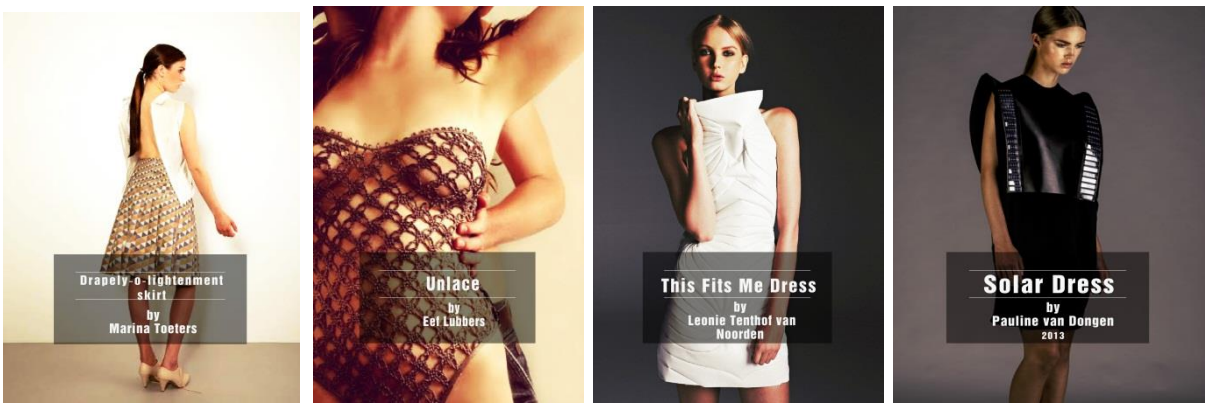
TECHNOLOGY AND FASHION: CROSSING THE INTERSECTION

Why smart clothing market isn't just there yet?



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Abstract

Would you like to wear a dress that could charge your smartphone? Or wouldn't it be great that your sneakers could post on the Twitter and Facebook? Recently, the wearable computing devices defined that smart garments receive great attention and become a hot topic of discussion. More and more individuals are experimenting with the possibility to embed high- tech devices, such as solar cells or LEDs, into textile. The added functionality enables the garment to provide unique aesthetic experience and, moreover, improve healthcare, foster interaction and support sustainability in fashion. Despite its promising potential, the smart clothing is neither in people's wardrobes nor in the fashion stores. It seems to be stuck somewhere between laboratories, museums and runway shows. The smart garment is making the first steps towards reaching the customer and establishing a market. Thus, the research aims to answer the following question: *why isn´t there a market for smart clothing?*

This research explores the recent development of smart garment with a focus on its commercial potential in the field of apparel industry. Moreover, it attempts to highlight the challenges that creative individuals struggle with while designing smart garment. Drawing on seven semi-structured in-depth interviews with smart garment creators and two interviews with experts from the fields of fashion and innovation, this research identifies factors that either hinder or intensify the smart garment market formation.

Keywords: *smart clothing, radical innovation, consumer appreciation, social acceptance, market formation.*

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SG: Smart Garment

SC: Smart Clothing

1. Introduction

Would you like to wear a dress that could charge your smartphone? Or wouldn't be great that your sneakers could post to Twitter and Facebook? ¨Smart clothing¨ nowadays is at the center of attention. This phenomenon stands at the crossroad where the cutting edge technology meets fiber and textile. In the last decades on the background of recent technological breakthroughs, the textile and garment have undergone considerable metamorphosis with texture, features, substance, functionality and performance (Tao, 2001). The conventional methods and techniques to work with advanced materials to create extraordinary pieces have transformed respectively (Tao, 2001).

On the way to this revolutionary changes numerous fashion designers, industrial designers, artists, IT engineers, technicians as well as scientists team up to create smart clothing.
The working process implies insertion of complex technological systems such as electronic devices, microprocessors, solar cells, LEDs into textile (Smelik, 2014). The advanced technology embedded into garment enables it to track movement, monitor heart rate, keep the body warm, extend senses and perform other functions. The integration of textile and high technology opens the door to immense possibilities to experiment with nanotechnology, microelectronics, biotechnology, wearable computers, etc. (Tao, 2001; Smelik, 2014).

Importantly, within the Dutch fashion scene the innovative creators are emerging as a growing force, among whom are Marina Toeters, Pauline Van Dongen, Iris Van Herpen, Anouk Wipprecht and others (Smelik, 2014).

However, despite the media attention, it is still not possible to see people walking down the street, wearing smart jackets that light up, or skirts that show the weather forecast (Smelik, 2014). It has appeared neither in people's casual wear wardrobe nor in the fashion stores (Smelik, 2014). Smart clothing prototypes are stuck somewhere between laboratories, museums and runway shows (Smelik, 2014).

The smart garment shows great potential, however, the number of obstacles, such as lack of knowledge, demand uncertainty, hinder smart clothing from becoming a commercially profitable product.

1.1 Relevance and Aim

The evolution of high technology greatly impacts the attempts of fashion to keep pace with time. For instance, the group exhibition titled ¨The Future of Fashion is Now¨ at the Museum Boijmans Van Beuningen in 2014 reflected the concerns of today's fashion industry and apparel market in general (The Future of Fashion is Now, 2014). The exhibition was pretentious enough to articulate the tension between the patterns where technology, individuality and aesthetics join to become an extraordinary outfit (The Future of Fashion is Now, 2014). The uncertainty around the future of smart garment phenomenon purposefully questions the established standards of fashion and challenges the apparel production chain offering alternative and innovative options (The Future of Fashion is Now, 2014).

The smart clothing enjoys a great deal of attractiveness among various professionals in the Netherlands, particularly among fashion designers, industrial designers, etc. However the prototypes of smart clothing remain in performative context of appealing objects. The items are commonly displayed at the art museums, galleries as well as shown at different fashion shows or presented during the workshops.

Is smart garment a passing fad or it is an evolutionary innovation bringing fundamental changes? The smart garment phenomenon already knocks at our door but it has not yet stepped into the path of mass production. Even though nowadays it receives great attention, it has not yet become widely available. The market is still in its infancy. Currently the products are making the first steps towards reaching the customer and establishing the market. This phenomenon is often regarded as an absolute novelty for its aesthetic appeal and intriguing devices, but the commercial potential needs to be unlocked.

Over the past decades scholars have advanced theories that contribute to the exploration of innovation products and processes. However, the demand uncertainty builds up barriers

to innovation. This research is concerned with expanding the understanding on the factors of uncertainty and revealing commercial potential of smart clothing on its way to market formation.

This research aims to contribute to the discussion of demand uncertainty at the early stage of market formation. It leads to a greater understanding of smart clothing design practice, product characteristics, identification of potential users and particular aspects of smart garment appreciation at this moment of its development. The outcome can predict the subsequent phases of market development and outline the niche somewhere in between high fashion and high technologies. The study is conducted in descriptive-explorative manner. It encompasses the viewpoints of creators and key figures in this field, which allows conducting profound analysis with regard to current social acceptance. Thus, the research aims to provide an answer to the following central question:

Why isn´t there a market for smart clothing?

Unlace is created to stimulate the interaction between partners. The thermo chromic ink was used to create the effect of color change or color movement (from black to skin color). When the garment is touched, the warmth heats up and changes the color of textile.

Source: Unlace (n.d.). Retrieved on May 15,, 2015 from http://www.eeflubbers.com/unlace.ht

1.2 Practical Implications

The study outcome offers academic insights for further research on smart clothing. Additionally, the thesis brings useful knowledge about the factors that affect consumer appreciation and lead to social acceptance, which is significant for disclosure of commercial potential. Noteworthy, this research introduces the perspectives of producers and key figures on the smart garment potential and its relevance to the modern society.

As an important step in the process of product development, a visual prototype test has been conducted with the key figures being regarded as future users. The result allows creators to discover new ideas, challenges as well as improve the functions and design of smart garment prototypes. In addition, this thesis can help designers to have a general understanding on how to position their smart garment pieces in the market.

This research can be also of great value for policymakers to consider the growing importance of smart clothing and identify the factors that support or prevent smart clothing market formation. Thus, the research can impact the Dutch government to establish fruitful conditions for professionals to develop it further.

1.3 Definitions

Recently, clothing and accessories that incorporate advanced technology have become a hot topic for discussion in the media, social networks, symposiums and conferences. The future of fashion is often associated with high technologies (Symposium of Fashion Technology - SOFT, 2014). Therefore various terms such as ‘’smart garment’’, ¨smart textile¨, ¨e-textile¨, ¨wearable technology¨, ¨wearable textile¨, wearable computing, ¨smart fabrics¨ or simply ¨ intelligent textile¨ have entered into ¨circulation¨ worldwide implying various smart devices and sensors embedded into fibers or accessories to make it responsive to signals received from surrounding environment (Tao, 2001). In order to avoid further confusion regarding these “Pleiades” of terms, hereafter I apply the terms smart garment (SG) and smart clothing (SC) for generalizing and referring to the particular clothing (the uniforms, accessories, interior products are not included) which demonstrates functional utility through application of advanced technological devices. Additionally, those items fulfill aesthetic and decorative needs. The aesthetic or decorative performance of the garment is analogous and shares certain characteristics with high-end fashion clothing such as exclusivity and uniqueness.

The research shows that individuals who are involved in projects on SG usually come from diverse academic and professional backgrounds such as software engineering, fashion design, art, etc. Therefore, hereafter they are classified as *creators* and *makers*.

1.4 Research Structure

The research is structured as follows: Chapter Two starts with the theoretical framework which brings empirical theories on the notion of innovation and places innovation in the economic perspective. The concepts of demand uncertainty, consumer appreciation measurement methods, such as experimentation and prototype testing methods, are covered. Moreover, the Chapter

reviews the concepts of demand for cultural goods, consumer behavior, outlining cultural product characteristics.

Chapter Three is about methods. It elaborates on how the study was conducted. The methodology section offers guidance on sample selection, data collection and data analysis processes. The relevance, validity and limitations of the method of research are introduced respectively. Afterwards, the subsequent chapter presents the analysis of findings. In the concluding chapter, the answer to the general research question is given, based upon empirical research and theory. The conclusion entails the suggestions for further research. The section with appendices includes background information about makers and experts, the interview protocol etc.

2. Theoretical Framework

The purpose of the theoretical framework is to explore the exiting literature i.e. “what is already known about this area”, in order to identify theories and concepts relevant to this research topic and show connections (Bryman, 2008, p.81).

Thus, the first chapter incorporates the overview and analysis of published literature contrasting academic approaches, theories and arguments on this subject. This chapter is constructed to reflect on knowledge gaps and open issues in the academic area of research. Therefore, the chapter acts as a reference point, linking other chapters throughout the study. However, due to the subject matter, there is a lack of theoretical knowledge with regard to smart clothing which places this piece of research into the context of an exploratory study.
The theoretical framework is designed in the following order:

- In the first section, the main focus is on theories of innovation. The first chapter introduces studies on innovation and determines the latter’s degrees and levels. Moreover, the demand uncertainty towards innovative products is deeply examined and the uncertainty reduction methods, such as experimentation and prototype testing, are offered.
- The second section expands on demand, consumer behavior and consumer appreciation towards cultural and innovative products.
- The third section presents the smart garment at its development stage in the worlds of technology and fashion.

2.1 Innovation

The modern reality is in constant motion: the distance between people is decreased, space is compressed and anyone can be reached at the blink of an eye. In the maelstrom of such changes the ones who continuously generate new ideas and methods stand out. Innovation is central from the early evolutionary stages of human history (Fagerberg, 2003). What seems ordinary and common today is an outcome of long and complex innovation processes (Fagerberg, 2003). The innovation was a shadow topic in academic research until 1960s when studies on innovation started to be considered as a separate field of research (Fagerberg, 2003). Since then, the role of

innovation has rapidly increased within economic and social realms (Fagerberg, 2003). Joseph Schumpeter has a significant contribution in innovation theory advancement. Schumpeter examined innovation as a leading force in social and economic growth (Fagerberg, 2003; Fagerberg, Fosaas & Sapprasert, 2011).

Importantly, innovation shall be differentiated from invention since invention results the idea of creation a novel product or a process whereas innovation is the commercial application of that product or process that requires sufficient knowledge, experience and resources (Schumpeter, 1934; Fagerberg, 2003).

Obviously, innovations differ and are therefore classified into typologies in order to distinguish the degree of novelty. Kleinschmidt and Cooper identify 'high', 'moderate', and 'low' degree of novelty and uniqueness (1998, cited from Garcia & Calantone, 2001, p.117). The difference between those degrees is that highly innovative product performance is unique and exceptional to the entire world, including the producers and the market. The moderate and low innovative products perform less authenticity, even though they can be modified to certain extent (Garcia & Calantone, 2001).

Innovations are categorized into two types: "product and process innovations" (Fagerberg, 2003, p. 4). The product innovation embodies the novel or improved device whereas the process innovation refers to the transformations in the process of production and distribution (Fagerberg, 2003).

Another way of measuring the degree of innovation is by classifying ¨radical, really new and incremental or marginal¨ innovation. Incremental represents minor modification, correction or improvements of the product quality (certain details, features, processes, etc.) by using existing technologies towards the existing market , as opposed to the really new category that implies the usability of new technologies in already existing market or usability of existing technologies within the new market (Garcia & Calantone, 2001). As to the radical innovative goods, they are characterized by novel technological input, as well as by total replacement of the established technology. As a result, radical innovative products catalyze the emergence of new market and new infrastructure and might lead to economic and social change (Garcia & Calantone, 2001; Fagerberg, 2003). When a radical innovative product emerges, new firms appear, enter the market, compete, and adjust using new communication channels and new marketing strategies (Garcia & Calantone, 2001). Thus, the radical innovation affects revolutionary to the whole chain

of production and distribution as well as management structure and organizational set-up (Garcia & Calantone, 2001). Additionally, innovation is a key driver of success since performs a competitive advantage (Garcia & Calantone, 2001).

Schumpeter applied the term entrepreneur to innovator implying a pioneer who first brings forward a product that revolutionizes the industry. But contrariwise, the imitator is the one who uses the existing innovation and introduces it into a different context (Fagerberg, 2003). However, Fagerberg (2003) states that the role of the imitator is significant in stimulating incremental innovations. The smart clothing creators are innovators who perform qualities of entrepreneurship.

Whilst the main focus of Schumpeter is on capabilities of individual innovator, Fagerberg (2003) pins down the importance of collaborative work in creating an innovative product. Garcia and Calantone (2001) shed light on ambiguity of classification and definitions of innovation. According to Garcia and Calantone (2001), technological innovations incorporate inventions and creative concepts from various disciplines such as art, engineering, design, science, etc. It is notable that the invented new product transforms into innovation only when it is processed through "the phases of product development, manufacturing, marketing distribution, servicing, and later product adaptation and upgrading." (1996, as cited in Garcia & Calantone, 2001, p. 112).

SG can be regarded as highly radical innovative product since it encompasses the combination of two totally different disciplines within specific contexts: the high technology and fashion.

2.1.1 Innovation and Uncertainty

Regardless this classification, innovation is a complex phenomenon. Innovation is fraught with high level of uncertainty. The market and demand responses are scattered since "uncertainty is inherent in innovation process" (Fagerberg, 2003; Kline & Rosenberg, n.d.; Jalonen, 2012, p. 2). Souder and Moenaert (1992) identify the following sources of uncertainty in innovation process: the consumer need, technological and competitive environments and resources. Accordingly, the constant interplay of those sources reduces innovation uncertainty.

When the innovative prototype is turning into commercial product it encounters market forces and technological progress (Kline & Rosenberg, n.d.). The market forces erect barriers for innovation to enter the market such as changes in income, innovation management,

manufacturing, price determination, etc. (Kline & Rosenberg, n.d.). On the other hand, the innovative product needs to keep pace with technological progress which means systematic improvement (process innovation) of its performance and design (Kline & Rosenberg, n.d.). The commercially successful innovative products should meet the requirements of market and technology (Kline & Rosenberg, n.d.).

There is a strong correlation between the degrees of innovation i. e. incremental and radical and the level of uncertainty: the greater the change, the stronger is uncertainty (Kline & Rosenberg, n.d.).

O'Connor (1998) examines the role of consumer in product development process. It is hard for consumers to describe their wants and needs towards a radically innovative and experimental product. Those types of products imply specific attitude and behavior from consumer. Radical innovation entails high risk of uncertainty, since there is no guarantee of success or positive market response (O'Connor, 1998). Thus, SG attributes high level of uncertainty and the target customer is obscure, because neither apparel nor tech markets encountered such a product before. The innovative product performs ¨technical uncertainty¨ when its functional utility can be reduced by prototype testing method (Thomke, 2003, p. 25). In case of ¨production uncertainty¨ the cost-efficient production remains uncertain even if the functional utility is reduced (Thomke, 2003, p. 25). Despite the ¨product and functional uncertainties¨, the regular change in consumer tastes lead to ¨need uncertainty¨ (Thomke, 2003, p. 25). As this kind of product has never existed before, the consumer is unaware of it. There is ¨market uncertainty¨ which is risky to predict and even more difficult to access. Thus the ¨market uncertainty¨ keeps usually the producers of innovative products alert (Thomke, 2003, p. 25).

O'Connor (1998) emphasizes the role customer plays in the process of radical and incremental product creation. In case of incremental products, the customer's voice is highly advantageous, since it reflects the weak points and leads to product correction and improvement. However, the picture is completely different with breakthrough products. It is more difficult to identify and measure the customer behavior, attitude or taste, when they are not yet formed (O'Connor, 1998).

2.1.2 Experimentation Matters

This dress incorporates 72 flexible solar cells that allow storing enough energy to charge a smartphone or any other portable device.

Source: Solar Dress (2013). Retrieved on May 15, 2015 from http://paulinevandongen.nl/projects/wearable-solar/

Figure 2 – Solar Dress

The uncertain nature of radical innovative products is resolved through experimentation as an important phase in product development (Thomke, 2003). Innovation depends on experimentation since it fosters knowledge creation and thus enables individuals to generate innovative ideas and concepts (Thomke, 2003). The experiment results in discovery, since it indicates what is needed to be modified, reinforced or replaced, i.e. any deviation from the constructed model opens more challenging questions and ultimately unlocks potentials for a new technology (Thomke, 2003). Therefore, there is no failure in experiment results (Thomke, 2003).

The main tools for running an experiment are the models and prototypes of the products or service. Lynn, Morone and Paulson (1996, p.15) measure the performance of highly uncertain radical innovative products through ¨probe and learn¨ method: the prototype, which is the early version of product, is offered to a variety of market segments and examined how the market segments respond to product's' functionality, design, certain features, etc. The ¨probing and learning¨ experiment brings the producer closer to the market as it provides clarity on the qualities of the product. The product development is a complex process especially for such radical innovative product as smart garment, since only customer knows what he/she wants and the producer should predict how to meet the needs of customer. Moreover, in the case of radical innovative products, consumers might not even completely realize their wants and needs. First, the consumer needs to gain information, knowledge, explore how does the product work, how does it look like, evaluate and weight and preferably try it out.

Prototype testing is an inseparable activity in the product development process. The prototypes are created generally from insufficient and poor information and during the test the prototypes are communicated with the early user. As a result, the preferences, taste and needs of potential customer are detected. The prototype testing reveals the weaknesses and strong points

of the product (Lim et al., 2008). The process of prototype testing has to be repeated until the satisfactory solution, i.e. the final ¨perfect¨ product is achieved. Prototype testing is learning by experiencing practice (Lim et al., 2008). It makes the product development process much faster and less expensive.

Design products´ prototypes differ greatly from other prototypes (Lim et al., 2008). According to Lim et al (2008, p. 24) the prototypes of design products are built up for ¨evaluation and testing, the understanding of user experience, need and values, idea generation and communication among designers¨.

SG is an experience good. Therefore, it can be fully appreciated through a direct sensory experience. The direct experience allows the user to identify whether the product meets his/her taste, preferences and appreciation.

In this research photos and videos of certain smart clothing prototypes are introduced to experts who are considered to be the knowledgeable representatives of the demand. This small prototype testing allows experiencing visually SG prototypes and elaborating more precisely on their weak and strong points.

2.2 Demand: Cultural Economics

Is smart clothing a luxury good? Does the smart dress have a close substitute or not? Does it satisfy the consumer's taste in case the consumer is not fully knowledgeable of this product? Is the modern consumer ready to appreciate the aesthetics and usability of smart pieces? How can consumer purchase behavior be affected and by whom? (Levy-Garboua & Montmarquette, 2011). This section sheds light on these questions.

The demand of cultural and creative goods is different from demand of other goods and services. Thus, the demand for cultural goods challenges the conventional economics theories (Levy-Garboua & Montmarquette, 2011). The standard economic analysis of demand is concentrating mainly on rational choice and utility-maximization which determine people's decision making of what to consume, when and how much (Caves, 2000). In classical economics, money, time and opportunity costs are the main factors affecting consumer behavior. However, cultural goods are specific and, thus, require an analysis of specific patterns of creative consumption which are not in line with the rules of standard economics (Caves, 2000).

The creative goods provide additional benefits to consumers: the more they experience and learn about the product, the more they enjoy that product in the future. This model is called ¨rational addiction¨ (Caves, 2000). The appreciation of cultural goods and, respectively, the consumer's choice depend on investments which aim to enhance knowledge, gain experience and move towards ¨taste¨ cultivation (Caves, 2000; Brito & Barros, 2002). Thus, the taste for SC can be acquired only through systematic visual and physical experience (Levy-Garboua & Montmarquette, 2011). The collectively generated ¨taste¨ toward a novel product leads to recognition of radical innovative products, i.e. social acceptance (Caves, 2000).

Figure 3- Rational addiction or SC appreciation

Source: Caves (2000); Brito & Barros (2002)

For instance, the fashion appreciation implies education, time and money investment towards exploring the industry, increasing knowledge and experiencing fashion products (Caves, 2000). The demand uncertainty is partly reduced by permanent experience (Levy-Garboua & Montmarquette, 2011). Therefore, the appreciation of fashion consumers depends on the previously developed taste, as well as time dedicated to unfold and evolve the cultural consumption capital and, finally money invested to physically experience the product (Caves, 2000). Apart from education, time and money, there are two other factors that play great role in consumer decision making process which are income and the cost of substitute products (Caves, 2000).

It should be noted that the consumption of such goods takes place in a social context. Therefore, an individual's decision about what to consume and how to respond to innovation go in line with the observation of preferences and needs of others (Caves, 2000). The ¨tribal¨ behavior, i.e. one follows other's choices, is common when it comes to creative good consumption. The information is mainly exchanged through word-of mouth communication (Caves, 2000).

On the other hand, cultural goods are experience goods and the utility remains uncertain before the direct physical experience. In other words, in order to fully appreciate the qualities of a

product, one must experience it (Caves, 2000). The full enjoyment of cultural goods comes through the ¨learning-by-consuming¨ process (Brito & Barros, 2002, p. 1). Also, the aesthetics of cultural goods increases the utility from consumption (Brito & Barros, 2002).

The pre-purchase information is provided by suppliers through promotion and advertising. The intermediaries, independent advisers such as fashion bloggers, or other certifiers for instance fashion weeks channel and disseminate information on the qualities of products (Caves, 2000).

The social context of consumption is vividly exposed in fashion domain where rivalry, social status competition and social differentiation are dominant (Caves, 2000). Along with the impact of fashion bloggers as taste formers or trend-setters, the collective consumption of fashion goods is also affected greatly by ¨celebrities¨ who provide visibility to fashion products (Caves, 2000). Thus, the learning-by-consuming and rational addiction models play significant role in the process of taste formation (Levy-Garboua & Montmarquette, 2011).

Most of the empirical works on measuring the demand for cultural goods show that the most important determinants of demand for cultural and creative goods are price, income, education or knowledge and experience (Levy-Garboua & Montmarquette, 2011). The cultural goods are characterized as luxury goods (Levy-Garboua & Montmarquette, 2011). The cultural, art or creative products embrace also symbolic and aesthetic values which are hard to measure using economic models and methods (Levy-Garboua & Montmarquette, 2011).

Table 1 – Overview of SG appreciation determinants

Determinants of SG Appreciation			
Opportunity Cost	*Time Investment*	*Money Investment*	*Education/Knowledge/Experience/Permanent exposure*

Source: Caves (2000); Levy-Garboua & Montmarquette (2011); author´s elaboration

2.3 Consumer Behavior towards Smart Garment

The contemporary shoppers are striving to satisfy their ¨hunger¨ wandering through apparel stores, surfing websites selecting fashion items that would best suit their taste, specific needs,

preferences, identify with their personality and certainly meet their budget. The shopper usually spends a great amount of time while selecting clothing that satisfies his/her requirements and meets his/her expectations. But why does the consumer choose one product type over another? What impulses impact the stimuli of consumers to make a choice? (Sheth, Newman, & Gross, 1991).

The primary driver triggering the consumer choice is the functional, utilitarian and physical performance of the product. This perfectly fits to the conventional economic model of rational choice with regard to reliability, price and durability (Sheth, et al., 1991; Ferber, 1973). However, the choice of fashionable products is highly stimulated by the latter's social image and are usually selected beyond its functional performance on the basis of its social acceptance (Sheth, et al., 1991). The symbolic value of exclusive, authentic, one-of-a-kind products goes beyond their utilitarian value. Thus the individual choice is highly influenced by the desire to belong to a certain ¨club/tribe/membership¨ (Veblen, 1899).

Fashion is a non-verbal communication where the wearer exchanges information about his/her gender, social status, taste, preference, hobbies, mood, likes and dislikes, etc. (Sheth, et al., 1991).

Godart (2012) pinpoints the social identity of fashion by defining fashion as a tool, as a camouflage for individuals and social groups to express the uniqueness of their personality in order to relate or distinguish from one another. The consumer choice is composed of emotions towards the object that provide pleasurable experiences and product satisfaction (Sheth, et al., 1991). The consumer behavior is also influenced by specific situations such as unexpected events, discounts, etc. (Sheth, et al., 1991).

To sum up, factors that stimulate the buyer's' preference, form attitude or intention to acquire smart clothing over traditional clothing are as follows.

Table 2 – Overview of theories on Consumer Behavior

Wearer Choice Behaviour			
Physical/Functional /the /electronic devices	Sentimental/Em otional /feeling	Social /friends, high-class, young,	Situational /new trends, see clothing on

protect from cold/rain, help to relax etc./	confident, unique and authentic wearing smart garment/	famous people start to wear smart clothing; desire to belong to certain ¨club¨/	celebrity/

Source: Godart, (2012), Sheth, et al. (1991) and author's elaboration

2.4 Product Characteristics

Due to insufficient information about the qualities of a good when the utility is uncertain the consumer has two alternatives to discover it by either searching available information about it, or experiencing it and generating information from one's own personal experience (Nelson, 1970). According to Nelson (2008) search goods are defined by possibility to obtain the fulfilling information on product before the purchase is made and experience goods are defined in case the information search is costly or/and limited thus the information can be obtained only through experiencing the good. Based on the classical economic scheme, the goods are differentiated by search, experience and credence attributes (Klein, 1998).

Accordingly goods are classified into three categories (Hutter, 2011):

- the full information on qualities of those goods is easily accessible prior to purchase for public,
- the information acquisition is costly or difficult to acquire which makes consumers to try in order to explore the qualities and benefits of the product,
- the credence goods imply those products the benefits of which are not fully recognizable even after the consumer has experienced it (Hutter, 2011; Klein, 1998).

Andersson and Andersson reveal four characteristics of experience goods which are intangibility, inseparability, heterogeneity and perishability (2006, as cited in Hutter, 2011, p. 211). During the information searching process when the expectation with regard to search benefits overlaps the perceived costs of search the consumer behavior changes respectively (Klein, 1998). Beatty and Smith (1987, p. 86) outline determinants impacting the information search process: ¨market environment, situational variables such as time/social/financial pressure, organization

pressure, physical and mental conditions, product importance which concerns the price and social visibility, product class importance, etc., knowledge and experience and individual differences, which includes education, age, income, personality, etc.¨

With digitization, the impact of interactive media on consumer purchase behavior grows (Klein, 1998). Nowadays, for the goods dominated by the search attributes, the advanced technologies make it possible to access information with ease, with reduced cost, time and distance (Klein, 1998). The experience and credence goods which require being experienced now can be experienced virtually. That is already transforming them into search goods (Klein, 1998) .

The Swing Skirt can be used for stress reduction since it is known that swinging provides the feeling of confidence and stability. The skirt can be used anywhere it can be hung.

Source: Swing Skirt (n.d.). Retrieved on May 15, 2015 from http://soomipark.com/main/?portfolio=swing-skirt

Figure 4 –Swing

For instance the information search for latest fashion trends is much easier and cheaper since there virtual platforms allow users to post, share and discuss the fashion items in detail (Klein, 1998). The presentation of the qualities of fashion products has been improved, which impacts significantly on consumer decision making (Klein, 1998). Nowadays consumers are able to get indirect usage experience by watching or reading about other's experiences and feedbacks in fashion blogs and forums (Klein, 1998). Also, uniqueness of content and generally the presentation of information to audience affects people's intention whether or not to buy a particular product (Klein, 1998).

The experience products are generally, subjected to continuous transformations, be it novelizing the content or updating design in order to attract and keep the attention of the consumer (Hutter, 2011).

Even though, extensively covered by online and offline media, the smart garment has not yet been mass produced. It attributes experience good characteristics. As a radically new product, it is hard to develop viewpoint without touching, experiencing and understanding the way it works and the way it fits. Due to the Nelson's (2008) theory, the information search for experience good

can be also outlined by marketing and advertising campaigns however, the consumers are likely to trust more their own or others' experiences rather than commercials.

2.5 Smart Clothing and Fashion: At the Intersection

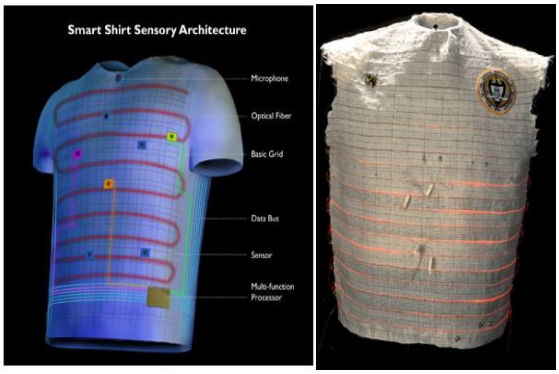
This chapter illuminates at what point of acceptance the modern society is now with regard to technology-based clothing. The modern society is driven by the overwhelming presence of advanced technological devices. Those smart machines and software that are capable of learning, understanding, reasoning, problem-solving, responding to signals received from environment (Bailey, n.d.). Our life is fuelled with smart phones, IPods, Ipads and other smart devices that have become an integral component of daily life. The world encountered the stage where innovations have been pushing artificial intelligence to intrude into broader life of human being. With the fast rhythm of seasonal changes in fashion the radical new futuristic styles emerge which move fashion forward to extremes (Inspiring Matter Conference [IMC], 2012).

During the past decades the information technology and innovative materials have gradually intertwined with fashion shifting it to a new paradigm. The specialists came out from different disciplines to evolve apparel industry through integrating smart electronic devices into textile (Bailey, n.d.). Hereby, when fashion converges with technology it brings new qualities, new aesthetics and new techniques for working with textile and fibers. Bailey (n.d.) states that smart clothing can be characterized due to its ability to feel, respond and adapt to environment.

The idea of improving clothing and constructing intelligent garment that is capable of interaction, communication, high-level protection does not belong to 21st century. The medicine and sports industries are actively experimenting with technology, integrating sensors into textile to collect information on body signals (Small & Roseway, n.d.).

The spacesuits, military clothing or medical smart garments have been developed in research centers of for instance NASA and/or other companies such as Philips, Nike targeting to improve physical condition of people and protect them in high-stress occupations (Bailey, n.d.; IMC, 2012). These are perfect examples on how smart garment has become widely applicable for professional use.

Figure 5 -¨Smart Shirt¨ by Sundaresan Jayaraman and the Georgia Tech University



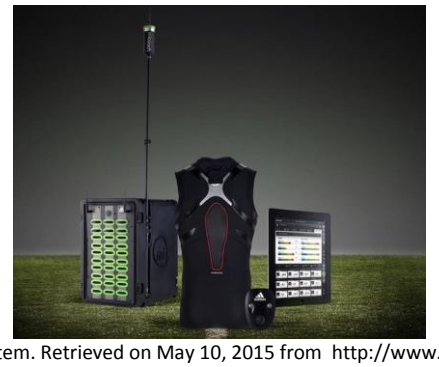
Source: Sensatex. (n.d.). 'Smart Shirt'. Retrieved on May 10, 2015 from http://azhar-paperpresentation.blogspot.nl/2010/04/nanotechnology.html

This ¨Smart shirt¨ prototype in *Figure 5* represents textile with embedded electronic devices. It is an outcome of collaboration between the scientist Sundaresan Jayaraman and the Georgia Tech University (Azhar, 2010; Bailey, n.d.). The electrical smart shirt was developed to monitor user's heart rate, body temperature, etc. through special interconnected sensors (Azhar, 2010). It was primary designed for the military usage missioned to detecting injuries on soldier's torso and informing the doctor (Azhar, 2010). Though, the ¨Smart Shirt¨ has also a great potential to be used in hospitals for monitoring the patient's health (Azhar, 2010; Bailey, n.d.). The ¨Smart shirt¨ piece is a good representation of clothing that is useful and valuable for its pure functional utility.

However, the investigation made by Bailey (n.d.) reveals that the role of fashion designers in smart garment creation and production is of key importance since their professional contribution allows intelligent clothing created for specific need to transmit to more comfortable clothing, accessible for wider audiences. The smart technologies open the door for designers and other professionals to develop new ways of interactions with people.

There are currently a lot of leading fashion designers, especially from performance brands and sportswear brands that are starting to work with informational technologies. For instance Adidas revolutionized the training process of sport teams by bringing forward the miCoach Elite System (Vazquez, 2013). This innovative product (*see Fig. 6*) is designed as a sport jersey which constantly collects data on player's performance through integrated special sensors and GPS trackers (Vazquez, 2013). The data such as heart rate, speed of the player are sent wirelessly to IPad that allow the coach to monitor and analyze the performance of the player (Vazquez, 2013).

Figure 6- MiCoach Elite System by Adidas



Source: Designboom (2012). MiCoach Elite System. Retrieved on May 10, 2015 from http://www.designboom.com/technology/adidas-micoach-elite-mls-create-the-worlds-first-smart-soccer-league/

The miCoach Elite System has been adopted by Chelsea FC after 2013 when every team of Major League Soccer used this smart system during games (Vazquez, 2013).

The fashion industry articulates artistic, cultural and creative qualities; thus it is an important driver of social mechanisms within sociocultural framework (Godart, 2012). Fashion reflects various strata of society engaging individuals and communities at large. Fashion deeply incorporates with artistic, economic, political, sociological, psychological and other realms simultaneously while generating symbolic and aesthetic meanings (Godart, 2012).

The fusion of fashion symbolism and high technology is portrayed in ¨The Printing Dress¨ (*see Fig. 7*) (Small & Roseway, n.d.). ¨The Printing Dress¨ portrays the ¨retrospective¨ of human interaction and accentuates the recent radical changes in communication channels i.e. the social networks, or other digital platforms that allow virtually finding, sharing, communicating and monitoring one another (Small & Roseway, n.d.).

Figure 7 - ¨The Printing Dress¨ by Microsoft Corporation, Microsoft Research.

Source: Small and Roseway (n.d.). The Printing Dress. Retrieved on May 10, 2015 from http://research.microsoft.com/pubs/149519/The_Printing_Dress.pdf

This piece from Microsoft intends to explore social experience by allowing the wearer to send tweets that appear on the surface of the dress (Small & Roseway, n.d.). There is an integrated custom keyboard and by pressing a key, the message is displayed immediately on the skirt for the public eye (Small & Roseway, n.d.).

The futuristic and innovative design of fashion designer Hussein Chalayan has been dazes and confuses today's fashion world (Huntington, 2006). Here is why: his collections are absorbed with substantial use of advanced technology, conceptual representation of sophisticated minimalism. The most experimental fashion pieces developed by Chalayan were showcased in 2006 on Paris Fashion Week featured 5 fabulous mechanical dresses with embedded microchips and animatronics that transform the textile on the body of models taking different shapes, colors and structures (*See Fig. 8*) (Huntington, 2006).

Figure 8 -Hussein Chalayan: One Hundred and Eleven collection.

Source: *AFP* (n.d.). Hussein Chalayan. One Hundred and Eleven collection. Retrieved on May 10, 2015 from http://www.smh.com.au/news/fashion/microchip-on-the-old-frock-has-transforming-effect/2006/10/05/1159641459022.html

"I've always been interested in the future, but the challenge was to do something less predictable than Robocop that could be realized in fashion." commented Mr. Chalayan during one of the interviews after the show (Horyn, 2006, para. 8). Currently, those incredible pieces are at the permanent display in various museums of the world (Symposium of Fashion Technology - SOFT, 2014).

On the one hand the high-end fashion designers lay out the path to smart clothing phenomenon and on the other hand there is a tendency of active engagement of high-tech corporations and technology companies. Interestingly, the Silicon Valley, the world tech capital

was celebrating a unique fashion-meets-technology runway show ¨Silicon Valley Fashion Week?¨on May 2015 in San Francisco (Rosenfeld, 2015). The ¨Silicon Valley Fashion Week?¨ show was unique of its kind compared to London or Paris Fashion Week extravaganza as the podium was provided to clothing with integrated gadgets, electronic devices, LED and other smart devices (Rosenfeld, 2015). All those prototypes which brought together people from different industries are in the chain of numerous attempts to revolutionize apparel and take it into the new level of more functional, resistant, supportive and sustainable clothing.

However, there are challenges that smart clothing faces on the way to public appreciation and acceptance (Smelik, 2014). By adding additional functionality to clothing the experts encounter the issues with limited battery power, washability of material or simply struggle with making textile with embedded electronics comfortable enough to wear on the body (Smelik, 2014).

Throughout the history of mankind clothing has been missioned to correct, support, shape and transform human body affecting one's personal identity and the manner bodies perceived by society (Galbraith, 2003). For instance the corsets have evolved into modern bra to better mold the body by using special technology as well (Galbraith, 2003). Thus, technology is a means for self-expression in a manner of encouraging fashion design to generate new styles and connect to the identity of individual (Galbraith, 2003). With the emergence of smart technologies, e-materials, fabrication processes, the clothing alters both the way we perceive our bodies or the garment aesthetics in general. The smart clothing is turning into personal outfit, which responds, adapts to one's personal taste, needs and preferences as well as monitors it and communicates with the public or surrounding environment (Galbraith, 2003). The SG seems to be another step in the process of clothing evolution.

Why would somebody wear smart clothing? The traditional fashion mechanism impacts greatly on consumer behavior since its features are identified by what Veblen coins as ¨conspicuous consumption¨ (Veblen, 1899; Pownall 2013, p 2). The ¨conspicuous consumption¨ implies to signaling certain ¨social signs¨ through fashion product consumption. Martins, Yusuf and Swanson (2012, p. 28) consider fashion as a ¨object¨ which embraces functional utility that is aiming to protect, shape and support the body. Notwithstanding, the power of fashion is featured within the ¨behavioral processes¨ driven by aesthetic and symbolic attributes as well as qualities such as ¨ego-gratification and ¨status-symbolism¨ (Martins, et al., 2012, p. 28). The fast-changing

fashion collections are produced in small quantities in order to retain exclusivity, symbolism forming collective taste. The trendy clothes reduce significantly the functional utility of clothing in other words apparel is not perceived as a ¨object¨ but more as a "meaning" (Martins et al., 2012, p. 28). According to Martins et al (2012, p. 28) the new fashion product is socially accepted and adopted only by passing through five phases: first and foremost the style of fashion product is adopted by "taste or change agents¨, namely impactful players in fashion, such as fashion magazines, fashion bloggers, etc. Their job is to provide the fashion product's visibility and display through blog posts, articles, discussions (King & Ring, 1980). In the next phase, the product occurs in the ¨use cycle¨ and reaches its specific ultimate target audience. Afterwards, it trickles down to various social layers and leads to ¨the social contagion and conformity¨ i.e. social acceptance (Martins et al., 2012, p. 28). On account of ¨market and social saturation¨ the product becomes accepted by wide audiences which actually lower product's exclusivity and authenticity (Martins et al., 2012, p. 28). In the course of the last phase the product ¨declines¨ due to emergence of new fresh fashion collections which target to replace the previous one (Martins et al., 2012, p. 28). And the circle starts again.

The See-thru-me top is an interactive piece, which creates an illusion of light shining through the body. It has incorporated LEDs in the front, so that if the light shines in the back, the front lights up.

Source: See-thru-me (2009). Retrieved on May 15, 2015 from http://meggrant.com/see-thru-me.html

2.6 Conclusions of Theoretical Framework

The theoretical framework starts with the studies on innovation and places this research in economic perspective. It introduces the determinants, the degree and categorization of innovation thereafter, projecting those characteristics of smart clothing. The conventional economics places innovation in the area of novel products and novel production methods.

The innovation has recently stepped out of the shadow and has acquired extra features. One of those features is demand uncertainty that is inherently attached to the innovation process. The uncertainty greatly affects consumer behavior, product development, production system and

market formation respectively. Importantly, the radical innovative products imply higher level of uncertainty than incremental products. Uncertainty has difference faces and mainly manifests itself in relation to consumer need, technological and competitive environments as well as resource allocation.

The innovation is a powerful creative destructor (Schumpeter, 1976) leading to economic and social change. It catalyzes the emergence of new markets and new marketing channels. The process of innovation is an outcome of a series of continuous transformations related not only to the technical performance and design of a product, but also changes in the market and social environments. In order to make the innovation commercially viable, the development of certain skills and capabilities is required.

The smart clothing is a radical innovation therefore suffers demand and market uncertainties. The theories and concepts touched upon the importance of interaction and collaboration between varieties of partners such as creators, government, companies, institution. At this point of SG development, the exchange, experience, pool ideas and resources is crucial for design practices. The social acceptance is the key to uncertainty reduction which can be reached by information and knowledge dissemination and permanent exposure.

Thus, the research aims to provide an answer to the question: why isn´t there a market for smart clothing? In the subsequent chapter the challenges faced by creators to commercialize the SG prototypes and the level of social acceptance are explored.

3. Empirical Setting

The empirical part erects cornerstones and adds flash to theoretical bones. In this chapter the research methodology and design are clarified. The first section includes the rationale for the choice of research methodology and strategy selected to investigate the topic. Next, the methods used for proper data collection are presented and the sample selection is specified. The third section describes the methods selected for data analysis. This chapter ends with discussion about limitations of research design with regard to validity and reliability that are related to selected research methods.

There are three Lace Sensor Dresses and each of them has embroidered a poem with different emotion and also embedded speakers. When the wearer presses the embedded sensors, the dress starts to play the poem loud.

Source: The Lace Sensor Dresses (2013). Retrieved on May 15, 2015 from http://meggrant.com/lacesensordresses.php

3.1 Method

This research aims at revealing the commercial potential of SG and factors that impact on consumer behavior with regard to radical innovative products. In order to explore the level of consumer appreciation at this early stage of market formation and achieve understanding on incentives of creators and expatiations of mass users, the qualitative research is chosen as the most appropriate method for this exploratory study. Qualitative research maintains an inductive approach, the purpose of which is to gain a deeper understanding of an individual or group experience (Bryman, 2012; Babbie, 2011). The exploratory study develops new theories and replaces the existing ones (Bryman, 2012).

Additionally, the qualitative method is applied, since it copes with symbolic elements of social world, such as the behavior and the attitude of consumers digging deep into their personal experience, viewpoints and observations (Bryman, 2008) whereas the quantitative method deals with the analysis of numerical data and is less flexible in design (Bryman, 2008). Since this is a new topic, there is a lack of literature and discussion around it. Therefore, it is important to approach it in a flexible way in order to cover all nuances and ¨uncharted¨ corners. Moreover, the in-depth face-to-

face interviews with experts and creators allow to identify challenges in the design practice and point out obstacles leading to social acceptance.

Therefore, this descriptive and exploratory study is constructed using the qualitative method since it allows zooming in particular details, pinpointing nuances that ultimately lead to comprehensive and in-depth understanding of the origins and reasons of particular phenomenon (Bryman, 2008).

Keeping in mind that SG is an experience good and best can be characterized through personal observation and experienced (Klein, 1998, Lim et al, 2008), the visual prototypes testing is applied in this research (Buchenau & Suri, 2000). Unfortunately, the physical testing of SG prototype was not feasible to achieve. The visual prototype testing is a tool to measure the level of social acceptance.

3.2 Unit of Analysis

The first step for proper research execution is to define the population. In order to accomplish the research objectives, the extensive information is offered on SG design process, SG characteristics and challenges involved in commercializing it. Furthermore, the incentives of creators as well as the reaction and feedback of knowledgeable target audience, i.e. experts are gathered to measure the level of social acceptance. The creators can gain valuable insight from that feedback which will possibly lead to uncertainty reduction. The purpose is to correlate creator's viewpoints with the observations of key figures regarded as representatives of demand. Hereby, two samples are selected from different populations and respectively research is conducted in two phases.

3.2.1 Participants: Creators

Phase I

In order to meet the afore-mentioned research objectives, the sample of seven participants was attentively selected (N=7). The main focus of selecting this sample is to identify individuals who have designed at least one piece of smart clothing in the Netherlands (referring to high technology integrated into textile). The sample is derived according to the search for projects on SG that happened to be realized in the Netherlands. Afterwards, the makers involved in designing process were detected and selected.

The population of creators that have built SG prototypes in the Netherlands is rather small. However, the following criteria for selecting a sample are applied. Firstly, the participants are the main ¨authors¨ of SC, i.e. the concept generators, as SC is generally an outcome of collaborative work. For instance the ¨Wearable Solar Dress" made by the Dutch fashion designer Pauline van Dongen which is a fashionable dress with integrated solar cells allowing to charge any electronic device (Dezeen, 2013). To turn the idea into reality Pauline actively collaborated with Christiaan Holland from the HAN University of Applied Sciences and solar energy expert Gert Jan Jongerden (Dezeen, 2013). However, the collaborative work is not always the case, the extent of involvement and participation in concept development and design practice differs and is based on project specificity. It varies form one project to another. For example, industrial designer Eef Lubbers developed her interactive SG piece, the "Unlace" without any collaboration. Secondly, each creator has at least once in his/her professional career completed SG project in the Netherlands. Thirdly, all participants pursue the goal to step in the commercialization process ultimately and turn SC prototypes into commercial products. Thus, the individuals, who previously and/or still develop smart garment prototypes in the Netherlands with the intention to market them one day, are selected for this study.

The sample was also selected using the snowball sampling method which is the non-probability sampling technique. The snowball technique helps to identify and gradually reach designers in the Netherlands by using the initial contacts and relationships to establish ties with other relevant designers (Bryman, 2008). Since the number of designers involved in smart garment-related projects is limited to a very small group of population, the snowball sampling strategy allows reaching the small community of makers by asking a designer to nominate others who may fit to this research.

Furthermore, this research does not disregard those creators who design traditional or ordinary clothing along with smart clothing. The main emphasis is on design practice. Therefore neither the age nor the level of professionalism is considered. Both, young and experienced makers are included. Also, the current place of residence and the nationality of creators are not criteria for the sample selection. The important condition is that these creators have made at least one piece of SC in the Netherlands.

The selection procedure started with Internet search for suitable participants. The preliminary interviewees were selected due to above-mentioned criteria. The sample included

Marga Weimans, Pauline van Dongen, Iris van Herpen, Soomi Park, Anouk Wipprecht, Ricardo O'Nascimento, Ebru Kurbak, Meg Grant, Marina Toeters and Eef Lubbers. The second step was contacting the potential participants via email requesting an informational interview and introducing the research aim. More information about creator´s qualification, background and occupation can be found in the Appendix A and the draft email for interviewee can be found in the Appendix B. Five participants responded positively to my email and the appointments with them were arranged. Namely: Pauline van Dongen and her design team, Soomi Park, Ricardo O'Nascimento, Meg Grant, Marina Toeters and Eef Lubbers. However, four interviewees form preliminary list were unable to contribute due to busy schedule. While interviewing Eef Lubbers, snowball sampling method was applied and Leonie Tenthof van Noorden was contacted based on her recommendations.

3.2.2 Participants: Key Figures

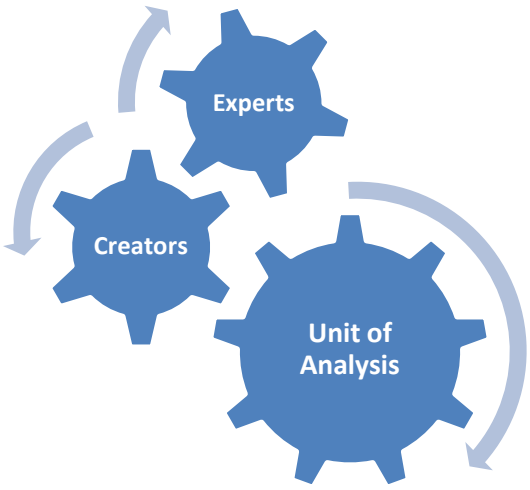
Phase II

The second phase of sample selection incorporates experienced experts in the fields of fashion and innovation. SG is a radical innovative product representing the fusion of high technology and fashion and it has not appeared in the market yet (Smelik, 2014). Therefore, in this research the social acceptance measurement and SG commercial potential evaluation are based on previously received reactions from the audience as well as the feedback collected from experts demonstrating high professional expertise in the fields of fashion and innovation. It should be noted that key figures can be regarded as knowledgeable representatives of the potential demand. Therefore, this approach allows detecting similarities and differences in the responses of supply and contrast with the perception and appreciation of demand.

In an analogical manner, as the selection procedure was conducted to identify suitable creators, first, the preliminary list of potential participants was created through Internet search. The list included Liesbeth de Strooper, Margreeth Olsthoorn, Anneliese van Buren, Victor Portes and Aynouk Tan. The emails were sent to each of them kindly asking for the possibility to interview and providing the research description. Victor Portes and Aynouk Tan reacted fast and confirmed their participation. The rest did not respond to the emails. The information about the professional background and current occupation of key figures can be found in Appendix A. Thus, the sample selection procedure was composed of two phases. According to two-phased strategy,

the sample of creators who design smart clothing in the Netherlands and experts active in fields of fashion and innovation were selected (See Fig. 11).

Figure 11 - Sample selection



3.3. Data Collection

The interview questions are built upon the theoretical framework. The semi-structured formal of interviews is used for this cross-sectional research (Babbie, 2011). In comparison with fixed and structured surveys or questionnaires which are quantitative methods to collect data, qualitative interviewing is an interactive, open, unpredictable method that concentrates particularly on interviewee's perspective (Bryman, 2008). This flexible method encourages the respondent to freely share his/her ideas, experience, point of view, personal observations and expand the topic by discussing it in details (Bryman, 2008).

Since the smart garment is a relatively new topic, there is a lack of researches and discussion around it. The semi-structured interviewing provides deeper analysis, allowing to cover hidden details that would have probably been unnoticeable and ignored using other forms of interviewing. The qualitative semi-structured interview is defined as an open conversation between researcher and responder. However, the specific questions for the interview should be prepared in advance and in a particular order (Babbie, 2011). This method implies a spontaneous interview construction based on the list of questions prepared beforehand the order of which may

vary due to responses of interviewees during the interview (Bryman, 2008). The prepared list of questions directs the flow of the whole interview, however it is not limiting the respondents to comments and reflect on the subject in an open and freely manner (Babbie, 2011).

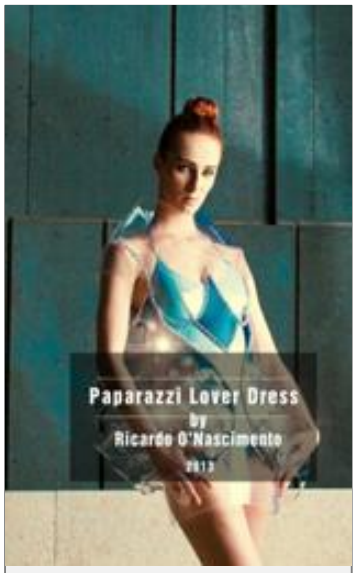
For this study four separate face-to face interviews were conducted in Amsterdam, Eindhoven and Rotterdam. Another four interviews were conducted via Skype due to geographical distance and time constraints. It was unfeasible to meet Pauline van Dongen and her design team in person and therefore the data was collected via email correspondence. All interviews were held in English.

It should be noted that two different lists of questions were composed to collect information from respondents. The first list of questions is addressed to creators whereas the second list is addressed to key figures. The interview protocols for creators and for experts can be found in Appendix C. The questions discussed with the creators are grouped in the following way: firstly, introduction to the educational, professional background and experience. Secondly, description of SG design practice referring to the potential of smart clothing, his/her incentives to develop a prototype and reflection on SG characteristics. Thirdly, the creator was asked to describe one or two smart garments in detail, since the study aims at introducing and testing one or two SG pieces with experts. The provided descriptions and details together with photos and videos were used subsequently to introduce those garments to the experts. The creator either confirms the piece selected by researcher or offers an alternative piece/s which he/she considered more convenient to test. The choice of SG was commonly made based on its functional, practical and aesthetic performance. The list of mutually selected smart pieces with provided descriptions can be found in Appendix D. Lastly, the preconditions of SC market formation and the challenges creators encounter so far are discussed.

The second list addressed to key figures has several questions in common with the first list. Those questions are particularly related to the professional, educational background and the future vision. Afterwards, the photos and videos of selected SG pieces were presented. The key figures were thoroughly instructed and explained about the technological capabilities of each of those pieces i.e. how they function. During the visual prototype testing the questions with regard to functional, wearable and aesthetic appreciation were asked and the feedbacks were collected. All the interviews were taped with a digital voice recorder and carefully transcribed afterwards. The transcripts can be found in Appendix E.

3.4 Data Analysis

The oTranscribe (http://otrascribe.com) web app was used for efficient transcription since it puts an audio player and text editor in the same window thus make it easier to transcribe.



This interactive dress incorporates 62 LED lights and lights up whenever somebody takes a photo of it. The Paparazzi Lover dress is sort of an "attention seeker" dress.

Source: Paparazzi Lover (n.d.). Retrieved on May 15, 2015 from http://www.onascimento.com/paparazzi-lover/

Except the interview with Pauline van Dongen and her design team (it was held through email correspondence, therefore there was no need of transcription), all interviews were transcribed using online oTranscribe app. The analysis was conducted through NVivo 7 software for Windows, where the categories and codes were set up to analyze the data. The transcribed interviews were uploaded to the NVivo 7 software for Windows (http://www.qsrinternational.com/products_previous-products_nvivo7.aspx) to ensure accurate and profound qualitative analysis. The interview questions were taken as a basis for identifying the general categories and during the coding process the general categories narrowed down until more specific categories appeared. First, the passages of interview texts were copied and pasted in the NVivo program. Then, the key words and phrases were detected and categorized in the section of ¨free nodes¨. Secondly, the similar categories within the ¨free notes¨ were grouped in the newly created ¨tree notes¨. This software supports to structure the analysis of findings and provide better understanding of the whole picture. In the end, all eight interviews were coded, categorized which means that similar categories and nodes were revealed and linked together generating meaningful patterns for discussion.

3.5 Limitations

The qualitative research has its distinctive advantages and limitations. This research intends to study "subtle nuances in attitudes and behaviors" and examine "social processes" (Babbie, 2011, p. 348). The strength of the qualitative method is that it supports researcher to have a better understanding on human behavior, desires, preferences, needs, taste, and emotions

through in-depth studies. Respectively, in order to explore consumer behavior, social acceptance and other relevant concepts, the qualitative method is the most suitable for this research. Flexibility is another advantage of this method (Babbie, 2011). The researcher can easily modify the research design whenever considers necessary.

However, the method has weaknesses in terms of validity and reliability. The knowledge produced by qualitative method might not be possible to generalize since it is more focused on a small population or particular case (Bryman, 2012). Also, the reliability is hard to achieve in qualitative research, because the results might be biased by the subjective insights of the individual researcher (Babbie, 2011). In addition, the reliability is also weak because the results of the measurement might differ if repeated (Babbie, 2011).

4. Results

The results are structured in three sections in order to answer the research question: Why isn´t there a market for smart clothing?

The sections are as follows:

- *SG design practice,* which opens the door into the studios of creators and discusses SG creation process, challenges makers struggle with, identifies SG specific characteristics as well as the platform and context of exposure.
- *Incentives* of creators reveal the personal motivation of makers and the potential of SG.
- *Market formation* discusses the level of social acceptance outlining the characteristics of potential target customer. It also touches upon the preconditions of market formation through covering the current concerns and resources necessary for further development.

The analysis of the findings is based on the interrelation of two perspectives: the creators and the experts. This approach allows giving a closer look to this topic, underlying the differences in attitudes and perceptions and detecting the challenges involved in market formation. Because of this two-track method, the data analysis is deeper.

Table 3 – Overview of categories and nodes

№	General Category ¨Tree Node¨	¨Free Node¨ level 1	¨Free Node¨ level 2
1.	SG design practice	Creation process	*collaboration, challenges*
		Characteristics of prototypes	*exclusivity & intimacy functionality vs. aesthetics,*
		Context of display	*exhibitions, design events, workshops*
2.	Incentives	Personal Motivation	*knowledge creation, commercial intent, fascination, art*
		Potential	*communication, supportive & caring fashion, sustainability, empathic fashion,*
		Social acceptance	*SG appreciation, SG relevance*
3.	Market formation	Target audience	*profile of ideal customer*
		Concerns	*health risk, comfort, aesthetics, privacy*
		Resources	*collaboration, communication, time & money investment, access to new technologies, business skills, intermediaries*

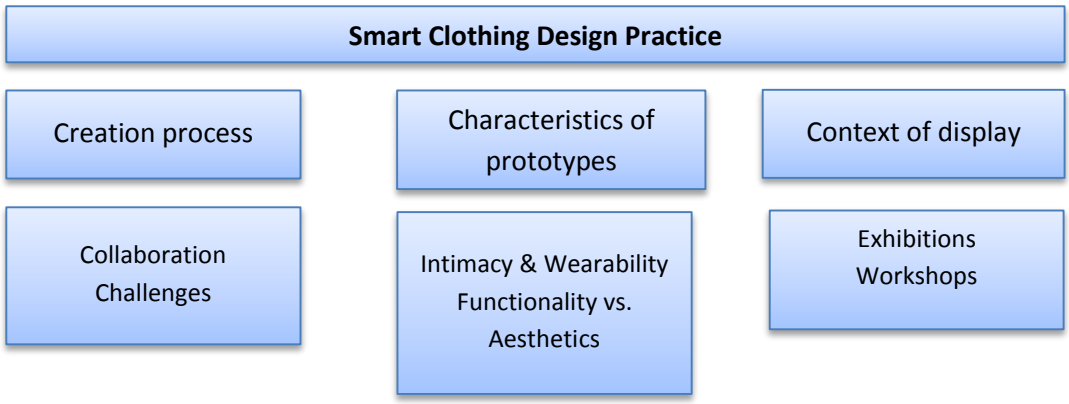
4.1 Smart Garment Design Practice

The category *smart garment design practice* provides information about SG characteristics and creation process. The creators described their own practice in the field of smart garment. This section is constructed around the questions: How is smart clothing created? What are the specific aspects that differentiate smart clothing creation process from ordinary clothing creation process? Where SG is commonly exposed nowadays?

During the coding process three nodes discovered: *creation process*, *characteristics of prototypes* and *context of display*. While *creation process* was described by interviewees, the certain SG specificities emerged which differentiate smart garment creation process from

conventional fashion clothing creation process. The creation process includes active collaboration with various specialists such as mathematicians, engineers, fashion designers, etc. Smart clothing creators encounter very specific challenges during the working process which are analyzed further in this chapter. The prototypes as an outcome of creative process have four essential features: *intimacy, exclusivity, functionality and aesthetics*. The smart garment prototypes are mainly communicated with the audience through *exhibitions, design events and workshops*.

Figure 13 – Overview of category: smart clothing design practice.



4.1.1 Creation Process

The smart garment *creation process* is unique for each creator. Each designer first comes up with the general idea, concept and starts experimenting with different materials, exploring new, devices, patterns and applying various techniques. The combination of high technology with textile enables creators to make complex smart designs. This process of creative visionalization for each designer is exceptional involving the application of mechanical engineering, numerous software, nanotechnology, 3D printing, etc. The smart garment design process consists of a series of phases that creators follow and pass to give a solution to a concept-problem. The innovation implies a chain of continuous problem solving actions. Therefore it is quite challenging especially for fashion designers to acquire extensive knowledge of high technology and electronic devices and apply during prototype development. Meg Grant is currently working on a problem of connecting textile and electronics to traditional electronics, i.e. “bridge between hard and soft platforms”. Grant considers if that problem is solved, the access to market will be possible.

Among the interviewees who are SG project leads were industrial designers, the artist, software developer and fashion designers. For instance Leonie Tenthof van Noorden does not use

smart devices as LEDs in her work, but experiments with combining and relating software from different disciplines (for instance software used in architecture), mathematical capabilities and algorithms to the fabric and textile. In other words, Leonie implements innovative digital fabrication to find new application in fashion. Thus, Leonie is developing “smart methods” to create smart clothing. The working process is intense and time consuming and in most of the cases requires collaboration with specialists from different backgrounds. Several designers refer to the aspect of time and draw parallels between the traditional fashion production process and smart clothing production process pointing out the discrepancy in time.

> Ricardo O'Nascimento: “The fashion works in seasons that has to be done like in 6 months and this is way too little time to research something and do something relevant with technology. […] Because they need things too fast. So, I don't know, this is my, what I think. I might be wrong. And, so it does not really follow the same speed.”

Collaboration

The working process involves *collaborative* aspects in different stages of prototype development. All interviews with creators contain certain components of this node. However, it should be noted that the extent of *collaboration* and participation in project depends on particular smart garment. In some cases the contribution from other parties is due to certain practical reasons, such as the lack of knowledge or expertise. In other cases makers work alone by themselves or together with their team. For instance, the industrial designer Leonie Tenthof van Noorden is currently developing a project together with the fashion designer Pauline van Dongen. Marina Toeters initiated “by-wire.net” platform with the purpose to foster collaboration between the engineers, technicians form the tech world and fashion designers.

> Marina Toeters: “I never work alone. I really promise to myself that I never had to do anything alone anymore.”

The collaboration and knowledge exchange is a common practice among makers who frequently work jointly to accomplish a goal. The collaborations take place with specialists from diverse backgrounds and experiences, such as fashion designers mathematician, architects, engineer, sound designer, software programmers, electrical engineers, textile experts, chemical experts, pattern makers, marketing specialists and many others.

Notably, creators who do not have fashion design training background eventually start to consult and cooperate with fashion designers on “certain materials, which one will look nicer and why” (Soomi Park). The cooperation with fashion designer is necessary in order to introduce the smart garment within the framework of the fashion logic. In some cases fashion designers are fully involved in the whole design process.

In addition the creators possess entrepreneurial behavior. The problem solving and collaborative skills render smart garment creators to become self-employed entrepreneurs that set up a team and coordinate project.

> Ricardo O'Nascimento: “Now I am acting as sort of as a project manager instead of really enjoying things myself. Because I started like programming and making the engineering and then developing everything but then it turns out that it is not sustainable economically because I have spent too much time doing this and at the end yeah, there is not enough money. So, I decided to change a little bit my approach on how to make business this year. So, I am working extremely a lot with collaborators.”

Leonie Tenthof van Noorden is running her own company in Amsterdam and planning to launch her first fashion collection this year. Marina Toeters founded “by-wire.net” platform around 5 years ago and has realized hundreds of projects on smart clothing prototype development. The entrepreneurial qualities of creators allow characterizing them as innovators (Fagerberg, 2003).

Challenges

All participants acknowledged that the secrecy in the tech world and the neglect from the fashion industry create barriers for development of this innovative product. The respondents mainly accentuate on the issues related to the interaction with the fashion industry. It seems that fashion industry has created thick walls against the innovations in the field of smart textile or smart clothing in general. The cooperation with the fashion companies is very weak and challenging for smart clothing makers. The 90% of projects on smart clothing realized by Marina Toeters through “by-wire.net” platform were possible with the investment and support received from technical companies and very few of them with the assistance of fashion companies.

Marina Toeters: "So in my practice I work so much more with the technical side, with technical companies, then I do with fashion industry. And I think that's really a shame also because I finished fashion design but wish working in that direction and right from the start I already got a lot of assignments from technical companies and actually still I am."

But, the fashion world seems rather unwelcoming and closed as Aynouk Tan describes it.

Aynouk Tan: "they built this secrecy around their brands and it is very hard to enter that".

One of the biggest challenges involved in convert SG prototype into the final commercial product and enter the global apparel market is to introduce SG within the fashion logic. Nevertheless the passive behavior and miscommunication with the fashion companies slowing down the process. All creators that have been interviewed for this thesis brought forward the concern related to the ignorance and neglect demonstrated by the leading fashion brands. Certainly, there is cooperation with fashion companies to a certain level, but they mainly remain in the phase of experimentation and prototype creation, and never evolve until the production of final product.

From the perspectives of professionals Aynouk Tan and Victor Portes, there are several reasons why the fashion industry is stubborn with accepting innovation. First of all, SG as a radical innovation implies high degree of uncertainty regarding the market and demand responses (Fagerberg, 2003; Kline & Rosenberg, n.d.; Jalonen, 2012, p. 2). Thus, for successful fashion companies the risk to invest and cooperate is high. Secondly, this innovation offers completely new aesthetics, questioning the established symbolic and aesthetic meanings that fashion generates (Godart, 2012). According to Aynouk Tan the embedded electronic devices undermine the symbolic and aesthetic value of garment. Moreover, Aynouk Tan emphasizes that generally the creator of smart clothing and the traditional fashion designer have completely different perception of fashion and therefore reside in different habitats. However, this research shows that there are numerous cases of collaborations with fashion designers.

Even though, there are collaborations with independent fashion designers, the big fashion companies are still reluctant. The only way to achieve the successful result seems to be a

productive communication with them (Aynouk Tan). Similarly, the creators mention that the key challenge for them is to establish a bridge with the world of fashion.

According to Aynouk Tan the most apparent problem "why those worlds do not connect is that they have very different mentality". The creators and fashion designers apply different approaches for reaching the final result. Consecutively, during the cooperation the technician speaks the language of practicality and functionality whereas the fashion designer prioritizes aesthetic experience and intends to create well-made, well-fitted clothing that embodies beautiful design, craftsmanship and artistry (Aynouk Tan).

> Aynouk Tan: "I also think people working in those fields do not understand each other at all. I think they are so miscommunicating, because they think in a different way. [...] How can you explain to technician that maybe it is nice to have a skirt like this, so it is very other way of thinking."

Aynouk Tan also indicates that the makers who have background or some knowledge of basic fashion design have higher possibilities of success in apparel market than others because they mediate "between two worlds." On the other hand, Marina Toeters is acting as an intermediary and bringing together technicians, engineers with fashion designers to work on smart clothing prototypes. Her experience also shows that only the SGs that relate to health care enter the market, which means the products are mainly appreciated for functionality but not for "fashionability" or aesthetics. According to Portes this radical innovation is still too much experimental for commercially successful brands such as Zara or H&M to get involved and start mass production. It needs to be adopted by people first. The absence of infrastructure, uncertainty of demand and other obstacles concerning market response, competition, etc. represent smart clothing as commercially unviable product. Portes encourages small companies and individuals to continue innovating and pushing smart tech clothing forward until "people will start to appreciate and accept it". Afterwards, the big fashion companies will be "convinced" (Aynouk Tan) and start to support the production.

The financial support, time commitment, cooperation and communication with the fashion and technical companies are crucial to develop the product and push it to the market. These are the main challenging aspects creators encounter with regard to placing the items in the market.

Ricardo O'Nascimento: “First, is to overcome the prototype phase because I always talking about that develop a prototype then it stay a prototype forever. […] We make the first prototype, we make the test and then we identify the weakness, what points that has to be improved but there is never a budget to actually improve those points.”

In addition to that, practical issues emerge during the prototypes building process. The obstacles include fashion design limitations with regard to “wearability”, functionality and aesthetic performance as well as certain ethical issues. Other practical issues are associated with selecting right materials which appears to be time consuming and complex process. The integration of hard conductor technology and computer components into textile in a way not to confront the body but be soft, flexible and comfortable is challenging as well. Also, the access to products of high technology is hard, since high tech devices are either expensive or produced in small quantities. On top of that, the most deep-rooted issues still remain how to extend the battery life as well as achieve flexibility and washability of smart textiles. The makers target to reach the balance between the aesthetic and technological usability and generate meanings that people would trust and believe in.

4.1.2 Characteristics of SG Prototypes

According to the responses, the most mentioned characteristics of smart clothing are uniqueness and exclusivity. The creators also accentuate the importance of making people to feel personally attached to it. At this point of development, smart garment is mainly characterized as “one of a kind”, customized product or produced in very limited numbers and generally made not for sale.

Ricardo O'Nascimento: “I never sold anything. So, what I do is that I lend the pieces for events or exhibitions, but I never sell”.

The smart clothing shares certain similarities with the high-end fashion garments with regard to singularity, exclusivity and high social value. However, as opposed to smart clothing, high-end fashion items cost great amount of money and are made solely for sale.

Meg Grant: “I think that they are really special, because they are only three of them.”

This sneakers are called ¨Jump!¨ If the wearer jumps once, the sneaker posts to Twitter, twice, the shoes take a Google Streetview photo and posts it in Facebook. The three jumps enable to pin the location of wearer on Google map. The shoes are connected to smart phone through Bluetooth.

Source: Jump (n.d.). Retrieved on May 15, 2015 from http://www.popkalab.com/portfolio/#jump

Even though the majority of creators consider SG as exclusive and expensive clothing within the context of traditional fashion, they distinguish the pieces from each other and characterize them separately: each SG item was created for particular purpose or specific situation such as performances, exhibitions, design weeks, festivals, etc. Therefore, each piece performs high or low level of exclusivity and "wearability" depending on the initial purpose it was developed for. The creators relate some of their creations as suitable enough for "everyday wear". Subsequently, those particular pieces were chosen and introduced to experts.

Ricardo O'Nascimento: "I mean it really depends on the piece. For example, piece like Paparazzi Lover I don't imagine lots of people wearing it because there is part of the concept that is also something more exclusive, you know, more like high fashion. It is not like Pret a Porter or Ready-to-wear things, you know. So I would say that there are some type of works that more towards like customization and really personalized things and other part could be more popular, like ¨Jump¨ could be more popular, indeed."

Eef Lubbers specified that the clothing she creates is more related to slow fashion items.

Eef Lubbers: "I would think it would be more of an exclusive garment, I wouldn't be

cheap at all. Probably, very expensive."

On the contrary, Marina Toeters aims at creating comfortable smart clothing with affordable prices and make it available for mass users.

Intimacy

Pauline van Dongen indicates that smart clothing having integrated electronic devices sort of contradicts and challenges the ultimate fashion destination which is elegance and sophistication. Therefore to be in the fashion industry, certain specific factors should be taken into account during the working process. First and foremost, intimacy was mentioned quite often by creators. The fashion is intimate as it is very close to the human body. Therefore, the issue of "wearability" of SG is seriously considered especially by makers who intend to create wearable garment for mass users. Along with developing the concept and building up the SG prototype, makers try to ensure the "wearability qualities" such as comfort and softness. As Pauline van Dongen and her design team explain how they deal with the technology-on-the-body design challenge.

> Pauline van Dongen: "This is why at our studio, we take the body itself as the leading element when designing a garment - the technology comes after."

The intimacy factor is mentioned by Soomi Park as well.

> Soomi Park: "It has to be really intimately like it is a fashion you have to wear it. It is not like you are carrying something like portable mobile phone or a laptop. It is something always attached to you and so there is some intimacy compare like to portable technology basically."

Park is interested in introducing human body through her work as a part of technology, thinking of a body as material that contributes to technology development. As opposed to other makers whose main purpose is besides communicating concept or vision to public, also create technologically and functionally wearable clothing for mass audiences.

The fashion journalist Aynouk Tan emphasizes the importance of having visionary professionals today that are able to conceptualize smart clothing phenomena and offer alternatives to the existing fashion system. Smart clothing was frequently viewed as an alternative to the existing fashion system.

Aesthetics vs. Functionality

Most of the interviewees empathized the importance of creating aesthetically pleasant clothing along with its high technological capability. The discussion with the fashion journalist Aynouk Tan brought forward the symbolic meanings that fashion industry has successfully been generating through "stories or myth" to attract and inspire people. Those symbolic and aesthetic meanings are translated into commercial benefit ultimately.

> Aynouk Tan: "The textile elegance, temptation, seduction. Seduction I think is very much in essence of what fashion is".

According to Tan, the functionality of smart clothing in current fashion system is a secondary value; the aesthetics is what comes first. The "gadgety" appearance should be avoided; instead aesthetic and symbolic values should be articulated more clearly.

> Aynouk Tan: "Jeans is also practical and pajama is also practical but people don't say they wear jeans because it is practical but they wear jeans because of its meaning."

The smart clothing creators take into account the fashionability and aesthetic performance of SG. However, the creators without fashion background or training usually design the clothing in an intuitive manner. The aesthetics is indicated by the fashion professionals as very important component for entering the apparel industry market. Even though the world is technology-driven, the aesthetics should be on a high level in the first place.

> Meg Grant: "You have to make sure that people wear it, but they are not going to wear it if it looks like a medical device. So, yeah, I think we are slowly getting there."

Aynouk Tan allegorically mentions that smart clothing should communicate in "fashion language" to move further from being an experiment and prototype to commercial product. The aesthetics and functionality of smart clothing is highly correlated with the intention of creator: whether the SG is created for the sake of a concept, vision to be displayed at exhibitions or developed as wearable and functional clothing for a potential customer to be turned into a marketable product. Respectively the conceptual and visionary smart clothing is viewed as an

artwork. As opposed to “wearable smart clothing prototypes” which are moving towards commercialization.

From another point of view, the principal value of smart clothing is in its functional utility, its usefulness and practicality, it´s technological capabilities in the first place. In this regards Victor Portes points out that the development of smart garment will be in the direction of health and lifestyle related. The SG provides authentic experience and will be appreciated for its usefulness rather than for its symbolic qualities or aesthetic attributes.

Thereby, the opinions of experts differ regarding the value of smart garment. The fashion innovation specialist Victor Portes highly appreciates technology, function, concept, design, technique as well as the appearance of introduced smart clothing prototypes whereas for the fashion journalist Ayounk Tan, the prototypes lack aesthetic, symbolic attributes which are inherent in fashion. Tan also considers even if the garment show promising potential, the practical usability is still underdeveloped for entering the market and resisting competition.

4.1.3 Context of Display

The smart garment prototypes are constantly displayed in the performative context: museums, galleries, design expo events, workshops festivals, fashion shows. These appeared to be the only platforms where SG physical prototypes reach the public eye and where its functional capabilities and aesthetic performance are revealed in front of wide audiences. Recently, SG prototypes are also appeared in movies.

The makers sometimes use the opportunity of exposure and conduct prototypes testing with regard to its performance and social acceptance. The prototype testing helps makers to identify the weak and strong points and modify them later on.

> Ricardo O'Nascimento: “Normally, I make pieces for specific event or an exhibition and then, I mean, to be really honest with you, I never have time to test it before because it is always finished like in the last minute. So, during the development we try to predict how people will interact with it and how people will use it but there is always surprises. People are very creative in using pieces at exhibition. So, and then I presented and observe how people deal with it. And, yeah, from that, yeah, we change things.

The physical display of smart clothing prototypes in art museums, design weeks or expos as well as demonstration during workshops is of great importance for reaching social acceptance. The constant exposure raises awareness on SG for different defined target groups.

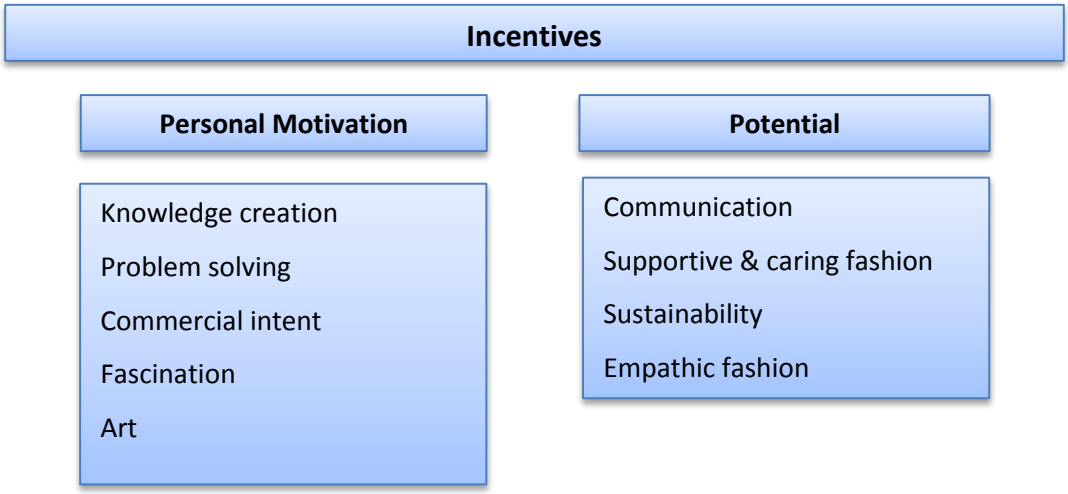
The knowledge dissemination also takes place at universities, conferences and research centers where participants willingly contribute by giving lectures, presentations and conducting workshops. For instance, Marina Toeters is a teacher, coach and researcher at Utrecht school of Arts, at Saxion University for applied science as well as at the Eindhoven University of Technology in the industrial design faculty. Similarly, Victor Portes teaches Design and Technology at the International School Almere.

O'Nascimento wishes the haute couture fashion houses such as Dior or Louis Vuitton to open research labs in order to investigate innovations in textile, fabrics, electronics, biology and interrelate to high-end fashion.

4.2 Incentives

The interviews reveal the incentives for creators. Throughout the section the level 1 Nodes *personal motivation* and *potential* are examined. This section can be translated into the following questions: why do makers create smart garment? And how do they envision the potential of smart garment? This section sheds light on why smart garment is created and reveals the potential of it from two stand points: the creators and the key figures. It should be noted that key figures are sort of knowledgeable representatives of potential demand. Therefore, this approach allows detecting similarities and differences in the responses of supply and contrast with the perception and appreciation of demand.

Figure 15 – Overview of category: incentives.



4.2.1 Personal Motivation

The interviews with creators clearly demonstrate that the main inspiration source comes from the *personal motivation*. A big range of possibilities offered with the development of high technologies stimulate creators to find innovative ways to integrate it into textile. Within the *personal motivation* category, participants share their personal intrinsic stimuli and external impulses received from surrounding environment which foster the creative process. The outlined main visible theme is appeared to be the contribution to society by offering a vision on better future and alternative to current fashion system. The participants are missioned to solve existing ecological, ethical and other issues existing in the fashion industry. The contribution to society is presented in a form of sustainable and supportive fashion which brings empathy (Marina Toeters) and care for customer. Additionally, three other participants refer to curiosity, fasciation, knowledge creation, interest in problem solving as key drivers impacting their personal motivation. Along with personal motivation and contribution to society, the participants find important to cultivate their artistic endeavors and passion for creativity.

> Ricardo O'Nascimento: "I was always; I am still interested in performance, in a more artistic approach to wearables."

The sub-category *fascination* is closely interconnected to *problem solving* and *knowledge creation* categories. The fascination towards exploring new technologies, experimenting with

smart materials and combining different intelligent products contributes to the ambition of creators to continue developing smart clothing. All the makers are keen to bring the technical innovations from the tech labs out to the world; make the technological innovation available and beneficial for mass audiences.

Commercial Intent

The discussion regarding *commercial intent* category was a little problematic. The primary goal of creators does not include the commercial intent. However, once the prototypes are built, tested and exhibited, the creators expect them to enter the market. The responses of participants generally fall into two groups: the first group apt to enter the market of exclusive and haute couture fashion whereas the participants of the other group prefer to operate in niche market and be able to offer functional clothing with affordable prices to mass users.

The only interviewee who prefers to present smart clothing prototypes in the context of exhibitions, performances and workshops is Soomi Park.

> Soomi Park: “My design is more about telling a story and showing a potential of wearable technology than suggesting. “This is a new product, so you have to buy it.¨

In contrast, other interviewees identify commercial applications and commercial potential for smart clothing in future. Furthermore, the participants mention that the radical innovative product needs to pave the path to market through social acceptance. The creators also recognize that the collaboration with professionals from the fashion industry can intensify SG adoption. The fashion industry has established marketing channels, which are necessary for efficient promotion of SG.

However, each creator creates his/her own strategy how to reach commercial viability.

> Ricardo O'Nascimento: “I sort of separate my projects into commercial projects which are projects that I do here in my studio to other brands and my personal project. But at the end everything is very mixed, because I, yeah. Because, when I receive a commission is not like an assignment. Like do this! But it is more like collaboration.”

This Fits Me garment based on 3D body scanning and generative algorithms. The garment reflects the customer´s taste and preference since customer can interfere the creation process and add his/her personal touch. The garment is unique and personalized design created by customer.

Source: This Fits Me (2014). Retrieved on May 15,, 2015 from http://www.leoniesuzanne.com/thisfitsme.html

Figure 16 – This Fits Me Dress

Pauline van Dongen.

4.2.2 Potential

As the high technology market continues to expand, the SG acquires more promising potential for application in various industries. The respondents are certain about the high potential of smart clothing to eventually revolutionize the apparel and fashion systems.

The creators are particularly enthusiastic about the possibilities of application of smart clothing in the domain of supportive, sustainable fashion and enhance communication and interaction between people and with clothing.

Sustainability

In some cases SG is regarded as a tool that can offer many countries a solution to the ecological crisis caused by the production system of the current fashion industry. For instance, Marina Toeters, the fashion designer, realized at earlier stages of her career that fashion is ¨non-innovative¨ and ¨self-repeating.¨ She committed herself to delivering innovative ideas by using technology as a tool to contribute to supportive and caring fashion. All participants reported their concern regarding sustainability in fashion and the development of smart clothing as a possible way out.

Meg Grant: “I don't think it is a good idea to necessarily put electronics in everyday clothing just for fun, because it is ecologically wasteful. Thus, this has to be justified. It has to improve people's lives, you know, delight them and give them some kind of benefits.”

There are particular SG items that directly offer an alternative towards sustainable fashion. For example the “Solar dress” created by

Communication

Three participants identify the potential of smart clothing in enhancing commination and stimulating different forms of interaction between people. For instance, O´Nascimento mentions that the potential of smart garment is in its "ability to extent your senses". Similarly, Park´s "Swing skirt" shares emotions, particularly stress and depression of wearer with others or the interactive smart lingerie created by Eef Lubbers induces intimate interaction between partners.

Reviewing the photos of smart clothing prototypes, Victor Portes brought out the aspect of self-expression which is essential in case of interactive smart clothing. Additionally, Portes considers that smart interactive clothing has a huge unfulfilled potential to be used in marketing campaigns, advertising, movies, marketing and PR. During the interview, many respondents highlighted the great potential of smart clothing in reshaping the healthcare provision. However, the health-related smart clothing is one step ahead from the smart clothing that can be related to high couture or everyday wear. The health-related and sport-related smart clothing are currently in their early adoption phase in the market.

> Meg Grant: "We have not really had the smart clothing that benefit in a way that for example smart phones benefited of. We have not had something that people wouldn't leave the house without."

The professionals Portes and Tan are also intrigued by the huge potential of smart garment and foresee promising application in the field of sportswear, lifestyle and health related products. They believe there is the strongest consumer base for now.

4.3 Market Formation

The category of *market formation* contains four sub-nodes: *social acceptance, target audience, concerns and resources*.

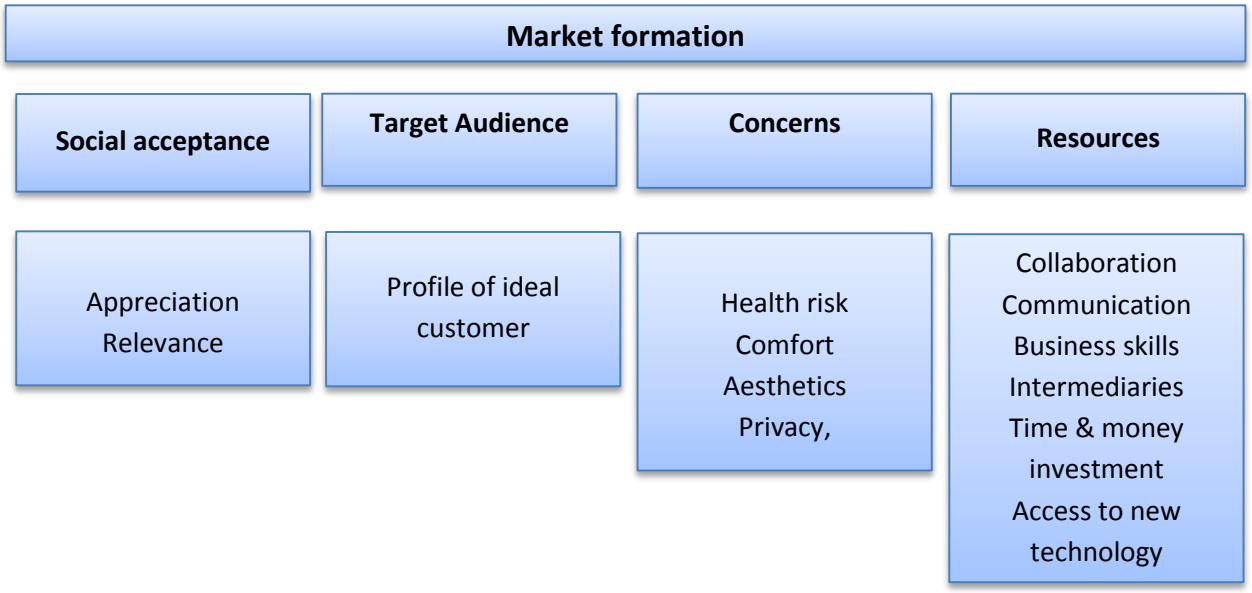
First of all, there is no smart clothing market as such, but it is at its early phases of formation.

This section focuses on the level of current social acceptance of smart clothing development. Due to the reactions received from the audience, the profile of potential customer

is outlined and the concerns expressed by people are identified. Those concerns can be considered as barriers for the social acceptance.

The creators and key figures describe the current developments and forecast future obstacles in market formation, as well as identify resources necessary to face and to cope with those obstacles.

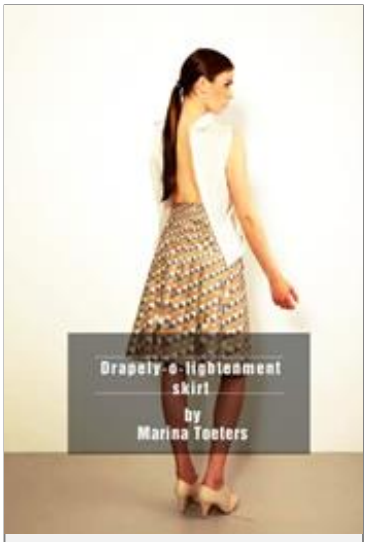
Figure 17 – Overview of category: market formation.



4.3.1 Social Acceptance

To begin with, all the respondents in this node found that process of *social acceptance* is an essential phase in market formation. The pieces created by participants have been displayed at exhibitions, design events, festivals, as well as workshops and conferences. The reaction from the audiences was predominantly positive. People demonstrate curiosity with the intention to touch and try the smart garment on, even though "they don't always really understand the whole interaction part and that there is actually electronics in" (Eef Lubbers). Especially, the interactive pieces gain more attention from the audience and trigger a desire to touch and wear. Despite the seemingly positive feedback, the side-effect of interactive clothing is that the wearer can sometimes experience discomfort from being perceived as a gadget or a device, not as an individual.

Meg Grant: “If you are wearing something that people can interact with, they quite often forget that they interact with a human and they just become sort of obsessed with the technology and forgetting about the person wearing it.¨



The skirt has embedded 6 OLEDS and over 2500 patches into the textile. This interactive smart piece communicates with light. When the sensors detect the movement around, the lights start to blink.

Source: Drapely-o-lightenment (n.d.). Retrieved on May 15,, 2015 from http://www.by-wire.net/20121123/

The fashion product is an experience good and therefore, the consumer appreciation is best observed when a person wears the item and expresses his/her feelings and emotions. According to the creators the individuals that model SG prototypes during exhibitions felt quite comfortable, safe and positively excited while wearing them. The only dress that does not allow the body to move freely is “Paparazzi lover” dress created by O'Nascimento.

The smart clothing brings new aesthetics, that intrigues and attracts attention, but it is still far from reaching mass appreciation.

Soomi Park: “Create new aesthetic in the fashion field as well so that's why people were quite intrigued by this.”

Relevance

The uncertainty around radical innovative products makes the relevance of it rather ambiguous. The respondents underline that the lack of knowledge and experience affect potential consumer behavior. In fact, the potential consumer is unaware of his/her need and preference with regard to SG. Four respondents draw parallels between smart clothing phenomenon and smart devices such as smart phones and Ipads and discuss the path to market success. The comparison helps to detect the skeptic and distrustful consumer behavior when, for instance Iphone was introduced and the drastic changes in consumer behavior later on. Those behavioral changes represent the product recognition, its relevance and social acceptance.

The participants express their concern regarding sustainability in fashion suggesting SG as an alternative option with a potential to replace today’s apparel production and consumption. Most

of the respondents including the experts assured that the modern society is ready to switch to smart clothing once it appears on the market.

4.3.2 Target Audience

The smart clothing is on its way to a pervasive consumer reality. As the interest and appreciation grow, the necessity to target consumer segments in order to position a product appears. It is worth mentioning that reactions received from the audience are the only indicator of potential demand appreciation. The coding of *target audience* category, has enabled to define the *consumer´s ideal profile* sub-node.

Generally, the intention of makers to position SG in global apparel market varies as was discussed above. For one group, the SG should be positioned as luxury, custom-made, expensive smart clothing whereas for other creators the SG needs to be positioned as practical, well-made, good quality products that are mass-produced at low prices. For example, Pauline van Dongen apts to “working further on making these solar garments more accessible to people”, so does Marina Toeters. Whereas the strategy of Eef Lubbers, Soomi Park and Leonie Tenthof van Noorden differs.

The interviews revealed interesting points about the *profile of an ideal customer*. The most common characteristics for ideal customer include: young fashionable men and women engaged in high technology, “like nerds, hipsters basically” (Ricardo O'Nascimento) as well as the ones who value longevity of clothing and focused on responsible consumption.

Marina Toeters: “Every product meets its own user.”

4.3.3 Concerns

The multiple cues received by the audience feature concerns that people experience with regard to smart clothing. The concerns are the following: *privacy, comfort, safety and aesthetic* performance. Those concerns can be considered as the main obstacles for social acceptance at this stage of product adoption.

According to creators the arguments on safety and in some cases on comfort and privacy are ungrounded and unrealistic. The reason is unawareness and lack of knowledge. It should be also noted that each of presented smart piece performs peculiar function and design. For example, the “Jump” shoes made by O'Nascimento are practical and comfortable since “all the electronics are

embedded in the tongue" (O'Nascimento) whereas the "Paparazzi dress" is functional, aesthetically appealing yet impractical. The fashion journalist Tan was not satisfied with the aesthetic performance and also practical implications of presented prototypes whereas Portes was fascinated by the functional capabilities of each item and was ready to try them on. However, both professionals detect privacy as a challenging aspect to appreciate smart clothing prototypes.

> Aynouk Tan: "And it is almost like having a chip inserted in our arm".
>
> Victor Portes: "Technologies that can be invasive."

Due to Portes, with the growth of such high technological applications, the new legal restrictive mechanisms will be developed by policy makers to secure privacy.

4.3.4 Resources

The sub category *resources* reveal something about the specific resources that creators and key figures consider necessary in designing the final product and entering the market. During the coding process the level 2 nodes *collaboration, communication, business skills, money & time investment, access to new technologies and intermediaries* emerged.

Apparently there are a number of other challenging aspects for creators to struggle with which have been already discussed in the sub-node *creation process*. The lack of resources prevents creator's ideas, concepts, plans and projects from development and realization.

Communication

All interviewees agree on the importance of raising social awareness on smart clothing by means of marketing and promotion. The constant exposure through media, exhibitions, presentation, etc. should be the starting point to communicate the concept and performance of SG to public. Moreover, the great majority state that communication is the most effective way to reduce uncertainty driven by knowledge gaps. By ensuring high visibility of smart garment prototypes, disseminate knowledge and "showing the clear benefits" (Portes), the level of concerns, such as privacy and safety can significantly lower.

> Marina Toeters: "And I think we really should do a better job in communicating that it is a lot better than wearing your mobile phone on your body which everyone is doing and no one is questioning the safety there."

Collaboration

The sub-node *collaboration* emphasizes the important role of establishing collaboration both with independent specialists such as engineers, fashion designers, etc. as well as with companies. The collaboration contributes to knowledge development. All creators describe collaboration as inseparable part of creative process.

However, the creators also mention that the collaboration with the actors of the fashion industry, leading fashion companies and brands is complex. In order to present SG in the context of fashion the relationship with fashion world needs to be improved. The cooperation with high-end fashion designers or big brands can significantly fuel knowledge diffusion and be a springboard for market formation. Though, the objectives of big companies seem to be not in line with the goals of creators. Therefore, nowadays the "grey area" of uncertainty, skepticism and disbelief exists between two worlds.

Business Skills; Money & Time Investment

The creators point out that the lack of business capabilities such as product positioning and marketing skills hinder cooperation with big tech and fashion companies. Although, in some cases the entrepreneurial attempts at launching the venture seem to be successful, the lack of business skills does not allow diving into production on a large scale.

The creators described their wishes and vision on future. Interestingly, the majority of participants are expecting to receive investment from the fashion industry. It should be noted that current projects on SG are predominantly realized with subsidies received from government. On top of that, the creators express their desire to enter the fashion world in future and start collaboration with the fashion marketing specialists.

> Ricardo O'Nascimento: "I think it is needed more like investments from the fashion industry. They have to be open."

The experts suggest creators to pursue the entrepreneurial endeavor and do not rely on support from the fashion industry. Instead of putting into practice "traditional business models" (Portes), expand smart garment exposure using movies, performances, arts, theater, ads, etc. (Tan).

The innovative products encompass high level of uncertainty. Thus, the traditional channels towards engaging big tech or fashion companies in creation and production process are complex (Portes; Tan). The creators are suggested to break through into a new niche market using alternative ways: instead of intruding into a fashion world create a separate world of smart clothing. However, it is important to "relate it to the fashion logic" (Tan).

> Victor Portes: "Instead of the masses, it is going to be individual countries, individual companies, small companies pushing great technology and then when they get it, then people will go like ¨ Oh, I want it!¨. Then they gonna make a big investment."

Intermediaries

The smart garment creators became by necessity *intermediaries* bringing together specialists form diverse backgrounds. The creation process is highly collaborative as was mentioned before. For instance Toeters acts as intermediary linking specialists from different industries for her company. Though, the intermediation with the actors from fashion industry is not easy.

> Marina Toeters: "Me and fashion labels do not find each other. Maybe I now need an intermediary between."

Portes emphasizes that the professional intermediaries or "connectors" can play an important role in connecting all the pieces of exiting "puzzle": bring together experts and specialists from different domains, find resources and solve challenges i.e. create an environment that intensifies smart clothing development. Hence, all the participants agree that the use of innovation-focused professional intermediaries is necessary for constructing production networks and directing smart clothing to take the path to mainstream.

5 Conclusion and Discussion

The lack of academic literature on this topic makes this thesis exploratory and descriptive. I narrowed it down by placing in the perspective of cultural economics, particularly in-between studies on innovation and demand for cultural goods.

The objective of this Chapter is to provide a profound conclusion on findings and link them to the concepts and theories discussed in theoretical framework. Thus, this chapter demonstrates the analysis of nine in-depth interviews and offers some practical application. This Chapter ends with the summary of research limitations.

Despite the promising potential of smart garment, it has not yet appeared in fashion stores. Generally, the smart clothing is introduced in a form of prototypes displayed at art museums, workshops, festivals and fashion shows. The market formation is at its early phase of infancy making its way towards commercialization. Thus, the research aims to answer the central question: Why isn´t there a market for smart clothing? This exploratory study reveals the obstacles that hinder the smart clothing prototypes from turning into commercial product and entering apparel market. Additionally, it explores the level of SG appreciation and relevance to modern society.

The research reflects on the topic from the perspective of SG creators and experts from the fields of fashion and innovation. By contrasting the interrelation of viewpoints of producer and potential consumer, the commercial potential and the factors preventing SG market formation are explored.

The consumer behavior has been transforming due to the emergence of technologically innovative products. Nowadays the consumption process is becoming more experience-oriented: the smart products question and entertain, interact and enhance people's sensual and intellectual capabilities (Martins et al., 2012).

Keeping in mind that SG is an experience good and best can be characterized through personal observation and experience (Klein, 1998, Lim et al., 2008), the visual prototype testing method is applied in this research (Buchenau & Suri, 2000). Unfortunately, the physical SG prototype testing was not feasible to implement. The visual prototype testing is a tool to measure the level of social acceptance.

The analyses of seven semi-structurered in-depth interviews reveal detailed information about internal and external factors that create obstacles for smart garment creators to turn the prototype into commercial product. The factors that intensify the development process are also covered respectively.

The findings stress the internal obstacles that creators permanently cope with during the SG design practice and external factors that are associated with the level of social acceptance and SG adoption, as well as the obstacles such as privacy concerns of potential consumers.

5.1 Internal Factors

The internal factors influencing creators' design practice are the scarcity and limited access to new technology, time and budget constraints, lack of cooperation and communication with established fashion and technical companies. These are the main challenging aspects creators encounter with regard to placing the items in the market. In addition, the creators deal with issues regarding the SG creation process itself: the integration of hardware and computer components into textile and achieve flexibility, ensure soft and comfortable clothing is a challenging task. Other limitations include the battery life and SG washability.

The key drivers that motivate creators are contribution to society by offering sustainable and supportive fashion. Among the intrinsic intentions are curiosity, fasciation, knowledge creation, interest in problem solving. The cultivation of passion for artistic endeavors also stimulates creative process. Interestingly, due to the majority of respondents the intention to commercialize the product was not considered as a primary goal.

Generally, the SG creation process implies collaboration. Fagerberg (2003) mentions the collaboration is crucial in creating an innovative product. The collaboration and experience exchange with different parties, especially from diverse backgrounds intensify knowledge creation. Also, this type of collaboration creates a platform where various innovations and creative concepts from various disciplines are intersected, interrelated and resulted in an outcome such as smart garment. Thus, the collaboration with individuals from different backgrounds is mutually beneficial.

On one hand, the SG is characterized as exclusive, unique and expensive piece for small target of people, on the other hand functional clothing with affordable prices to mass users. SG can also

be characterized as a luxury good (Levy-Garboua & Montmarquette, 2011). The target audience is outlined as young men and women who are interested in technology and fashion.

5.2 External Factors

The external obstacles consist of lack of professionalism in business and marketing skills, as well as time and financial constraints. The SG market is at the early stages of formation. Nevertheless, the key figures highlight a huge variety of applications for business and retail: specifically, in the domains of supportive, healthcare-related products, also sportswear and interactive fashion.

Even though, during the displays, the reaction from audience is mainly positive, the main question remains whether or not the consumer demonstrate desire to wear SG as casual, everyday clothing. The physical display of smart clothing prototypes at art museums, design weeks or workshops is of great importance for reaching social acceptance. The constant exposure raises awareness on SG for different defined target groups.The results show that the concerns regarding privacy and safety are ungrounded. Those concerns can be reduced through efficient communication.

There are other hurdles to overcome before the potential of SG is fully fulfilled. The creators frequently mention the budget constraints during SG prototype design process. The prototypes are predominantly created with the subsidies received from the government. However, there are cases when creators possess entrepreneurial qualities which are becoming a good tendency: the small companies can intensify the niche market formation.

The aesthetics is as important as technical capability. In order to become culturally adopted, the SG needs to start to speak “the fashion language” and create meanings.
One of the biggest challenges involved in converting SG prototype into the final commercial product and entering the global apparel market is SG introduction within the fashion logic.

The uncertainty of demand, the absence of infrastructure and unusual aesthetic performance keep investors, big fashion and tech companies in a distance. The experts suggest using the potential of smart clothing and make it visible through different platforms, such as art (museums, galleries), entertainment (movies, theater).

Especially, in case of radical innovative products, when the consumer is completely unaware of the product, the communication of aesthetics and potential benefits of SG is crucial. In

order to reach the social acceptance, first the taste towards SG needs to be cultivated (Brito & Barros, 2002). The awareness raising can be linked to the concept of “rational addition”: as much the consumer learns and, gains experience enhances knowledge about the product, as more enjoy and appreciate that product in future (Caves, 2000).

Despite exhibitions and cultural events, the knowledge is diffused at universities, conferences and research centers where the participants give lectures, presentations and conduct workshops.

5.3 Research Limitations

There are numerous limitations to this study. First and foremost, the limitations related to the method of the study. The qualitative study brings forward the validity and reliability problems. Also, the findings of this study are not possible to generalize.

Due to the time constraints it was not feasible to provide deeper analysis and engage more participants. The quantity of interview questions was limited as well and therefore it was hard to grasp all the aspects of smart clothing development, design practice and obstacles involved.

The sampling size is small, especially with regard to the experts (two persons) which is not sufficient representative of population. For the future research, the suggestion would be to conduct a mixed method study and involve larger sample.

Lastly, the physical prototype testing instead of visual prototype testing method would have revealed more precise measurements of consumer appreciation.

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APPENDIX A – Interviewees

Respondent	Smart garment item	Prof. Background	Occupation	Place of residence
Eef Lubbers	Unlace	Industrial Designer	MA student in Industrial Design at the Eindhoven University of Technology	Eindhoven, NL
Leonie Tenthof van Noorden	This fits me	Industrial Designer	Fashion Technology Designer at Leonie Suzanne	Amsterdam, NL
Marina Toeters	Drapely-o-lightment skirt	Fashion Designer	Founder and owner of fashion technology Company by-wire-net,	Utrecht, NL
Meg Grant	Lace Sensor Dresses See-thru-me is a top	Fashion Designer Software Developer	Creator of wearable electronics, e-textiles and fabric interfaces.	San Francisco, USA
Pauline van Dongen	Solar dress	Fashion Design	Fashion Designer, Owner at Pauline van Dongen	Arnhem, NL
Ricardo O'Nascimento	Jump shoes Paparazzi dress	Artist and Researcher in new media and interactive art	Founder of POPKALAB – a design/research studio	Rotterdam, NL
Aynouk Tan	Not applicable	Journalist	Freelance editor, Fashion journalist	Amsterdam, NL
Victor Portes	Not applicable	Experiential Design, Branded	Founder & Brand	Amsterdam, NL

Soomi Park	Swing skirt	Environments, In-store Retail Communication 2D & 3D, Strategy and Concept Development, UX / UI Design, Storytelling, Publishing, Art Direction and Education. Speculative Designer and Multimedia Artist	Communication Specialist of Dutch Catwalk 3D Printing Consultancy & Fashion Innovation Platform Ph.D student in Media and Arts Technology (MAT) in School of Electronic Engineering and Computer Science at the Queen Mary, University of London	London, United Kingdom

Source: author´s elaboration

APPENDIX B - Draft Email for Interviewee

Dear [NAME],

My graduation paper for the MA programme Cultural Economics and Entrepreneurship at Erasmus University Rotterdam examines the consumer's perspective on smart clothing at this point of its development.

The study aims at revealing factors that impact potential customer/user appreciation towards smart garment prototypes and synchronize with incentives and expectations of fashion designers. The research will offer insights into potential, relevance of fashionable technology as well as outline the extent of public acceptance, appreciation and preference.

Hereby, I conduct interviews with fashion/industrial designers and other fashion professionals in the Netherlands as part of a research study. I am hoping that you might be willing to partake in an informational interview and contribute to it. I am curious to hear about your work and your personal observations on smart clothing potential and relevance.

The interview would ideally take place until the end of April and will last around half an hour. I will be happy to come to your office/studio to meet you or to interview by phone/skype if that would be more convenient for you.

In the end I need about ten interviews, so if you know any other fashion professionals who might be interested in answering my questions on smart clothing it would be great if you could let me know. Thank you very much in advance!

I sincerely hope that you will be able to help me with my research.
If you have any questions do not hesitate to contact me.

In anticipation of your reply,

Kind regards,

Ashley Minasyan
T: 06-87225373

Contact details supervisor:
Dr. Mariangela Lavanga
T: +31 10 4082459
E: lavanga@eshcc.eur.nl

APPENDIX C– Interview Protocol

Participant:
Interview time:
Date:
Place:

Interviewer Instructions:
Ask for permission to use voice recorder (to enable verbatim transcription of the audio in order to use it for analysis of this research)
Expressing gratitude for time and interview
Introduction research (title, research question, relevance and aim)
Introduction interview (method, qualitative, questions)

Semi-Structured Questions for Creators

a. Background of creator

Please tell me a little about your professional background?
When were your first steps towards your specialization in wearable technology?
How would you characterize wearable technology? What is specific about it?
What are the main challenges you have encountered when designing wearable technology?
What is next in your plans? Any new project, ideas?

b. Zoom into one particular project: Background of smart clothing item

(Characteristics of smart clothing item, potential, concerns)
How did you come up with the idea to create [SMART GARMENT ITEM]?
What materials did you use for this garment?
How comfortable/safe is it to wear [SMART GARMENT ITEM]?
How would you describe the style of [SMART GARMENT ITEM]?
What do you think, what is the potential of [SMART GARMENT ITEM]?
Is it necessary to develop it further?

c. Incentives of creation and consumer appreciation

Did you get any reaction from the audience? /exhibitions/workshops/models who happened to wear it/
In which context do you show the [SMART GARMENT ITEM]?

What are the main obstacles for smart clothing to be accepted and appreciated by the mass user? Is the society ready yet? Is it relevant today?
What are your strongest incentives to continue creating smart clothing?

d. Market Formation

Do you want a large group of people to wear Lace Sensor Dress and See-thru-me top or you want to keep it in performative/other context?
Do you see your products spreading worldwide, reaching bigger audiences?
Do you see your products on the market? What stage are you in terms of moving from prototype dress/top to commercial product?
What is the profile of your ideal customer? What do you do to attract/reach him/her?
Smart clothing is the future of the fashion. At which point of the development are we now?

e. Future Vision

As one of the pioneers in this field, what do you think is the next step?
How do you see you smart clothing development in 10 years?
What is needed for taking these steps?

Semi-Structured Questions for Experts

a. Background of professional and level of knowledge on smart clothing

Please tell me a little about your professional background?
Smart clothing has become popular over the past few years. What do you think is it overhyped or are it is really going to be revolutionary, to be the next big step?
Have you ever been involved in projects on smart garment during your career? Could you please briefly describe those projects?
How would you characterize smart clothing? What is specific/special about it?
What is the potential and where do you see the most growth potential for smart garment? Is it necessary to develop it further?
What is next in your plans? Any new project, ideas?

b. Introducing photos of selected smart garment items

Do you consider this piece as a work of fashion or do you consider it as a piece of art or perhaps both?

Why would you want such a thing? Why would you put it on you?
In which context would like to wear it? Would you prefer to wear it in performative context, as more of a fashion statement or?
What are the factors that would impact your decision to consider it for everyday wear?
Would you feel safe and comfortable in it?
What would you change to adapt it better and feel more comfortable on your body?
Do you consider it fashionable?
Which qualities of this garment are particularly attractive for you?
What wearable device would you prefer the most, the one to get information about physical state like heart rate or the device the allows to communicate better, interact, express your feelings and emotions, express your personality and stay connected or the device that is fashionable and aesthetically pleasing?

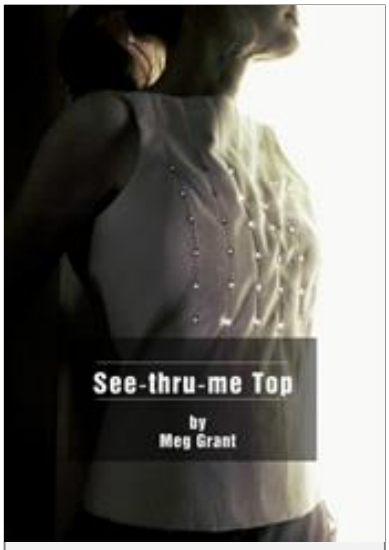
3. Social acceptance and commercial potential

Do you think this piece is commercial? Do you see this product on the market? Would you be willing to pay for it?
What would be the challenging aspect for you to own smart clothing?/Price/Aesthetics/ Privacy/other?
What do you think what the main obstacles are for smart clothing to be accepted and appreciated by you as a user? Are you ready yet? Is it relevant for you today?

4. Vision on Future

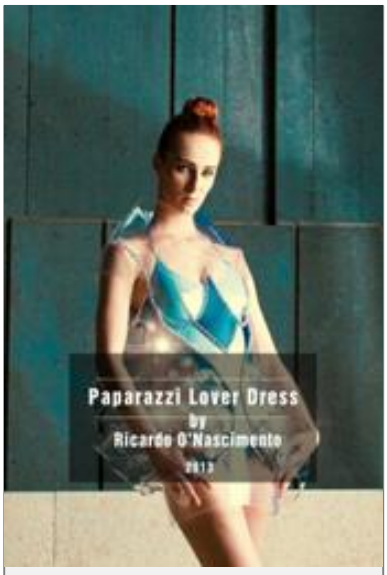
What do you see for the future of smart clothing? What do you think will push significant numbers of people to adopt this kind of fusion of technology with fashion?
What do you think at which point of the development are we now and how do you see you smart clothing development in 10 years?
What do you think is the next step? What is needed for taking this step?

APPENDIX D – Smart Garment Description



The See-thru-me top is an interactive piece, which creates an illusion of light shining through the body. It has incorporated LEDs in the front, so that if the light shines in the back, the front lights up.

Source: See-thru-me (2009). Retrieved on May 15, 2015 from http://meggrant.com/see-thru-me.html



This interactive dress incorporates 62 LED lights and lights up whenever somebody takes a photo of it. The Paparazzi Lover dress is sort of an "attention seeker" dress.

Source: Paparazzi Lover (n.d.). Retrieved on May 15, 2015 from http://www.onascimento.com/paparazzi-lover/

This dress incorporates 72 flexible solar cells that allow storing enough energy to charge a smartphone or any other portable device.

Source: Solar Dress (2013). Retrieved on May 15, 2015 from http://paulinevandongen.nl/projects/wearable-solar/

This sneakers are called ¨Jump!¨. If the wearer jumps once, the sneaker posts to Twitter, twice, the shoes take a Google Streetview photo and posts it in Facebook. The three jumps enable to pin the location of wearer on Google map. The shoes are connected to smart phone through Bluetooth.

Source: Jump (n.d.). Retrieved on May 15, 2015 from http://www.popkalab.com/portfolio/#jump

The Swing Skirt can be used for stress reduction since it is known that swinging provides the feeling of confidence and stability. The skirt can be used anywhere it can be hung.

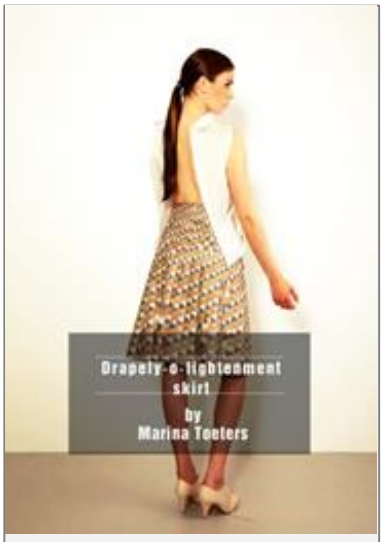
Source: Swing Skirt (n.d.). Retrieved on May 15, 2015 from http://soomipark.com/main/?portfolio=swing-skirt

There are three Lace Sensor Dresses and each of them has embroidered a poem with different emotion and also embedded speakers. When the wearer presses the embedded sensors, the dress starts to play the poem loud.

Source: The Lace Sensor Dresses (2013). Retrieved on May 15, 2015 from http://meggrant.com/lacesensordresses.php

This Fits Me garment based on 3D body scan of the customer and generative algorithms. The garment reflects the customer´s taste and preference since customer can interfere the creation process and add his/her personal touch. The garment is unique and personalized design created by customer.

Source: This Fits Me (2014). Retrieved on May 15,, 2015 from http://www.leoniesuzanne.com/thisfitsme.html



The skirt has embedded 6 OLEDS and over 2500 patches into the textile. This interactive smart piece communicates with light. When the sensors detect the movement around, the lights start to blink.

Source: Drapely-o-lightenment (n.d.). Retrieved on May 15,, 2015 from http://www.by-wire.net/20121123/

Unlace is created to stimulate the interaction between partners. The thermo chromic ink was used to create the effect of color change or color movement (from black to skin color). When the garment is touched, the warmth heats up and changes the color.

Source: Unlace (n.d.). Retrieved on May 15,, 2015 from http://www.eeflubbers.com/unlace.html

APPENDIX E – Transcripts of Interviews

The transcripts of interviews can be found in the DVD enclosed to thesis.