within the textile and clothing industry while considering the previously presented theory.
The chapter confronts the reader with the challenges of the industry and introduces the scope of R&D within the two relevant sectors. Moreover, it examines current practices of various companies and introduces an area of possible cooperative activity. The fourth chapter “Results” evaluates all findings and gives an answer to the main research question as well as the related sub-questions. The chapter furthermore closes the loop of research by concluding the research and proposing further research possibilities.

In order to present a thorough yet structured research report, certain limitations had to be made. Whereas the first chapter identifies general R&D cooperation activities, the second chapter narrows down the research of R&D partnerships within the textile and clothing industry mainly to the happenings within the EU. Although, local, national and international activities are mentioned, the focus lies on the European textile and clothing industry due to its interesting state of development. Europe can be seen as the centre of interdisciplinary R&D and the countries are currently investing a lot in this field. Especially now when the production is more and more coming back to European countries, companies are able to directly implement their R&D efforts and see results (Rossi, 2015). Furthermore, although it is interesting to see development in R&D within different clothing sectors, the research is aiming at the performance wear sector (sportswear, workwear, protection and safety wear). This limitation has been chosen to highlight the sector where essentially function plays a highly important role of a garment.

This research report forms the foundation of the article about research & development cooperation within the textile and clothing industry. The article is the final product, required to submit assigned by the Amsterdam Fashion Institute in order to obtain the bachelor degree. The article aims to present the findings and inspire businesses within the industry to be aware of what the possibilities of R&D cooperation are and why adapting to new conditions in this field is vital.

1.3 Methodology

This section explains the choice of methods used to conduct the research.

1.3.1 Research Method and Rationale

The report will contain a partial structure, where literature is first being analysed and experts of the industry are consulted in order to lead to a detailed conclusion. It examines current activities on collaborative R&D activities within business surroundings and investigates if the clothing and textile industry is engaging in this particular area. The report furthermore evaluates what present and future R&D developments within the textile and clothing sector are and if cooperative approaches are already taking place or if it is a viable option for both parties. In order to come to these conclusions,
an extensive literature research (Journals, Articles, Books and other) and a present overview of what is happening in this field at the moment, is being presented. The thesis investigates on joint ventures and collaborative activities between different stakeholders and evaluates advantages and disadvantages of a possible collaboration between two parties. Valuable expert interviews that work within the field of R&D and the general clothing and textile sector add to these findings as well as recent company examples.

The expert interviews regarding the clothing and textile sector side were being held to formulate a realistic view on the current happenings in the industry and to capture the vision of particular businesses or institutions. At the renowned textile company Schöller in Switzerland, I acquired primary data on how their research lab works and what their observation is regarding the main research question. Head of Coatings and Finishings, Roland Lottenbach, introduced me to the efforts and aims of this innovative Swiss textile supplier. Furthermore, a first-hand interview with René Rossi, Head of the Protection and Physiology Department at the EMPA – Swiss Federal Laboratories Material Science and Technology enabled me to expand my view on the relevant players regarding Research & Development in the 21st century. R&D expert, professor and scientist Hein Daanen was able to share his knowledge about this topic to fully understand practical business challenges and to highlight current happenings within business surroundings. Through an interview with Rens Tap from Modint, the trade association for fashion, interior, carpets and textiles in the Netherlands, I was able to exchange information on industry developments that further confirmed previous findings.

Next to meeting experts in the working field, I talked to teachers at the Amsterdam Fashion Institute who specialize in textiles and related departments to experience and (re)view the research topic from various angles.

1.4 Theoretical Foundation

This section focuses on the explanation of the relevant terms appearing in this thesis. It will explain the meaning of “Research and Development, further referred to as R&D as well as the terms Cooperation, Open Innovation, Joint Venture as well as high-tech industry in relation to the main research question of the thesis. Moreover, it shortly explains certain industry-specific abbreviations and other terms supporting the understanding of the report.

1.4.1 Research and Development

The international organization for economic co-operation and development (OECD) defines the term Research and Development as follows: “Research and (experimental) Development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including
knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications, products and processes. The expression furthermore covers the following fields: basic research, applied research and experimental development (2008). It describes the activity undertaken for the purpose of discovering or developing new products, including improved versions or qualities of existing products, or discovering or developing new or more efficient processes of production (System of National Accounts, 1993) In other words, “R&D is the process of discovering what goods and services best suit the company's needs and developing those products in order to sell them” (Farlex Financial Dictionary, 2012).

R&D is often related to innovation but there is a clear distinction between both terms. The definition of innovation is much broader than just R&D or scientific research. “Innovation in the field of business can be defined as the transformation of new ideas (for the organization) into high-potential businesses” (Intelecticum, 2014). An article on Bloomberg Business claims, “innovation should be understood to include the entire value chain, from R&D to engineering, manufacturing, distribution, sales, marketing and even facility utilization and investment strategy” (Sirkin, 2013). Innovation can happen in any area of the business and does not only rely on the investment of an R&D department. R&D is one part of a business but only one of many departments of a company that can thrive company innovation.

1.4.2 Open Innovation
Over the years, innovation strategies of companies have opened up more and more according to the OECD. It describes the phenomenon that the innovation process is not only taking place within the company, but that enterprises choose to open up this process and engage with other parties relying on outside innovation that can lead to new products and processes. Initially, companies heavily relied upon their own R&D departments and in-house capabilities regarding new developments but the open innovation model suggests cooperation to use inputs from internal and external sources. The publication OECD Global Innovation Networks describes the open innovation model as „a dynamic and less linear approach in which companies look both inside out and outside in“. (Backer and Cervantes, 2008)

1.4.3 Cooperation
Cooperation is „an act or instance of working or acting together for a common purpose or benefit; joint action (Dictionary.com, 2015). Within the scope of this thesis the term refers to the partnership of different interest groups for purposes of joint activities within the field of R&D also referred to as co-innovation, alliance or partnership.

1.4.4 Joint Venture
A joint venture is a specific form of cooperation where the partner companies share the financial risk
of investments and managerial functions of the joint company (Gabler Wirtschaftslexikon, 2015). Two or more parties decide to combine their resources within a business arrangement in order to accomplish a specific task. The venture is not a part of the other business activities of the participants; it is its own unit (Cornell University Law School, n.d.).

1.4.5 High-tech industry

According to the dictionary, a high-tech industry is “An industry using or involving advanced methods and the most modern equipment” (Macmillan Dictionary, 2009). In the textile and clothing industry, besides the development of highly technological textiles, developments in the area of RFID technology, 3D prototyping technology, 3D body scanners, 3D printers and new online retail environments have transformed the traditional industry towards a high-tech industry (Schumacher et al., 2007).

1.4.6 Abbreviations and other Terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AMFI</td>
<td>Amsterdam Fashion Institute</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization for Economic Co-operation and Development</td>
</tr>
<tr>
<td>EMPA</td>
<td>Swiss Federal Laboratories Material Science and Technology</td>
</tr>
<tr>
<td>SME</td>
<td>Small and Medium Enterprises</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>T/C Industry</td>
<td>Textile and Clothing Industry</td>
</tr>
<tr>
<td>MODINT</td>
<td>Trade Association The Netherlands</td>
</tr>
<tr>
<td>RFID</td>
<td>Radio-frequency Identification</td>
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<tr>
<td>CRISP</td>
<td>Creative Industry Scientific Programme</td>
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<tr>
<td>3D</td>
<td>Three dimensional</td>
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Patent The exclusive right to produce and market a certain good for a limited amount of time.

Trademark A name, sign, or design used on a product to show it is made by a particular company.

Nonwoven A textile that is neither knitted nor woven (example: cleaning cloth)

Composites Two different materials mixed to produce a new material (textile)

1.5 Phenomena and Hypotheses

The growing importance of companies in the textile and clothing sector to be competitive through innovation has been displayed. New customer demands request innovative approaches towards products. Research and development plays a vital role in this and opening up innovation processes has become an emerging movement. Sharing knowledge and skills offer new possibilities to expand and grow as a company. To capture these movements and evaluate them in the last chapter of the report, two hypotheses have been formulated:
Hypothesis 1: Through combining their individual R&D activities, both textile supplier and clothing company can benefit.

Hypothesis 2: There are areas within the textile and clothing industry where R&D cooperation can be made possible.

These hypotheses have been formulated prior to the research and are therefore a sole estimation. The concluding chapter will elaborate on these hypotheses and state why they are found to be true or false.
2 R&D Cooperation

This chapter focuses on general joint activities within R&D departments up onto this point in time. It identifies the cooperative approach of companies today and demonstrates joint R&D case studies. Furthermore, general departmental developments regarding R&D are being presented and accompanied by an overview of future expectations regarding R&D partnerships. In order to find out if there are cooperative activities happening or even possible between textile suppliers and apparel companies, the report firstly identifies the general departmental developments of R&D within different industries to detect patterns, ways of communication and details on the possibility of joint R&D.

The research question evaluates the possibilities of a partnership within the field of R&D. It leads to the investigation of how synergies can be used within the value chain cooperation and specifically focuses on how communication takes place during a possible partnership. Terms like interoperability, knowledge spillover and supplier engagement were frequently found. The terms cooperation, alliance, partnership, interoperability or co-movement can be considered as synonyms referring to an “agreement between independent organizations that combine tangible and/or intangible resources to cooperate in R&D activities” (Ingham and Mothe, 1998). When looking at product innovation, multiple areas contribute to the various aspects of a product that can be innovated. They all require specific knowledge that is not always present firm-internally (C., Cuervo-Cazurra and Asakawa, 2010). This is the reason, why companies seek the cooperative approach with external partners. Multiple studies have investigated the effect of joint R&D activities on corporate performance with the final conclusion that external R&D cooperation has a positive effect on a company’s innovation performance (Lhuillery and Pfister, 2009).

2.1 Open Innovation

According to Luca Berchicci fast-changing business environments lead to companies that increasingly open up their innovation process by making use of external sources of knowledge (Berchicci, 2013). The concept of innovation is changing in a way that businesses do not rely only on their own R&D department anymore but instead are willing to learn, invent and develop together with different stakeholders (Backer and Cervantes, 2008). Partners in shared R&D activities can be federal institutes, universities, competitors, suppliers or even consumers. There are two different types within the open innovation process according to the OECD; inside-out or the outside-in approach. The paper defines that the inside-out approach contains the development of internal technologies that might better be further developed, implemented or eventually commercialized by other parties. This way the
company uses their knowledge and R&D capabilities to a certain extent from which another expert can step in to continue the process of the individual project. On the other hand, companies start to find ways of consulting the expertise of partners specialized in a certain field to give input on developments and research that is being carried out by the company - the so-called outside-in approach. During the research, several successful case studies from various industries have been found, where vertical cooperation (buyer – supplier relationship) was successful:

As Andrew Chang cites Powell and Grodal (2006) in “Network of Innovators; inter-firm partnerships are important in innovation. Both for cost-splitting and information exchange reasons. He further explains that cooperation between inter-firm partners can advance R&D between linked industries, displayed in an example of the aviation industry (2013). When the aircraft manufacturer Boeing constructed the first commercial airplane, the Boeing 787, they invested enormously in their R&D department in order to construct the airplane from composite material instead of aluminium. Big investments were required to create new parts, develop advanced systems and test new materials for the aircraft. This resulted in Boeing’s suppliers (Mitsubishi Heavy Industries, Toray Industries, Honeywell, Rockwell-Collins) to start investing in their own R&D in order to produce and deliver new products and processes that were compatible with the new 787 model.

The example of Boeing displays that the suppliers of a company investing in R&D can respond to the advanced environment by participating in new research and development for an externally developed product.

2.2 Knowledge Transfer

R&D partnerships can happen between different parties such as universities, suppliers, competitors or consumers. According to research, each type of cooperation is different in the breadth of new knowledge and in how this knowledge is accessible (C., Cuervo-Cazurra and Asakawa, 2010). New knowledge on product innovation is generated through combining the existing knowledge of the company together with the retrieved knowledge of the R&D partner. R&D partnerships are seen to explore new areas of knowledge that are part of the key competencies of a firm (Lhuillery and Pfister, 2009). Their research reveals that the alliance of a firm with one of their suppliers is proven to be the most successful regarding new product innovation compared to other partnership combinations (universities, institutions, consumers). The paper has identified that this is due to the ease of accessing each other’s knowledge. Moreover, empirical results show that the successful sustainable innovation orientation of a company is being positively influenced by the external knowledge of stakeholders (C., Cuervo-Cazurra and Asakawa, 2010).
Furthermore, in order to successfully identify knowledge and assess its relevance, the knowledge assets have to be structured. Knowledge exchange and identification models need to be in place so that it can be stored, retrieved, updated and communicated (Stellmach & Weiss, 2007). Another way of accessing knowledge in the time of Web 2.0, that has a focus on interoperability and content created by users, so-called knowledge networks are being established. They encourage and add to existing communication channels (Lesser et. al. 2012). This phenomenon is often referred to as wisdom of the crowd or collective intelligence, which is also a way of driving innovation through collaboration (Lesser et. al, 2012).

However, research conducted on regional knowledge spillovers and R&D cooperation, researchers have concluded that R&D cooperation is a “relatively unimportant medium for knowledge spillover (Fritsch & Franke, 2004). The publication on knowledge spillover states that cooperative relationships as such do not result in to necessary knowledge spillover relevant for innovation activities (Fritsch & Franke, 2004). In other words, companies have to structure their own knowledge in a way that it can be used internally and communicated externally. And their own acquired knowledge is actually driving their individual innovative activities. Knowledge acquired externally in the setting of a cooperative relationship apparently does not influence the innovative behaviour of a company. This source implies that companies should do what they are good at, use and grow in their own field of expertise and interact with other businesses but not engage in joint activities in R&D to enhance innovative activities.

2.3 Communication

However, if companies decide to transfer knowledge, it is not possible without various ways of communicating their individual expertise. Different tools of communication are used to pass along information, share insights or discuss findings. A necessary attribute of partnerships within business surroundings is trust. It not only improves communication but progresses transparency between firms (Ingham & Mothe, 1998). However, within vertical cooperation (with suppliers) the risk of sensitive information being leaked is present if competitors for instance have the same suppliers (Un, Cuervo-Cazurra and Asakawa, 2010). Therefore, direct communication channels are necessary embedded within a preferably long-term buyer-supplier relationship built on trust and experience.

2.4 Alliance Advantages and Disadvantages

New technology innovation empowers firms to be ahead of their competitors, launch new products, better fulfil consumer’s needs or reduce costs (Sun & Lee, 2011). An alliance is a way to build up a partnership between two companies within the field in order to influence their company performance.
According to Pan Kwan Yuk, reporter of the Financial Times, strategic alliances are now in fashion. He states that alliances can be the only route for companies to access emerging markets (Yuk, 2012).

Other benefits or R&D cooperation are the possibility of joint financing of R&D and the reduction of uncertainty (Becker and Peters, 1998; Camagni, 1993; Robertson and Langlois, 1995 in Becker & Dietz, 2004). Moreover, acquiring knowledge from available external sources can be more cost beneficial than investing in in-house R&D (Becker & Dietz, 2004).

Whether cooperative R&D is successful or not strongly depends on how the cooperation is structured and what the contents of the cooperation are (Okamuro, 2007). If a company starts an alliance with large or familiar firms in other industries, research has shown that the outcome is favourable to technological success. On the other hand, if a company starts cooperating with many different partners without subsidy, it can provide commercial success (Okamuro, 2007).

But, transaction costs are the cause of disadvantages of R&D partnerships. Whenever there are different or multiple parties involved it can be a challenge to coordinate, manage and control all activities. Organizational routines may differ, setting prices for intangible goods (knowledge or information) can be difficult and the regulation result acquisition can be challenging. (Pisano, 1990; Williamson, 1989 in (Becker & Dietz, 2004). According to Becker and Dietz, only if the cost-benefit relationship of joint R&D activities is positive, a partnership between two companies is an efficient strategic step.

2.5 Effect on the buyer/supplier relationship

Starting an alliance with an external business partner in the area of R&D has an influence on the organization. Studies show that ways of informal exchange of knowledge seem to be preferred than formal ways like joint ventures or cooperative development teams (Harabi, 2002). Increased evidence on the importance of supplier involvement has been found and to show that it might not always be successful (Wagner & Hoegl, 2006). For a supplier involvement strategy to be successful, two areas have to be taken into account: risk factors on the organizational level and the management of suppliers on the project level.

When looking at the organizational level, the interaction of the process from concept to results with the supplier must correspond with each other (Boutellier & Wagner, 2003 in Wagner & Hoegl, 2006). When several suppliers develop certain components, the project must be more linked than when only one supplier is cooperating on the innovation process (Schrader & Göpfert, 1997; von Hippel 1990 in Wagner &Hoegl, 2006). Moreover, the choice of the right supplier cannot be
neglected and has an immense effect on the organizational level (Henderson and Clark, 1990 in Wagner & Hoegl, 2006). So does the assessment of the supplier – if a firm cooperates with a chosen supplier, the evaluation on special capabilities and performance is crucial (Moneczka et al., 2000; Wynstra, Wagemann & Van Weele, 2003 in Wagner & Hoegl, 2006). In order to establish a cooperative and advantageous atmosphere, commitment and trust are inevitable (Sobrero & Roberts, 2002; Walter, 2003 in Wagner & Hoegl, 2006).

There are two main issues that have to be kept in mind concerning the management of supplier involvement on the project level. Firstly, the company has to be aware of how the exchange of knowledge and specialists between both parties will happen in order to keep the so-called “coordination gap” as small as possible. (Wagner & Hoegl, 2006). Secondly, empirical research revealed that the level of supplier involvement of a certain project would not influence the success of the project (Wagner & Hoegl, 2006).). It is rather the quality of the partnership between buyer and supplier and their project members that influenced the project’s success.

2.6 Conclusion

The research paper so far identified successful ways of cooperative working environments in the field of R&D when holding on to certain rules to exclude unnecessary risks. Most importantly, cooperative companies have to set standards and rules when working together and decide how tasks are being divided. Vertical cooperation is said to be one of the most successful ways of cooperative R&D due to short communication ways and the most accessible way of entering new knowledge areas.

Nevertheless, it also appears that there is different empirical evidence depending on diverse research methods and specific areas of research. R&D is an area many industries indulge in and therefore cooperative ways of working can differ immensely per industry. Some sources suggest that your activities as a firm are not more innovative if you acquire new, external knowledge within the setting on a cooperative relationship. There are many conditions that a company has to be aware of in order to start joint R&D activities. Especially, if a supplier/buyer engagement is a win-win situation and cost-beneficial for both.

The next chapter investigates how R&D is executed in the textile as well as in the apparel industry, followed by the conclusion if R&D cooperation activities have been possible or could be executed in the future keeping in mind the theoretical structure of R&D Cooperation of the previous chapter.
3 R&D in the Textile and Clothing Industry

The textiles and clothing industry is viewed often as a so-called low-tech sector which means that the R&D intensity is relatively low, the output of new products might not be as high as in other industries and the level of employee skills could develop more (Tunzelmann & Acha, 2005; Harris and Halkett, 2007; Hirsch-Kreinsen, 2008 in Dachs et al., 2011). Research conducted by Dachs, Zahradnik and Weber, concluded that the level of innovation is indeed below average and that activities within this field are focusing on acquiring external technologies instead of investing in their internal R&D department. Furthermore, they found out that cooperative activities concerning innovation are lacking as well as the use of patents. Patents are used by companies to acquire a certain right for a specific amount of time to produce and sell a product on the market. Reasons for the lack of innovative achievements within the sector are stated to be the following:

- Low average firm size (SME)
- Poor access to financial resources
- Lack of qualified personnel
- Shortcomings in the ability to transfer research into products

On the other hand, empirical studies have identified companies that invest heavily in innovative projects but only represent a minority within the textile and apparel industry. They are R&D orientated and tap on external sources for specific knowledge. Their level of innovation and investment in R&D can be compared to firms in high-technology sectors (Dachs et al., 2011). Moreover, within various areas of Europe the textile and apparel sector brings forward a vast amount of innovative companies investing in the development of new materials and advanced production technologies. In fact, businesses interact with suppliers and clients to access new markets and improve their products (Dachs et al, 2011).

René Rossi, department manager protection & physiology of EMPA, forecasts an increase in the area of functionality. He states, that it is important to watch future orientated firms since they will have a major influence on the developments of the textile sector in five to ten years. In his eyes, R&D will increase more and more based on the awareness on how crucial it is in today’s time (Rossi, 2015).

In regards to the industry’s investment in R&D, industry expert Hein Daanen observes two different behaviours. According to him, R&D is more pronounced within the textile industry than it is in the apparel industry (2015). One has to realize that textiles are a much bigger industry than clothing. Textiles are not only connected to the clothing industry but also present in the following sectors: healthcare, building, mobility, sport & leisure and safety. There are various ways of textile application
like clothing, household-textiles, bed linnen, buildings, interior textiles or technical applications (Wintermans et. al., 2012). And other sectors might be added to the list in the future.

Also, industry expert Rens Tap from Modint, the Dutch entrepreneurial organization for fashion, interior, carpets and textiles, explains that textile companies focus on the chemical and technical research of textile whereas apparel companies invest in developing their brand image and consumer satisfaction strategy (2015). Because apparel companies focus on selling to the market, they conduct market research where innovation is merely driven by the consumer demand. Companies within the textile industry however, try to find new materials and are always on the verge of discovering new innovations themselves. This results in selling these inventions and applications to the clothing companies (Daanen, 2015). Rens Tap states; “where the textile industry makes investments, the clothing industry claims profits” (Tap, 2015). However, other opinions state that the situation might not be as simple as Daanen and Tap refer to it.

According to the Consortium Europe INNOVA Sectoral Innovation Watch of the textile and clothing industry, textile companies have the tendency to engage more frequently in technological innovation, invest in in-house innovation activities and spend more of their turnover in activities regarding innovation than average companies in the business sector. (Dachs et al., 2011). Also patents play a more important role in textile companies than it does in clothing businesses. Instead of using patents, clothing enterprises invest in trademarks that protect ownership of new developments. When looking at public funding, clothing companies are found to receive only half of what public funds invest in textile companies. Although it is being claimed that the textile and clothing sector is a low-tech industry, recent studies based on CIS microdata (Clausen, 2007, Leiponen and Drejer, 2008, Srholec and Verspagen, 2008 in Dachs et al, 2011) reveal that these claims are not true for a large part of the sector. Although the intensity of research and science might not be as high as in biotechnologies or the aerospace industry, certain areas of the textile and clothing sector are highly innovative. It is important to notice that certain players are R&D intensive players in the industry and others are not. Generalizing the whole textile and clothing industry would lead to false conclusions.

3.1 Relevant European Organizations and Networks

Especially in Europe, experts witness the rise of an innovative, high-tech and diversified EU textile and clothing sector. The companies that have survived economic set backs and the loss of many industry job opportunities, have developed in a very competitive way and are stronger than ever before (Canonico, 2015). During the 10th annual public conference of the European Technology Platform for the Future of Textiles and Clothing, which took place in Brussels in March 2015, Clara
de la Torre, Director for Key Enabling Technologies, the industrial research part of the EU’s Horizon 2020 research funding programme, pointed out the success of the textile and clothing industry in participating in EU programs in the past ten years. Furthermore, she stressed the high priority of the European Technology Platform, which brings together different players of the industry to engage in funding opportunities and take part in cross-sector cooperation (Innovation in Textiles, 2015).

The European textile industry has heavily transformed and developed over the years according to Lutz Walter, Head of R&D Innovation and Projects Department of Euratex (European Apparel and Textile Confederation). The sector employed over 1.8 million people in more than 146’000 companies in 2011 and keeping in mind the rising competition of the Far Eastern market, the industry realized the importance of investing in R&D to stay competitive (Walter, 2013). Europe holds an advantage with its unique educational infrastructure and has a natural cultural exchange, which enables to respond quickly to industrial trends and challenges within society that require innovative material solutions (Walter, 2013). Also Rossi mentions the unique position Europe holds with being the area of focus in terms of R&D and innovation. Several organizations and networks form the umbrella of the textile and clothing sector in Europe - one them being the European Technology Platform for the Future of Textiles and Clothing. (ETP) The platform functions as the core of the industry building bridges between players of the industry, research organizations, public authorities, financial institutions and other stakeholders. The aim is to facilitate and coordinate all activities in the field of R&D and innovation. Their Strategic Research Agenda targets cooperation within the field of R&D of the textile and clothing sector as well as related industries. They have the following key objectives:

/ Organization of EU-wide expert network
/ Implementation of Strategic Research Agenda
/ Improvement of overall research, development and innovation framework conditions

The transparent organization ETP invites all organizations and interested individuals to join their activities to facilitate industry competitiveness. Through their efforts they are able to influence economic growth, create jobs and take part in sustainable development within Europe (Euratex, 2013).

Another coordinative institution is the European Union’s Research & Development Information Service (CORDIS). CORDIS is the European Commission’s portal to demonstrate and share all R&D activities, programs and results of EU funded research projects. The information platform is currently adding information on new EU research projects under Horizon 2020. Horizon 2020 is the current framework program of the European Union for research and innovation from 2014 to 2020. It is the
so-called financial instrument to secure Europe’s global competitiveness in all industries. The global scale of the program is to thrive science, industrial leadership and to challenge societal issues.

Furthermore, the European Apparel and Textile Confederation (Euratex) is the political voice of the Textile and Clothing industry in Europe (Euratex, 2013). Their mission is to “promote the competitiveness and the sustainable growth of the industrial textile and clothing pipelines in Europe by promoting the interests of the industry towards European and international institutions” (Euratex, 2013). The confederation forms the link between its member organization and functions as a spokesperson regarding issues of common interest like R&D, trade, environment, education, sustainability and more. It promotes alliances between the textile and clothing sector and related industries like the chemical industry or machinery manufacturers for instance.

In fact, many EU textile research projects are taking place to promote research and development within the industry. All current programs are divided into four different areas:

1. New materials, processes and eco-efficiency
2. New applications for textiles (technical and smart textiles)
3. Clothing, Fashion Design and Mass Customization
4. Information Technology, Management, Innovation and Networks

The first area includes research initiatives focusing on textile structures, intelligent multi-reactive textiles, novel temperature regulating fibres and garments and others. The second area involves initiatives trying to find new textile applications in the field of textile architecture, smart textile applications, protective clothing or the agro textiles from renewable sources. The third research area includes projects trying to find virtual collaborative design environments, researching customized wearable functionalities and eco materials or engage in consumer open innovation research. The fourth area of EU textile research projects evolve around programs that try to harmonize e-business processes and electronic data exchange for textile, clothing and footwear SME’s in Europe or invest in innovation partnership for better innovation support tools and delivery mechanisms in sustainable water and waste water for instance. A complete overview of all textile research programs within the EU can be found in the appendix.

Next to the importance of networks and organizations, is the role of research centres. “The role of R&D centres can be to initiate fundamental research and innovation, but also to structure knowledge of innovations done in companies, to assist process development, to give a second opinion on new products, to validate and certify (test) results, or to develop training and education programmes” (Scheffer, 2011). They represent an important role within the t/c industry regarding R&D. According
to empirical research, the two major research centres in textiles are AUTEX (Association of Universities for Textiles) and Textranet (European Network of Textile Research Organizations). But due to the lack of transparency in the quality of the research, there is no structured system for benchmarking – comparing company’s efforts with others (Scheffer et al, 2011).

3.2 R&D Developments in the Textile Industry

Like mentioned above, the textile industry is in some cases heavily investing in new technologies and chemical processes. Worldwide, especially countries such as Taiwan, Korea and Japan have developed into textile-innovation-hubs (Tap, 2015). “Taiwan’s textile industry stands for the first choice of internationally well known sportswear and outdoor retailers while they are sourcing functional as well and environmentally friendly textiles” states Justin Huang, Secretary General of the Taiwan Textile Federation (Huang, 2012).

3.2.1 Main players investing in R&D within the textile sector

Many challenges of today like the aging population and megatrends such as the quantified self, which aims to track all activities of the human body with technology, are influencing today’s R&D of textile research institutes (Rossi, 2015). The industry is inspired by leading companies in other industries to see certain trends and movements that could be influencing the direction of their own research and development. The textile and clothing sector researches on inventions and applications that might be relevant in five to ten years.

It appears that there are three main sources that invest in the advancement of the textile industry through R&D. Firstly, universities have the indispensible position of generating new knowledge, occupy advanced research facilities and offer an interdisciplinary research environment. Universities are built to be research hubs and educate skilled experts of the future and therefore play an important role within the industry. Secondly, research institutes find interdisciplinary solutions to built a scientific foundation for society (EMPA, 2015). Research projects can be contract-based or have public funding. Some institutes like the Sächsisches Textilforschungsinstitut e.V are an non-profit organization aiming to be a partner in research, development and consulting. Another example is the renowned Hohenstein Institute that focuses on the testing and certification of textiles. And lastly, textile suppliers individually initiate product applications and protect their inventions through patents (Tap, 2015). Textile suppliers use their internal laboratory and experienced personnel resources to innovate and stay competitive on the market. In many cases, their customer requests a certain product and they try to find a solution for it (Lottenbach, 2015). Schoeller AG is a perfect example to display the efforts of a textile supplier trying to answer new customer needs, engage heavily in research and development to further advance the industry in a sustainable manner.
3.2.2 Case Study Schoeller Textil AG

The renowned and well-known Swiss textile supplier Schoeller Textil AG has approximately 200 employees of which 20% is working in R&D. According to Roland Lottenbach, Head of R&D Coatings and Finishings at Schoeller, the company itself initiates many new developments. Twenty years ago, the company had to decide whether to close their doors or invest 150 million Swiss francs into new technologies, first-hand infrastructure and expanding their production facility. The chose the latter and are now one of the top leaders of the industry producing textile innovations according to the bluesign standard. The bluesign® system is the solution for a sustainable textile production (bluesign AG, 2013).

They strive to be state-of-the-art when it comes to textiles and praise themselves to be one of the top leaders of the industry regarding new innovations. Whenever, Schoeller might need external knowledge concerning a certain process or field, they seek advice and work together with universities or institutes like the EMPA - the Swiss Federal Laboratories for Materials Science and Technology.

In order to be as innovative as we are, you need innovative people. We definitely have them at Schoeller. – Roland Lottenbach, Head of R&D Coatings and Finishings

Schoeller works closely together with their customers and seeks the multidisciplinary environment of a buyer-supplier relationship to develop new products with them. For instance, they have cooperated with automotive giant BMW for several years now to create new and better products. The company recently developed a fabric that provides optimal protection of the body of a motorcyclist during the summer months. In this case, sufficient air supply was necessary to provide comfort for the wearer. But the fabric that was being used around the upper body also had to adequately protect the wearer in case of an accident. It could not slip too much nor could it be too resistant on the pavement.

At Schoeller, buyer-supplier cooperations are nothing novel. They are built on long-term relationships, trust and necessary agreements. They can lead to exclusivity on the product for the buyer, which will ensure them that they are the first and the only company to launch a certain product in the market (for a certain amount of time). In order for a product to come to this stage, BMW has an assigned contact partner that works closely together with Schoeller.

The cooperation process includes idea development sessions, process meetings and result evaluations. Laboratory research is primarily executed in the beginning of the process. The company recently opened the ResearchLab – a high-tech research facilities just ten kilometres away from their headquarter in Sevelen, Switzerland. Here, chemistry is being synthesized and external chemists are invited to participate in their research projects.
In the past, Schoeller has been copied a lot by Asian competitors and together with the conviction of offering new technologies for everyone; the company started a joint venture with one of their competitors in Taiwan. This was 14 years ago and according to Roland Lottenbach, the alliance between the two textile companies ensured the availability of Schoeller textiles also for customers that were looking for an authentic Schoeller fabric at a reduced price. Not everyone is able to afford Swiss-manufactured fabrics and this is an optimal alternative. Their customers can choose between a Schoeller fabric entirely produced in Switzerland or go for the alternative made in Taiwan.

To sum up, the innovative textile supplier Schoeller heavily relies on their in-house infrastructure and knowledge before they look for external partners to build any form of alliance. Customer partnerships are present, but it is primarily used as a service to provide clients with products that transformed their skill and expertise into requested solutions. When working with institutes or universities, the company also experienced challenges in the field of communication. Scientists and professors have the tendency to communicate in a quite scientific manner – this might not always be the case at a SME like Schoeller. Whenever, they participate in cooperative ways of working it is primarily on a project-base. Furthermore, time plays a different role for each party. While in business time is money, it is difficult to conduct scientific research within a certain time frame. In the future, Schoeller is open for new cooperative activities regarding performance apparel. Also they are investing in expanding their licensing business and to spread their technologies over multiple industries.

3.2.3 Textile Developments
Developments in the area of textiles are very versatile. Next to the traditional use of textile to cover, protect or adorn the human body, new applications are being invented to make use of the dynamic properties of the fabric. In earlier days, traditional processes like spinning, weaving and knitting have been innovated but nowadays, chemical finishings are a major focus point. Moreover, sustainable solutions and the use of energy and raw materials are more and more on the rise. New structures of weaves, high-tech non-wovens and structured fibres enable many new textile applications (Wintermans et al. 2012). Areas of development and innovation include advancements in the industry include:

/ Smart Textiles and Nanotechnology
/ Fibres, Yarns and Fabrics
/ Machinery and Equipment
/ Nonwovens and Converting
/ Composites
/ Testing and Standards
/ Dying, Finishing and Printing
The properties of dynamic textiles can adapt to different environmental situations and react upon them. A piece of cloth can change its colour based on temperature or a piece of garment can be elongated due to moisture. Moreover, smart textiles have been invented to support the quality of life and to improve safety. Smart textiles are able to keep track of the human body like measuring a heartbeat or respiration frequencies or even to respond and react upon an environmental situation like a fire. Nowadays, possibilities are endless and numerous research institutes invest in the research and development in the field of textile products and applications.

3.3 R&D Developments in the Apparel Industry

Daanen explains that innovations within the apparel industry are mostly driven by the consumer demand and that within the company there is not a lot of innovation happening. Scientific research is hardly being executed and in general opening up the innovation process is not happening within the apparel industry (Daanen, 2015). He even takes it a step further and explains that there are also major differences in scientific publication between the clothing industry and other industries. Publications are limited compared to other areas of expertise (Daanen, 2015).

3.3.1 Role of non-technological innovation in textile and clothing

The textile and clothing industry may not heavily invest in technological innovation carried out through an R&D department, but the sector does invest in non-technological innovation according to literature. Non-technological innovations remain often invisible in statistics on company innovation and this is a reason why the sector suffers from external underestimation regarding its innovation efforts. These non-technological innovations often “fall under the definition of design rather into the definition of R&D, although design also includes some technological aspects” (Dachs et al., 2011).

It is important to know that products such as textiles and clothing do not only answer to the functional aspect like covering and protecting the body, but also have a symbolic meaning, a “non-tangible, emotional component” (Ravasi and Lojacono, 2005, Di Maria and Finotto, 2008 in Dachs et al, 2011). A piece of fabric or a garment is able to adorn the consumer and let him show personal taste and express identity. This important attribute of a product makes it unique and can help companies to set them apart from others by satisfying this specific consumer demand. This characteristic can influence companies and help them be ahead of their competitors. The emotional characteristic of a garment or textile reflecting the innovation efforts of a company is a type of non-technological innovation that represents an immense part of the activities within the textile and clothing sector. The OECD has developed definitions on technological product and process innovation. Many of the non-technological innovations described above, would not fit the definition with the focus on improving functionality (Dachs et al.):
Definition of product innovation:

“… the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics” (OECD 2005, p. 48).

Definition of process innovation:

“... the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software” (OECD 2005, p. 49).

It is clear that both definitions refer to the advancement of functional aspects (Stoneman, 2007). But products of the textile and clothing sector are actually often so-called marketing innovations. Also for this term, the OECD has a definition:

“the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing” (OECD 2005, p. 49)

3.3.2 Marketing Innovation

According to OECD, Marketing innovation is “a significant departure from the firms existing marketing methods”. These different types of innovation might explain the distinction of Hein Daanen referring to two types of R&D within the textile and clothing sector. When talking about a technology-based research done by textile companies it likely represents the product and process innovation defined above by OECD. On the other hand, garment companies investing in the image of their brand and focusing on the consumer demand are more likely to execute marketing innovation.

The theoretical framework in the beginning of this research thesis explained the role of R&D within the innovation process. Innovation can affect all departments of a business, of which marketing and R&D are two fields. In order to distinguish the terms R&D and marketing innovation the illustration below displays the connection of three areas that drive innovation within a business. The three areas are Human Values, Business and Technology. Within the area of technology, R&D finds its place with scientific research for new products and processes. It is evident according to Daanen that Apparel Companies do not heavily invest into their in-house R&D department, but this does not necessarily mean that they are weak in R&D. They seek external knowledge and patents. Together with the area of Human Values, functional innovation can happen. One refers to process innovation if the area Technology and Business are touched. Marketing Innovation however, is situated between the area of the Human Values and Business. It affects both areas since it requires the assessment of
their consumer in order to drive new innovative concepts that are viable in the market place. It represents the term Emotional Innovation.

Marketing Innovation refers to the activities partly responsible for driving innovation in apparel companies. “A change in the characteristics of a product is a marketing innovation but not a product innovation, as long as the functional or user characteristics of the product are not significantly changed” (OECD 2005 in Dachs et al, 2011). Also Mossinkoff stresses that “products are quickly rendered obsolete by changing values, trends and related norms of behaviour (and dressing) (Mossinkoff, 2012). Furthermore, he mentions how Saren notes that “products are constantly changing as producers adapt and develop them, find better ways to produce them as different consumers use them in different ways and view them in different ways” (Saren 2007 in Mossinkoff, 2012). It is evident that both authors state that products do not necessarily always have to be entirely new to the market, but can also be developed further to meet different consumer demands. In both cases it can be called an innovation. A sole piece of clothing eventually becomes fashion and fashion is innovation or like Mossinkoff states “Innovation is the name of the fashion game” (2012).

Dachs et al. refer to the phenomenon marketing innovation as transaction innovation (Jacobs, 2007 in Mossinkoff, 2012). Transaction innovation focuses on the relationship the consumer has with the product or a company and how this product perception can be influenced through marketing (Jacobs,
2007 in Mossinkoff, 2012). Another way of explaining the term marketing innovation is that “radical innovation refers to major changes in technology/knowledge that stem from the discovery of something new. Incremental innovations, on the other hand, are major advances to an established technology/knowledge” (Garcia and Calantone, 2002 in Naidoo, 2010). And according to Naidoo’s sources, marketing innovation is in the marketing literature seen as “a type of incremental innovation” (Grewal and Tansuhaj, 2001 in Naidoo, 2010).

To conclude, it is the aim to highlight the different approach towards innovation by textile companies and apparel companies. It is important to differentiate the role R&D plays within both sectors. Experts of the industry like Daanen and Tap have mentioned the difference of R&D of textile respectively of clothing companies. It is evident that R&D in the textile sector is very much focused on technological research and development. Clothing companies however, do mention R&D efforts (according to their company websites and annual reports) but their true force behind innovation is their R&D department in which research is being conducted from a different angle. An angle that is predominantly directed towards research of the consumer and marketplace instead of technical and scientific research. Marketing innovation requires research of the consumer and the marketplace and therefore clothing companies might participate and invest more in R&D towards a result in marketing innovation.

3.3.3 Technological Advancements

Companies, however, that are interested in new technological advancements are primarily within the performance wear sector of the clothing industry which includes functional wear like work wear, outdoor wear, sportswear or safety wear. Here, the right textile ingredients are vital and a profound interest in technological advancements is present (Tap, 2015). Like mentioned above, not many companies invest in scientific and technological R&D in-house but rather buy patents to use or have suppliers that answer to their specific product needs (Lottenbach, 2015).

Another sort of interest group within the apparel industry however, is the independent fashion designer. Technological Inventions such as 3D printed garments have entered the Haute Couture world and designers such as Iris van Herpen are strongly participating (Howarth, 2014). Designers such as van Herpen collaborate with expert from various fields like architecture and digital technology professionals to develop new insights into the field where fashion meets technology (Kirchner, 2014). In regards to the limitations set to the research report, it will focus on performance wear apparel mainly and not go further into the advancements of independent fashion designers exploring the forefront of technology within fashion where engaging in R&D is inevitable.

The example of Nike, the top player of the sportswear industry, displays how an apparel company invests in the knowledge base of its manufacturer (supplier) when it comes to R&D. Nike partnered
up with its strategic partner MAS Active – “a producer of competition sportswear and fashion leisurewear, and a subsidiary of MAS Holding” (Textile World Asia, 2009). Together, they created a global Apparel Innovation and Training Centre (AITC) in Sri Lanka where employees of both Nike and strategic partners are able to develop their skills in various disciplines. Next to this, MAS Active started an apparel manufacturing plant dedicated to manufacture Nike products. The facility is being used as a hands-on training centre for staff engaging in a course at the AITC.

"The new Apparel Innovation and Training Centre provides a standardized foundation of training and education to create industry leadership in lean manufacturing, innovation, and continued learning that elevates the quality and craftsmanship of the Nike product," said Dipayan Dasgupta, Nike Global Apparel Manufacturing director. "We appreciate the opportunity to partner with strategic suppliers, like MAS Active, who show a deep understanding of the positive impact of training and workforce empowerment and working towards reducing manufacturing waste, among other qualities." (Dasgupta, 2009).

The company Nike and its manufacturer established an R&D facility solely for the purpose of advancing Nike’s products and processes. MAS Active in this case, functions as a supplier of research and development for Nike. It is a strategic partner alliance where the sportswear company provides the necessary means to create the facility for both Nike employees and MAS Active employees to engage in research in lean manufacturing and overall innovation. The alliance could be seen as a way of R&D cooperation, because both employees of Nike and MAS Active participate in the training and education of the training centre.

3.4 R&D Examples in the Clothing Industry

Company websites and annual reports show that performance apparel companies achieve innovation in various ways by structuring their R&D department in a way that multiple areas influence the innovation process. Here are four different examples of how companies innovate:

3.4.1 Nike – Consumer Involvement

One way to push product and process advancement within the company is to use consumer involvement. The sportswear giant Nike started a so-called Explore Teamsport Research Lab where science and design merge (Nike, 2014). This is where they ask professional athletes for opinions on how they can improve their products according to their need of better performance and protection and product information. In fact, Nike is at the forefront of co-creation. The company strongly believes in the intelligence of consumers and developed several projects making use of this phenomenon (Roser et.al., 2009):
Involvement of customers in dialogue, both individually or as part of thematic communities

Idea-generation from consumers about product improvements, including options for the customisation of Nike products

A competition for a select group of customers to design a new Nike shoe

Co-design and customisation of shoes on ‘Nike ID’ web site

Creation of a social networking site, Jogga.com, which included user generated content that allowed the upload of videos showing off individuals’ soccer skills

Sponsoring experiences like soccer competitions

iPod sport kit and sensor that can be placed in Nike shoes and connected to an iPod, which then provides workout-based voice feedback or particular songs to keep the runner going

Help customers develop good training methods that reduce the risk of injury

This example shows that companies in the clothing sector (sportswear) have certain ways to specifically collect data from their end-consumer in order to adapt and improve their products. In the case of Nike it is a way to get to know the consumer and find out what it is that they are looking for in clothing, footwear or special sporting gear with a strong focus on the performance of a product. The research conducted is valuable to the company in a sense that they are able to tap on those innovation areas Business and Human Values visualized in the illustration above.

3.4.2 Adidas – New Product Technologies

The next example of Adidas displays how the R&D department of another sportswear company is actually organised and how the company, like in the example of Nike, invests in researching the consumer and relevant markets. The adidas brand states in their annual report that the company’s R&D is interwoven in multiple areas of the business such as the sourcing, design and product marketing department. Their product creation process starts off with the development priorities defined by the marketing department. These priorities originated from different sources such as feedback from consumers, the analysis of their competitors and the execution of their own product testing. Only then, their so-called “Future-Teams” investigate further into material developments, new ways of productions and scientific research. Regarding their research into textiles and possible new materials they describe that the Future Teams are in close contact with the product development department who, again, cooperate with their suppliers. (Adidas Group, 2014).

But, after the concept phase of a product, is the moment where a brand like Adidas differentiates itself from other clothing companies that do not engage in an atmosphere where new product technologies are actually engineered by the company itself. They use hi-tech systems and approaches that go far beyond traditional processes to create new product technologies. Only when these new technologies are sufficiently tested and considered feasible, an actual physical sample is being created. And whenever the extensive testing phase of these samples have been successful, the product technology
will be further developed at the product-marketing department to “commercialise the technology in to a final product” (Adidas Group, 2014).

Although performance apparel brands like Adidas invest in their own research of new technologies and technical applications, they, however, also access the knowledge of other parties of the industry. An example is the alliance with Clothing+, a Finland-based company specialized in the development and manufacturing of “comfortable wearable sensor solutions for leading brands in the sports and medical segments” (Clothing Plus, 2015). R&D Expert Hein Daanen mentions the cooperation between major sportswear leaders and Clothing Plus. According to Daanen, the clothing companies might not be specialized in the field of wearable sensor textiles and therefore use the external knowledge of companies like Clothing Plus to successfully be at the forefront of these inventions (2015). He explains that actually a company like Clothing Plus is the researcher of this technology and a brand like Adidas does “not even do it themselves”. This fact strongly connects with the statement of Rens Tap, which implies that clothing companies profit of the investments of textile suppliers regarding technological innovation.

3.4.3 The North Face – Consumer Involvement and Material R&D

The third example of how the R&D department of a clothing company is structured, is the one of the outdoor clothing company The North Face. According to their website, they do not only team up with top athletes that go on expeditions around the world, like in the example of Nike, but they also use their in-house laboratories and employee skills to develop new technological ideas that go beyond what is existing already.

The main focus of the R&D department, however, is that their designers and fabric technicians turn these revolutionary materials into actual products. Next to using the feedback of their team of athletes, they go on adventures all over the whole wearing The North Face clothing and using their gear, the company states to partner up with material engineers. This part of their R&D department is known under the name “Advance Material Research and Development”.

According to their website, they work together with highly innovative companies that are experts in new material innovation like W. L. Gore & Associates. However, it is not entirely clear if the North Face also is involved in scientific material research when stating the following: “The North Face, in conjunction with W.L. Gore, created the concept and helped to launch PacLite the most compressible, lightest weight GORE-TEX shell fabric available - weighing only 3.2 ounces per yard (108,5 gr/m²)” (The North Face, 2014). The outdoor clothing company says that they created the concept and helped to launch the product PacLite. But after the material research and development, however extensive it might be, their designers turn the materials into products that are being tested by their laboratory and a
whole range of testing methods including testing wind resistance with engines of a plane for example that produce wind speeds that exceed the performance of regular wind tunnels. In addition to this, the North Face examines how their apparel and gear functions in the real nature to test their performance and resistance in all weather conditions and environments (The North Face, 2014).

Maybe only a handful of clothing companies of the performance wear sector actually execute their own basic research, applied research and experimental development to gain new insights, acquire knowledge and use this knowledge to create new applications, products and processes or improve them. Examples like Nike, Adidas or The North Face do invest in R&D since their product and brand image requires the most state-of-the-art technologies. But even though, investments of these firms include technological innovations, it is not the only driver of innovation and it does not keep them of partnering up with specialized experts to acquire external knowledge on technologies. It seems that they rather buy the technologies than investing time and money to participate in developing them.

3.4.4 Freitag – New Material Development F-abric

Another company example that illustrates the activities of in-house research and development, yet with a focus on workwear is the Swiss bag company Freitag. They are famous for their re-use of truck tarps into highly functional bags but whenever they were looking for workwear for their own factory employees they could not find a suitable fabric to use. They wanted to find “solid clothes for the workers in the Freitag – factory” (Freitag, 2014). Their aim was to design functional and sustainable work wear that was fully biodegradable. In order to find a suitable fabric that met their requirements, the company established a complete supply chain from raw material to final product where the production of fabric and clothing is with the least amount toxic chemicals and executed in Europe. They learned about flax, modal and hemp first-hand at their newfound raw material supplier in France. Together with textile experts in a weaving factory in Italy, Freitag cooperated in finding the best technique to spin the yarn, weave it into a robust fabric and dye it with the smallest amount of chemicals possible. After creating the multiple samples of the F-abric, employees of their own Freitag-factory wear-tested them. But also in this example, R&D ideas have been formulated but executed by a different party – an expert in the certain field.

The process of creating this whole new value chain displays the interest in researching possible solutions by the company itself. They initiated the research and cooperated with various experts to evaluate options and find the best solution. Freitag developed their knowledge of various material development areas as they were going along. It can be seen as a trial-and-error process, which most likely happens at a majority of research being executed in companies worldwide investing in R&D.
3.5 Smart Textile Applications

Exploring all facets of R&D and trying to find ways where R&D can be executed in partnership between clothing company and textile supplier, research discovers the fact that the definition or focus-area of R&D can be quite diverse. Especially when comparing R&D efforts between textile and clothing companies.

During the research process of finding overlapping areas of R&D, Hein Daanen mentions the possible teamwork of textile suppliers and apparel companies in the field of smart textiles. In order to find out if this area is a platform for a possible partnership, the concept of smart textiles known under various synonyms like e-textiles or wearable technology, has to be explained. Researcher and professor Rebeccah Pailes-Friedman at Pratt Institute said in an interview with the business-site Forbes that “the future of clothing is about to change in a big way” and that the smart textiles are paving this way to extraordinary things. She explains that smart textiles are “fabrics that have been developed with new technologies that provide added value to the wearer”. It is their specialty to have the ability to do much more than fabrics we know so far. They are able to “communicate, transform, conduct energy and even grow.” (Pailes-Friedman, 2014). They can be divided into two areas: aesthetic and performance enhancing textiles. Fabrics can adopt to their environment like a chameleon or textiles that light up are part of aesthetic smart textiles. They react upon inputs from outside or from the wearer and react upon them in terms of aesthetics. Then there are performance-enhancing textiles, which perform in a certain way depending on their specific use. These fabrics are for instance relevant to the sports or military industry to improve overall performance, as well as the medical or beauty industry where textiles have drug-releasing properties or beauty properties implemented in them (Gaddis, 2014).

A challenge of this phenomenon is the adaptability of non-visible technology inside of a textile. Billy Whitehouse, co-founder of Wearable Experiments, a company that builds the bridge between fashion and technology is convinced that technology and fashion are becoming one and “everything becomes invisible” (Whitehouse, 2015). As the market leader of material technology, textile technology firm Ten Cate, responded to the developments of smart textiles by investing in the future of smart wearables through developing the entire value chain and more specifically the infrastructure of digital inkjet technology. Ten Cate states that “with the applications of digital inkjet technology, textiles can become “smarter” (Ten Cate, 2014).

Competencies from many different areas are needed to execute cooperative solutions of these high-tech textile projects touching the field of smart textiles (Marusak Hermann, 2012). Smart textiles bring together universities, research institutions and industrial research and development laboratories.
For countries such as Switzerland, high tech is the future of textiles since technical textiles represent one-third of the countries textile exports (Marusak Hermann, 2012). Furthermore, also in the Netherlands, activities like knowledge platforms are happening and they add value to the already existing high-tech industry environment that is claimed to be one of the most innovative in the world (Holland Trade, 2013). These platforms invite (fashion) designers, researchers, entrepreneurs, product developers or specific area experts (healthcare, beauty, etc.), to take part in interdisciplinary discussions evolving around smart textiles. The goal of these platforms like the Careful Designs@Waag Open Space organized by the Dutch Waag Society, “an institute for art, science and technology and pioneer in the field of digital media” (Wildevuur, 2013). Another platform that encourages the exchange of knowledge in this field and the building of partnerships is the Dutch organization CRISP, which leads the Creative Industry Scientific Program. Their core is the meeting of academic excellence with the creative industry in order to respond to these new developments regarding smart textiles.

Where textile becomes an interactive product, it touches a whole array of areas within the field of technology, business and creativity. Interactivity asks for scientific knowledge and applied solutions. In the scope of this research, textile suppliers partner, that is being able to accumulate scientific knowledge on technological innovation regarding smart textiles. Whereas a clothing company has the expertise of how these smart textiles can be applied. They know what the specific demands of the textiles are and how these functions are being used in the most efficient and effective way possible.

3.6 Conclusion

The in-depth analysis of the textile and clothing industry regarding their innovation efforts shows a picture of an industry that is trying to engage in innovation but has two different business players with a individual interest regarding it’s end product. The aim of textile suppliers that engage in R&D aspire to be leaders of the industry and invest immensely in the skills of their own employees, their laboratories and acquisition of new knowledge. Their research and development strongly focuses on chemical and technical processes where experts are invited to participate in finding new technological advancements and textile application. A major difference to the clothing industry is, that the products of textile suppliers engaging in R&D, are high-technological fabrics which are not only produced for the clothing industry but more importantly for others such as the health care industry, car industry, building industry or aerospace industry. In order to respond to new solutions and to conquer the challenges in all areas, a competitive textile supplier invests in scientific R&D.

A clothing company, on the other hand, is very different. Their product is primarily clothing (other product categories might be accessories, bags, footwear…). The end user of a clothing company is
their consumer who responds to a certain image of a brand. Clothing companies that engage in R&D are only a few and those who actually conduct scientific research are maybe only a few. These are often situated in markets such as in the protective equipment market where dangers such as heat, water or chemicals play an important role as well as in the workwear or sportswear market. The interest of clothing companies investing in scientific R&D is quite low and if they engage in R&D, their efforts are more directed in the area of market and consumer research.

So, the question arises, where could an apparel company and a textile supplier possibly meet in their R&D endeavors? Or should they even participate in joint activities? Would it be beneficial for both parties, or will R&D cooperation only result in a costly partnership? The following concluding chapter discusses the findings in the chapters above and outlines the results of the research in order to give an adequate answer to the main research question: “What are the possibilities of R&D Cooperation between clothing company and textile supplier?”.
4 Results

This chapter evaluates the findings of the research and proposes an answer to the main research question. Furthermore, the sub-questions and hypotheses are being addressed and further research possibilities are being outlined.

4.1 Evaluation of Research

It was my aim to map the activities of R&D Cooperation in general and to have a close look at the activities within this field of textile suppliers and clothing companies. In order to evaluate the findings, I tried to visualize what R&D Cooperation in the researched context is while I pictured the two different stakeholders clothing company and textile supplier.

Starting Situation: A company, whether it be a garment business or textile supplier, does not possess the required or desired knowledge firm-internally and is not able to or willing to acquire this knowledge though in-house research and development actions, the company tries to access external knowledge. The company can choose to do this in two ways: with the inside-out approach or the outside-in approach. They can either open up their own innovation process and let external experts participate in their process or they share their findings up until that point and let other parties execute it.

In order for the reader to understand the complex map of stakeholders, individuals interests, advantages, disadvantages, company efforts and different R&D activities, I created three illustrations explaining the facets of R&D Cooperation between the two mentioned business parties. Firstly, I mapped the above stated starting situation where special knowledge within a company is not present and the company looks for external knowledge to advance its products. This illustration explains what R&D cooperation is:
If the case occurs that knowledge is not available within the company, they are able to reach out to external partners to engage in R&D cooperation. The requirement for this is the opening up of the innovation process. Knowledge can be seen as an intangible good, which can be exchanged between both parties. In case of a R&D cooperation, it is more likely to succeed if it is built on trust and commitment between both parties. External partners could be universities, institutions, suppliers or competitors. Through joint R&D activities, the access of key competencies of a firm can be combined with the retrieved knowledge of an external partner. Benefits of this alliance would be the sharing of costs of investments, information exchange and the access possibility of emerging markets. Disadvantages of a partnership would be the challenging cooperation structure, transaction costs and the fact that knowledge spillover does not influence the innovation activity of a firm. All in all, a cost-benefit relationship should always be present when considering an R&D cooperation.

In relation to this thesis, two interest groups can be defined: the clothing company and its textile supplier. It is important to outline their R&D activities and goals in order to see if joint R&D activities are a feasible option and present an adding value to the company. Based on the extensive research carried out on the R&D landscape of a clothing company, the following illustration has been created:
When looking at companies within the performance wear sector, the research report presented examples of companies within the sportswear, outdoor and work wear sector as well as industry expert opinions that revealed that R&D activities are taking place but the R&D that is being carried out is often directed towards consumer and market research. Therefore, R&D activities of clothing companies are often directed towards non-technological innovations. The reason for this is that, next to its functional properties, the clothing companies’ end product also has an emotional meaning to its consumer. The clothing company wants to meet this demand and tries to achieve this through extensive market and consumer research (web 2.0, collective knowledge described in Chapter 3). If the demand of the consumer involves new technological advancement, innovative ideas or products might be developed together with experts until a certain extend. Open innovation refers to the approach, where other parties might further commercialize possible findings. In order words, if specialized companies such as Clothing Plus sell their technologies to companies like Adidas, the sportswear brand is able to commercialize the new technology although it did not conduct the necessary research in-house. Clothing companies rarely develop their own technological applications but rather buy them from external area-experts. Clothing companies have the possibility however, to share their expertise on marketing innovation with other players of the industry.

Clothing companies rather invest in their specialty of knowing the consumer instead of making investments in a field of scientific R&D where other players of the industry already possess excellent facilities and knowledge. They rather access this knowledge through buying patents and technologies.
instead of engaging in the type of R&D that textile suppliers focus on which is more directed towards technological innovation.

To complete the picture, the R&D activities of a textile supplier have been illustrated as follows:

**Figure 4: R&D Textile Supplier**

Innovative textile suppliers focus on scientific R&D in order to meet the advancing demands of several industries, not only the clothing industry. They invest in employees, machinery and state-of-the-art laboratories to ensure the research of various areas. In case they need external expertise they consult universities, research institutes and optionally also competitors. They engage with their buyers through licensing agreements and sell patents of their technologies. A possibility of sharing their knowledge in case of a textile supplier is when they work together with clothing companies directly on a project basis for instance. The outside-in approach within the concept of innovation often occurs with textile suppliers like Schoeller, who consults research institutions like the EMPA for further expert consultancy while further developing in-house.

### 4.2 Conclusion Sub Questions

In order to be able to answer the main research questions, related sub-questions have been formulated. These sub-questions aim to research general R&D cooperation activities as well as its advantages and disadvantages regarding various partners, R&D developments within the textile and clothing industry and how joint R&D activities influence the buyer/supplier relationship.
1. **What are the current activities of Research and Development cooperation in general?**

Current activities include joint R&D between institutions, universities, suppliers, customers or competitors. Empirical research revealed that R&D cooperation between buyers and suppliers is one of the most successful partnerships comparing to alliances with universities, research institutions or competitors. On the other hand, some sources state that joint activities in R&D do not really have an influence on the innovative behaviour of a company. It is evident that there have been mixed findings regarding this topic depending on which industry under what circumstances has been analysed. Detailed information regarding the topic of this sub-question can be found in the second chapter of the report “R&D Cooperation”.

2. **What are the advantages and disadvantages of joint R&D activities between different business partners/stakeholders?**

Alliances in R&D are built in case of a common goal or interest. Benefits include the possibility of sharing costs, being able to jointly finance the research and have the option of accessing emerging markets. It is a way for companies to be ahead of their competitors, launch new products, better fulfil consumer’s needs or reduce costs. They can start a long-term relationship and influence each other’s performance. But, an alliance can also have negative effects on the participating companies. Transaction costs can arise when organizational adaptions need to be made for instance. Furthermore, official formal partnerships like joint ventures can be challenging to coordinate manage and control. Companies would end up spending more time on reorganization than on investing in R&D. Moreover, another disadvantage of an alliance could be the cost-benefit splitting of intangible goods like knowledge or information. Within the sub-chapter “Alliance Advantages and Disadvantages” of Chapter 2, this second sub-question is being addressed in more detail.

3. **What effects does a possible Research and Development Cooperation have on the buyer/supplier relationship?**

It becomes evident that a successful and long-term alliance can only be built on trust and commitment of both parties. Research revealed that more casual project based teamwork is preferred over formal ways of partnering up. Furthermore, it is very important to make the right choice of supplier/buyer for joint R&D activities since the quality of work is influencing the success of the alliance. The individual introduction of apparel brands and their R&D activities within Chapter 3 display different angles on what the effects on a buyer/supplier relationship can be in form of actual examples. Overall, companies aim for long-term partnerships with their suppliers to maximise positive effects of the
buyer/supplier relationship. This sub-question goes hand in hand with the previous sub-question since they both refer to the results of a partnership. Within the sub-section “Effect on the buyer/supplier relationship” of Chapter 2 this sub-question is further explained.

4. What are the future developments and demands of Research and Development within the apparel and textile industry?

The demand of technical textiles is rising and textile companies invest in scientific research, skilled employees and state-of-the-art infrastructure to meet this demand. Clothing brands want to meet the demand for functionality of the customer and focus on extensive market as well as consumer research. This shows that there are two very different approaches towards R&D in the textile respectively the clothing industry. In the future, it can be expected that these developments with be intensified where both parties invest in improving the existing skills and expertise. More information regarding this topic can be found in the third chapter “R&D in the Textile and Clothing industry”.

4.3 Conclusion Research Question

Although R&D activities are quite different within both industry players, cooperative approaches are happening. When keeping in mind the definition of R&D Cooperation, where one company accesses the knowledge of another one to drive innovation, clothing companies do access external knowledge of textile suppliers regarding material developments and technological applications. This is happening in a form of buyer-supplier relationship where the clothing company asks the textile supplier for a specific product like in the presented example of Schoeller, the Swiss textile company in chapter 3 on page 24.

The clothing company asks for a custom made order. However, this cooperative situation does not fully cover the idea of R&D cooperation in the sense that both parties open up their innovation process. They work together in terms of meetings where knowledge is being exchanged and product fulfilments are being discussed. But in the end, it is the textile supplier that is delivering a final product and the clothing company did not engage in the specific research of creating that final product. The clothing company might have influenced the road of research but it did not conduct it. It represents the inside-out approach where expert knowledge is being used in order to advance the initial idea of the apparel company. The textile supplier further develops the clothing companies’ internal technologies, which are then being commercialized as an end product by the apparel business. I classify this partnership more as a supplier fulfilment instead of a cooperative way of conducting R&D.
The role of local, national and international institutions in the clothing and textile sector are vital to provide a platform that enables cooperative practices between all industry players. The research report has revealed numerous programs as well as funded projects by the EU that call for cooperative activities regarding research and development areas. According to studies, many firms prefer project-based cooperation to structurally tied cooperations like joint ventures. Research-based project groups are a way of sharing knowledge, access new market insight and engage in the advancement of the whole sector. Textile supplier and clothing company are able to meet in the framework of a program where also other participants like independent individuals, industry experts or R&D institutions might be present. An advantage is, that sometimes these programs are funded by the government could mean that leads small and medium companies are more likely to engage due to the share of costs.

An area of flourishing R&D efforts within a cooperative environment is smart textiles. These state-of-the-art developments regarding technical textiles are still in their beginning phase. Researchers are only about to discover all the possibilities within this field and in the future, the question of where and how these textiles can be applied arises. Wearable smart textiles combine the scientific character of textile with new clothing adaptations. If clothing companies focus on the market and its consumer, it becomes the expert of what the whole scope of demand for smart textiles can be.

To sum up and answer the main research question “What are the possibilities of R&D Cooperation between apparel company and textile supplier”, I concluded that there are currently no formal ways of cooperative activities in R&D that would both benefit the textile suppliers as well as the garment company. They strongly focus in doing what they are doing best and this is definitely not something negative. An important remark is the difference between cooperation and collaboration. Cooperation refers to the task where individual goals are trying to be met while exchanging knowledge with others to influence this. Collaboration on the other hand, explains the situation where two parties work together to meet a shared goal (Stoner, 2013). It is important to distinguish the two different situations since both garment company and textile supplier want to meet their individual goals concerning R&D and this is probably the important point where a formal partnership is difficult to achieve.

However, industry-wise there are immense efforts in thriving innovation and an informal way of sharing knowledge along the way would be engaging in non-formal project group activities. The three areas mentioned above all imply a project-based cooperation where informal knowledge exchange is made possible. And especially the area of smart textiles could form a more collaborative meeting point for both industry sectors. The research and especially the interviews with industry experts showed that there is no demand for engaging in more formal ways of R&D cooperation. Companies want to focus on what they are good at and share that knowledge with others. I want to refer to the source by Fritsch and Franke who strongly emphasize this. Working together in closed-knit, long-
term project teams like a joint venture is not in the interest of either clothing company or textile supplier.

Their R&D efforts are not similar and therefore they would not want to engage in research and development activities that do not correspond with their individual R&D focus. But it is not to forget that they still depend on each other within the value chain and the option of accessing each other’s specific knowledge is an advantage.

### 4.4 Hypotheses Evaluation

Based on the relevance and description of phenomena, two hypotheses have been formulated which will be evaluated in this chapter based on the analysis of the research:

**Hypothesis 1:** Through combining their individual R&D activities, both textile supplier and clothing company can benefit.

Since the activities of R&D executed by textile supplier and clothing company vary a lot and are directed towards a different end-goal, combining activities can be quite challenging or not in the mind of both parties. However, if they do choose to cooperate in an informal and project-based way, research has shown that this interaction can be beneficial. Both parties are informed on what is happening at other players of the industry and respond to this by adapting their R&D efforts and have the ability to benefit.

**Hypothesis 2:** There are areas within the textile and clothing industry where R&D cooperation can be made possible.

Like explained in detail in the research question evaluation, there are future areas that invite textile and clothing industry participants to engage and find out novel application forms for which R&D is vital. Smart textile can form an area of interest in the nearby future since it is still in development and strongly asks for interdisciplinary approaches in order to launch products to the market. Textile suppliers and clothing companies together form a very broad field of knowledge that is necessary to tackle new textiles and textile applications when it comes to smart textiles.

### 4.5 Further Research Possibilities

The topic investigated in the scope of this research revealed that in the field of R&D, many SME’s and suppliers see an advantage in working together with sectorial research institutes. They have the means and educated professionals to conduct valuable research into different areas and willing to advance the whole industry. The interaction of institutes with other drivers of the sector is of utmost
importance and further research into this interdisciplinary exchange of knowledge would provide the industry with valuable insight to further drive platforms and special projects regarding R&D solutions.

Another interesting subject related to the research, is the rise of technologically inspired collections or garments made out of alternative, natural material resources by young, entrepreneurial fashion designers. Examples like Suzanne Lee who initiated the biocreative design consultancy “Bioculture” and started growing her own fabric out of bacteria. Or Leonie Tenthof van Noorden, who is a master student for Industrial Design at the TU Delft in the Netherlands. She wants to push the boundaries of traditional fashion engaging in modern technologies regarding smart wearables.

Through rising interest of technological, chemical or natural advancements, independent fashion designers conduct their own research and develop new techniques. It would be interesting to further explore, how they interact within the textile industry and if and how they cooperate with other experts regarding R&D.
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Appendix

The appendix includes primary data collected during the phase of conducting research.
Interview Questions

EMPA Switzerland - Swiss Federal Laboratories for Materials Science and Technology
René Rossi, Head of Protection and Physiology Department

The EMPA is the interdisciplinary research institute of the ETH for material science and technology development. It functions as a bridge between research and practice by providing solutions for the challenges of industry and society. They work together with industry partners to implement their findings into tangible innovations for the market.

Aim of the Interview: Get to know current activities of EMPA Switzerland with regards to their department “Materials and Life” and their view on future developments regarding collaboration, innovation and the future of R&D within the textile industry as well as the functional garment industry.

1. What is the goal of the Materials and Life department?
   Textiles for protection, sports and medicine. Further possibilities.

2. What are current activities of this department?
   25 projects with various industry partners regarding smart textiles. We are trying to achieve the optimal balance between protection and comfort.

3. Does EMPA work with other demand groups regarding R&D activities?
   We work with universities, textile companies and various KMUs. This can also be clothing companies.

4. How does such a cooperation look?
   Our activities are material development and optimization. We work according to a specification.

5. How do you ensure that new technologies are really implemented?
   EU research, Switzerland not us. We work with KTI (Commission for Innovation and Technology) on various research projects where you can participate.

6. What is your opinion on sustainable development in the R&D area?
   End of Life, Biopolymer, End of Life

7. What communication channels are being used to enable this partnership? How do you work together?
   Important is a cross-disciplinary atmosphere. Natural sciences, biologists, physicists, chemists. Exchange is important. The institute often acts as a mediator between professors and business people of the KMUs. Our employees are not only from the university but also from the universities to ensure diversity and to be able to practically implement highly technical developments.
8. Was kann verbessert werden bei der Zusammenarbeit mit verschiedenen Anspruchsgruppen?

9. Welche Kommunikationsmittel brauchen Sie bei der Zusammenarbeit mit verschiedenen Unternehmen?

Persönlicher Kontakt ist am wichtigsten! Auch mit Asia/USA. Zusammenarbeit mit TNO Niederlande. Sonstige Kommunikationsmittel sind Skype, Telefonkonferenzen etc.

10. Wie sehen Sie die Zukunft der Textilindustrie?

Entwicklungen im Bereich Funktionalität werden aus meiner Sicht standing zunehmen. Es ist wichtig zukunftsorientierte Firmen im Auge zu behalten, denn Sie haben einen grossen Einfluss auf die Entwicklungen in 5-10 Jahren. Es wird immer mehr in R&D investiert, da man merkt wie wichtig es ist.

11. Können Sie mir mehr erzählen über Ihre Zusammenarbeit mit Bekleidungsunternehmen?

12. Bekommen Sie Vorschläge oder Fragen von Ihren Partnern?

13. Wenn ja, wie berechnen Sie die Erfolgsquote bevor man in R&D investiert?

KTI erwartet Business Plan und darin wird bestimmt ob die vorgestellte Entwicklung oder Forschung realistisch ist und auch machbar ist. Indem man den Markt analysiert und berechnet ob dies möglich ist. Es ist nie garantiert dass es so raus kommt wie man erwartet aber man versucht so deutliche Analysen und Hypothesen wie möglich zu machen.

14. Wie berechnen Sie den Wert einer neuen Entwicklung?

15. Wie gehen Sie mit Trends um? Wie finden Sie Trends? Arbeit Sie mit Trends? Wir verfolgen sogenannte Megatrends. Trends, welche deutlich langlebiger sind als reguläre Trendmomente. Diese sind die Überalterung der Gesellschaft (in Würde altern), the Quantified Self und Komfort Mensch/Gebäude (Textilien am Mensch anstatt Materialien um ihn herum e.g. Klimaanlagen in Hong Kong)

A2 – Interview Hein Daanen, AMFI

Interview Questions
Prof. Dr. Hein (H.A.M.) Daanen

Professor in Fashion Research and Technology, AMFI - Amsterdam Fashion Institute, CREATE-IT Applied Research, Amsterdam University of Applied Sciences
Professor in Thermal Physiology, MOVE Research Institute, Faculty of Human Movement Sciences, VU University Amsterdam
Scientist at TNO
Director at Sizing Science

1. How important is R&D in businesses today? And why is it important?

2. How is an R&D organization best organized?

3. What is your view concerning Open Innovation?

4. What are the advantages and disadvantages when working together on innovation?

5. At TNO, do you work together with other parties for example SMEs or Universities?

6. How do you think TNO benefits from co-operating with different parties?

7. How do you make sure that newly developed technologies are actually being implemented?

8. Why are companies looking for external knowledge/innovation?

9. What are according to you important developments within the textile industry that would be interesting to know by apparel companies?

10. What is your opinion on the current cooperation between textile supplier and apparel company?

11. Do you see things that can be improved regarding the collaborating with different stakeholders?

12. How do you see the future of the textile industry?
I think that R&D is more pronounced in the textile industry than it is in the apparel industry. I have a lot of contact with them and if you think that R&D is in textile than it is more chemically oriented (like Dupont) they look at aramids – very strong fibres for the military. The textile market is much bigger than clothing alone. The other markets are expanding (building industries (BMW made a car from textiles). There are all areas where textiles are more pronounced. It is more chemic and basic research. If I look at the research that apparel companies like Nike or Adidas do then Nike is very focused on research on the image of the brand. Adidas have a group that investigate the trend of hooligans. They have people that go to soccer games to look what they were. It is very applied research. Its is completely different than the research they are doing in textile companies.

Joint R&D activites are difficult since both industries do different research.

At schoeller textiles they said they come to them with a specific problem.

What you should do it look at the yearly report where they give numbers. It is good to ask them since I think the R&D is very low in the apparel companies.

Isn’t TNO working with apparel companies? We stopped doing that. First of all it was very difficult to get money for knowledge development. You can do testing. And in the textile industry a lot of it is done by standards. So in every garment there are textile standards. There are companies that do those tests. They buy a system (e.g Martindale). You buy it, do it and give the report and you sell it but you do not get new knowledge. It is very uncommon to do research in that area. At TNO we thought it wasn’t a good market so we sold it to TUV Rheinland.

If the R&D of apparel companies and textile companies are so different – are there still ways of them to work together? Why should they work together? Because the apparel companies are focusing on selling to the market their research is market research. And textile companies
are selling to clothing companies. What is the best material, what new innovations can I have? And in the fashion industry most innovations are driven by the consumer demand and testing it out on the market while textile innovations are more driven by textile innovations. I have to say that there is not much innovation going on. One of the innovation areas is smart wearables. That can be seen as an innovation area. This is interesting for the textile supplier as well as for the fashion company. For the textile supplier is is very basic research on conductive yarns. And for an apparel company like Adidas they try to make products out of it that measure heart rate. That is were I could see a cooperation.

How could they work together?
They can share information but what I see is: all the smart wearables like the polar thing and the adidas shirt are made by one company called clothing plus. So they don’t even do it themselves. They outsource it to clothing plus in Finland they have contacts with companies that make conductive yarns. So this is another sign that there is no direct contact between R&D of apparel and textile.

I don’t think that Adidas or Nike put effort into supplier engagement. Adidas or Nike have all equipment but they hardly use it. Technical research on the flexibility or so they do not do. Most of their research is market-related.

MAS is an interesting company to talk to. They are producing in low wage countries. They were producing all the time but started doing R&D.

Isnt this a partnership then?

MAS is their own company and they try to be more competitive and less dependant of the other companies by presenting new products. I think part of their drive is to become less dependant of the main companies. They don’t have that much of in the real material technique – they invest in knowing the market, seeing where they should go, invest in branding research and making nice posters to visualize it. But the real material they buy it from others like MAS.
There is not much R&D in fit. If you look at the scientific things – there it is really poor. What generally the issue is is that they have a certain model to start with then they make the garment and start grading. Scientifically grading is very old-fashioned it is not very innovative. And we also know that you have to make a lot of garments that don’t fit the user.

A lot of new research is also done for the military.

So more utility wear? Functional wear? Like Work wear, corporate wear?

Yes it is more critical to have a good fit there. Because there is so much in it. For fashion wear fit is not that critical. Most of the research there is in the military area.

But how it works is we do research and try to come up with better products in the end but I don’t think that there is much information on sharing R&D.

No not in the textile industry…or the fashion world. There is so many things about alliances in other sectors but not in the apparel wear.

This is why it is an interesting topic. And I haven’t seen much there. Normally are R&D – the universities publish.
My conclusion on the scientific publications on fashion and clothing is that it is relatively limited compared to other expertise areas.

The way I see it is that it is rather separated now, that they are focusing on different things. There are universitites that publish but that is poor. You have patents. You can look at patents. How many patents are there. And the smart wearables is a topic where it changes a little. Because here it seems to be a topic where they can collaborate.
In the apparel – it is very difficult to open up.
The companies are all very reluctant to share information with you as a scientist.
A3 – Interview Roland Lottenbach, Schoeller Textil AG, Switzerland

Interview Questions
Schöller Textil AG Switzerland
Roland Lottenbach, Head R&D Coatings and Finishings

Aim of the Interview: Get to know current R&D activities of Schöller Switzerland and their view on future developments regarding collaboration, innovation and the future of R&D within the textile industry as well as the functional garment industry.

1. What are your activities within the Research and Development Department?

Was sind Ihre Aktivitäten im Bereich R&D?

2. How is the R&D department organized?

Wie ist ihr R&D Department aufgebaut?

3. What are your main goals for the R&D department of Schöller Textiles?

Was sind die Hauptziele dieser Abteilung?

4. How do you make sure your R&D department and textile innovations stay ahead of the competition?

Wie garantieren Sie, dass die Abteilung R&D besser als die Konkurrenz ist?

5. What does the term “open innovation” mean for Schöller?

Was für eine Bedeutung hat der Begriff "Open Innovation" für Schöller?

6. Does the company participate with different stakeholders regarding their R&D activities? If yes, with who and how do you work together?

Arbeitet Schöller mit verschiedenen Anspruchsgruppen "Stakeholder" zusammen betreffend neuen Entwicklungen?

7. How do you make sure that newly developed technologies are actually being implemented?

Wie versichern Sie, dass neue Entwicklungen durch Schöller auch wirklich eingesetzt warden in der Praxis?

8. Could you tell me more about the newly acquired Research Lab?

Können Sie mir mehr erzählen über das neue Research Lab?
9. What are your views on sustainable development regarding the R&D department?

Was ist Ihre Einstellung zu nachhaltiger Entwicklung im R&D Bereich?

10. According to your website you praise your partnerships with different stakeholders like universities, innovative garment producers or other stakeholders – why do you work together with these different parties?

Gemäss Ihrer Webseite schätzen Sie den Austausch und die Zusammenarbeit mit verschiedenen Anspruchsgruppen wie Universitäten oder innovative Bekleidungsunternehmen. – Wieso arbeiten Sie mit diesen verschiedenen Parteien zusammen?

11. Could you elaborate on your partnership between you and apparel companies?

Können Sie mir mehr erzählen über Ihre Zusammenarbeit mit Bekleidungsunternehmen?

12. What communication channels are being used to enable this partnership? How do you work together?

Welche Kommunikationsmittel brauchen Sie um eine Zusammenarbeit sicher zu stellen?

13. Do you see things that can be improved regarding the collaborating with different stakeholders?

Kann die Kommunikation mit verschiedenen Anspruchsgruppen Ihrer Meinung nach verbessert werden?

14. How do you see the future of the textile industry?

Wie sehen Sie die Zukunft der Textilindustrie?

Was kann die Bekleidungsindustrie besser machen?

Was macht die Bekleidungsindustrie falsch?
Transcript Interview – 09/03/2015

Was sind Ihre Aktivitäten im R&D Bereich momentan, in welchen Areas sind Sie tätig?


Wie ist diese Zusammenarbeit und wie findet diese statt?


Betrifft dies gezielt neue Bereiche?
Ja, diese Projekte sind wirklich für die Forschung gedacht. Man schaut auf die Machbarkeit und Entwicklung. Dies sind meistens längere Prozesse die über zwei, drei Jahre laufen.

Auf Ihrer Website habe ich gesehen, dass sie auch mit der EMPA in Zürich bzw. St. Gallen zusammen arbeiten?
Ja genau, Momentan haben wir 3 Projekte, die wir mit Ihnen erarbeiten.

Können Sie mehr erzählen, wie diese Zusammenarbeit statt findet? Wie ist der Arbeitsaufwand und die Arbeitseinteilung und wie entsteht am Schluss auch wirklich ein Projekt was man am Schluss auch gebrauchen kann?

Enge Zusammenarbeit, Meetings, Resultate evaluieren, Ideen entwickeln und anfangs vor allem im Labormasstab.

Hat man am Anfang schon die Idee, was dabei rauskommen soll?
Natürlich, das immer.

Haben Sie immer schon ein Ziel im Auge und dort müssen wir hin oder was kommt und dan...

Die Idee ist immer schon am Anfang.

Wie garantieren Sie, das Ihre R&D Abteilung besser ist, als die Ihrer Konkurrenz?

Welche Bereiche sind das?
Wir haben Menschen mit sehr viel Erfahrung mit Textilien, Chemiker, Designer.

Was sagt Ihnen der Begriff “open innovation”, was bedeutet dies für Schoeller?


 Sie erwähnen die Zusammenarbeit mit Universitäten und Institute. Arbeiten Sie auch mit Bekleidungsunternehmen zusammen? Wobei ein Kleidungsstück beispielsweise entwickelt wird wobei sie das Textil dafür entwickeln?

 Ja, wir haben sehr viel Kundenentwicklungen. Unsere Kunden sind die Brands. Hier kommt die Idee vom Kunde die wir dann weiterentwickeln.

 Ist es so, dass der Kunde sagt: Ich brauche das, und Sie versuchen Ihm das zu bieten?


 Ich habe gelesen, dass sie beispielsweise auch mit Colombia Sportswear zusammen arbeiten. Entwicklungen die Sie mit ihnen erarbeitet haben, werden diese auch wieder für andere Unternehmen verwendet? Oder gibt es hier die Exklusivität.


 Sind sie auch beteiligt am Kleidungsentwicklungsprozess?

 Wir geben die Funktion des Textils an und wo und wie man am Besten einsetzen kann. Der Schnitt, das Design, das ist Kundensache.

 Ich habe gelesen, dass sie ein neues Research Lab haben – können Sie mir mehr dazu erzählen?

 Das Research Lab is ca. 10km entfernt und hier wird die Chemie synthetisiert und dort haben wir die ganze Analytic. Hier baseln wir an der Chemie die es nacher gibt auf dem Markt und suchen nacher einen Partner, einen Chemieproduzenten, die uns diese Chemie produzieren kann.
Im Reserach Lab?


Was ist Ihre Einstellung bezüglich Nachhaltigkeit im R&D Bereich?


Man investiert gerne in Nachhaltige Technologien im Productionsbereich?

Sicherlich auch in unserer Färberei. Mit Färbebächen die nur 2 mal so viel Wasser brauchen als den Stoff. Der nächste Schritt ist das wir gar kein Wasser mehr brauchen.

Gibt es nicht schon Waschungen die kein Wasser brauchen?

Ja genau.

Hier legt man viel Wert drauf?

Ja sehr.

Können Sie mir mehr über die Zusammenarbeit mit andern Kleidungsunternehmen, wobei man ein neues Produkt erarbeitet hat?


Hier kam Remova auf uns zu. Viele Kunden oder Firmen kommen auf uns zu und möchten gerne mit uns entwickelt. Sie lesen das wir eigentlich die innovativsten der Welt sind.

Dürfen Sie auswählen, mit wem Sie zusammenarbeiten?

Ja genau. Aber nicht mit allen. Wir müssen natürlich das Potential sehen, denn eine Entwicklung kostet immer sehr viel.

Wie garantiert man dass beide Parteien am Schluss ein win-win haben?

Wie denken Sie dass die Bekleidungsindustrie momentan auf neue technologien im Textilbereich reagiert?


Hat der Kunde demnach die Wahl ob man die Textilien made in Switzerland bzw Taiwan möchte?

Ja genau. Jedoch sind die Taiwanesischen Textilien doch nicht genau so hochstehend wie die, die wir hier in der Schweiz produzieren.

Wir wurden früher sehr viel kopiert. – Vor allem aus dem Asiatischen Raum. So gingen wir in die offensive und gehen eine Partnerschaft mit einem grossen Unternehmen ein – damit er uns nicht mehr kopiert und wir daran verdienen können. Schon seit 14 Jahren.

Welche Kommunikationsmittel verwenden Sie um eine Zusammenarbeit sicher zu stellen?

Intern : viele Sitzungen, Standortbestimmungen, Telefon, Email. Vor allem kurz Zusammensitzungen.

Gibt es Verbesserungspotenzial in der Zusammenarbeit mit verschiedenen Anspruchsgruppen wie Universitäten etc? Was kann man besser machen


Noch weitere?

Die Zusammenarbeit ist sicherlich positiv, sonst würden wir es nicht machen. Sie arbeiten auch nicht gratis.

Wie stellen Sie sicher, dass die Technologien die sie erforschen, dann auch wirklich zum Zug kommen?
Über unseres Marketing. Wir wollen es bekannt machen, wir gehen auf Messen. Menschen wollen immer die neusten Technologien und nach zwei Jahren ist das was man entwickelt hat schon wieder alt. Wir erhoffen uns hier vielleicht mehr Zusatzgeschäfte. Wir sind teuer und da ist die Luft auch dünn.

Sie sind skeptisch gegenüber Bekleidungsunternehmen bezüglich der Langlebigkeit ihrer Innovationen. Aber wie ist das bei funktionellen Kleidern wie Arbeitskleider etc.

Ja genau, das ist auch der Bereich in dem wir wirklich tätig sind. Im outdoor bereich, Medizin Bereich.

Hier fäng man auch eher mit einer Problemstellung an: Was kann man machen, dass man am Schluss ein Produkt hat?

Genau. Wir haben beispielsweise eine Inkotinez Unterwäsche entwickelt. Das erste Kleidungsstück das wir selber auch vertreiben und produzieren.

Möchte schoeller auch in Zukunft mehr solcher Sachen machen?

Ja, den in dem Bereich gibt es schon noch einiges zu tun. Wir haben auch ein Anti-Inkubitus Betttuch.

Was haben Sie für Textilien mitgenommen.


Bei den Messen sind Sie auch wirklich mit den Kundne in Kontakt. Geben Sie auch input wo sie die Textilien einsetzen können?


Was ist Ihr Hintergrund und wofür sind Sie zuständig?
Alle Coatings, Haftung und die ganze Funktion.

Wie sind zu schoeller gekommen?

Wir hoffen, dass es so weitergeht. Wir sind im hohen Preissegment.
Ist es ein Ziel auf für ein tieferes Preissegment zu entwickeln?
Dafür habe wir die Tochterfirma schoeller technologies um die technolgies zu verkaufen. Sie müssen uns garantieren, dass kein Konkurrent unsere innovationen bekommt. Eine sogenannte Blacklist.

Mit der EMPA haben sie das 7 lagen system entwickelt? Wir das heute im Milīar eingesetz?

Ja aber noch nicht sehr viel, da es sehr teuer ist.

Merk man, Leute es schätzen dass sie in der Schweiz produzieren?

Die Funktion muss stand halten und Trends sind wichtig. Wir arbeiten mit Trends zusammen.

Schauen Sie auf den Kunden für den Trend?
B1 – Notes from phone call Rens Tap, 3. April 2015

Notes Phone call Rens Tap, Modint, 3. April 2015

sell machines / patents
andere form van textiel - kleding zonder patronen karin vlucht
nonwovens spuiten
taiwan/ korea / japan textile leveranciers and institutes, texprocess stuttgart mai
daycoo machines weesp verven kleding iijn de stoffemet co2
technisch bedrijf wasmachines voor stoffen - met nike als klant
productie taiwan (daar zijn de stoffen en de productie)
man y ideas in rd - national en european - door over overt'
iedereen d
performance wear, work wear
industrie investeert en de groothandel profiteert - wacht wat ontwikkeling is en
ten cate bv stoffen voor defensie
americaanse defensie - zij zijn klant en maken de kleding

veel te duur

material sense

vernieuwing in mode zit in het modebeeld zelf - modeontwerp word niet beschouw als R&D. innovatie

NL hennep/ eukalyptus/ coffe beans toepassing vind hier plaats
C1 – Complete List of EU Textile Research Projects

**RELEVANT EUROPEAN ORGANISATIONS AND NETWORKS**

The European Apparel and Textiles Confederation – Euratex – [www.euratex.eu](http://www.euratex.eu)

The European Network of Textile Research Organisations – Textranet – [www.textranet.net](http://www.textranet.net)

The Association of Universities for Textiles – AUTEX – [www.autex.org](http://www.autex.org)

**EUROPEAN TEXTILE RESEARCH CONFERENCES**

The International Man-Made Fibres Congress, Dornbirn, Austria – [www.dornbirn-mfc.com](http://www.dornbirn-mfc.com)

The International Aachen-Dresden Textile Conference, Aachen & Dresden, Germany – [www.aachen-dresden-ite.de](http://www.aachen-dresden-ite.de)

**EU TEXTILE RESEARCH PROJECTS**

**NEW MATERIALS, PROCESSES AND ECO-EFFICIENCY**

**AVALON** - Multifunctional textile structures driving new production and organizational paradigms in textile SME networks - [www.avlon-eu.org](http://www.avlon-eu.org)

**Digitex** - Digital Programmed Jetting of Fluids for Multifunctional protective Textiles - [www.digitex-eu.com](http://www.digitex-eu.com)

**Inteltex** - Intelligent multi-reactive textiles integrating nano-filler based CPC fibres - [www.inteltex.eu](http://www.inteltex.eu)

**Natex** - Aligned natural fibres and textiles for use in structural composite applications - [www.natex.eu](http://www.natex.eu)

**NoTeReFiGa** - Novel temperature regulating fibres and garments - [http://extra.ivf.se/noterefiga](http://extra.ivf.se/noterefiga)

**Microflex** - Micro fabrication production technology for MEMS on new emerging smart textiles/flexibles - [http://microflex.ecs.soton.ac.uk](http://microflex.ecs.soton.ac.uk)

**NuWave** - Developing & demonstrating innovative technology approaches in European textile machinery SME’s - [www.nu-wave.eu](http://www.nu-wave.eu)
**ModSimTex** - Development of a rapid configuration system for textile production machinery based on the physical behaviour simulation of precision textile structures - [www.modsimtex.eu](http://www.modsimtex.eu)

**ARTISAN** - Energy-aware enterprise systems for low-carbon intelligent operations - [www.artisan-project.eu](http://www.artisan-project.eu)

**SESEC** - Sustainable Energy Savings in the European Clothing industry

**NEW APPLICATIONS FOR TEXTILES (TECHNICAL & SMART TEXTILES)**

**PolytecT** - Polyfunctional Technical Textiles against Natural Hazards - [www.polytec.net](http://www.polytec.net)

**Contex-T** - Textile Architecture - Textile structures and buildings of the future - [www.contex-t.eu](http://www.contex-t.eu)

**BioAgroTex** - Development of new agrotex tiles from renewable resources and with a tailored biodegradability - [www.bioagrotex.eu](http://www.bioagrotex.eu)

**Dephotex** - Development of photovoltaic textiles based on novel fibres - [www.dephotex.com](http://www.dephotex.com)

**PASTA** - Integrating Platform for Advanced Smart Textile Applications - [https://projects.imec.be/pasta/node/1](https://projects.imec.be/pasta/node/1)

**PLACE-IT** - Platform for Large Area Conformable Electronics by Integration - [www.place-it-project.eu](http://www.place-it-project.eu)

**ProfiTex** - Providing fire fighters with technology for excellent work safety - [www.project-profitex.eu](http://www.project-profitex.eu)

**Prosys-Laser** - Intelligent personal protective clothing for the use with high-power hand-held laser processing devices - [www.prosyslaser.eu](http://www.prosyslaser.eu)

**Prospie** - Protective Responsive Outer Shell for People in Industrial Environments - [www.prospie.eu](http://www.prospie.eu)

**SafeProTex** - High-protective clothing for complex emergency operations - [www.safeprotex.org](http://www.safeprotex.org)

**No Bug** - Novel release system and bio-based utilities for mosquito repellent textiles and garments - [www.no-bug.info](http://www.no-bug.info)

**Safe@Sea** - Protective clothing for improved safety and performance in the fisheries - [www.saferatsea-project.eu](http://www.saferatsea-project.eu)
iProtect - Intelligent PPE system for personnel in high-risk and complex environments - www.ciop.pl/21160.html

Susta-Smart - Supporting Standardisation for Smart Textiles - www.susta-smart.eu

Smart@Fire - Integrated ICT Solutions for Smart Personal Protective Equipment for Fire Fighters and First Responders - www.smartatfire.eu

CLOTHING, FASHION DESIGN, MASS CUSTOMISATION

LEAPFROG - Leadership for European Apparel Production from Research along Original Guidelines - www.leapfrog-eu.org

Serve - Service oriented intelligent value adding network for clothing-SMEs embarking in Mass-Customisation - www.serve.eu

Open Garments - Consumer open innovation and open manufacturing interaction for individual garments - www.open-garments.eu

EnviroTexDesign - Virtual collaborative design environment - www.envirotexdesign.eu

Corenet - Customer-oriented and eco-friendly networks for healthy fashionable goods - www.corenet-project.eu

MicroDress - Customised wearable functionality & eco-materials - extending the limits of apparel mass customisation - www.micro-dress.eu

Fashion-Able - Development of new technologies for the flexible and eco-efficient production of customized healthy clothing, footwear and orthotics for consumers with highly individualised needs - www.fashionable-project.eu

INFORMATION TECHNOLOGY, MANAGEMENT, INNOVATION, NETWORKS

CrossTexNet - ERA-Net Project: Textiles at the crossroads of new applications - www.crosstexnet.eu
PROsumere .NET - Networking European Technology Platforms in the Consumer Goods Sectors - www.prosumer.net.eu

Systex - Coordination action for enhancing the breakthrough of intelligent textile systems (e-textiles and wearable microsystems) - www.systex.org

eBIZ-TCF - Harmonising e-Business processes and electronic data exchanges for textile, clothing and footwear SMEs in the EU Single Market - http://ebiz-tcf.eu

TexWin - Textile Work Intelligence by closed-loop control of product and process quality in the Textile Industry - www.texwin.eu

InnoWater - Innovation partnership for better innovation support tools and delivery mechanisms in sustainable water and wastewater - www.europe-innova.eu/innowater

SmartNets - The Transformation from Collaborative Knowledge Exploration Networks into Cross Sectoral and Service Oriented Integrated Value Systems - www.smart-nets.eu

MatVal - Alliance for Materials - A value chain approach to materials research and innovation - www.matval.eu

RELATED EUROPEAN TECHNOLOGY PLATFORMS

European Commission website on Technology Platforms - cordis.europa.eu/technology-platforms/home_en.html

Water Supply and Sanitation Technology Platform (WSSTP) - www.wsstp.org/default.aspx

Technology Platform on Sustainable Chemistry (Suschem) - www.suschem.org

MANUFACTURE - Platform on Future Manufacturing Technologies - www.manufacture.org

The European Construction Technology Platform (ECTP) - www.ectp.org

EUROPEAN COMMISSION WEBSITES

Cordis – the European Commission’s Research Portal - cordis.europa.eu

The 7th EU Research Framework Programme (FP7) - cordis.europa.eu/fp7


Website of the Unit for Fashion and Design-based Industries of DG Enterprise and Industry - ec.europa.eu/enterprise/textile/index_en.htm

INNOVA – The Innovation Portal of DG Enterprise and Industry - www.europe-innova.org