Technical Textile Retrospective

Maria Pettersson

- the Swedish heritage
Acknowledgement

The thesis is made in collaboration with the Textile Museum in Borås with the purpose to present a historical overview, a retrospective of our technical textile heritage. I would hereby like to thank Torsten Hild and Eva Blomqvist at the Textile Museum for proposing this interesting and relevant topic. Furthermore I am very grateful for receiving valuable information from Katrin Bjerrome at Göteborgs Remfabrik and Kenneth Herpel at Jonsereds hembygdsförening. I would also like to thank my supervisor Gunnar Wramsby for his support and constructive input during the creation of this thesis.

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Abstract

Innovative technologies and products, high-performance materials and multi functional fibres are nowadays emerging and are known as technical textiles. This phenomenon, which is quite new in our vocabulary, but the technique and heritage of using textile as functional applications is rather old. The purpose of this thesis is to track the technical textile industries and product segment in Swedish history since the beginning of the industrial revolution and hereby contribute to a broader insight in the Swedish technical textile history. Five different technical textiles segments have been described with a company example after each.

A case study methodology is chosen to deepen the analysis of two companies that acted in this particular segment of technical textiles. The companies Jonsereds Fabriker AB and Göteborgs Remfabriks AB were selected. By applying the business model canvas is this thesis trying to illustrate why the companies experienced difficulties to keep up the technical textile production during the 1970s and finally had to close down. By applying a modern business model to historical companies is this thesis furthermore proposing to additional research in the emerging technical textile field.

Keywords: technical textile retrospective, business model canvas
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1. Introduction

Chapter 1 introduces the reader to the concept of technical textiles, the definition and how it once started. After that is the purpose, research questions and delimitations presented.

1.1. Background

In recent years technical textile has become a known term in the textile field. Innovative technologies and products, high-performance materials and multi functional fibres are frequently in the call. Textile Terms and Definition (1995) states that technical textile is “textile materials and products manufactured primarily for the their technical and performance properties rather than their aesthetic or decorative characteristics”. Horrocks and Anand (2000) consider the definition to be quite brief and it can be hard to define a technical textile especially when it comes to products that combine visual appearance with function. There are also a number of factors that matter when it comes to characterize a technical textile, for example linguistic and cultural interpretations and it can differ within geographical regions. Klaus Fischer (2003) argues that technical textiles are impossible to define precisely.

For example, a textile can be made into classical clothing, or, if it is first provided with a coating, into technical clothing. Abrasive-coated fabrics are technical textiles. Hand-made carpets are archetypal classical textiles. Tufted carpets are used in the home, but are also used as technical products in automobiles. A nonwoven padding, e.g. for an anorak lining, is grouped with the clothing textiles, but a similar product, used as a filter, is a technical textile. A coated material can be used for clothing or as a tarpaulin.

(Fischer 2003, p. 162)

This phenomenon is quite new in our vocabulary, but the technique and heritage of using textile as functional applications, i.e. for technical use, is old. Technical textile is not just connected to high-tech materials and modern artificial fibres. Still today we are using natural fibres as cotton, flax, jute and sisal in a variety of products as tents, ropes, sailcloth and sacking (Horrocks & Anand, 2000).

Textile has not only been a physical comfort or a way of protect our self’s, it has also had a function when it comes to give shelter, securing, storing and transporting. Archaeological
findings show that our ancestors 30,000 years ago made strings to create leashes, fish lines, and nets for hunting animals and to weave basket for collecting and storing. Maybe even as long as between 40,000 and 60,000 years ago simple but strong boats made of fibre was created in Southeast Asia (Gordon, 2011). Rope making is an ancient activity and paintings of a rope maker has been found in the Egyptian graves from 2600 B.C. In Sweden was rope making a special handicraft and is mentioned in Visby town law around year 1350 (Bergsten, 1957). It is also found that flax was used as tax payment in Marks region in year 1527. Flax was an important material when for example making fishing nets (Mark, 2013).

Today technical textile applications are essential components in aerospace, military and protective clothing, medical and hygiene products, geotextile, construction, building and roofing products, among others. Hence what we today name geotextiles was used many years ago in the Roman period to stabilize the soil with woven mesh (Horrocks & Anand, 2000).

The textile industry was transformed during the industrial revolution starting of in England in the middle of the 18th century. Around hundred years later was Sweden ready to adapt to the changes (Schön, 2007). Let the perspective go back in time, to the beginning of the 19th century and in the cradle of the Swedish industrialisation to look for the story line of technical textiles in the western part of Sweden.

1.2. Purpose
The purpose of this thesis is to track the technical textile industries and product segment in Swedish history since the beginning of the industrial revolution.

1.3. Research questions
The research questions for this thesis are connected to the importance of knowing the background and the history of Swedish technical textile development. They were constructed to provide a better understanding and a foundation of the present technological area of today’s technical textiles. There are many studies done of technical textile nowadays, new developments, researches and applications are frequently emerging, but the derivation and the roots back in time are less analysed. Therefore, the first research question to address is:

Research Question 1: In which industries and product segments of the 19th century can technical textile be found?
The industrial clusters and economics emerged during the time of industrialisation in Sweden, but the market was volatile and global crises made the supply and pricing unstable. Innovative fibres development made its commercial entrance and new competitors to the standard natural fibres and applications arose. That directly relates to the second question:

**Research Question 2: How can the business model canvas illustrate the technical textile companies’ closure?**

This thesis will answer the raised questions and try to contribute to a broader insight in the Swedish technical textile history.

**1.4. Delimitations**

Archaeological findings show that technical textiles existed many thousands of years ago when humans explored the benefits of using textiles not only for bodily comfort. Though this thesis will not be a pre-historical investigation, it is an historical overview of the industries that handled technical textiles when Sweden changed from a rural to an industrial country. It will furthermore not be a description of technical textile applications of today’s market and new technology development concerning materials and fibres. There are many other studies, ongoing researches and literatures in this field explaining the subject in detail. Instead this thesis will hopefully contribute to an understanding of technical textiles that can be found in the beginning of the Swedish textile production phase.

Five companies have been investigated in detail and these companies are all connected to the western part of Sweden. This selection has nothing to do with the whole countries technical textile tradition, although the industrial development where strong in these regions and became this thesis’ focus area.
2. Method

Chapter 2 describes the used method with the purpose to demonstrate the systematic way of reaching this thesis objective. This is done by presenting and motivating the choices of the research method, research design, structure of the study, data collecting, data analysis and quality of the research.

2.1. Research method

The aim of this thesis is track the technical textile industries and product segments in Swedish history since the beginning of the industrial revolution. Within this work I also want to find out how two of the selected industries managed the changing market by applying the business model canvas. The industries chosen for the second research questions are Jonsereds Fabriker AB and Göteborgs Remfabriks AB. The motivation to the sampling is further described in chapter 2.3.

The research method in this thesis is done by a qualitative approach, which is using words to describe the study instead of numbers as in quantitative methodology where you are testing hypotheses against theory and/or experiment research. The relationship between theory and social research in qualitative method is inductive where the research is forming the theory. The qualitative method is associated with the constructivism and interpretivism where the interpretivism doctrine is to go out in the world without knowing of what to find (Bryman, 2012).

2.2. Research design

I compared different methods and decided that a multiple case study was the preferred research design to use for the second research question. According to Yin (2009) is the “how“ and “why” questions also more explanatory and therefore are the cast study, histories and experiments a better research method to use. Although as a retrospective lack this study the ability to direct observe and interview living persons as a normal case study approach and could therefore be seen as a conventional historical study. However describe Yin (2009) the ability of the two research designs to overlap and histories can also be done about contemporary events. Hence the two businesses I have chosen to study further have trustworthy people connected to the industries, which I have interviewed to confirm the findings in documents and for additional answers. Important aspects within a case study are the ability to explain, describe, illustrate and enlighten situations that cannot be done with other methods (Yin, 2009). I want to illustrate the development of the technical textile business with a contemporary business model and therefore recommend the case study research with a qualitative approach. The multiple case study is
performed to analyse the companies Jonsereds Fabriker AB and Göteborgs Remfabriks AB with purpose to explain the development in historical businesses with a modern business model.

The first research question addresses the importance of mapping the technical textile industries and their product segments in the beginning of Sweden’s industrialisation. The empirical findings are gained with documents as sources of data as official documents deriving from private sources and textbook.

2.3. Structure of the study
The research started of with meeting with the Textile Museum in Borås. They addressed the issue of not having the background to the technical textile development in our country to the upcoming exhibition about technical textiles that will open in May 2014 in the new building of Textile Fashion Center.

This investigation starts of in the beginning of Sweden’s industrial revolution. I had to go further beyond the known Swedish textile history and its development and instead take a look at our industrial heritage. The empirical findings have been gained through literature, documents and exhibition at Göteborgs Remfabrik AB a working life museum as well as unstructured interviews, semi-structured interviews and searching at the working life museums databases and local history societies. The theory has been developed with textbooks about the milestones in the development of technical textiles and concerning Sweden’s industrialisation, which is essential for the background knowledge. Finally has the business model canvas been described with purpose to analyse the second research question with interest if a modern business model can explain the development in historical businesses.

From the investigation and the findings I decided to describe five different technical textile segments with a company example to each section. It can be seen as a purpose sampling approach with the typical case sampling type with the aim of “sampling a case because it exemplifies a dimension of interest” (Bryman 2012, p. 419). The companies worked within the technical textile field and started of over hundred years ago. The selection of these product segments was determined of the literature I found, my personal knowledge, visit at a working life museum and search at the working life museums database. I wanted the samples to be relevant to my research. In a case study is the selection made to understand the selected case or cases in depth and there may be only one or two units of analysis. The cases should moreover be selected according to the criteria relevant to the research (Bryman 2012, p. 12). The selection of the case study companies Jonsereds Fabriker AB and Göteborgs Remfabriks AB has been made
with the motivation that the companies had the same struggle of keeping the technical textile production going during the 1970s. They also had different organizational structures, which make the case more interesting to analyse.

2.4. **Data collection**
Data have been conducted through unstructured interview, semi-structured interview, exhibition, documents and searching at working life museum databases and local history societies, see figure 1.

![Figure 8 Structure of data collection](image)

*Exhibition*
The exhibition was made at the working life museum Göteborgs Remfabrik which produced weaved transmission belts to the industry. It is one of Sweden’s best preserved environment from the industrial time. At the museum was everything kept as it once was, with machines, tools, materials and things left at the office. It was like stepping into the old factory. The tour was guided by Katrin Bjerrome, which is one of the driving spirits in the association. During the exhibition I could gather information and ask questions relevant to my research.
Unstructured interview
Unstructured interview was conducted with Katrin Bjerröme at Göteborgs Remfabrik before the exhibition and continued with e-mail conversation. This led me to other technical textile findings and example of technical textile industries. She also hand over useful material of the company’s growth and production.

Semi-structured interview
Semi-structured interview was made with Kenneth Herpel at Jonsereds hembygdsförörening (Jonsereds local history society) through e-mail, mail and telephone correspondence to obtain additional information about Jonsereds Fabriker, see appendix 1. Kenneth Herpel worked at Jonsereds Fabriker in 30 years from 1953 - 1983 and is now running exhibitions and maintaining the local history society.

Data base search
To collect further information I have search in the working life museums database http://www.arbetslivsmuseer.se/. Sweden has a number of 1424 working life museums with the aim to preserve the knowledge and tell the story of the ancient Sweden. In this way I found Repslagarmuseet in Älvängen, which presents the rope-making tradition and the company P.A. Carlmarks. Furthermore gave the database of Sweden’s local history societies, available at: http://www.hembygd.se/en an overview of their history and valuable contact information, in

Documents
Documents are defined as official documents, private sources, visual objects etc. and are the case studies third main source of information. It requires some resourcefulness from the researcher to find the relevant documents and to be able analyse its content and also its authenticity (Merriam, 1988). I found relevant literature, good textbooks and received bachelor thesis from the University of Gothenburg regarding Remfabrikens development, an abstract of the company’s production orientation, quantities, turnover, revenue and customers written by Lars-Olov Lindblad (1984). He has gone through annual reports, journals, diaries, notes and interviews for gathering information about the company. I have also received literature from Jonsereds hembygdsförörening and from Remfabriken concerning the companies’ history.

2.5. Data analysis
The case study is formed by the collected information and it is therefore important to define the research questions and delimitate the research. Though it is difficult during the research to know
what to find, what to concentrate on and what the eventual analyse will show (Merriam, 1988). I have followed some useful advice by Bogdan and Biklen (referenced in Merriam 1988, p. 137):
- Delimitate the research and realize that it is not possible to do everything. Otherwise is there a risk that the findings can be irrelevant and ambiguous.
- Define if the research includes the whole picture of the environment or just some aspects.
- Develop analytical questions to create a focused research.
- The observations or interviews partly need to generate the next one’s, to guide the findings.
- Continues take notes and aide-memoires to reflect upon the investigation.
- Test ideas and thoughts at the people one talk to.
- Go though the literature at the field to get an insight of the situation.
- Lift up the findings and broaden the view.

2.6. Quality criteria
Qualitative case studies are a special form of research and can sometimes be referred to as interpretive research (Merriam, 1988). My case study research is not an observing one, since the industries that I am analyse does not exist anymore. I lean on documents as source of data and interview of people familiar with the businesses for additional answers. The analysis of the case studies is later on made with help of a contemporary business model, the business model canvas, for answer the research question. The content in the building blocks of the model and the external forces are made upon assumptions of the gathered information from documents, interviews and theory.

*Internal Validity*

Internal validity defines whether the result comports with reality (Merriam, 1988). To ensure the internal validity I have used horizontal examination described in Merriam (1988), that is when colleagues have the ability to give feedback to the results. The documents have furthermore been evaluated with four criteria’s described in Scott (referenced in Bryman 2012, p. 544): authenticity, credibility, representativeness and meaning.

*External Validity*

External validity is somewhat harder to evaluate in a case study while the research character makes it difficult to generalize, though a case study may not have these intentions as it is a deep analyse of a certain situation or phenomenon (Merriam, 1988). A single case can have the problem of generalization because it is not a sample of one. According to Bryman (2012) is it
important that the researcher knows this fact. I test my research question upon multiple cases and use two companies with the same phenomenon, Jonsereds Fabriker AB and Göteborgs Remfabrik AB. To use a multiple case study increases the grade of generalization according to Merriam (1988).

Reliability
A study’s reliability means that, using the methods described, the research can be repeated with the same results by another researcher. The internal validity and reliability goes hand in hand and as the internal validity increases, increase the reliability (Merriam, 1988). As I use a historical approach in the case study, relying mainly on documents as sources of data, the reliability could be gained, as the findings are not dependent on observations and interpretations.
3. Literature review

Chapter 3 is intended to guide the reader through Sweden’s development in the 19th century and explain some technical textile milestones. Moreover to describe the business canvas model that will be used later on in the analysis chapter.

3.1. History

Sweden became gradually industrialized in the middle of the 19th century. The industry where by then strongly connected to local areas and regions because of the concentration of raw material, local knowledge and the limited access to transportation abilities (Schön, 2007). An example is the trade tradition of cotton weaving in the Sjuhärads region. The home weavers bought yarn and then sold the finished fabric to the textile barons, which later played a significant role when starting up the first weaving factories in the region. (Schön, 1981). Another strategic resource was the availability of skilled people and also access of the amount of workers that determined the position of the factories. Until year 1846 had the guild system limited people’s freedom of trade and the abolishment of the system is also an important milestone in the progress of the industrialisation (Schön, 2007).

The cities were in the middle of the 19th century still small and most of the countries population lived in the countryside. The demand from the countryside was therefore crucial for the industry in the beginning of the era. The textile industry was important for the industrialisation and made Sweden to become a modern country. The textile businesses diversified into a variety of other types of industries and the fast growth in the 1890s lead to more activities and additional orders of example general castings, forging, steam boilers and steam engines began (Olsson, 2012).

Gothenburg’s connections over the sea to Great Britain and the Atlantic had advantages when it came to import of raw material for example cotton and mineral coal. The city had also a developed infrastructure in terms of transportation ability on Göta Kanal and good railway connections (Olsson, 2012). Because of the city’s situation became Gothenburg to be a centre of activity and with the countries most modern financial and trading structure. The population in Gothenburg increased strongly and the capital Stockholm had until 1880 the lowest population increase in the whole country (Schön, 2007).

The build of canal system in the 1780s to 1820s was a huge improvement of the infrastructure and in the middle of the 19th century came the railway. This made the
industrialisation to, not anymore only be a local activity in certain regions, but instead be seen as a national development. The second industrial revolution, in the end of the 19th century, developed big industry cities and with new conditions could the large-scale production exist. Faster shipping and expanded railways made it possible to distribute the goods and concentrate the production. The raw material and energy assets did not anymore determine the productions’ location. It was from now on the market and the knowledge that was an important asset. (Schön, 2007).

At first did the waterpower determined the situation of the early established weaving and spinning mills, but with the steam engines arrival was the water not a dependent source anymore. After steam power became electricity the third phase of modernizing the factories (Winberg, 1999). The electrification changed the industry and the fine textile quality improved when the machines could work without any interruptions and with increased effectiveness. The industry made fabric where about to outcompete the home weavers. The textile business characterized of large and highly mechanised factories, mergers and rise of big integrated mills with few owners (Olsson, 2012).

The industrialisation accelerated in Sweden and the years from 1890 to 1930 where successful. New innovations and companies arose, the office work developed and lead to production of office furniture and other applications as calculating machines. Companies from the early phase of the industrialisation went through reconstructions and changes. Although in the 1930 began the severe depression that affected the whole Europe with severe social and political outcome (Schön, 2007). According to Schön (2007) failed the system to manage the power that came along with the industrialisation and the crisis became a fact. The crisis lasted until the 1950s and it was by then a huge gap between the leading nation, the United States and the nations in Europe, which however became a starting point and urge for growth and development. The period between 1930-1950 had much in common with the previous crisis in 1910-1930, the interwar years surrounded by the World Wars and prelude and postlude phases. Isacsson (2002) divides the industrialisation in three characteristic phases. The first industrial revolution occurred in Sweden in the middle of the 19th century as an effect of the industrial changes in Great Britain hundred years before. During this era changed the society completely, the machines and factories increased and the people moved to their locations, new social differences arose and political and union organisations. The second industrial revolution is distinctive what happened in the United States shortly before 1900, mass production in large
factories with long assembly lines, rigid and standardized production of rather cheap products. The volume production was important and as the salaries gradually increased began new markets to be interesting. The third industrial revolution came with new technology, new information channels and global markets in the 1970s. Although cheap production costs still was central started the customer to look for differentiations and branding was an important asset (Isacsson, 2012).

3.2. Fibre development

Natural fibres
Until the early 20th century were the fibres used for technical and industrial purpose natural fibres, mainly cotton, flax, jute and sisal. They were used for products like heavy canvas sacking, ropes and twines. In the beginning of the 20th century had the jute industry its peak period but declined later on due to the entrance of other materials on the market. Some companies managed the change to synthetic fibres and when the polypropylene fibres came in the 1960s it proved to have the same properties as the jute fibre, though with much more stable supply and pricing. Jute fibres are also used for furniture, carpets, roofing felts and linoleum flooring (Horrocks & Anand, 2000).

Wool fibres from the sheep are the most common kind, but it comes also from the Angora or Cashmere as well as from the hair of camel, alpaca and llama (Hatch, 1993). According to Hatch (1993) the amount of wool fibres in 1989 in the United States was mainly used for apparel products. 12,6 % was produced for carpeting, 10 % for household and interior textiles and 4,8 % for industrial products as for example military and airline personnel, protective clothing and different kind of felt. Wool has excellent insulation and flame resistance characteristics, but also great sound absorbing properties. It has moreover proved to be filtering chemicals and has for long been used for filtering liquids and gases (Hatch, 1993). Though according to Horrocks and Anand (2000) has “wool proved far less versatile and economic for most industrial applications”, but they agree upon that it is useful for high temperature products.

Silk was an exotic material when it appeared on the European market and not a common material for technical and industrial use (Horrocks & Anand, 2000). Though it is a fine, long filament fibre it is strong and gets even stronger in water (Hatch, 1993). The fibres properties made it for a long time suitable for surgical suture thread (Horrocks & Anand, 2000).
**Synthetic fibres**

Viscose, or rayon fibre was the first synthetic fibre available on the market around 1910. It had good temperature resistance and tenacity properties that made it useful in industrial applications and in the upcoming automobile business as in reinforcement material for tyres, drive belts, conveyers and hoses. According to Hatch (1993) can the first attempt to produce viscose be traced as far back as 1664 but the first commercial production development came in 1884 with the patent of producing artificial silk fibre by Hilaire de Chardonnet. Viscose is regenerated cellulose and proved to be useful in non-woven applications (Hatch, 1993).

In 1939 was the polyamide fibre, or nylon developed. It was an elastic fibre with high strength and with good abrasion and moisture resistance (Horrocks & Anand, 2000). Nylon has the highest moisture regain of the synthetic fibres and high tenacity properties along with high elongation and elastic recovery (Hatch, 1993). The nylon sock got incredible popular among women all over the world. In only one year sold the nylon in 64 million pieces in the United States. Though in 1942 was the entire production completely dedicated to military applications, as parachute fabrics, strings and harness to parachutes, that before was made out of silk fibre. Nylon tents used in tropical climates become a very important textile products as well as mosquito nets and hammocks (Dahllöf, 2012).

Polypropylene, polyolefin and also polyethylene fibres were developed in the 1960s. These fibres have low density, good abrasion and moisture resistance and with its low production cost it became popular in products like sacks, bags and packaging, carpet backings, furniture linings, ropes and netting (Horrocks & Anand, 2000). Horrocks and Anand (2000) mean “many of these markets were directly taken over from jute and similar fibres but newer end-uses have also been developed, including artificial sports products”. The hydrophobic fibre with poor temperature resistance became also good for non-woven as in hygiene applications (Horrocks & Anand, 2000).

**High performance fibres**

The high performance fibres introduction was a small revolution for the technical textile sector, although its only account for around 5% of the technical textile use (Horrocks & Anand, 2000). The first meta-aramid fibre available on the market came in 1963 and was trademarked Nomex® by Du Pont. They have high temperature resistance and are really difficult to set fire to. The same force that is needed to break a meta-aramid fibre at 250°C is enough to break a standard textile fibre at room temperature. Du Pont also developed the para-aramid with the trademark
Kevlar® that was commercially available in 1973 (Hatch, 1993). The para-aramids have a very high strength and are the component of bulletproof vests to reinforcements of tyres, hoses, ropes and advanced composites (Horrocks & Anand, 2000).

Another type of fibre in this category is the carbon fibre that was commercially available in the 1960s. It has been an important fibre in aerospace applications and today also in high technology sporting gear and industrial products as turbine blades. In the late 1980s came a range of different high performance fibres as for example ultra-strong high modulus polyethylene (HMPE) and polytetrafluorethylene (PTFE) (Horrocks & Anand, 2000).

**Glass and ceramic fibres**

According to Horrocks & Anand (2000) has glass fibre been the most underrated technical fibre for many years. Today it can be seen in high technological composite applications, in filtration, protective clothing, packaging and sealing materials. The fibre has excellent fire and heat-resistance properties. Though it was for many years just used in cheap insulation material and as reinforcement in plastics, as for example fibreglass. It is also today a substitute in the automotive business for metal body parts and products (Horrocks & Anand, 2000).

Ceramic fibres have been developed with a variety of high performance properties, though the applications are limited because of the high cost and poor mechanical properties (Horrocks & Anand, 2000).

### 3.3. The business model canvas

There is no simple method or single model to apply, but a business model is critical for any company to succeed mean Meertens, Iacob and Nieuwenhuis (2012). The process and framework differ from one approach to another, which makes the business model implementation more like art, rather than science according to the authors. Meertens, Iacob and Nieuwenhuis (2012, p.114) continue with simplifying the concept: business is “the way a company does business or create value” and the model is “a conceptualization of something – in this case, or how a company does business”. To generalise the meaning: “the way a company earns money” (Meertens, Iacob and Nieuwenhuis, 2012, p.115).

Zott, Amit and Massa (2011) describe the rise of business model concepts developed during the mid-1990s along with the growth of Internet. They recognized, in their selection of literature, that scholars do not agree on what a business model is. Giesen, Berman, Bell and Blitz
(2007) found out that, in terms of choosing business model innovation and succeed with it, it actually doesn’t matter which one to choose.

A common and known business model to use is the “business model canvas” containing nine building blocks developed by Osterwalder and Pigneur (2010) authors of the Business Model Generation. They mean companies need a common language to be able to create new strategic alternatives and a by simply visualizing how to earn money. This business model is developed for people to discuss and analyse its company in a creative way and for helping to explore for example new growth opportunities and competitors, developing customer relationships and finding the key success factors. The nine building blocks are as follows:

**Customer Segments:** Without the customers no company can succeed. To be able to satisfy the customer and give them what they desire it is important to group them into right segments of common attributes, for example common needs and behaviours.

**Value Propositions:** It is important to address the value a company want to deliver to the customer, if it is a problem to solve or a need the customer wish for. It is simply the reason why the customer stays with the company.

**Channels:** Through the channels communicates the company with its customers. To satisfy the customers and reach them is it essential to finding the right mix of the different channels, as for example sales force, own stores or partner stores.

**Customer Relationships:** This explains the necessity to specify which relationship the company want to have with its customers, if it is customer acquisition, customer retention or for improving sales.

**Revenue Streams:** This building block describes the money that each customer segment generates and for what value they are preparing to pay.

**Key Resources:** This is the most important component in the business model. It represents the value proposition the company creates which leads to visibility on the market, build of relationships and in the end earn revenues.

**Key Activities:** To be able to run the company successfully a number of key activities have to be undertaken. They differ depending on company and business model type, but like the key resources, this building block improve to create value proposition and reach out to the customers.
**Key Partnerships:** This building block represents the importance of knowing the partners and suppliers that creates a network around the company. To have good partnerships and alliances optimize the business model, which reduces the risks.

**Cost Structure:** The most central costs necessary to run the business model are illustrates with this building block. When the key resources, key activities and key partnerships are clear the remaining costs in the business model can be calculated as well.

![Business Model Canvas](image)

**Figure 9 Business model canvas, Osterwalder and Pigneur (2010)**

Osterwalder and Pigneur (2010) explain the business model environment and the importance of continuously check the external environment and adapt the business model to the market changes. The key is to forecasting and to conjecture the external trends in terms of market forces, industry forces, key trends and macroeconomic forces. This will make the business model better prepared for the future. The market forces are described as a market analysis and contain market issues, market segments, needs and demands, switching costs and revenue attractions. The industry forces are explained as a competitive analysis and include competitors, new entrants, substitute products and services, suppliers and other value chain actors and stakeholders. Key trends are the foresight and are clarified by technology trends, regulatory
trends, societal and cultural trends and socioeconomic trends. The macroeconomic forces are the global market conditions, capital markets, commodities and other resources and the economic infrastructure.

3.4. **Summary**

The industrial revolution made Sweden to become a production country with high-mechanised factories. At first did the waterpower determine the situation of the early-established factories, but with the steam engines arrival was the water not a dependent source anymore. After steam power became electricity the third phase of modernizing the factories. This changed the industry and the quality improved when the machines could work without any interruptions and with increased effectiveness. The textile business characterized of large and highly mechanised factories, mergers and rise of big integrated mills with few owners. In 1910 came the first synthetic fibres which changed the textile market forever and some of the former natural fibres where outcompeted. New applications and innovations constantly saw its light and made the technical textile sector to take new forms. The industrial revolution can be divided into three phases where the last one began to crystallize in the 1970s. New markets arose as the economy became more globalised and a price hunting started.

A business model is critical for any company to succeed but the process and framework differ from one approach to another. It is a helpful tool to analyse the company and its environment. The commonly used business model is the business model canvas that illustrates nine important building blocks for any organization to address. In chapter 5 this business model will be used for analysing the chosen companies in the case study.
4. Empirical findings

Chapter 4 has the purpose to provide the reader with the empirical findings of five technical textile industries that was established during the industrialisation in Sweden. Furthermore a general explanation of the product segment connected to the chosen businesses.

4.1. Rope making

When the humans started to explore the world emerged a need for cordage and ropes to the shipping boats. Rope and strings has always been an essential product for the mankind made out of tendons, roots and vegetable fibres (Dahlberg, 2008). Since the Stone Age did people in Sweden for sure make ropes and strings used for bowstrings, fishing nets, clothes, huts and later on tied timber for floats and ropes for tying cattle. Around some thousand years ago did the humans use the wind and sailcloth of wool and flax was held up of ropes made out of bast and horsehair. Later on became hemp an important material (Repslagarmuseet, n.d.).

In Sweden was the guild of rope makers founded around 1400 or 1500. Hundred years later, with an increasing number of ships and larger ships were build, enhanced the rope making labour. In the late 1800 came a short but intense period and ropes could in the turn of the century be punched with steam engine machines instead of manually making (Dahlberg, 2008). In the 1900 were there over 100 rope-making factories in Sweden, above all in the harbour cities. Coconut, sisal and abaca fibre became common material to use. In the 20th century was the raw material made out of rayon and paper and around the Second World War came the new synthetic fibre, nylon. As the technique got more developed and new synthetic fibres arose in the 1950s, as polypropylene, polyester and aramids did the factories and long ropewalks disappear. Though the old rope-making technique is much the same as it was during the Stone Age (Repslagarmuseet, n.d).

Practical Example

Lars Carlmark had been making ropes since the beginning of the 19th century and in 1848 did he start up the company P.A. Carlmark together with his son, Per-Adolf Carlmark. The company moved from Åmål to Älvängen in year 1917 and the factory was then modernized and build with a longer ropewalk than before. The company was during the years up to 1983 family owned and experienced its best period around the Second World War and post-war era when the export of cordage increased. The company had as its most 400 employees. Though the competition arose in the 60s and 70s especially due to low price import. In 1983 was the company sold to the Pollux concern and passed through different owners until its bankruptcy in year 2003. The
factory was almost destroyed due to planning of industry hotels but was saved of a financial crisis. Today is the ropewalk and the old factory a working life museum and a cultural memory. The machines are repaired and still in use for different projects and in 2006 made Carlmarks 26.000 kg cordages to Ostindiefararen Götheborg (Repslagarmuseet, n.d).

4.2. Jute sacking
Jute sackings were the main packaging material in the 19th century, used for transporting grain etcetera. The increasing world trade and the industrialisation in Sweden made jute products to become a fast growing product segment. The custom duty on imported jute yarn and weavings made domestic jute production a lucrative business and raised many new companies in the western part of Sweden (Olsson, 2012).

Practical Example
In 1888 stood the waterfall in Oskarström unused and in 1889 was the company Skandinaviska Jutespinneri and Väfveri AB founded and took over the waterfall and factory in Oskarström from Wallbergs Fabriks AB. The factory was build up of German owners and investors, the Norddeutsche Jutespinnerei und Weberei AG, with a large share capital of 1,2 million SEK where 1,1 million came from the German investors (Dammvik, 2012). The company was controlled from the management in Hamburg and in nine month was the whole factory ready,
with spinning mill, weaving department and energy plant. The company had 200 hundred looms and around 700 hundred workers, though jute was only profitable in large-scale production. Oskarström became like a small north German industry region to attract German workers and supervisors.

The competition of jute production at the Swedish market was tough and the company struggled up to year 1910. Less good speculations and investments in other jute companies in east Europe also lead to the economical crisis (Olsson, 2012). In year 1896 started the company up flax production and it became a well-known product with its own brand. The brand was sold in 1964 (Dammvik, 2012).

During the First World War became the company Swedish owned and the main holder was H. Wicander. In the beginning of the war made the company big profit of the jute production, but along with sanctions and import difficulties began a period of paper yarn spinning (Olsson, 2012) and production of paper weaving (Dammvik, 2012). During the years 1919 to 1921 were the jute production outcompeted of the German market and the workers were then employed with forestry. The import difficulties continued during the Second World War and the paper yarn production proceeded. The importance of jute sackings declined during the 1950s and the company started to produce jute felt and weave for linoleum flooring. The jute wallpaper became a big success in the end of 1950. In the 1980s took glass fibre production over the jute business and the company underwent a reconstruction. In 1981 was Tasso AB created with the responsibility for the production and Skandinaviska Jute AB managed the other parts of the company’s assets as energy plant and forest properties. In 1998 required the American company Johns Manville Tasso AB and continued with the fibre glass production, although in 2011 did it come to an end (Dammvik, 2012).

4.3. Paper machine clothing
Papermaking has an ancient history traced back to China century B.C (Dahlberg, 2008) and was used in the hole of Europe in the 17th century (Avango & Lundström (red.) 2003). The paper mills were situated in regions with a tradition of water-powered works and often nearby mitten factories. One step in the process when making paper contained pressing the water out of the paper with wool felt. The felt was the most expensive element and the felt were made out of fine white wool fabric, which was made in the mitten factories. The two industries had much in common as buildings, equipment and working operations were similar. The spill from the mitten
factory could also be used for simply paper as grey wrap and cardboard (Avango and Lundström (red.) 2003).

The first Swedish papermaking factories were established in Stockholm and Skåne in year 1560 and in the end of the 19th century were the number of paper mills around 100 – 150 (Dahlberg, 2008). The reason for the increasing number of paper factories had two causes. The Napoleonic War cordon the country and the import of paper decreased drastically during the years 1807 – 1815, which made the domestic production progress. Moreover, freedom of the press act in year 1810 and the freedom of entry changed the market of papermaking and new book and newspaper binderies established and newspaper was founded (Avango and Lundström (red.) 2003).

**Practical Example**

Wallbergs Fabriks AB were established in year 1824 and produced wool garment to the Swedish military and navy. The production for the military could be done without any outside competition due to the countries wish for of self-supporting in this category. The company expanded its product segment to include civil fabrics and was the biggest cloth factory outside Norrköping. The factory had a complete system with spinning mill, weavery, dying and finishing facilities. The company moved from the fall in Oskarström in 1887 to Halmstad. Wallberg became to be the leading enterprising family in this region and they were also involved in politics and railway building. They expanded their product segment to include hats, although this was not that profitable. Their real cash cow was the press cloth of wool for technical purpose and especially for the fast growing paper industry in Sweden, i.e. paper machine clothing. In year 1904 was Nordiska Maskinfilt AB founded by two former employees of Wallbergs. It was one of the factories that were developed around the paper industry. The company increased during the First World War along with import sanctions and no foreign competition and became one of the rising industries in Halmstad (Olsson, 2012). The company where in 1969 joined together with the American company Albany International Corp. (Albany International, 2011). In year 1990 acquired Albany International also Wallberbs Fabriks AB that also still produced paper machine clothing (Encyclopedia, 2003).

### 4.4. *Sailcloth*

Sailcloth was an important business during the middle of the 19th century when large sailing ships still were used for transportation and connection with foreign trading, though in 1870 started a change from sail to steam power (Olsson, 2012). The sailing ships could however until
the end of the 19\textsuperscript{th} century still compete with the steamboats on the seas, especially when it came to transportation of bulky goods as timber (Schön, 2007). The material used for sailcloth where natural fibres as hemp, flax or cotton, though when the synthetic fibres became available on the market it more and more took over the material selection. (Bra Böckers Lexikon, 1980).

**Practical Example**

William Gibson was a Scottish entrepreneur who had lived in Sweden since the age of fourteen. He established in 1826 a sailcloth factory in Majorna in Gothenburg, which soon was the leading one in the city. Two years after he expanded and started Sweden’s first waterpower driven flax spinning mill to be able to produce yarn to the sailcloth. Together with his brother in law, the engineer Alexander Keiller, was the company Gibson & Keiller founded in year 1828. The waterpower in Gothenburg’s port channel was however too small for the expanding spinning mill and they moved some years later to Jonsered within Säveån and thereafter bough Jonsereds säteri (Franck, 2004). The transportation abilities on Säveån were also one of the reasons to the move. Coal and iron could be shipped on the river to Partille. The finished products where transported to Gothenburg with horse carriage and flax yarn was picked up (Olsson, 2012). The founders were innovative and powerful and between the years 1832-1836 was the company leading in the country of sailcloth weave. Though only seven years after the establishment left Keiller the business and due to heavily expansion experienced the company some economical problems. Gibson brought later in his sons and changed name to William Gibson & Söner in 1848. The company became a limited company in 1872 and changed name to Jonsereds Fabriker AB. 1872 started the production of fire hoses. It was a high qualititative product and the company made the best ones at the market made out of flax and later on synthetic coated. Though the customer failed and in the 1950s was the mainly customer the government (Haneson, 1997). In the end of the 19\textsuperscript{th} century had the company broaden their product line to include for example towels, cotton straps, jute sackings, coffee grinders, castings, forging and different types of woodworking machines.

Tarpaulin production and rental business became their real cash cow. Sailcloth weaving was consequently over but the modern cargo ships needed likewise tarpaulin for cover the goods. 1935 start the company with rental business of the tarpaulin products and this increases after the Second World War. It was a great success and the main customers where the port and
building enterprises. The company had the whole control from raw material, to spinning, weaving, impregnate process, sewing, rental, washing, repairing and sell new and used tarpaulins. Though during the 1960s captured the plastic tarpaulin the market and Jonsered had a hard time to keep up with the changes. The flax fibre was strong, but too heavy and expensive to maintain. The customer disappeared as the new material entered the market and cheaper production could be found overseas. Though Jonsereds Fabriker could acquire their main competitor Albrektsons and change the raw material in 1971 from flax fibre to plastic material ended the textile production at Jonsereds in year 1972 (Haneson, 1997). 1975 became the company a subsidiary to Asken and changed name to Jonsereds. In 1978 where it acquired of Elextrolux and later on moved some parts of the production to Huskvarna. Today is nothing left in Jonsered of what used to be one of Sweden’s utmost companies (Franck, 2004).

4.5. Transmission belts
Until the First World War was belt drive essential in the industry. The transmission system where powered from a central source which run all the driveshaft and belts to the different machines in the factories. These kinds of belts had to be strong and where made in different width and length (Lindblad, 1984). This system of power the industry machines is nowadays replaced by single run, an electric motor to every driveshaft (Svensk Uppslagsbok, 1963).

Practical example
Gustav Olson and Fritz Malmström had an idea of making continuous belts and wanted to start a business (Lindblad, 1984). Together with Harald Zetterström, who was a bookbinder at the spinning mill in Rosenlund (Bjerrome and Sjölin (red.) did they found Göteborgs Remfabriks AB in 1891. They acquired the belt drive company Mariedals and took over the complete interior with machines and material (Lindblad, 1984). Remfabriken was situated at Åvägen in Gårda but burned down in year 1900 and a new one had to be build up, this time out of bricks (Bjerrome and Sjölin (red.) 2003).

For more then eighty years did Remfabriken produced transmission belts, transportation belts and straps to the industry. At first were the belts made out of several layers of cotton cloth that was sewed together, but when looms came from England in early 1900 they managed to weave the belts (Bjerrome and Sjölin (red.) 2003). Some attempts were made to produce fire

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1 Kenneth Herpel, Jonsereds Hembygdsförening, telephone conversation the 24th of May 2013.
hoses but this was done better at the factory in Jonsered\textsuperscript{2}. Though they developed the technique and started to weave the belts instead the sewn belts never disappear in the product line. The only factory that produced weaved belts was until now Jonsereds Fabriker. The belts had to be impregnated with chemicals to withstand moisture and outdoor climate and the finishing was made at the rubber factories, for example Göteborgs Gummitolad and Skandinaviska Gummiaktiebolaget (Lindblad, 1984).

Paper machine clothing was produced during a few years and the Domnavets Pappersbruk and Papyrus where some of the customers. Belts made out of camel hair, imported from Egypt, were really strong and used for heavy transmission systems. It was an expensive product and after 1962 did the production of this type of material stop. Göteborgs Remfabrik expanded until the First World War and in year 1917 had the factory the highest number of employees with 57 employed. The need of transmission belts where huge and the lack of import competition increased the domestic production. Though the import difficulties of raw material forced the company to make belts out of other type of material, as hemp and paper, with less quality.

During the Second World War could the company continue to produce belts made out of cotton due to licence. During the 1930s started the company to export its products and the export was growing until the 1970s. The main customers of transmission belts where the machine companies although when the belt drive system started to decrease became a new customer segment in the 1960s and 70s to be the really important, it was the bakeries and accumulator factories. The bakeries used plastic coated continous weaved conveyors for transportation of the bread. They were made out of cotton and had the to be coated due to hygiene. The coating was outsourced for example to Galon AB in Västra Förlanda (Lindblad, 1984). According to Lindblad (1984) was the woven pattern under the bread recognition for transportation belts produced by Remfabriken.

1971 came the first unprofitable year and the employees decreased steadily, the main reason was that the decreasing demand for weaved belts. In 1977 was the company bound to shut down (Lindblad, 1984).

\textsuperscript{2} Katrin Bjerrome, Göteborgs Remfabrik, exhibition the 15\textsuperscript{th} of April 2013.
4.6. Product segments and development within the cases
Jonsereds Fabriker AB

The figure points out some important years and facts of the technical textile development at Jonsereds Fabriker AB from sailcloth, fire hoses to tarpaulin.

Figure 11 Production and development at Jonsereds Fabriker AB in a selection, Haneson (1997)
Göteborgs Remfabrik AB
The figure shows the development at Göteborgs Remfabrik AB throughout the years of technical textile production.

Figure 12 Production and development at Göteborgs Remfabrik AB in a selection, Lindblad (1984)
5. Analysis

Chapter 5 analyzes the results derived from the empirical finding and the case studies according the business model canvas.

The business model canvas is applied on the two companies Jonsereds Fabriker AB and Göteborgs Remfabrik AB. The companies are hereby further investigated through a modern business model and by mapping the business model environment is the aim to illustrate the companies’ technical textile development and closure. This is interesting while the two companies investigated, Jonsereds Fabriker AB and Göteborgs Remfabriks AB have different product segments, company sizes and abilities, but the same pattern occurred, the technical textile production closed in the 1970s.

One product from each company’s product line is chosen to make the analysis understandable and to state the company’s value proposition. The selection of the products is motivated with the companies necessitate to adapt to the market changes and by extend the product line they were meeting a new customer segment. The two different products are furthermore chosen because of the transition from natural fibre to synthetic and plastic raw material. Tarpaulin is selected from Jonsereds Fabriker AB and plastic coated transportation belts from Göteborgs Remfabrik AB.

The nine building blocks in the business model canvas are in this analysis, due to the need for certain information that is not available, decreased to the number of seven: key activities, key resources, value proposition, channels, cost structure and customer segment. Some of the concerns in the external forces segment, which is most relevant for this analysis, are described as follows. To describe the market forces are switching costs and needs and demands selected, which illustrates the forces that makes a customer chose the company and its offer and what the customer need and why the demand is increasing or declining. In the industry forces section is competitors chosen, to define the competitors and the dominant players in the sector of technical textile. The technology, society and cultural trends are determined as a main factor in the key trends and as macroeconomic element are the global market conditions and economic infrastructure applied.
## 5.1. Business model environment Jonsereds Fabriker AB

![Figure 13 Business model environment Jonsereds Fabriker AB](image)

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<thead>
<tr>
<th>Key Partners</th>
<th>Key Activities</th>
<th>Value Propositions</th>
<th>Customer Relationships</th>
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<td>Manufacturing People</td>
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**KEY TRENDS**
- Technology trends
- Society and cultural trends

**INDUSTRY FORCES**
- Main competitors

**MACRO ECONOMIC FORCES**
- Global market conditions
- Economic infrastructure

**MARKET FORCES**
- Switching costs
- Needs and demands
5.2. Business model environment Göteborgs Remfabrik AB

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<th>Key Partners</th>
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Figure 14 Business model environment Göteborgs Remfabrik AB
6. Conclusions

Chapter 6 ties the results derived from the analysis together with the purpose to answer the research questions.

In the empirical finding, five technical textile segments did crystallise: rope making, jute sacking, paper machine clothing, sailcloth and transmission belts. The different product segments followed with an industry example connected to each section: P:A Carlmark, Skandinaviska Jutespinneri and Väferi AB, Wallbergs Fabriks AB and Nordiska Maskinfilt AB, Jonsereds Fabriker AB and Göteborgs Remfabrik AB. This answers RQ1: In which industries and product segments of the 19th century can technical textile be found? These companies all have a history of technical textile production and knowledge and were established in the 19th century.

Moreover, the business model canvas and external forces were applied to address RQ2: How can the business model canvas illustrate the technical textile companies’ closure? The global market conditions during the third phase of the industrial revolution made both companies and customer to look over the boarders for cheaper production and products. By applying the business model environment and addressing some of the external forces the second research question can be answered.

- One can assume that the companies’ value proposition could be adjusted to meet the industry forces of new competitors, higher branding of the products to prevent customer from choosing the competitors.
- Furthermore an alteration of the key resources to address the trends in technology and the change from natural to synthetic fibres. Consequently this was done at Jonsereds Fabriker, but too late and the customer turned to other producers.
- Consider the ability of enter partnerships to meet the new customer needs and demands.
- By forecasting the global market conditions an earlier adaption to the changes in technology, information channels and globalisation could be made.
6.1. **Suggestions for additional research**

Five industries connected to technical textiles have been found and described, but to improve the retrospective and forming the puzzle of our technical textile heritage additional companies and product segments could be investigated, as for example the medical, military and vehicle development.

The approach of using a modern business model to illustrate historical companies growth and decline could also be further investigated. The business model canvas is a useful tool to explain a company’s key assets and how to earn money. By using the external forces and putting the business model into its acting environment the over all picture takes form. In this thesis could only an outline of the external environment be explained. Further information regarding the external forces that acted during this particular time would be necessary to carry out a precise analysis. For example *which shifts in cultural and or societal values affect the business model? Which trends might influence buyer behaviour?* By doing a business model environment analysis new companies can be provided with essential information and learn from historical examples and their precursors. In this emerging area of technical textiles it is crucial to know how to compete and survive at the market.
7. Reference list


Appendix 1

Interview questions and answers
The questions and answers are translated from Swedish to English, conducted with Kenneth Herpel at Jonsereds Hembygdsförening.

1. What kind of products of textile character was produced at Jonsereds Fabriker?
   Answer: The main product was from the beginning sailcloth but as the business grew expanded the product line to include: sheeting, different type of flax woven fabrics as towels and cloth. Jute sacking was during that time important as packaging material for coal, potatoes. For finer products as flour and sugar was cotton fabric used.

2. Did they stop to produce sailcloth and in that case why?
   Answer: Sailcloth did gradually disappear with the change from wind power to steam engines. Then began awning cloth a big product. Also when the railway system increased became roof lining in the passenger cabins a produced product. The company adapted its product segment to the time.

3. Why did they start to produce fire hoses and was it a profitable product? Answer: The fire hose was a big and profitable product where Jonsered was world leading in quality as in weaving technique. They developed a loom with circular weaving. They decided to produce fire hoses because the country needed to be self-sufficient in case of war. The material was at first flax that had good properties in wet conditions and a rubber tube inside the hose could later on stabilize the product. They changed later on to synthetic material. The fire hoses are today produced in Kinna or Skene, probably with the machines from Jonsered.

4. Which were their main customers?
   Answer: Which the main customers to Jonsereds were is hard to say but the government was a big customer of fire hoses as well as SJ when it comes to roof lining. Moreover was the products sold globally.

5. How did they manage the depression years, did they for instance have to change anything in the raw material choice?
   Answer: During the World Wars was it of course hard to get the raw material but Gibson had most certainly good contacts. Jonsereds textile era ended in the beginning of the 1960s except the fire hose production that continued to the end of the 70s.

6. When experienced the company its best period and respectively its worst?
   Answer: It is hard to answer when it was better or worse in the case of the company’s ability to change the production after the time. But of course did they experience ups and downs during the late 19th century when both the society and industry expanded.
## Appendix 2

### Time plan

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