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INFLUENCE OF THE EUROPEAN FASHION STYLE ON THE DEVELOPMENT OF SMART TEXTILES IN ESTONIA

Bachelor's thesis

International Business Administration

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TABLE OF CONTENTS

ABSTRACT

The fashion industry is constantly changing and dictating contemporary trends, something remains the base, and something we call "fast fashion". Companies are developing new materials, innovative solutions to produce clothing and, moreover, today technology is a significant part of the fashion business. "Smart textiles", which will be discussed in this study, is just one of the newest branches in the field of fashion.

In this study, we learn about the influence of the fashion industry, and specifically the European style of clothing, on the development of smart textiles in Estonia, a country where people strive for innovative solutions and successfully develop their startups even in this area. The purpose of the study is to understand how to bring smart textiles to the Estonian market successfully while taking into consideration the European sustainability principles and fashion styles. The method used in this study is an analysis of patterns based on business models. A survey was conducted as a tool for data collection to assess the “influence” of design on certain patterns and smart textiles' adoption. A tool that was used for ideation – was the business model navigator framework, the NABC framework - for evaluation of ideas. And the magic triangles were presented for visualization of the proposed business models.

Based on the results of the study it was found that the rate of acknowledgement of people about smart textiles is relatively low, and the participants mostly believe that the mass adoption of these innovative wearables can be done. The acceptance of smart textiles in the market is low due to the fact that the innovation is new and little studied in the Estonian market, and people are worried about the difficulties associated with it. Two new business models were created based on the participants’ votes. It was revealed that smart textiles should be fashionable, modern and comfortable, as is customary in European fashion, and then the innovation can be used even in everyday life.

Limitations were that a small audience was taken into account (91 participants), and also only two stages of the business model navigator were studied because the last two are not feasible to do in this research.

The social implications are that this study may help smart textiles companies rapidly introduce their new products – smart textiles.

Originality/value of the study is based on the self-conducted survey among Estonian residents, as well as this study examines smart textiles specifically from the fashion industry in Estonia.

Keywords: smart textiles, adoption, fashion, business model, influence

INTRODUCTION

Fashion is something through which people can express their character and their worldview, and it is also a big and very influential business that plays a significant role in our lives.
The fashion industry today is developing rapidly, changing one trend after another, but a completely new and innovative trend in its development has been the introduction of technologies called “smart textiles”. Smart textiles are a combination of fashion and art with the latest technology and science that can be divided into four classifications: 1) healthcare/medical, 2) fashion/entertainment, 3) military/public sector, and 4) sports/fitness (Stoppa, Chiolerio 2014, McCann 2009).
The introduction of smart materials and computing technologies makes it possible to develop textiles with a new type of behavior and functionality. Smart textiles and computer technology are changing textiles, from passive behavior to dynamic behavior, from textiles with static functions to products exhibiting dynamic functions (Berglin 2013). As Mariya Gabriel, EU Commissioner for Research and Innovation said - “By being a bridge between the world of art and culture on one side and the world of science and technology on the other, we will make sure to involve society as a whole,” thus we understand that such a synthesis leads to profound changes in the fashion industry as well as in the entire world.

Today, this branch of smart textiles is also developing in Estonia: for example, the textile producer Protex is working hard to create a uniform with implemented speech recognition, GPS system, fall-down identification, and activity monitor. Eco-friendly fabrics are being developed by the materials engineers of Tallinn University of Technology, and researchers are looking for new ways for textiles and fashion to be more sustainable through the implementation of technology.

The adoption of innovative smart textiles is a complex process because the production of smart textiles faces such problems as excessive costs, lack of standardized regulations, and different concerns in introducing technology into everyday clothing, so it is necessary to understand the factors influencing adoption.

This study is structured to analyze smart textiles and business models that can bring these innovative textiles into the market. The fashion industry has faced a substantial number of changes since World War II and is changing constantly.

The study focuses on the adoption of smart textiles, on understanding the level of awareness of smart textiles Estonian people have at the moment and on the analysis of the new potential business models to bring these textiles to the market.

The topic of this bachelor's thesis is about the influence of European fashion style - a style that is associated with sophisticated, well thought out, sustainable, even custom-tailored outfits - on the adoption of smart textiles in Estonia and what are the best suitable business models to bring those innovative wearables into the market. The focus of the research question is "How to develop new business models to bring smart but stylish textiles or wearables to the market while preserving the European sustainability principles and fashion styles?". The second research question is "What is limiting the adoption of smart textiles in Estonia?" And the last research question - "What is the level of awareness of smart textiles Estonian people have at the moment?"

Theoretical background will focus on the fashion industry - fashionable trends and history, and on the development and implementation of new smart textile solutions in the field of fashion and will provide a better understanding of this market, especially in Estonia. Moreover, it will be focused on the business model theory and frameworks.

The last chapter concludes the methodology, research findings, and discussion of the results on finding the most suitable, new, and innovative business model. The business model navigator (Gassmann et al. 2014) was used for ideation, NABC analysis (Carlson, Wilmot 2006) - for evaluation of ideas, and the magic business triangle (Gassmann, Frankenberger, Csik 2013) - for visualization of business models.

1. THEORETICAL BACKGROUND

Theoretical background will focus on the development and evolution of European fashion, and implementation of new smart textile solutions in the field of fashion and will provide a better understanding of this market, especially in Estonia.

1.1. Fashion industry evolution

The emergence and formation of the fashion industry is closely related to the simultaneous development of prestige consumption and the "mass consumer society".
Fashion has been known to mankind since ancient times, but only at the end of the 19th century did the very concept of the fashion industry and its distribution appear. Until these years, people used only essentials not for style, but for the functionality of clothing. Jewelry and various expensive clothes, which were considered fashionable, could only be afforded by some aristocrats.

Between about the 1890s and 1960s, fashion began to take shape as a separate industry, and fashion making moved to the level of mass production as a middle class of people emerged. The adoption of fashion begins with the elite upper class who adopt a certain style. People from a slightly lower class try to imitate the upper class by adopting this fashion, thereby giving the appearance of a higher status. (Eicher, Tortora 2010)

Throughout much of the nineteenth and twentieth centuries, many people assumed that the desire to be fashionable was a feminine trait. (Eicher, Tortora 2010) A fashion forecasting system began to take shape in developed countries. This is because the mass production of clothing required large fabric purchases and premeditated production. The manufacturer then could offer only those products for which the materials were available on the market, and create collections long before their release. Since the emergence of the trend forecasting system, fashion has been divided into haute couture (tailor-made for the elite) and ready-to-wear (mass production for the middle class). Since the seventeenth century Paris has been recognised as a highly creative generator of culture and that became the era of the famous Parisian couturiers - Coco Chanel, Christian Dior, Yves Saint Laurent, Hubert Givenchy and others. (Montagné Villette, Hardill 2010)

After the invention and the beginning of widespread usage of the Internet, the pace of change is accelerating as information about new styles quickly spreads through new media and people become more aware through better access to information. The fashion industry used to target adult and affluent consumers, but now it targets younger, millennials. Also, talented designers and fashion capitals no longer identify manufacturing companies as they used to in order to promote and recognize brands. Multimedia, as an important part of AI nowadays, provides powerful tools for analyzing, understanding, and predicting fashion (Song, Mei 2018). These trends indicate that the fashion industry is moving from one main standard to different fashion standards.

Fashion today is a diverse sphere that plays a significant role in the European manufacturing industry. Breward and Evans have written that "fashion is a process in two senses: it is a market-driven cycle of consumer desire and demand, and it is a modern mechanism for the fabrication of the self. It is in this respect that fashion operates as a fulcrum for negotiating the meeting of internal and external worlds" (Breward and Evans, 2005) Relying on the official data of the European Commission, the industry employs 1.7 million people (about twice the population of Delaware) and generates a turnover of 166 billion euros.
The highest concentration of fashion activity is in Italy, other southern EU countries - Spain, Greece, Portugal, and in the new EU countries - Poland, Romania, Bulgaria, Hungary. The countries with the largest number of fashion distribution and retail companies are Italy, France, Poland, and Germany.

Nowadays, an important trend in the European apparel market is sustainability. "By 2030 textiles placed on the EU market should be long-lived and recyclable, made to a considerable extent of recycled fibers." - said the EU environment commissioner, Virginijus Sinkevičius. Sustainability includes consumer education, fashion sharing, vegan clothing, transparency, standardization, and natural dyes. The European Union strongly directs its activities towards the sustainable development of countries and the maintenance of the environment, and the fashion business is also striving for this. The production of clothing and textiles has a large environmental footprint, for example, high consumption of non-renewable resources - an average of 98 million tons per year (Perry 2018). The textile industry uses oil reserves to produce synthetic fibers, and 93 billion tons of water per year (UNCTAD 2020) to grow cotton, which is produced by exporting countries - China, USA, Pakistan, India, and Turkey. The fashion industry is responsible for 8-10% of humanity's carbon emissions – more than all

international flights and maritime shipping combined (UNEP 2018). If the fashion sector continues its current trajectory, that share of the carbon budget could jump to 26% by 2050 (Ellen MacArthur Foundation 2017).
Since sustainable development includes both environmental and social and economic aspects, interested companies are striving to change their vector of work in all three directions. Green and Environmental Protection will still stay a constant theme soon. “It is about matching sustainability with style, to bring the European Green Deal closer to people's minds and homes”, said Commission President Ursula vonder Leyen. Naturally, the development of smart textiles should coherently run towards an ecological green direction (Deng et al 2016).

After revolutions, changes in all spheres of life have always taken place at an extremely high rate, and changes in many areas of science and technology have taken place at an extraordinary speed. Each industrial revolution radically transformed economic systems and social structures (Schwab 2016), so the fashion industry also went through an enormous number of changes and the creation of new fashion styles around the world.
Against the background of the fact that today's global economy is very uncertain, the 4th industrial revolution is taking place. The emergence of the Internet of Things (IoT), 5G, artificial intelligence (AI), data science, and big data - are big technological advances, through which both the economic environment and the social environment are changing. This industrial revolution is "a new chapter in human development, enabled by extraordinary technological advances commensurate with those of the first, second, and third industrial revolutions." - as the World Economic Forum describes it.

The fourth industrial revolution, fast and wide-ranging, is not only technological change. The changes are so imminent that it shall either be a good gain to humans or a great loss. (Andriole 2018). The revolution will affect all people, and various activities, and will also lead to the creation of new innovative technologies necessary for sustainable development in the future. Accordingly, colossal changes will also affect the fashion sector, primarily due to new textile solutions - smart fabrics.
Smart textiles, also called e-textiles, include electronic components, and can perform various functions. Smart textiles are intelligent systems, and they can react to environmental stimuli, collect information about it, and then use this information to react or adapt to circumstances (Ariyatum et al. 2005). E-textiles use electrical, thermal, mechanical, chemical, magnetic, and other inputs and outputs.

According to the results of the latest European Innovation Scoreboard, Estonia, a dynamic and rapidly developing country, is one of the strong innovators for the third year in a row and has made the biggest development leap in the seven years (Ministry of Education and Research 2021). Moreover, research and production of smart innovative textiles are developing rapidly in Estonia. The textile producer Protex Balti AS, for example, is working to create “a uniform equipped with speech recognition, GPS positioning, fall-down identification, activity monitor, and many other features.” (Life in Estonia 2018). An Estonian smart textiles researcher Kärt Ojave is also working with her team to develop helpful and innovative fabrics for hospitals. “One of the ideas they have is very simple – shadows of trees that move slowly over the ceiling changing the mood of the interior. The effect it will have on people becomes clear later, after presenting the first mockup,” Ojavee said.

Globally, smart textiles are developing at a high speed - this research area has widespread support from both the research and commercial sectors. For example, in Europe, the European Union is funding smart textiles research with up to more than €100 million, spread over more than 30 R&D projects (Coster 2009). The global smart fabrics market size was valued at USD 878.9 million in 2018 and is anticipated to expand at a CAGR (Compound Annual Growth Rate) of 30.4% from 2019 to 2025 (Market Analysis Report 2019). Drawing conclusions, we see that the combination of the latest tools and technologies with innovative smart materials is actively leading us towards a successful future for the global textile market.

1.2. Smart textiles and innovative technologies used in fashion

The term "smart material" was first introduced in Japan, in 1989, it was a "smart" material - silk thread with a memory effect. The discovery of shape-memory materials occurred in the 1960s, and smart polymer gels in the 1970s, although it was not until the 1990s that such textiles were brought to market (L. Van Langenhove et al. 2007). It can be assumed that these events led to the further development of this industry. Now the structure, production, and range of capabilities of smart textiles are much more complex. Electronic devices such as microchips, touch screens, batteries, sensors, and switches are sometimes embedded in intelligent materials. The difficulty is that such smart clothes should not only be useful and

innovative but also meet such conditions as comfort, durability, and environmental friendliness. It should be comfortable and familiar to people in performing useful functions, otherwise wearing such clothes will only complicate life and there will be no demand for smart textiles.

Smart textile materials are functional textile materials actively interacting with their environment, responding, or adapting to changes in the environment and smart textile systems are textile systems exhibiting an intended and exploitable response either to changes in its surroundings/environment or to an external signal/input.

Smart textiles can be made by incorporating smart materials, conductive polymers, encapsulated phase change materials, shape memory polymers and materials, and other electronic sensors and communication equipment. These materials interact – according to their designed features with the stimuli in their environment (Tao 2001) Via the incorporation of nanotechnology, the clothing itself becomes the sensor, while maintaining a reasonable cost, durability, fashionability, and comfort (Kalambur 2005).

Smart textiles can be divided into three subgroups depending on their level of intelligence (Zhang 2001):

- passive smart textiles that can only sense the environment, called sensors
- active smart textiles that can sense the stimuli from the environment and react to them, besides the sensor function they have an actuator function
- very (ultra) smart textiles that achieve the highest level of intelligence, they can adapt their behavior to the circumstances.

	Sensing the environmental conditions	Reacting to stimuli	Adapting behavior
Passive smart textiles	X		
Active smart textiles	X	X	

Very (ultra) smart textiles	X	X	X

Table 1. Classification of smart textiles

Source: own elaboration

Smart textile fibers and fabrics could stimulate the outside environment (such as heat, chemistry, light, humidity, machinery, electromagnetism, etc.). Moreover, they have such abilities as good self-adaptivity, self-judging, and self-healing (Lianzhen 2012).

We can find smart textiles in the fashion industry, to provide the garments with an enhanced aesthetic, improved performance, and interaction capabilities with the environment and external devices. As humans prefer to wear comfortable textiles rather than hard, rigid boxes, first efforts have been made to use the textiles themselves for electronic functions.

Smart textiles present a challenge in several fields such as the medical, sport, and artistic communities, the military, and aerospace. The early European Commission's 6th and 7th framework programs provided significant research and development funding for personal health monitoring through smart wearable systems and for projects targeting the integration of sensors, energy sources, processing, and communication inside the clothing. (Stoppa, Chiolerio 2014)

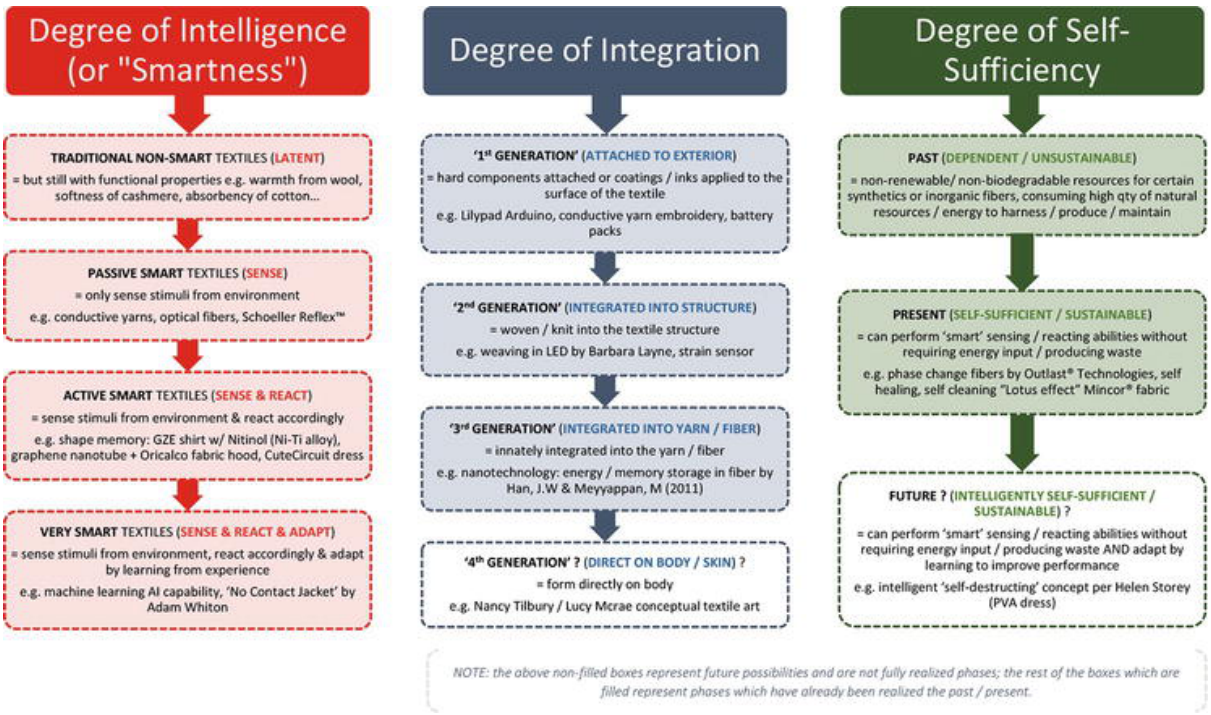

Figure 1. Flowchart summarizing the evolution of Smart Textiles & Apparel
Source: Dong 2019

1.3. Adoption of smart textiles

In the process of adopting and introducing a new trend or technology to the market, the most basic element is consumer attitude toward the new technology, and understanding the market and the needs of potential buyers are the key factors of success of the innovation. Smart textiles offer many benefits to the wearer and the industry is moving towards greater adoption, but there are issues that need to be addressed to make their use more widespread. The use of smart textiles in everyday life must be comfortable and look fashionable, and built-in technologies should not affect the comfort and washability of smart textiles, i.e. they must be durable enough to withstand daily use. Smart textiles can also be too expensive for the average consumer. Moveover, Hunn (2015) stated that if companies want to establish lasting revenue in the area of smart textiles, they need to develop compelling service models after sale - as software services will be central to smart clothing uptake.

The development of smart textiles requires the convergence of the fields of electronics and textiles, two contrasting industries. Two completely different industries - electronics and textiles - are involved in the creation of smart textiles, however, most research on smart textiles is carried out through the field of electronics, based little on aspects of textiles and its design. Developments focused on the clothing industry are unusual due to a lack of knowledge about new textile technologies or simply a lack of motivation to use smart fabrics in clothing (Ariyatum, Holland 2003). Finally, there is currently no clear direction for the development of smart textiles. (Cherenak, Peterson 2012).

Everett M. Rogers (2003) identified five factors that influence the acceptance of innovation and its future success. With the help of these identified adoption factors, potential barriers to the introduction of new ideas to the market can be identified in advance and improved. The newer an innovation and the higher the uncertainty associated with this newness, the more an individual is dependent on the innovation decision process. (Rogers 2003)

Figure 2. Variables determining rate of Adoption
Source: Lurin 2014

1. Relative advantage is the degree to which an innovation is perceived as better than the idea it replaces. Thus, the greater the society's perceived relative advantage of an innovation, the faster it will be adopted. In the case of smart textiles, it has many advantages over traditional clothing, as smart fabrics have various functions (interact with the environment, respond to and adapt to external stimuli).
2. Compatibility is the degree to which an innovation is perceived to be in line with the values, past experience and customer needs. The adoption of an incompatible innovation is difficult to adapt to the market, so smart textiles must also comply with all ethical norms, existing fashion styles and be appropriate for customers' current needs on the market.
3. Complexity is the degree to which an innovation is perceived as difficult to understand and use. New ideas that are simple and understandable to consumers are accepted much better and faster. The functions of smart textiles in this case should be well explained to the buyer, and should not cause difficulties in themselves.
4. Triability is the degree to which the buyer can experiment with the innovation on a limited basis. Thus, innovations that can be tried in advance will be adopted much faster due to the opportunity to gain experience and be more confident in the decision to purchase this new idea. Smart textiles should be available for fitting in offline stores or be available for ordering online.
5. Observability is the degree to which the results of the innovation are visible for the customers. Accordingly, smart clothes should be well marketed in order to be sufficiently discussed among potential buyers, then their adoption will be faster and more efficient.

Research (Lurin 2014) has shown that the first three factors—relative advantage, compatibility, and complexity—constantly affect the rate at which innovations are adopted. Those technologies that best meet these criteria are likely to reach the highest levels of saturation among potential users.

According to Rogers (2003), "the five attributes of innovation have been found to explain about half of the variance in innovations' rate of adoption". The other half is influenced by:

- intensity of promotional efforts, including through aggressive marketing campaigns;
- right timing and mix of media and interpersonal channels;
- whether the decision to adopt is made individually, collectively, by consensus, or authoritatively by the state or the management of the company, since collective decisions are disseminated more slowly, and authoritative ones more quickly.

Nowadays, the consumer wearables market continues to grow, resulting in investment in new smart textiles and their associated manufacturing technologies (Cherenack, Pieterson 2012). The following graph in Figure 3 is the illustration of the forecast of the possible growth in the market of smart textiles.

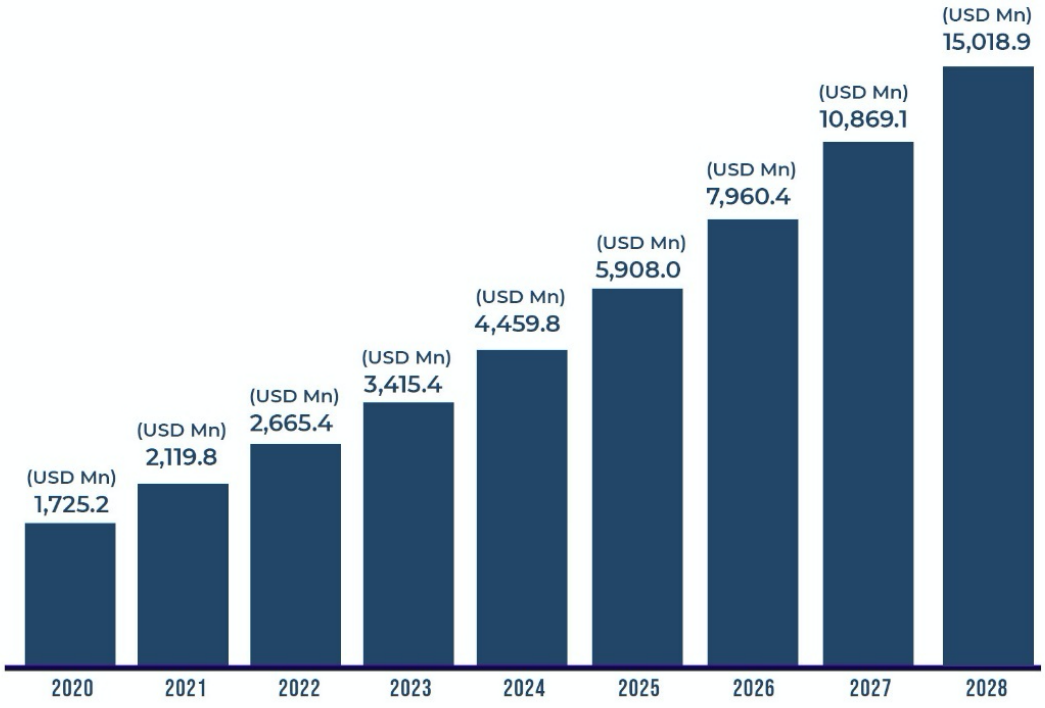

Figure 3. Global e-textiles and smart clothing market, 2021-2028

Source: Acumen Research and Consulting, 2021

2. BUSINESS MODELING FRAMEWORKS

The development of digital technologies, the emergence of the Internet, smartphones, AI, IoT, 5G "leads to the destruction of traditional barriers between computers, telecommunications and audiovisual industries." (Rédis 2007). It also brings great influence and change to the textile industry. Now the behavior of customers is changing, their principles and preferences are changing, as well as the fashion market is changing, entailing a restructuring of the competition of companies.

In this study we are going to analyze what new business models are potentially suitable for the most successful introduction of smart textiles to the market and how to develop them. “The concept of a business model refers to the company's position in the value chain and the nature of the partnerships it develops, as well as the degree of hybridization of business activities, financing methods and their development trajectories" (Rédis 2007).

Based on literature and previous studies, here are the main definitions of a business model:

Article	Definition of a Business Model	Components of a Business Model
Chesbrough and Rosenbloom, 2002	The business model is thus conceived as a focusing device that mediates between technological development and economic value creation.	1) articulate the value proposition; 2) identify a market segment; 3) define the structure of the value chain within the firm required to create and distribute the offering; 4) estimate the cost structure and profit potential of producing the offering, given the value proposition and value chain structure chosen; 5) describe the position of the firm within the value network linking suppliers and consumers; 6) formulate the

		competitive strategy by which the innovating firm will gain and hold an advantage over rivals.
Magretta, 2002	Business models describe, as a system, how the pieces of a business fit together. Business modeling is, in this sense, the managerial equivalent of the scientific method – you start with a hypothesis, which you then test in action and revise when necessary.	The author mentions that business models must pass two tests: the narrative test (who are the customers, what do they value, and how does a firm make money by providing them with that value) and the numbers test (the customer assumption must be linked to sound economics for the company to make a profit).
Shafer et al., 2005	A business model is a representation of a firm's underlying core logic and strategic choices for creating and capturing value within a value network.	1) strategy selection, 2) value creation, 3) value capture, and 4) value network
Rasmussen, 2007	The business model concept is concerned with how the firm defines its competitive strategy through the design of the product or service it offers to its market, how it charges for it and what it costs to produce. How it differentiates itself from other firms by the nature of its value proposition. It also describes how the firm integrates its own value chain with that of other firms in the industry's value networks.	1) who the customers are, what they value, 2) how that value can be delivered to the customer at an appropriate cost, 3) and how the business deploys its assets.

Zott and Amit, 2010	A business model is "a system of interdependent activities that transcends the focal firm and spans its boundaries. The activity system enables the firm, in concert with its partners, to create value and to appropriate a share of that value."	1) Activity system content, 2) structure, and 3) governance
Osterwalder and Pigneur, 2009	A business model describes the rationale of how an organization creates, delivers, and captures value.	1) Customer segments, 2) value propositions, 3) channels, 4) customer relationships, 5) revenue streams, 6) key resources, 7) key activities, 8)key partnerships, 9) cost structure.
Afuah, 2003	A business model is a way for a company to make money. It is the set of activities a firm does, how it does it, and when it does it to offer its customers the benefits they want and make a profit	1) activities, 2) industry factors, 3) costs, 4) resources, and 5) positions.
Johnson et al, 2008	A business model is a set of four components that are connected to each other to create and deliver value	1) Customer value, 2) profit formula, 3) key resources, and 4) key activities.

Table 2. Business model's definitions

Source: Composed by the author based on the existing business models definitions

Implementing a better business model can help a business ensure that a product or business unit is separated into an existing or different market (Ritter, Pedersen 2020). The main goal of

any business model is to create a sustainable chain, as well as unlock value for market participants, which is determined by the value proposition or promise of key players and partners in the market (Seetharaman 2020). Performance measurement is presented through value creation, while value measurement is about value proposition and customer management (Osterwalder, Pigneur 2010). As we can see, the resources and competencies of the firm, the value proposition, and the organizational system constantly interact; thus, changing one element will affect not only other elements but also the interaction between these elements. This can affect business performance both positively and negatively (Demil, Lecocq 2010).

Thus, the business model can be called the most important aspect of the success of any startup, and the development of a business model itself is an extremely holistic approach that is needed not only to monetize a business but also to increase its value and further development. Moreover, companies should strive to improve their offering by meeting key customer needs, given the rapid development of digital technologies. It is important for companies to successfully enter the market, to have the ability to compete both with other small companies and with international giants (Google, Amazon, Apple, etc.).

2.1. Business model navigator

Gassmann, Frankenberger, and Csik developed a business model - “a magic triangle”, consisting of four main dimensions: who, what, how and value (see Fig. 4). Also, they identified 55 business model patterns by analyzing 250 BMs across the four dimensions of the schema. The authors suggest that 90% of BMs that exist today can be broken down into the same 55 patterns (Gassmann, Frankenberger, Csik 2014).

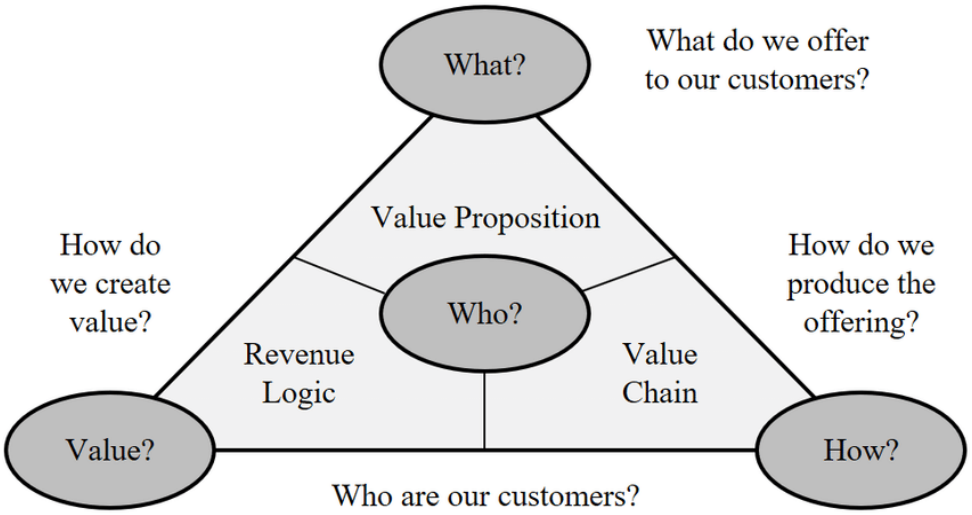

Figure 4. The magic triangle of business models
Source: Gassmann, Frankenberger, Csik 2014

The first question in the “magic triangle” is "Who is the consumer?". Each business model serves a specific group of customers (Chesbrough, Rosenbloom 2002; Hamel 2000). "Failure to adequately define the market is a key factor associated with enterprise failure" (Morris et al. 2005), so it is important to correctly identify who the company's target customer is in the process of creating a business model.

The second dimension describes what is offered to the target customer or what the consumer values. This is called the customer value proposition (Johnson et al. 2008). It can be defined as a holistic view of the set of company products and services that provide value to the customer (Osterwalder 2004).

The third question of the business model is how? The company's processes and activities, together with the resources (Hedman and Kalling 2003) and capabilities (Morris et al. 2005) involved, and their alignment in the focus firm's internal value chain, enable the firm to intelligently create and disseminate its value proposition.

The fourth dimension focuses on why the business model is financially viable. This aspect describes the value. It combines the income and expenses of the company and considers the mechanisms for making a profit.

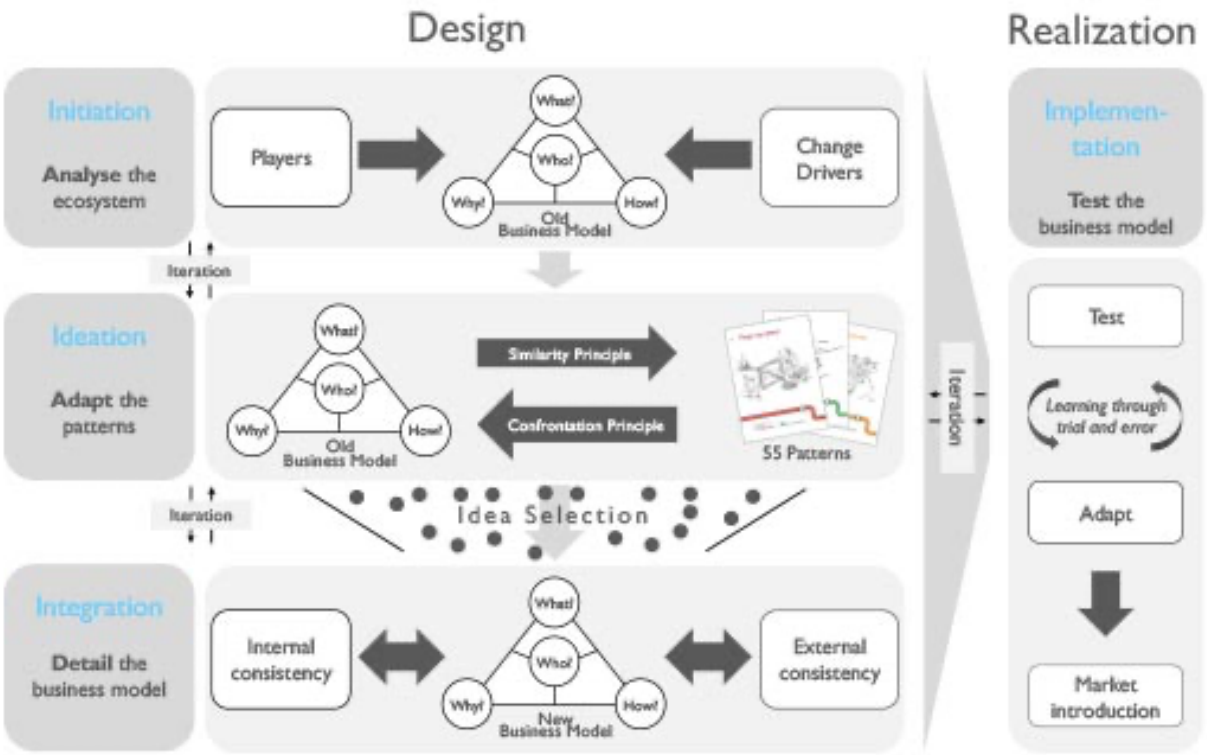

Figure 5. St. Gallen business model navigator

Source: Gassmann, Frankenberger, Csik 2013

The navigator business model consists of four stages, namely, initiation, ideation, integration, and implementation (see Figure 5). In the first step, a new business model is started by describing the current business model using the "magic triangle" mentioned above. Thus, shortcomings and inaccuracies of the business model are found, and ideas are created to change them. Next, in the ideation phase, 60 business model templates are applied to an existing BM organization to develop new BM ideas. They are applied both according to the principle of similarity and the principle of opposition.

Next, 5-8 patterns are named, which are transferred to the current BM of the organization to identify suitable ideas for solving previously found organizational problems. At the integration stage, ideas are transformed into new consistent business process models, considering the internal requirements of the organization and the external environment. After designing a new BM, the implementation phase is carried out. For smooth implementation, it is suggested to minimize the risk by testing BM on a small scale. After choosing a prototype, a market entry can be made.

3. RESEARCH METHODOLOGY

This chapter gives an overview of how the research was planned and conducted, including the research methods used, questionnaire design, and data collection and analysis methods.

3.1. Research plan and design

The aim of the research is to determine how the development, acceptance, and consumption of the fashion industry in Europe affect the development of innovative technologies such as smart textiles in Estonia. The main research question is - how to develop new business models to bring to the market smart but stylish textiles or wearables (based on cutting-edge technologies such as 5G, AI, IoT, data science, or big data), while preserving the European sustainability principles and fashion styles? The second one is “What is limiting the adoption of smart textiles in Estonia?” The last research question - “What is the level of awareness of smart textiles Estonian people have at the moment?”
To collect a broader set of data in order to obtain an initial understanding of the topic, a primary quantitative method of questionnaire research was used. An online questionnaire was chosen as the data collection method due to its convenience, while the Google Forms platform was used to design the survey due to its ease of use. The purpose of the survey was to understand the attitude of Estonian residents toward such an innovation as smart textiles, their awareness of this, and their opinion on the topic.

Survey planning began with the development of question topics based on the authors' research questions and background information collected on the topic of smart textiles. Questions were then designed using the attitude and technology acceptance models (Davis, 1989). Mostly closed, multiple-choice questions with one or more answers were used, with the addition of some questions on a five-point Likert scale. Also, part of the survey was a vote, in which it was necessary to choose one or two predictions based on the business model navigator.
The structure of the survey was kept simple and included the introduction of the research and questionnaire, the main part with questions related to attitudes, expectations, and awareness regarding smart textiles, and the final part with questions related to predictions based on various companies applying their existing business models on the smart textiles' business.

Respondents were also presented with an opportunity to present feedback or questions about the survey in the final part through an open-ended question. The time that it took to complete the survey was tested to be about 5-10 minutes on average, which was an appropriate length to keep the respondents attentive and interested.

The study included the search for new business models for bringing smart textiles to market, one of the business model innovation approaches - business model navigator - was used for ideation. It helps to understand the key drivers of business model success, as well as foresting business model innovation via a structured approach. 60 business model patterns identified by Gassmann et al. (2014) were analyzed and 10 of them were selected for further creation of a new business model. Predictions were made, based on the description of each of the 10 selected patterns, about how each individual company with a different business approach could run a smart textile/clothing company. Further, based on the votes of the survey participants, one business model was selected for further consideration.
In this study the first two stages of the business model navigator are done: initiation and ideation.
For the assessment and the selection of BM ideas, the iterative NABC approach (need, approach, benefits, and competition) has proven successful. Based on key questions, each idea that can be clustered is described from four different perspectives. Afterward, they are presented in an elevator pitch and then discussed. On this basis, weaknesses and challenges are addressed, novel ideas are applied, assumptions are revised and a new NABC is elaborated. Subsequently, another cycle of presenting and discussing ideas is and one to two ideas are selected. To gather a wider set of data in order to get an initial understanding of the topic, the primary quantitative research method of questionnaire research was used. An online questionnaire was chosen as the data gathering method for its convenience, and the Google Forms platform was used for designing the survey for its ease of use.

The magic triangle business model developed by Gassmann et al. (2014) was used for the visualization of business models. It consists of four central dimensions: the Who, the What, the How, and the Value. This business model framework builds the foundation of those 55 business model patterns.

The result of carrying out this approach is a new marketable BM, which can be launched next.

3.2. Data collection

The survey was distributed mostly by using the author's own contacts and shared through different social media platforms like Instagram and WhatsApp. As the target group of the research was relatively narrow and finding respondents proved to be rather difficult, school staff was also contacted to get help with reaching university students in Estonia. The target audience was Estonian citizens and residents of different ages, mostly the younger generation, as they can be potential consumers of smart textiles and their responses and needs give us a deeper understanding of the acceptance of smart textiles in Estonian society. The data collection period was one week from the 11th of April to the 17th of April 2022 and provided a total of 91 responses.

The first two questions were about the gender and the age of participants. Out of the 91 respondents, 49 were male and 42 female which represents the approximate equality of the respondents. The age groups of respondents are visualized below (Figure 6), which shows that most of the respondents were between 18 to 28 years old as expected since the survey was aimed mainly at the younger generation, prone to novelty and innovation, but also many people noted the age category 29-39 years old. And only ten of 91 respondents have chosen the 40-50+ category.

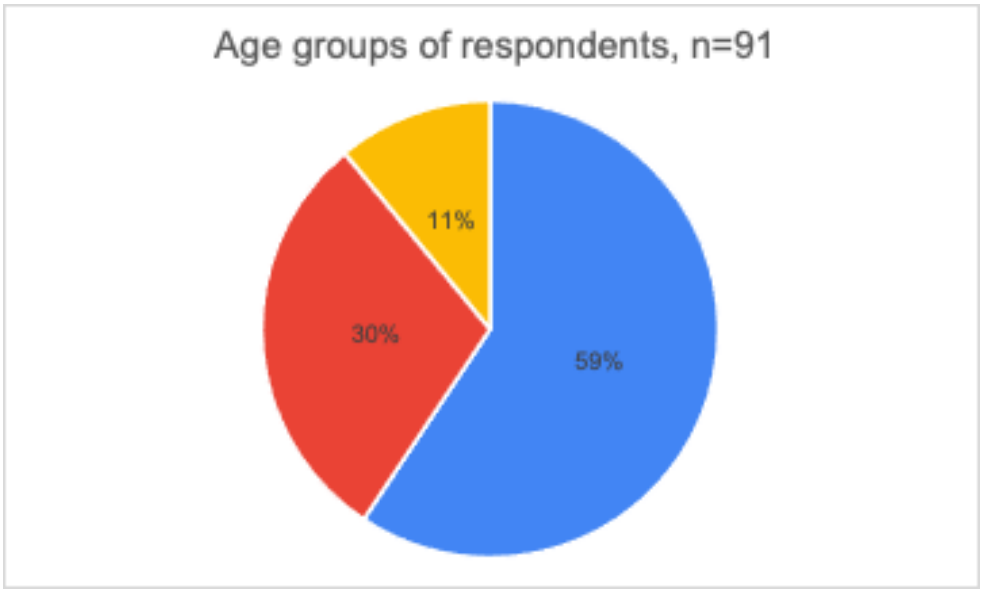

Figure 6. Age groups of respondents, n=91

Source: Composed by author

3.3. Analysis of data

At the end of the data collection period, the collected data were manually checked for response problems and then imported into Microsoft Excel for further analysis. Using MS Excel, a descriptive statistical analysis method was used to organize the data and create charts to help visualize the results. IBM SPSS was used to find correlations between the smart textiles' claims shown in Figure 12, for which the results can be examined in more detail in Appendix 2.

For finding possible correlations between statements, Spearman's rank correlation coefficient ρ (rho) was calculated for some of the data. Spearman's correlation is calculated with the ranks of the values instead of actual values, which makes it suitable for ordinal data like a Likert scale. Spearman's coefficient ranges from -1 to +1 with 0 meaning no correlation between the data and 1 or -1 meaning perfect correlation. Coefficient value of 0.10-0.39 shows weak correlation, 0.40- 0.69 moderate correlation, 0.70-0.89 strong correlation and 0.90-1.00 a very strong correlation between the data. (Schober *et al*. 2018)

For the statements about smart textiles (Figure 12), the Likert scale data was also converted to values according to the following scale: 1 - strongly disagree, 2 - disagree, 3 - neutral, 4 - agree and 5 - strongly agree, in order to be able to calculate the average agreement levels for further analysis. Average values for agreement levels were calculated for all answers (n=91).

For the assessment of two business model ideas that were identified with the help of survey participants' votes, the iterative NABC approach (need, approach, benefits, and competition) has been used. Based on key questions, ideas were described from four different perspectives. Afterward, they were presented in an elevator pitch and then discussed. Further, to visualize the chosen idea, a business model was drawn - a "magic triangle" consisting of four dimensions – the What, the Who, the How, and the Value.

4. EMPIRICAL ANALYSIS

The first part of the empirical analysis chapter presents the results of the survey by applying the descriptive statistical analysis methods and includes charts composed in MS Excel to help visualize the results. Second part of the chapter focuses on the NABC analysis of selected business models.

4.1. Analysis of survey results

The first question in the main part of the survey was meant to observe the awareness level that the respondents had of smart textiles by asking them directly their own assessment of the familiarity they had with the concept. As seen in Figure 7 below, the knowledge level on the subject was relatively low according to respondents' own assessment as 39 of the respondents stated that they were only slightly familiar with the concept, and 35 of the respondents were not familiar with the topic at all. Only the other 17 people were moderately familiar, very familiar or extremely familiar with smart textiles (18,7% of all the participants).

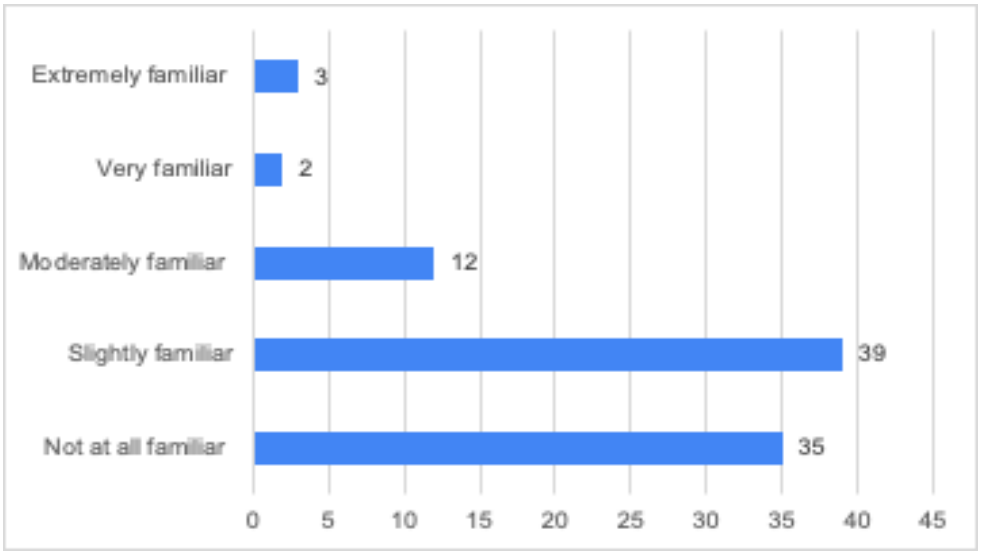

Figure 7. Respondents' familiarity with the concept of smart textiles, n=91
Source: Composed by author

The next question revealed how many people have ever texted smart textiles themselves. Based on the answers shown in Figure 8, the majority, namely 76 people out of 90, have never come across smart textiles in their lives. However, 14 people are familiar with this concept and have been tested.

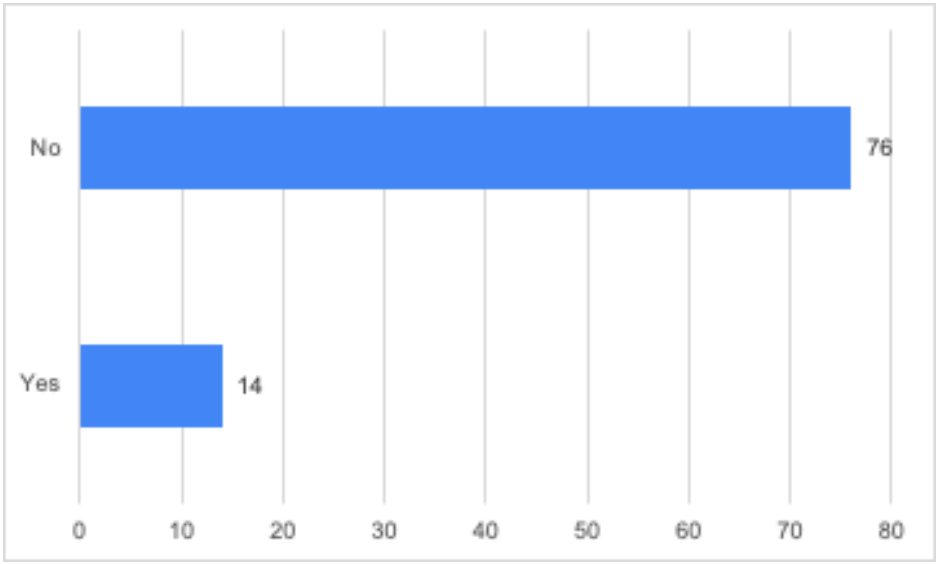

Figure 8. Respondents' experience using and testing smart textiles themselves, n=91
Source: Composed by author

The respondents were asked to assess the biggest advantages that could be achieved with smart textiles by choosing from a list of the advantages most associated with the technology. The result can be inspected in Figure 9. The respondents were asked to choose up to two options associated with smart textiles, but some of the respondents chose only one option, bringing the total number of answers to 171. The most associated advantage with smart textiles was that they look modern, innovative, and fashionable with 48 answers. The second most voted statements were that they are sustainable and environmentally friendly (41 answers), and comfortability, durability, and resistance to regular wear (40 answers). The ability to monitor your health got 17 answers and the possibility to stay connected without using your phone gained 16 answers. Three of the respondents thought smart textiles have no advantages and six could not answer.

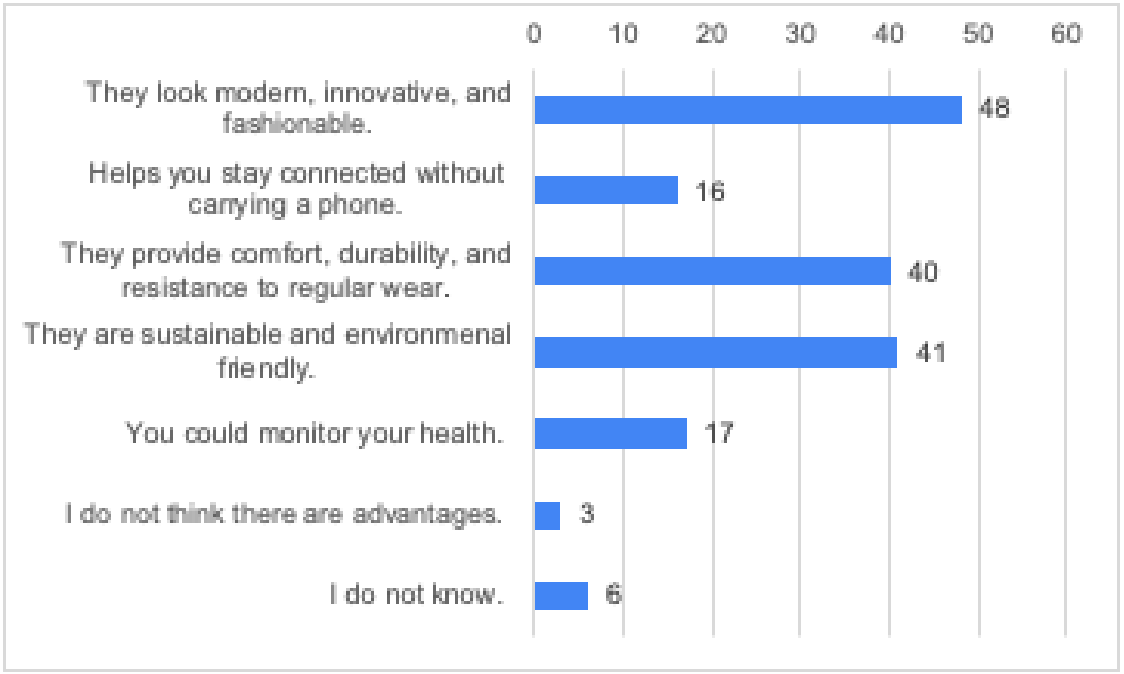

Figure 9. Advantages associated with smart textiles, n=91

Source: Composed by author

The perceived disadvantages were asked with the same type of question as in the previous question and respondents were again asked to choose two options that seemed most fitting to them (the total number of answers was 153). The data presented in Figure 10 shows that respondents were most concerned equally about the waterproof issues of smart textiles with 38 answers, and non-compliance with medical rules and regulations with 37 answers. The inaccuracy of data gained by smart wearables was a fear of 27 respondents. The lack of strength and durability of the materials used was chosen by 23 participants, and the fact that smart clothes would look too technological and unsuitable for everyday wear - by 13 participants. Only 10 answers were that there are no disadvantages associated with smart textiles and 5 respondents did not know how to answer.

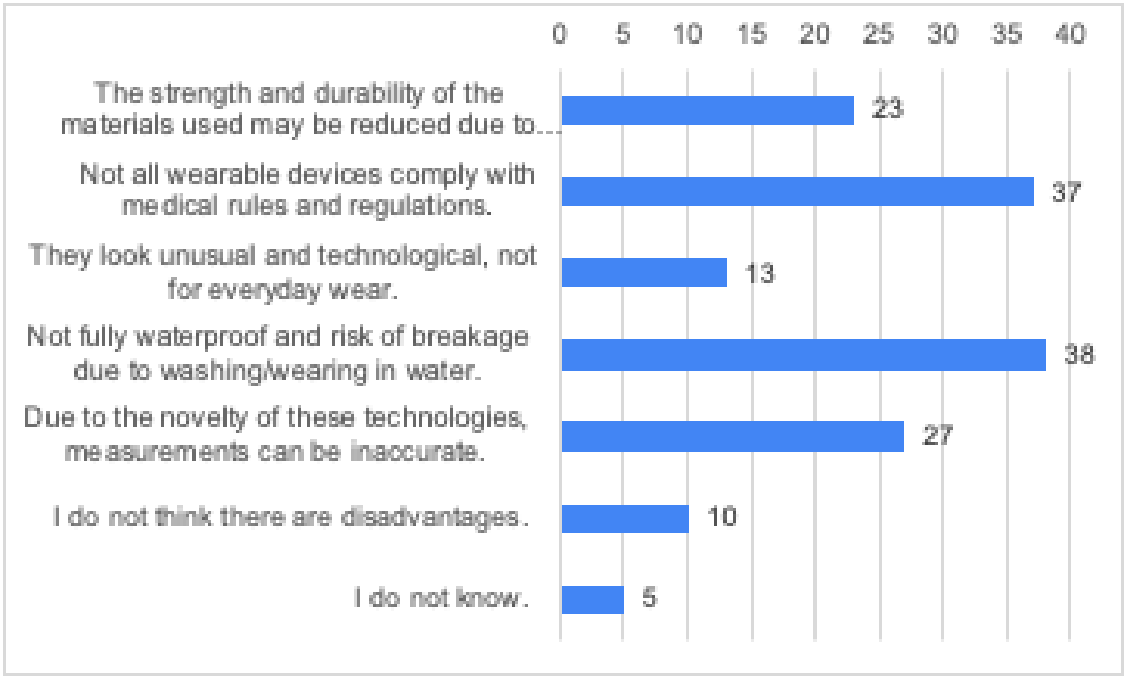

Figure 10. Disadvantages associated with smart textiles, n=91

Source: Composed by author

In Figure 11 we can see how long the respondents expected the mass adoption of smart textiles will take. The most popular answer for this question was 5-10 years with 32 answers, followed by 5 years with 20 answers, and 10-15 years with 19 of the answers. Twelve respondents predicted mass adoption to happen in 15 to 25 years, two in 25+ years, one believed they would never see mass adoption and five respondents did not know how to answer.

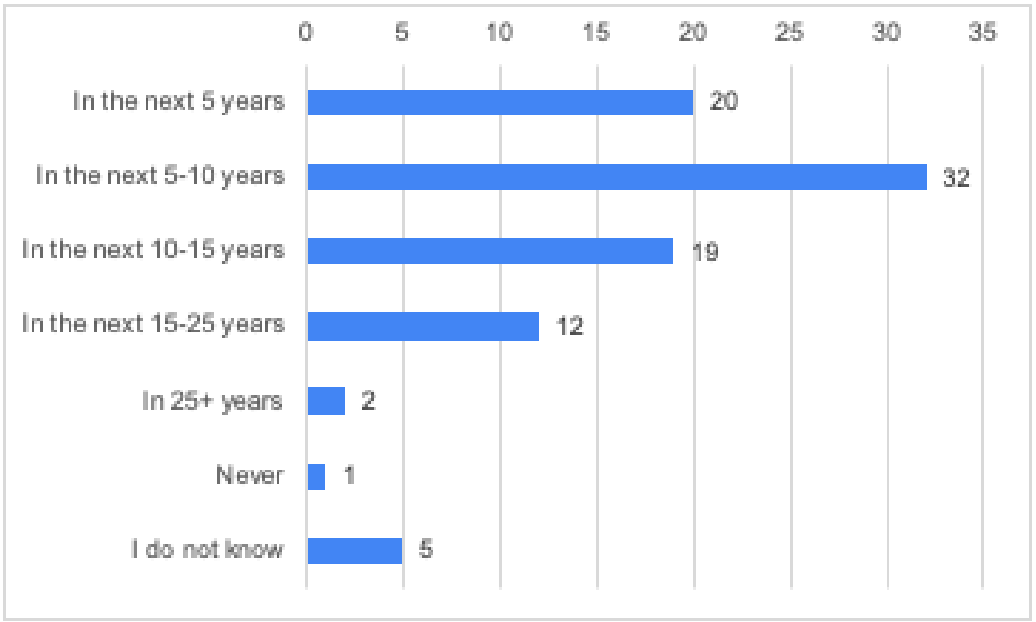

Figure 11. Respondents' estimation of when smart textiles will get mass adoption, n=91
Source: Composed by author

The respondents were also asked what industry will be the first to extensively adopt smart textiles in their opinion. Figure 12 shows that the fashion industry is considered the first field to adopt smart textiles by the biggest group of respondents with 26 answers. Military and security (21 answers) and sports (18 answers) were the next most voted options. The fields of science and healthcare gained 13 and 8 answers respectively. Four people did not know the answer to the question.

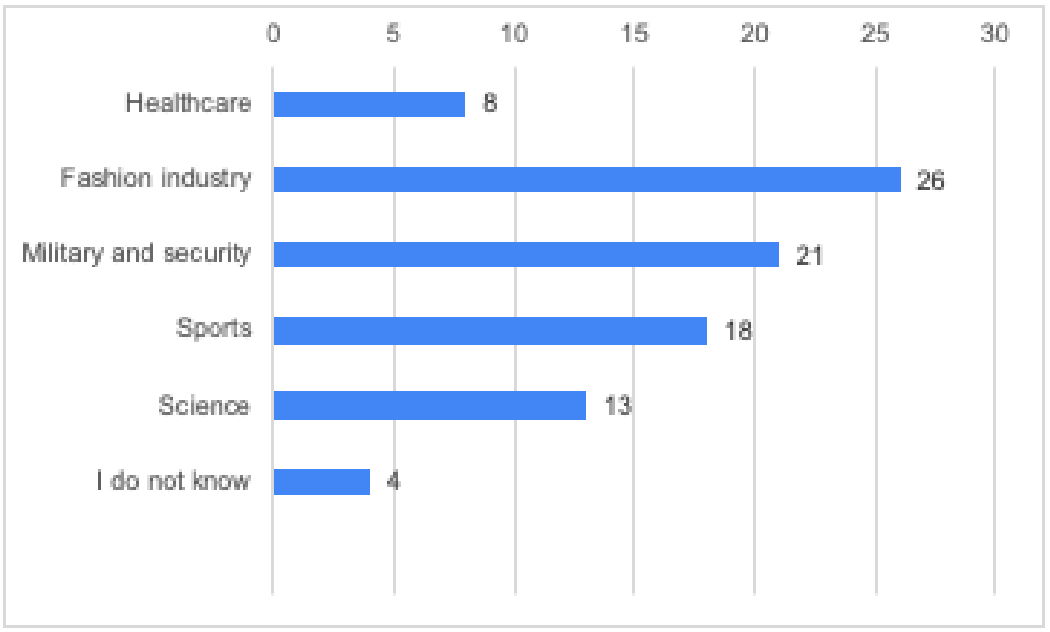

Figure 12. Respondents' estimation of what industry will first widely use smart textiles, n=91
Source: Composed by author

The respondent's attitudes toward smart textiles were measured by gathering data on the agreement level the respondents had with the statements presented in Figure 13. A five-point Likert scale was used for the option choices including strongly disagree, disagree, neutral, agree, and strongly agree. The respondents mostly agreed with the statements about the advantages of smart textiles, e.g., only 20 respondents disagreed or strongly disagreed with the statement that they would like to buy or wear smart clothes. Almost half of the people (44 answers) agreed and strongly agreed that the production and usage of smart textiles would be

more environmentally friendly, and more than a half (52 answers) of people were sure that smart clothes will look fashionable and trendy. 53 and 54 people are excited by the possibilities offered by new technologies and see no barriers to using smart textiles in everyday life respectively. Looking at the question of comfort in wearing smart clothes, most people (37 answers) chose a neutral answer, however, only 13 completely disagreed or disagreed, while the rest considered smart clothes to be comfortable. Only 14 people found themselves skeptical about the reliability of smart textiles, and only 20 people out of 91 were not interested in fashion. Talking about the disadvantages of smart textiles, 48 participants agreed and fully agreed that smart clothes will be too expensive for an average consumer. People's opinion about the dangers of smart textiles for health was divided into almost equal answers among disagreeing, neutrality and agreeing: 23, 25, and 24 votes, respectively. However, 16 people completely disagree with such a negative impact of the new technology, and only three people completely agree. The last question was about personal security and privacy issues and 28 people agreed with the statement, while others (33 people) disagreed with it.

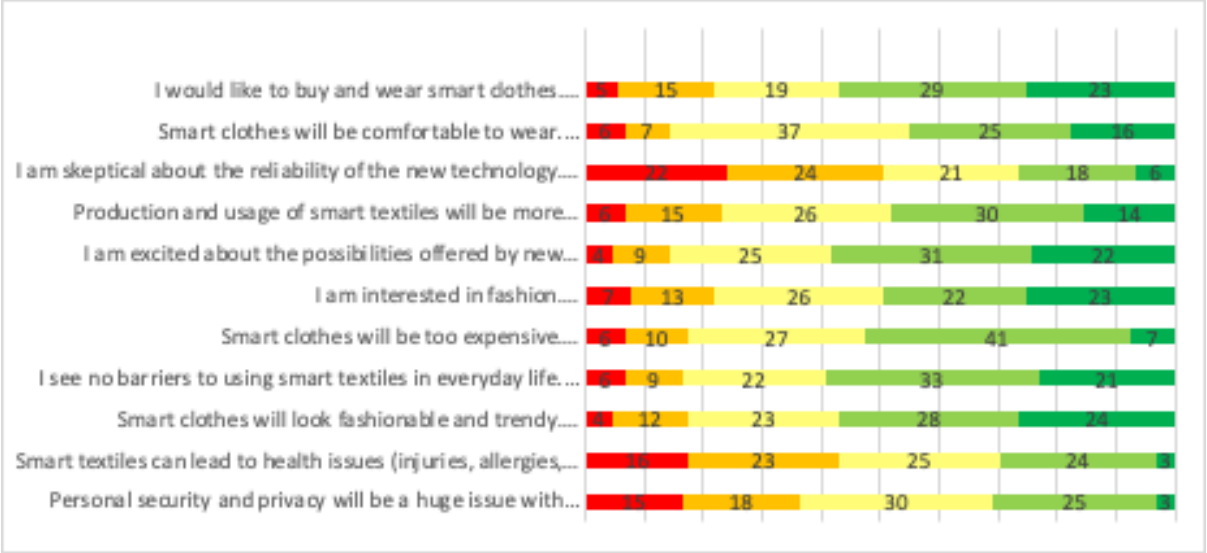

Figure 13. Likert scale of respondents' opinion about smart textiles, n=91
Source: Composed by author

Correlations between answers for the statements were analyzed by using IBM SPSS software which revealed some moderate correlation between the statement answers (Appendix 2). The answers to statements about willingness to buy and wear smart clothes were found to correlate positively with answers to statements about the comfortability of smart clothes, their

environmentally friendliness, excitement of the possibilities offered by new technologies, seeing no barriers to using smart textiles in everyday life, and fashionability and trendiness of smart clothes. Significant correlation was also observed between statements about the interest of participants in fashion and the statement about fashionability of smart clothes which means that people who are following current trends in fashion are open to innovations and believe that smart clothes will follow these trends and can become part of the daily style. The third and fifth statements were both related to the attitude to the possibilities of new technologies but were formed as a positive statement for the one and negative for the other and had a negative correlation, which shows that respondents were attentive to the questions during the survey.

The two most voted predictions on the ideas based on the business model navigator were Zara and Amazon. Their business models are “From push to pull” and “Long Tail” relatively. The “From push to pull” pattern describes the strategy of a company to decentralize and thus add flexibility to the company's processes in order to be more customer-focused. To quickly and flexibly respond to new customer needs, any part of the value chain - including production or even research and development - can be affected. Instead of concentrating on blockbusters, the main bulk of revenues in the “Long Tail” business model is generated through a 'long tail' of niche products. Individually, these neither demand high volumes nor allow for a high margin. If a vast variety of these products are offered in sufficient amounts, the profits from resultant small sales can add up to a significant amount.

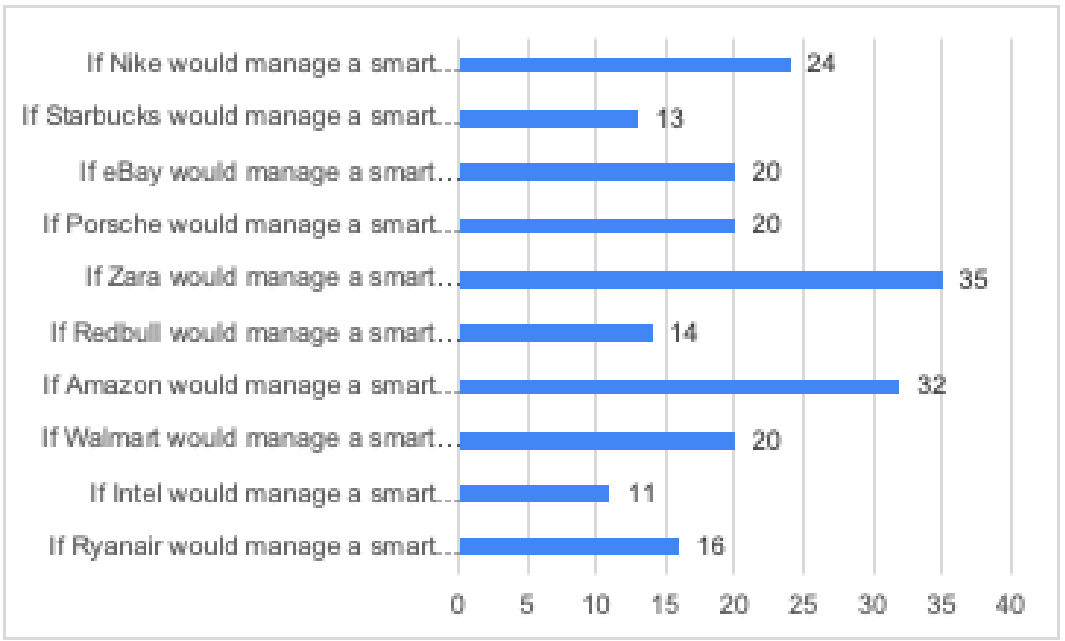

Figure 14. Participants' predictions on ideas that were based on the business model navigator
Source: Composed by author

4.2. NABC analysis

Business models were analyzed with the help of an NABC analysis. NABC includes four core principles that define a project's value proposition.

NABC Analysis of the Long Tail Business Model:

1. Need: The ability to buy smart clothes online for convenience, while having a large selection of products based on customer preferences and recommendations on the site, at an affordable and relatively low price, with fast, convenient and free shipping. This need is currently not being met.
2. Approach: Creation of an online smart clothing and smart textiles retail store in Estonia, including both the most popular and purchased goods, as well as less popular, but necessary for a particular buyer, based on his desires and personal needs. The sellers will be companies that produce smart clothes, displaying their products on the site for a percentage of the sale. Thus, the prices will be relatively low, the order can be placed remotely, and the delivery will be carried out immediately using the online store itself and delivery services.
3. Advantage: Reduced marketing and distribution costs, as well as the sale of many niche products. Also, there is no need for storage costs due to cooperation with manufacturing companies. Mechanisms collect data about the needs of buyers, which allows them to recommend the right products to them, increasing the chance of a sale. It is convenient for customers to buy the necessary goods online thanks to convenient search and recommendations, at low prices, as well as in the shortest possible time to receive orders.
4. Competition/Alternatives: There are currently no such platforms on the market that specialize in the online sale of smart clothes. Amazon uses the same business model, but does not specialize specifically in smart textiles, and the delivery time for goods to Estonia is much longer, since the logistics consists of more stages.

The NABC analysis of a "From Push to Pull" business model:

1. Need: Buying fashionable clothes based on the latest trends, fast fashion, at an average price. You can also try on clothes yourself in a physical store and immediately pay for the purchase.
2. Approach: Opening a physical store of smart clothes in Estonia, mostly produced in-house, rather than outsourcing. Quick response to new trends, creating collections regularly, based on changes in the industry, and not several years ahead. Trend collections are limited, and basic products of different styles are always in stock.
3. Benefits: More than 50% of smart clothes are produced in-house, reducing outsourcing costs and speeding up response to the latest trends. Also, the limited number of products prevents the "supply more than demand" problem. Clothes are presented in different styles, allowing the client to always find the right model. Some smart products are simply made from eco-friendly materials, and some include many smart features, so that the price range also covers the needs of various customers. The company spends less money on production, reduces the cost of advertising, storage, and there is no need for frequent and large discounts on goods.
4. Competition/alternatives: There are currently no similar smart clothing stores in Estonia, but some brands, such as Spektr, provide customers with eco-friendly, waterproof, innovative fabric clothing. However, focusing on a large audience and adjusting collections specifically to the needs of buyers and trends makes it possible to make prices lower, and demand and recognition higher.

4.3. A “magic triangle” of business models

At this stage of integration, the ideas that have passed through the NABS analysis are transferred to a new business model. In the business models below, four dimensions are described and interconnected. External coherence raises the question of the extent to which new business models meet the needs of different actors and how trends and competitive conditions meet. “Magic triangle” business models were done for the “From Push to Pull” and “Long Tail” strategies for smart textiles companies as a visualization part of a research.

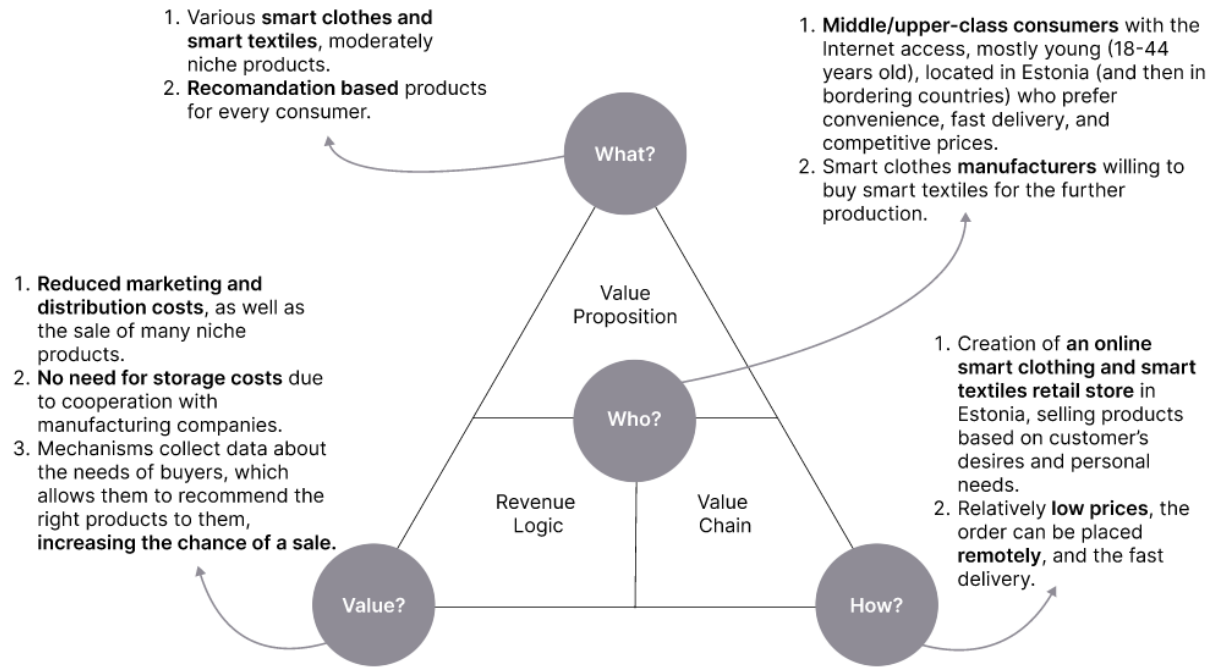

Figure 15. A "magic triangle" business model (Gassmann, Frankenberger, Csik 2014) of a smart textile company based on the "Long Tail" business model.

Source: Composed by the author

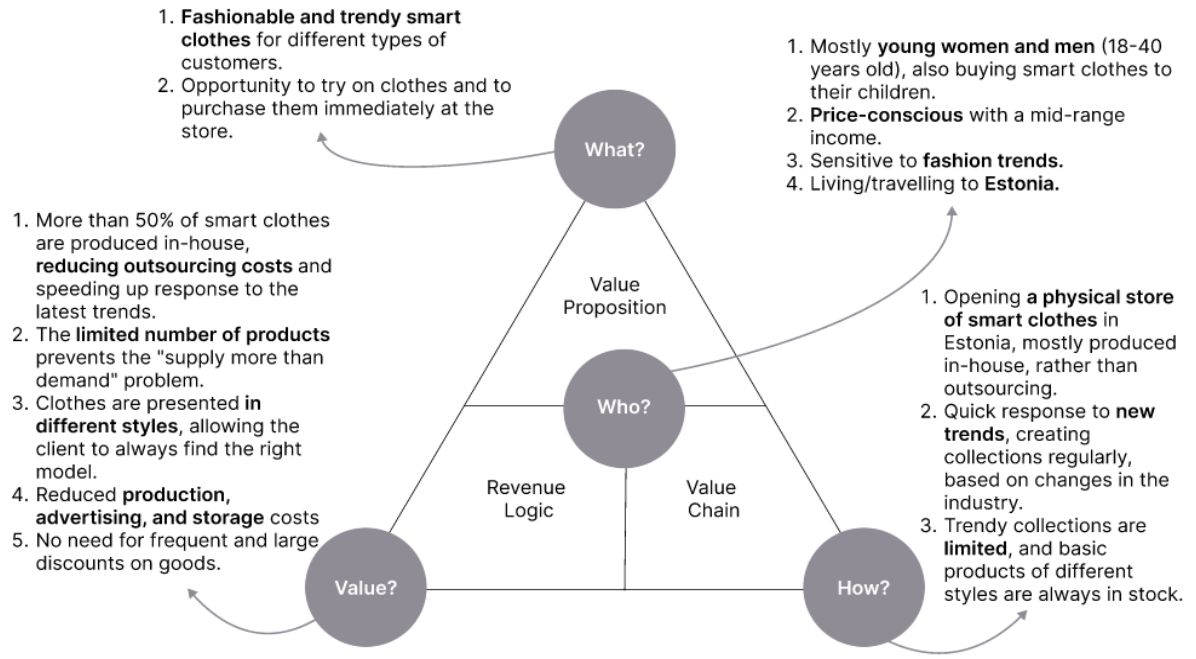

Figure 16. A "magic triangle" business model (Gassmann, Frankenberger, Csik 2014) of a smart textile company based on the "From Push to Pull" business model.

Source: Composed by the author

DISCUSSION

A large number of respondents were unfamiliar or slightly familiar with the topic, 74 out of 91 answers. The relatively low knowledge level can partly be explained by the fact, despite the fact that Estonia is one of the fastest innovators in Europe, smart textiles are not yet widely used in society and this topic is not yet hotly debated among citizens. But, based on the survey, it is clear that the majority of people are interested in this topic and would like to buy smart clothes, 52 out of 91 people agreed with this.

The most common advantage linked to smart textiles by the respondents was fashionability, modernity and trendiness of smart textiles efficiency with 48 answers. It means that people believe that smart textilesõ first of all, should focus on fashion trends, match the style, and then they can be applied both in the fashion industry and in people's daily wear. This is also confirmed by the fact that the biggest number of the votes (26 out of 91) were received by the fashion industry as the field that is the first to widely adopt smart textiles.

One more important finding is that 40 people believe that smart clothes will be comfortable to wear, and 41 stated that smart textiles are environmentally friendly. It can be connected to the fact that European fashion style is considered to be comfortable, moderately simple, and following the latest fashion trends. Thus, the development of smart textiles and the creation of smart clothes should primarily rely on these key adoption factors.

With disadvantages associated with smart textiles, the most voted ones were the problems with medical rules with 37 answers out of 91, the risk of breakage due to washing with 38 answers, and 27 people stated that they are worried about the health issues caused by smart textiles. It can be explained by the fact that this technology is innovative and not yet well understood by consumers, resulting in a lack of trust in smart clothing. Also, 28 of 91 participants are worried about the privacy and personal security issues. However, testing and researching smart clothes and observability and trialability as factors influencing adoption can help convince customers who are risk averse and put off using the technology because they are unsure about the technology.

The biggest concern of the interviewed about smart textile is the too high price for smart clothes. More than half of the respondents, 48 out of 91 participants, thought so. This may be

the most difficult challenge that smart textiles will face in the adoption process, as innovative materials and manufacturing will be costly for the companies themselves.

Speaking about the business model results, the navigator business model was applied in only two stages, which provides a basis for future research and companies wishing to produce smart textiles in Estonia. It was found that the “Long Tail” and the “From Push to Pull” strategies may be the most suitable for introducing smart textiles to the Estonian market. In the first case, an online platform could be created for the sale of both smart clothes and individual smart textiles through vendors. Thus, manufacturers will be able to find an audience for their products, and the company itself will be able to both receive a percentage of sales to the site, and eventually launch its own production of smart clothes, also selling it in its online store. If, however, the From Push to Pull model is used, the company can open a physical store as a "mass market" for smart clothes, where the main principle will be to follow the constantly changing European fashion trends. Thanks to our own production right in Estonia, outsourcing and logistics costs can be reduced, as well as regular creation of smart clothes based on the preferences of store customers and fashion trends will help increase company awareness, increase sales, and reduce the risks of the futility of the products sold.

In the process of further developing business models for smart textile companies, it is necessary to take into account the comfort, environmental friendliness and fashionable style of smart textiles created, as revealed in the study.

CONCLUSION

Estonia is a developing, innovative European country striving for an environmentally friendly lifestyle, in which the fashion industry also plays a big role. There are already several companies specializing in smart textiles in Estonia, but little research has been done on the Estonian market on this topic.

The study found that Estonian residents are relatively less aware of the topic of smart clothes, but the majority believe that they will be more environmentally friendly, more comfortable, and would also like to buy and wear them. Also, based on the votes of the respondents, two business models were selected for further research, which were further applied to the field of smart textiles. Thus, the aim of the study was to collect up-to-date information on the level of awareness and attitude of Estonian citizens and residents towards innovative smart textiles, as well as to find out what new business model can be created to successfully introduce new textile solutions to the market. The target group chosen for the study were people of different ages and gender, but more emphasis was placed on the younger generation, as they are always more inclined towards innovation and the latest technologies. It was found that the European style of clothing and its trends are also important for consumers in Estonia, as many people are interested in fashion, want to be well-dressed and follow fashion trends, and at the same time are ready to use and buy smart clothes that combine useful technologies and stylish solutions.

The following research questions were established to help reach the aim of the research:

RQ1: How to develop new business models to bring smart but stylish textiles or wearables to the market while preserving the European sustainability principles and fashion styles?

RQ2: What is limiting the adoption of smart textiles in Estonia?

RQ3: What is the level of awareness of smart textiles Estonian people have at the moment?

Firstly, to answer the research questions the quantitative research method was used and an online survey using Google Forms was conducted to gather the data. Convenience sampling was used for the survey and it got 91 responses of Estonian citizens. Then, the answers were analyzed with the help of the Microsoft Excel and IBM SPSS software. Secondly, the business model navigator was used for the ideation stage, the NABC analysis was applied to

the most voted business models' predictions and the "magic triangle" of the business models were done for the visualization.

The limitations of the research are the relatively small number of participants of the survey and also only two stages of the business model navigator because the last two are not feasible to do in this research.

For future researchers in the smart textiles' field in Estonia, several suggestions are presented. Due to the fact that there were relatively few participants in the survey, research of a wider audience may be necessary in further studies for the accuracy of the results, and a specific target group among people from the fashion industry can be chosen in order to better understand the connection between European style and smart clothes. Also, to study the business models of companies involved in smart textiles, it was possible to conduct interviews with already existing Estonian companies in order to find out more specifically what business models are currently used here, their advantages and disadvantages. Moreover, for a deeper understanding of the topic, specific smart textiles can be taken for further research, for example, smart textiles with special sensors designed for medical workers, or fabrics created only for aesthetic perception (changing color, shape).

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APPENDICES

Appendix 1. Questionnaire with answer distribution

Dear Member,

This survey is part of the authors' Bachelor of Business Administration thesis at Tallinn University of Technology. The aim of the dissertation is to determine the level of knowledge and attitude of Estonian people towards smart textiles* in order to provide up-to-date data for use in creating new business models aimed at developing and introducing smart textiles to the market in Estonia.

The survey includes questions with multiple choice and a scale about the perception of smart textiles, as well as questions about your

Filling out the questionnaire will take about 5-10 minutes, and the data collected is completely confidential and anonymous. Thank you for taking the time to help with this research.

*Smart textiles are fabrics that are designed using new materials and technologies. Smart textiles can be used both for aesthetic purposes and for protecting the human body. Some fabrics are able to change color, glow, transform a pattern, while others can record data about the state of the human body or the environment. Intelligent textiles not only collect information, but can also react to external stimuli or environmental changes: temperature, pressure, magnetism, mechanical impact.

For example, thermochromic fabric will change color depending on temperature. The intelligent handbag accumulates sunlight during the day and illuminates the content at night. Impact-hardening fabrics will serve to protect athletes and military personnel.

What is your gender? (n=91)

Male	49
Female	42

What is your age? (n=91)

18-28	54
29-39	27
40-50+	10

How familiar are you with the concept of smart textiles? (n=91)

Not at all familiar	35
Slightly familiar	39
Moderately familiar	12
Very familiar	2
Extremely familiar	3

Have you tested smart textiles yourself? (n=90)

Yes	14
No	76

What do you think are the biggest advantages of smart textiles? (Respondents were asked to choose up to 2 options, n=171*)

They are sustainable and environmentally friendly.	41
Helps you stay connected without carrying a phone.	16
They look modern, innovative, and fashionable.	48
They provide comfort, durability, and resistance to regular wear.	40
You could monitor your health.	17
I do not think there are advantages.	3
I do not know.	6

What do you think are the biggest disadvantages of smart textiles? (Respondents were asked to choose up to 2 options, n=153*)

The strength and durability of the materials used may be reduced due to the harsh environment.	23

Not all wearable devices comply with medical rules and regulations.	37
Not fully waterproof and risk of breakage due to washing/wearing in water.	38
Due to the novelty of these technologies, measurements can be inaccurate.	27
They look unusual and technological, not for everyday wear.	13
I do not think there are disadvantages.	10
I do not know	5

When do you think we will see the mass adoption of smart textiles? (n=91)

In the next 5 years	20
In the next 5-10 years	32
In the next 10-15 years	19
In the next 15-25 years	12
In 25+ years	2
Never	1
I do not know	5

What do you think will be the first field to see the mass use of smart textiles? (n=90)

Healthcare	8
Fashion industry	26
Military and security	21
Sports	18
Science	13
I do not know	4

Choose the option that represents how you feel about the statement. (n=91)

Statements:	Strongly disagree	Disagree	Neutral	Agree	Strongly agree

I would like to buy and wear smart clothes.	5	15	19	29	23
Smart clothes will be comfortable to wear.	6	7	37	25	16
I am skeptical about the reliability of the new technology.	22	24	21	18	6
Production and usage of smart textiles will be more environmentally friendly.	6	15	26	30	14
I am excited about the possibilities offered by new technologies.	4	9	25	31	22
I am interested in fashion.	7	13	26	22	23
Smart clothes will be too expensive.	6	10	27	41	7
I see no barriers to using smart textiles in everyday life.	6	9	22	33	21
Smart clothes will look fashionable and trendy.	4	12	23	28	24
Smart textiles can lead to health issues (injuries, allergies, etc).	16	23	25	24	3
Personal security and privacy will be a huge issue with smart textiles.	15	18	30	25	3

Business model navigator.

Choose up to 2 statements you agree the most with.

	Business model	Company	How "company" would manage a smart textile/clothes company?	Votes

1	Add on	Ryanair	If Ryanair would manage a smart textile/clothing company, Ryanair would charge for extra sensors.	16
2	Ingredient branding	Intel	If Intel would manage a smart textile/clothing company, Intel would exploit the properties of high quality alpaca wool to produce comfort.	11
3	Customer loyalty	Walmart	If Walmart would manage a smart textile/clothing company, Walmart would offer all needs in the form of smart textiles: underwear, socks, shirts, pajamas, etc.	20
4	Long Tail	Amazon	If Amazon would manage a smart textile/clothing company, Amazon would offer smart textiles in all their forms, including used smart textiles/clothes.	32
5	Experience selling	Redbull	If Redbull would manage a smart textile/clothing company, Redbull would create fabrics that increase your level of energy or enthusiasm throughout the day.	14
6	From push to pull	Zara	If Zara would manage a smart textile/clothing company, Zara would open physical stores everywhere to sell their fashionable and trendy smart clothes.	35
7	Ultimate Luxury	Porsche	If Porsche would manage a smart textile/clothing company, Porsche would sell expensive and high-quality men's suits for lawyers with the best sensory and wool.	20
8	Auction	eBay	If eBay would manage a smart textile/clothing company, eBay would do online auctions with an initial relatively low price for smart textiles.	20

9	Cross selling	Starbucks	If Starbucks would manage a smart textile/clothing company, Starbucks would open physical stores where they will offer the experience of using/wearing smart textiles and also sell smart accessories (jewelry, eyewear, bags, etc.).	13
10	User designed	Nike	If Nike would manage a smart textile/clothing company, Nike would let customers create customized smart clothes containing additional sensors, LED screens, and electronics.	24

If you have any questions or feedback concerning this survey, you can write them here. (For a reply, please leave your contact information and I will get back to you)

Appendix 2. Correlation between statements about smart textiles.

Correlations

			VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011	VAR00012	VAR00013	VAR00014	VAR00015	VAR00016
Spearman's rho	VAR00006	Correlation Coefficient	--										
		Sig. (2-tailed)	.										
		N	91										
	VAR00007	Correlation Coefficient	,664	--									
		Sig. (2-tailed)	<,001	.									
		N	91	91									
	VAR00008	Correlation Coefficient	-,194	-,287	--								
		Sig. (2-tailed)	,065	,006	.								
		N	91	91	91								
	VAR00009	Correlation Coefficient	,562	,534	-,200	--							
		Sig. (2-tailed)	<,001	<,001	,057	.							
		N	91	91	91	91							
	VAR00010	Correlation Coefficient	,506	,448	-,115	,466	--						
		Sig. (2-tailed)	<,001	<,001	,279	<,001	.						
		N	91	91	91	91	91						
	VAR00011	Correlation Coefficient	,371	,295	,018	,496	,509	--					
		Sig. (2-tailed)	<,001	,004	,866	<,001	<,001	.					
		N	91	91	91	91	91	91					
	VAR00012	Correlation Coefficient	,207	,296	,189	,446	,315	,315	--				
		Sig. (2-tailed)	,049	,004	,073	<,001	,002	,002	.				
		N	91	91	91	91	91	91	91				
	VAR00013	Correlation Coefficient	,573	,536	-,049	,529	,460	,275	,309	--			
		Sig. (2-tailed)	<,001	<,001	,648	<,001	<,001	,008	,003	.			
		N	91	91	91	91	91	91	91	91			
	VAR00014	Correlation Coefficient	,543	,449	-,187	,565	,611	,543	,232	,584	--		
		Sig. (2-tailed)	<,001	<,001	,075	<,001	<,001	<,001	,027	<,001	.		
		N	91	91	91	91	91	91	91	91	91		
	VAR00015	Correlation Coefficient	-,110	-,134	,533	,085	,093	,129	,279	,136	,056	--	
		Sig. (2-tailed)	,300	,207	<,001	,424	,379	,224	,007	,198	,601	.	
		N	91	91	91	91	91	91	91	91	91	91	
	VAR00016	Correlation Coefficient	-,039	,047	,410	,024	,105	,183	,339	,082	,002	,547	--
		Sig. (2-tailed)	,710	,656	<,001	,824	,323	,083	,001	,442	,982	<,001	.
		N	91	91	91	91	91	91	91	91	91	91	91

Q1	I would like to buy and wear smart clothes.
Q2	Smart clothes will be comfortable to wear.
Q3	I am skeptical about the reliability of the new technology.
Q4	Production and usage of smart textiles will be more environmentally friendly.
Q5	I am excited about the possibilities offered by new technologies.
Q6	I am interested in fashion.
Q7	Smart clothes will be too expensive.
Q8	I see no barriers to using smart textiles in everyday life.
Q9	Smart clothes will look fashionable and trendy.
Q10	Smart textiles can lead to health issues (injuries, allergies, etc).
Q11	Personal security and privacy will be a huge issue with smart textiles.

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