INDUSTRY 4.0 REPORT

INDUSTRY 4.0 REPORT

THE BARRIERS AND OPPORTUNITIES FOR IMPLEMENTATION OF DIGITAL TECHNOLOGY IN THE FASHION AND TEXTILE INDUSTRY

Overall Aim

The aim of this report is to give a short overview and report potentials of new digital technology such as 3D scanners, CAD/CAM systems, sewing robot systems, 3D printing, digital printing and 3D animation in the Danish fashion industry.

Purpose

This report will give a short overview of how the technology providers identify possibilities and challenges and how these might be linked in the production chain. Based on the interview guide developed for the project, the below report describes the tendencies and reflects on the applicability of a number of different technologies. The first part of the report was presented at a workshop and was intended as a starting point for a wider discussion of the use of new technology and its potential for new business opportunities, which will improve sustainability.

The report is divided into two parts. The first part describes the potential and the barriers as the technology providers see them. This part is based on interviews with seven different providers. The findings from the interviews were then presented at an industry workshop with representatives from companies, institutions and networks in the fashion and textile industry. The second part of this report presents the discussion of barriers and opportunities that the participants had during the workshop. At the end of the report, a summary presents the main findings of the research.

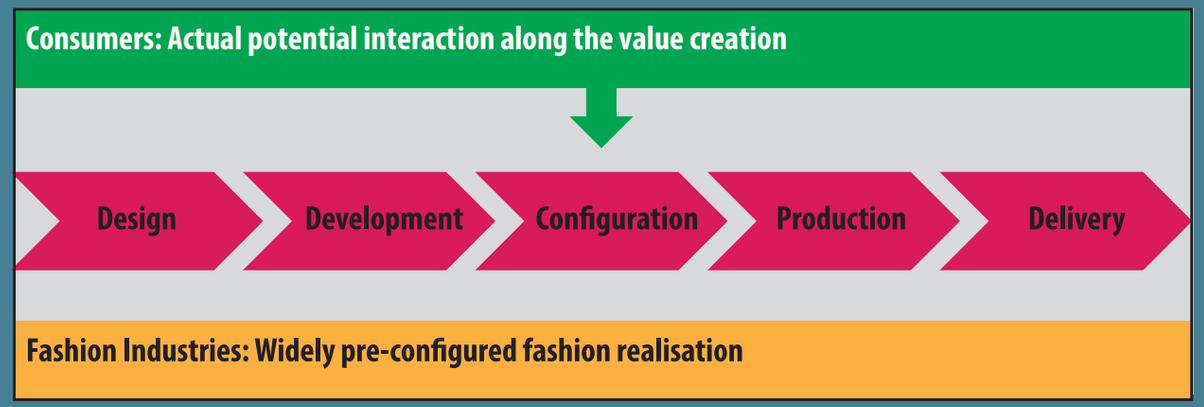
Background

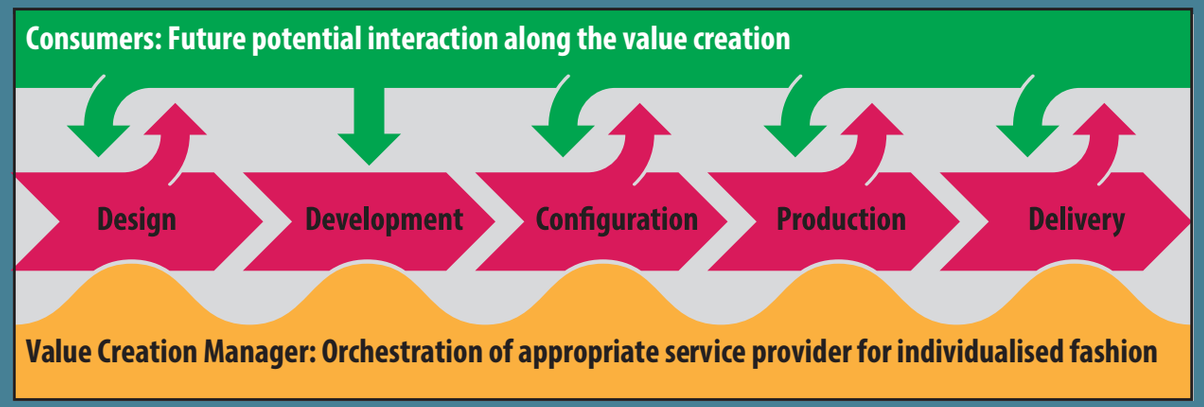
The Danish fashion industry is nearly 100% production outsourced. Few companies have a focus on new production technologies, and the possibilities they present in insourcing part of the production, but also for value adding products, sustainability, tailor made products and shorter development times. Therefore, benchmarking and description of new technologies in the fashion industry and its effect on future production is needed. This requires vision points for the industry in regards to future production, and analysis and interpretation of how to incorporate those new technologies.

FASHION DESIGN 4.0

Industry 4.0 is a term used mainly in Germany and the U.S. for a number of digital technologies related to the digitization of industrial processes – from creation to production, and the organization of corporate ecosystems and supply chains.

This network-generated system enables communication flows between machines, internal and external value chain players, including automation, simpler product development / manufacturing processes that are capable of handling higher levels of complexity.





McKinsey defines Industry 4.0 as digitalization of the manufacturing sector, with embedded sensors in virtually all product components and manufacturing equipment, ubiquitous cyber physical systems, and analysis of all relevant data. Disruptive technologies that are in many cases not linked to major machinery upgrades will enable productivity gains and new business models and fundamentally alter the competitive landscape. (McKinsey & Company)

Industry 4.0 transforms the nature of global manufacturing through:

- Individualized products, customer integration
- Flexibility
- Large scale production will decrease – lot size –> 1
- The creation of a basis for local production
- Inter-sectoral communication and innovation
- Sustainability and resource efficiency
- New business models and new markets
- Demographic changes and change of work-life balance.

The implementation of digital operation technologies as part of the digital transformation process is the next logical step in maintaining and further strengthening the leading market position. However, the majority of the mostly small and medium-sized enterprises in the industry seems rather reluctant to start the digital transformation process.

According to Dennis Küsters, Institut für Textiltechnik der RWTH Aachen University, this 'wait and see' attitude poses a serious risk in today's rapidly changing digital world.

Internationally, we already see changes in large companies like Adidas and in small companies like Atacac. Digital technology affects production by allowing more customization and, in terms of retail, by producing directly to end consumers. This report outlines the possibilities and barriers to assisting Danish companies navigate in these new developments.

Recipients

The purpose of this report is to provide preliminary findings for discussion with select Danish fashion companies. The fashion companies will get an insight into new possibilities of production as well as insourcing, and the final report will be available to the wider fashion and textile industry.

Authors

The report was developed in a collaboration between Design School Kolding, VIA University College and the Lifestyle and Design Cluster. Interviews were conducted by Richard Lehner (DSKD), Poul Erik Jørgensen (VIA) and Mette Terkildsen (VIA). The report is written by Frederik Larsen (DSKD), Poul Erik Jørgensen (VIA), Mette Terkildsen (VIA) and Nadine Möllenkamp (DSKD). Additional chapters were added by Betina Simonsen (LDC).

This report was initiated by Nadine Möllenkamp (DSKD) who is also the project leader.

1.1

The first step in this project was to interview technology providers about their programmes, products and visions for the next 3–5 years. These interviews provide the basis for further discussion later on. This part of the report presents the preliminary findings from interviews with technology providers and centres on the following questions:

What change will the Industry 4.0 / digital technology bring to the design and production process?

What are the new opportunities for using these new technologies in regards to new business potentials, and what are the major barriers?

The following technology providers were interviewed:

Davinci Developments
www.davinci.dk/

Protech. Stratasys 3-D printers
www.stratasysdirect.com

CLO 3-D animation/visualisation software
www.clo3-D.com

ACG Nyström. Gerber Accumark . Pattern cutting system. Digital cutters. 3-D animation software.
www.acgnystrom.dk & www.gerbertechnology.com

Human Solutions GmbH, 3D body scanning
www.human-solutions.com

Lectra, integrated 3D technology solutions. Belgium
www.lectra.com

Ergosoft (Mimaki) Digital textile printing
www.ergosofttech.com

Specific information about the different companies can be found through the links above. In each case, a representative from the company was interviewed.

Gerber: Carina Yu, Application Engineer,
CLO: Daniel Seo, Director of Operations,
Davinci: Søren Andersen, Sales Manager.
Protech: Thomas Tønnesen, Country Manager.
Human Solutions: Dr. Martin Lades (Acting Representative) Business Unit Fashion Product Development.
Lectra: Dennis Van Haute, Sales Manager Northern Europe and the United Kingdom.
Ergosoft: Andy Brunner, Product Manager.

The interviews were conducted in Danish or English either in person or over the phone using an interview guide developed by the project managers. The information on sewbots was obtained by Betina Simonsen as part of her involvement with Sylab and was not based directly on interviews.

3D BODY-SCANNING

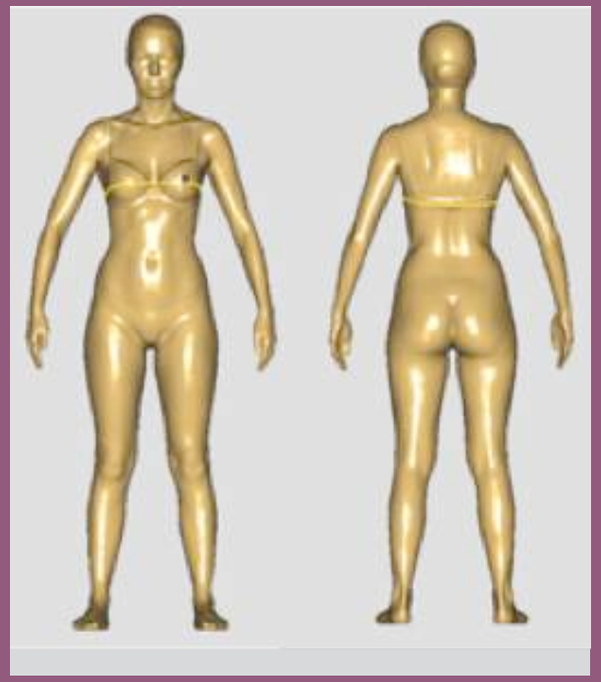
3D body scanning offers an accurate method of measurement and makes it possible to integrate size & fit data into your processes at the same time.

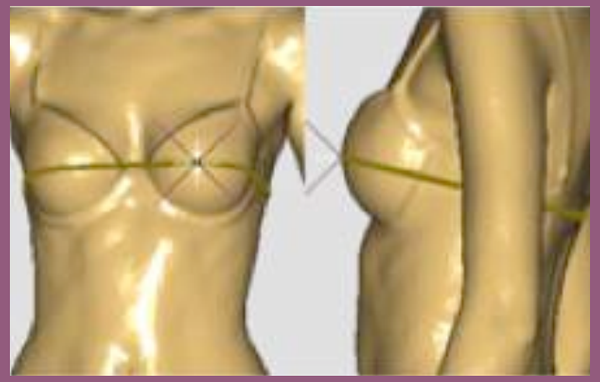
One essential advantage of the 3D scanner technology is that it provides us with a virtual twin of the person measured that enables us to go back and check uncertain data or add additional measurement points if necessary.

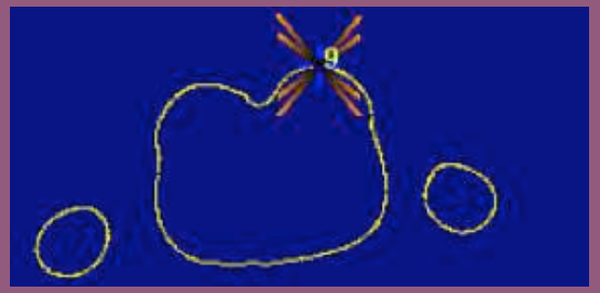
The data is also useful for additional purposes and can be used for deriving information about three-dimensional body forms. Based on the data, it is also possible to derive body form based on surface measurements or see cross-sections for example in relation to communicating fit and size virtually.

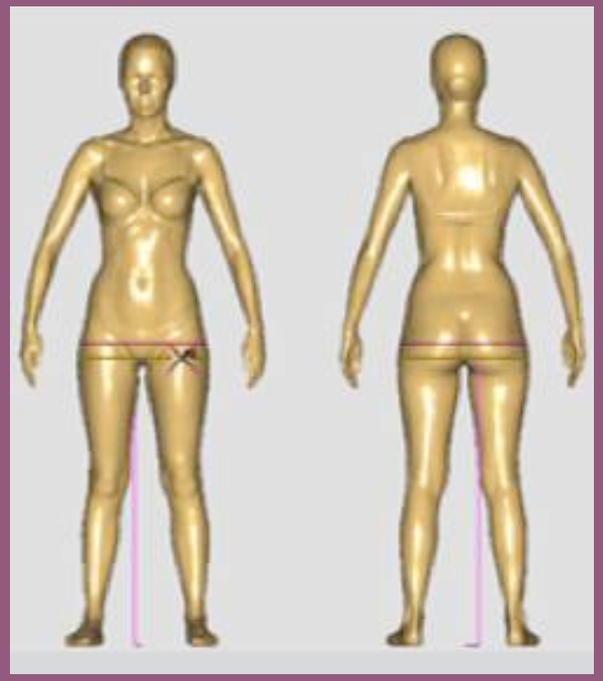
Based on a 3D avatar, the garment can be developed in 3D in the CAD system. The advantage of using 3D is that you can immediately check the impact of size & fit, colour, fabrics, stitching and accessories of your designs and models in all versions and sizes – and thus reduce the number of physical samples.

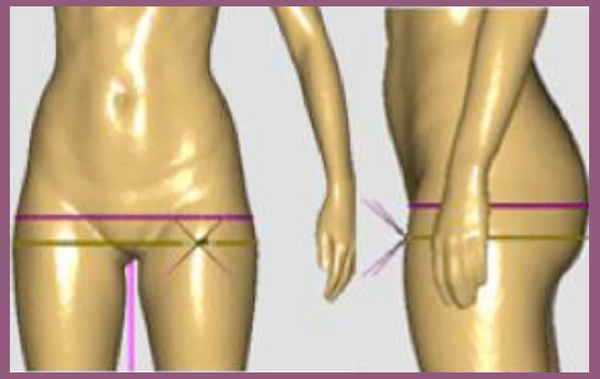
Fewer prototypes reduce costs and time frames. Necessary changes or corrections can be detected early (and carried out more cost-effectively).











1.2 OVERVIEW OF TECHNOLOGIES

As part of the increased interest in automation in recent years and the booming use of robotics (cobots – robot arm that works side by side with the manual worker) in other industries, we have seen a strong interest in the development of robotics for the textile, footwear and clothing industry.

In 2018, the Chinese manufacturer, the Tianyuan Garments Company, will open a new factory in Arkansas equipped with 21 production lines staffed with sewing robots designed to make 800,000 T-shirts a day. SoftWear Automation will be developing these robots. The production lines involve robots that perform one step at a time – they can add a label, sew a shoulder seam or add sleeves while the vision technology moves the fabric.

In the German city of Ansbach, Adidas has opened a 'speed factory' that utilizes robotic cutting, computerized knitting and 3D printing. A second speed factory is being built near Atlanta, Georgia, to target the US market. The aim is to reduce lead times but still produce in small quantities (around ½ mio. shoes per year is a small amount compared to Adidas' production of 360 mio. shoes per year)
https://www.youtube.com/watch?v=LXn2AI-HOU_g

Other brands are also experimenting, including for example Nike (which is using electro adhesion with start-up Grabit and aim to reduce waste), Zara and Uniqlo.

Sewbo uses thermoplastic to stiffen the fabric so that existing industry robots can be used.
www.youtube.com/watch?v=oeSu9Vcu0DU

At Sylab in the Danish town of Ikast, a workflow for small, flexible orders is being developed using robot arms for some of the sewing processes:
ldcluster.com/portfolio-item/mode-og-tekstilproduktion-i-danmark

Automation and sewbots in the footwear and fashion industry

3D printing, body scanning technology, computer-aided design, wearable technology, nanotechnology, sustainable/environmentally-friendly manufacturing and robotic automation are disruptive technologies in the textile, footwear and clothing production industries. These industries are particularly labour-intensive.

Prior to the large-scale outsourcing of production to lower labour-cost countries in the 1990s, automation gave rise to new processes involving less manual labour. However, the movement of production from one country to another with low entry barriers to start-up in an attempt to reduce costs did not initially result in significant investment in the development of automation, including robotic production; this has only occurred in recent years as labour costs have risen fast. In China alone, prices have risen 260% in the past ten years.

Footwear and clothing manufacturing is labour-intensive but also complex as many different steps are involved in sourcing materials, trimmings and different finishing processes. Production companies are under pressure to perform and to organize the many steps in a short time.

Moving production to cheaper production areas and lean manufacturing have resulted in more efficient production planning, reduced defects, less use of excess raw materials, less inventory, digital orders etc., thereby reducing costs. As a result, clothing and footwear prices have gone down. In recent years, automation of the cutting process has reduced the manual labour involved, improved productivity and ensured better usage of the fabrics.

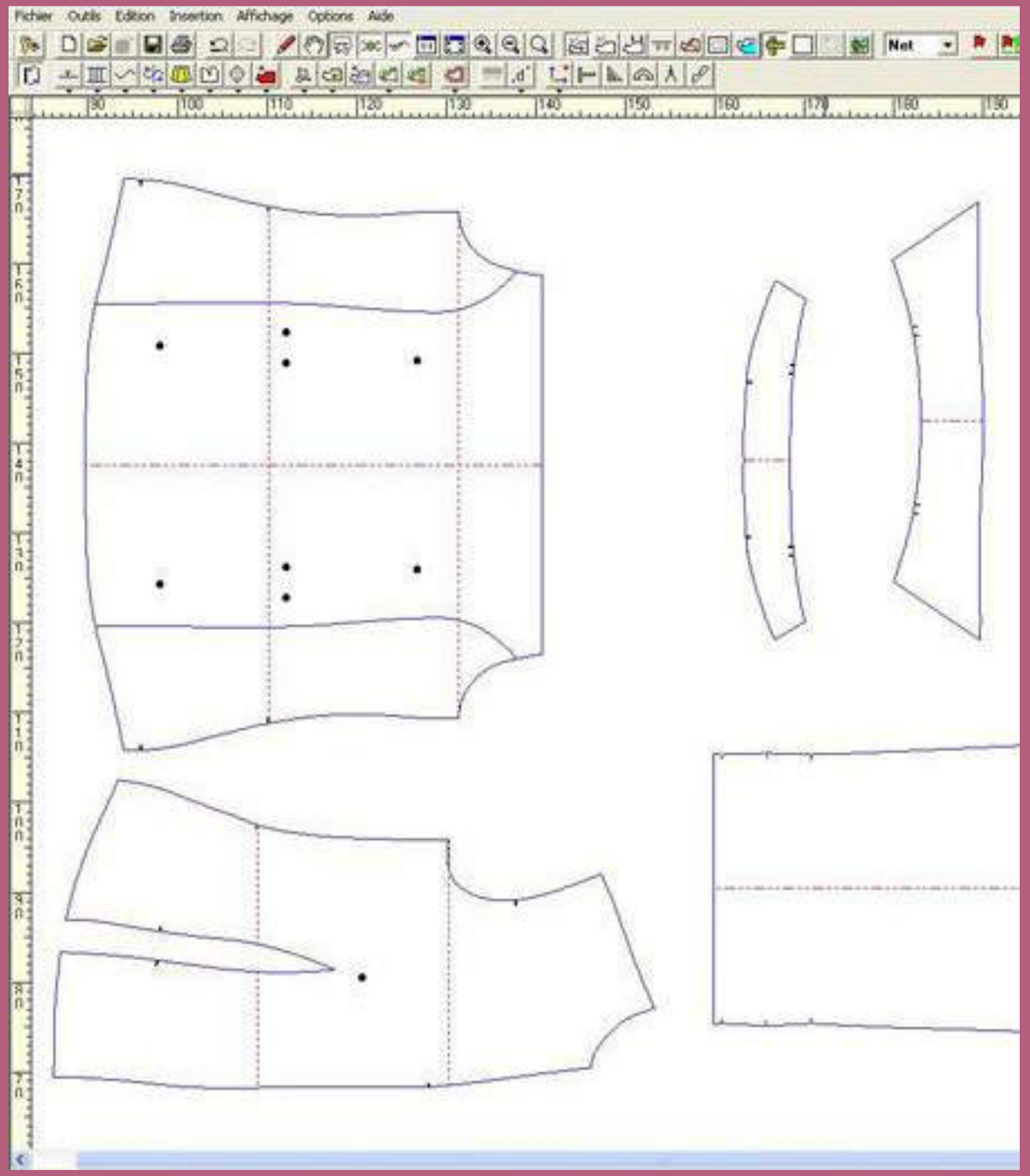
CAD/CAM

CAD/CAM is a manufacturing software and has been widely used for decades in the textile and fashion manufacturing and sampling process. CAD stands for "Computer Aided Design". This means that products are developed and designed using a software computer system. CAM stands for 'Computer Aided Manufacturing'. CAM means that products are actually manufactured or produced using a computer-lead production process.

CAD-CAM is a software programme used for production purposes. There are several providers of CAD/CAM systems. These systems may have different applications from design to computerized pattern development, digitalization, grading, cutting, lay planning, sampling and costing. Companies that use a CAD-CAM system can manufacture large series of products as well as single pieces.

The use of a CAD-CAM system has several advantages for a company. In production, errors in programming and planning are reduced. As a result, the production works more efficiently and by using bulk, it is possible to conserve materials. You can also adjust the volume of production quickly and effectively. In addition, adjustments based on customer needs, shape and design of products can be made quicker and easier.

Furthermore, the system provides files and documentation that can be used in combination with PLM software (Product Lifecycle Management Software). PLM refers to the process of managing the entire lifecycle of a product from idea through engineering, design and manufacture as well as service and distribution of the final product.



1.3 ANALYSIS

This section will provide an overview of the use of new technologies, such as 3D- scanners, CAD construction system, 3D animation, 3D printing, digital printing and sewing robot systems. The first section describes the companies' existing involvement in the fashion industry. The next section describes the barriers that prevent the implementation, and finally, the opportunities that the companies identify are presented.

1.3.1
Existing Involvement in the Fashion Industry

Gerber Technologies has delivered software and hardware to the fashion and textile industry since 1968. Over the past 20 years, hardware has more or less disappeared from the fashion industry, so Gerber now focuses on software solutions. One of the main success products is an automated cutting system launched in the 1970s, and AccuMark launched in 1988 is the first PC-based pattern making, grading and marker system. Gerber is now a leading provider of Product Lifecycle Management (PLM) systems next to development software, digitalization, plotting, cutting and printing for the textile, apparel, transportation and aerospace industry. Gerber's PLM method optimizes product development through risk management. This is done by creating an overview of functionalities and geographies to create efficiency and speed-to-market across the supply chain.

Protech has 25 years of experience and has developed into a leading Nordic supplier of 3D printers and CAD/CAM systems. The company has delivered thousands of systems and printers in the Nordic countries and offers training and support. Their 3D printers are from Stratasys, MakerBot and Desktop Metal. The products range from desk-friendly 3D printers from MakerBot to the more professional production systems from Stratasys. The 3D printer uses FDM or PolyJet technology.

The company is indirectly involved in the fashion industry through the print of accessories, watches, jewellery and shoes. However, Protech does not focus strategically on the fashion industry. From their point of view, printing components for industrial production, regardless of the type of industry, is the main area of growth.

CLO 3D Virtual Fashion is an animation software provider that offers 3D garment visualization mainly aimed at designers in the apparel and accessory design industry. In the past 15 years, CLO has focused on enhancing creative solutions and user experiences during the virtual design process and aims to innovate how we communicate and design fashion. It may become possible to skip sampling and shorten the production phase through accurate virtual animation of garments. This will save a significant amount of resources and enhance speed to the market. The software is compatible with pattern cutting systems and several other software providers. CLO 3D Virtual Fashion is not currently involved in the Danish fashion industry. At the moment, they are, however, working on a large deal with H&M in Sweden.

Davinci Technology is a Danish engineering and 3D print production company handling product development tasks from idea to finished product mainly for the transportation industry and healthcare sector. Davinci Technology has been involved in the fashion industry doing 3D print of jewellery, accessories, buttons and frames for glasses. They also do printing for Ecco's shoe production. However, at the moment, they consider their involvement in the fashion industry limited. As design for manufacturing grows, they believe there will be more potential for involvement.

Human Solutions has been one of the world leaders in 3D body scanning for almost 20 years. Therefore, the data from Human Solution/Vidya represent the world's largest database of body measurements. With Product Fit Technology, they combine the process know-how in our industry with body dimension data and methods from the fields of anthropometry, ergonomics, statistics, cutting technology, simulation, visualization and virtualization.

They implement this knowledge into technology to actively support company-specific processes using data and workflows in fashion, from product development to production or even all the way to the point-of-sale.

Lectra is one of the world leaders in integrated technology solutions (software, automated cutting equipment and associated services) specifically designed for industries using fabrics,

leather, technical textiles and composite materials to manufacture their products. It serves major world markets: fashion and apparel, automotive and furniture as well as a broad array of other industries. Lectra's solutions, specific to each market, enable customers to automate and optimize product design, development, and manufacturing. With more than 1,550 employees, Lectra has developed privileged relationships with prestigious customers in more than 100 countries, contributing to their operational excellence. Lectra registered revenues of $288 million in 2016 and is listed on Euronext.

Ergosoft & Mimaki are two of the leading providers of digital inkjet print technology for the textile industry. Mimaki as a worldwide pioneer in digital printing and cutting technologies that manufactures high quality digital printers for large-scale production as well as smaller units for design and prototyping. Ergosoft is a leading software company developing and selling the so-called 'RIP'- software which is used for communicating with the digital print hardware. Ergosoft has more than 25 years of experience, and its RIP software creates the highest productivity and brings quality control and a broad variety of colour, production controlling and automation tools into the printing facilities.

1.3.2
Opportunities

This section presents the opportunities for digital solutions identified by the technology providers:

Gerber technologies identify opportunities in made-to-measure production and 3D visualization. They believe that in order to implement the new technologies, the process has to start from the top to create innovation and anchor the new tools.

Protech also believes there are plenty of opportunities for creating customizations and small-scale production in Denmark.

Implementing CLO 3D animation and visualization software makes communication easier and saves resources. It makes it possible to optimize the process of sampling and prototyping in design and production by making this process available online. Now it is possible for designers to start their process in 3D software and then work on a 2D design with construction. Before the process was the opposite. We also see new business models such as production on demand and customization. In this case, the use of big data and trend data going directly to the companies allows them to customize their designs. For example, Adidas has implemented an automated robotics concept in the stores to produce directly to customers. New communities are also developing, and small fashion companies like the Swedish Atacac, who shares its patterns with their follows. They have also launched the new pricing system with prepaid orders where the retail price goes up as the product approaches the launch deadline.

Humans Solutions: Digitalization leads to a completely new way of working and provides many new possibilities. Human Solutions have been part of a micro factory for fashion, which has been presented on two fairs so far. There, the software Vidya is used for the design of an individualized T-shirt which can be produced in less than four hours. Human Solutions also developed a body profile which generates an individual avatar based on four parameters – age, gender, weight and height. This avatar can be used for a digital try-on.

Another example is the use of 3D data for virtual meetings. Human Solutions have developed a 'digital showroom for fashion', a virtual reality room that especially caters to the needs of the apparel industry. In this room, people from all over the world can come together to coordinate a collection like they would do in a real showroom.

We are convinced that digital work processes will completely change the whole fashion industry – from the way fashion is developed to the coordination processes and to the way fashion is sold. New jobs have to be developed, and the customer will be increasingly be involved in the design process and product development.

Incorporating new technology and processes increase production capacity and lower the overall cost per unit. Streamlining the company's workflow and implementing 3D animation and visualization software makes clearer communication between development teams possible. This saves time and provides the agility and the

competitive edge to be a serious fast-fashion player. In the developing process, the technologies make it possible to optimize the process of sampling and prototyping in product development and production by making this process available online. Furthermore, 3D prototyping simulation offers an advanced 3D design tool that can largely cut down the number of real prototypes and thus significantly reduce the time to market. In conclusion, the technology allows new business strategies/concepts, and we see that there are great opportunities for both small and large-scale companies to innovate and optimize products and processes.

Ergosoft and Mimaki: The coming years will see a complete change in the way we design and produce textiles and fashion. Ergosoft and Mimaki work closely together to support the digital opportunities that will enable this development. Ergosof's RIP software and colour management software allow you to get a complete overview of the entire value chain, making advanced user right management possible. User right management is shared storage of data and thus access to the process. This also makes future automation of the entire flow of digital print jobs possible. It is already possible to use ErgoSoft XML format for full automation of complete print jobs. This is all based on the web service API, which monitors production status and provides real-time feedback on capability and productivity and enables bi-directional communication.

The evolution of digital technologies is fast. Current digital systems can change quickly, and changes are global.

Ergosoft already sees textile and fashion companies investing in digital technology in Europe to move production back from Asia where labour costs are increasing rapidly and where logistics are difficult.

In addition, the design process is undergoing major change, and this will alter the way we design and produce. At the same time, it will make new business models possible.

Everything can be digitalized and automated; it is only a matter of time!

Sewbots are solving a number of the problems faced by the footwear and clothing industries. Sewbots can perform many of the routine tasks that contribute to poor conditions for workers; they may contribute to reducing the number of errors and make 24-hour production lines possible. No less important is the fact that sewbots will also make it possible to locate production in countries with higher wages than the current production countries.

1.3.3
Barriers

Gerber Technologies believes the main challenge is educating enough designers with the competences to use the new technologies in the fashion and textile industries. Another challenge is that smaller, up-and-coming design companies have difficulties funding new technology as well as providing the resources and competences for developing business models in this area. In comparison, the Swedish market shows more interest in 3D animation and visualization. Design and production in small quantities is still difficult and expensive in Denmark.

Protech: Traditionally, 3D print has been used within engineering. Creating the software to print textiles will require competences in this area. For this reason, the industry will need designers with these competences. But the change has to come from inside the industry; this requires education and development of skills.

Davinci: At the moment, 3D print is often implemented as a way to quickly create success and cut costs. We need a top-down implementation to develop 3D in the industry.

Human Solutions: One challenge is that it requires new business models based on new technologies. It has to include the concept of how to use and link the technologies in a global network. It is all about processes, and to change processes is challenging for any company. One thing is clear; a process of change needs time. Human Solution recommends working in small steps with a clear goal. Another barrier is to bridge the gap between the different technologies. This will require new job functions in the fashion industry as well as a change in the curriculum for design educations.

Opportunities

Lectra acknowledges that Denmark is not a first mover on implementing new technology. In comparison, Finland and Sweden are ahead in this area and show more interest in 3D technologies. It is difficult to say why, but it is a challenge that almost 100% of the production in Denmark is outsourced and that production sites are often changed. Optimal utilization of the technologies requires a platform solution where data can be accessed across department processes and location. Furthermore, there is a need to educate employees so that they acquire competences not only to use the new technologies but also to facilitate the processes in an interdisciplinary context.

Ergosoft. As we do not have a standard file format to transfer all data, it is still not easy to connect all the digital hardware components. But this problem may soon be solved as file formats named .pdf and .xml may become common international standards.

Sewbots: It is obvious that sewbots will further reduce footwear and clothing prices, putting pressure on fast fashion prices and leading to more over-consumption. They may move production away from countries that are heavily dependent on footwear and clothing production, increasing unemployment in countries where poverty is already a problem.

The technical challenges in developing robotic production are:

- Fabric grip. Fabrics have different surfaces and textures and are hard to grip. Human touch and adjustment skills acquired through years of experience with the sewing process are hard to emulate even with good vision technologies and sensors.

- Clothing production involves many small operations and the use of different sewing machines. This makes it difficult to set up a fully automated production line; automation is often only feasible for large production runs, and it is more suitable for certain types of clothing.

There are still many problems to be addressed in the development of sewbots. Pressure to solve these problems and introduce sewbots comes from many different angles. The factors driving this pressure include:

- the potential for faster adaptation to market needs and faster delivery times

- the spotlight being cast on poor conditions and stories of mistreatment of workers

- the demand for footwear and clothing production to be environmentally-friendly

- the growing popularity of locally sourced products and protection

- the potential for recycling products and product parts and using them in new products.

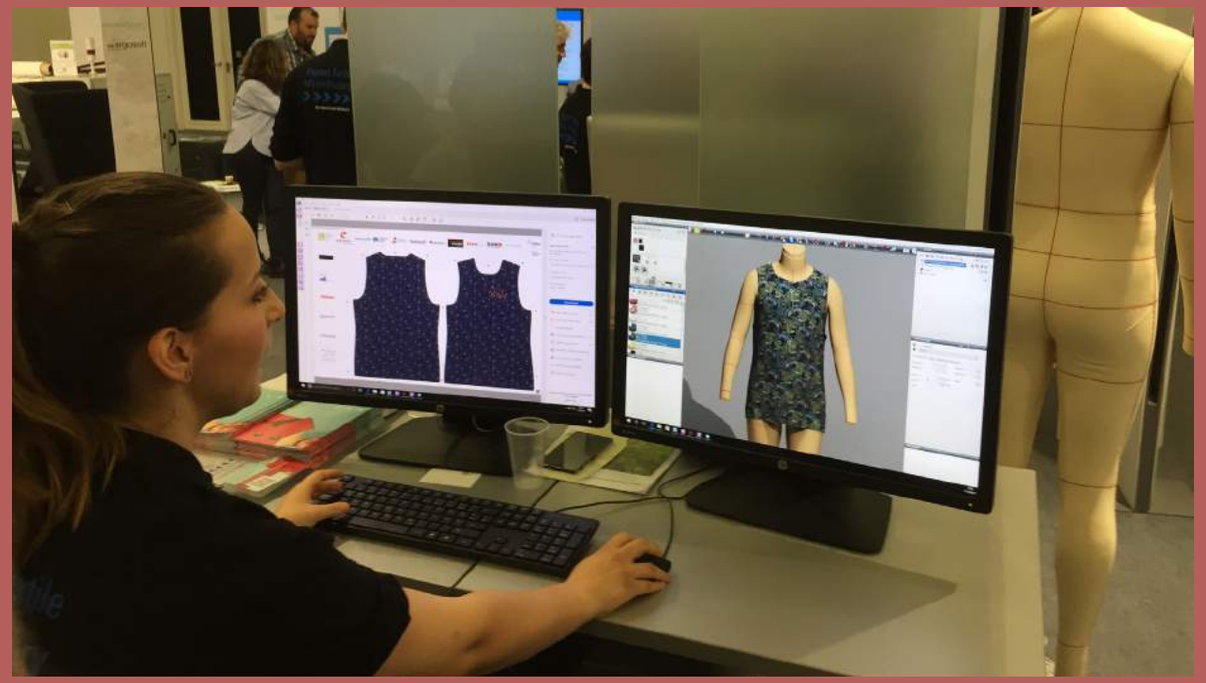
Grabit estimates that the market for sewing robots is worth $200 – $300 million (a single robot costs approx. $100,000).

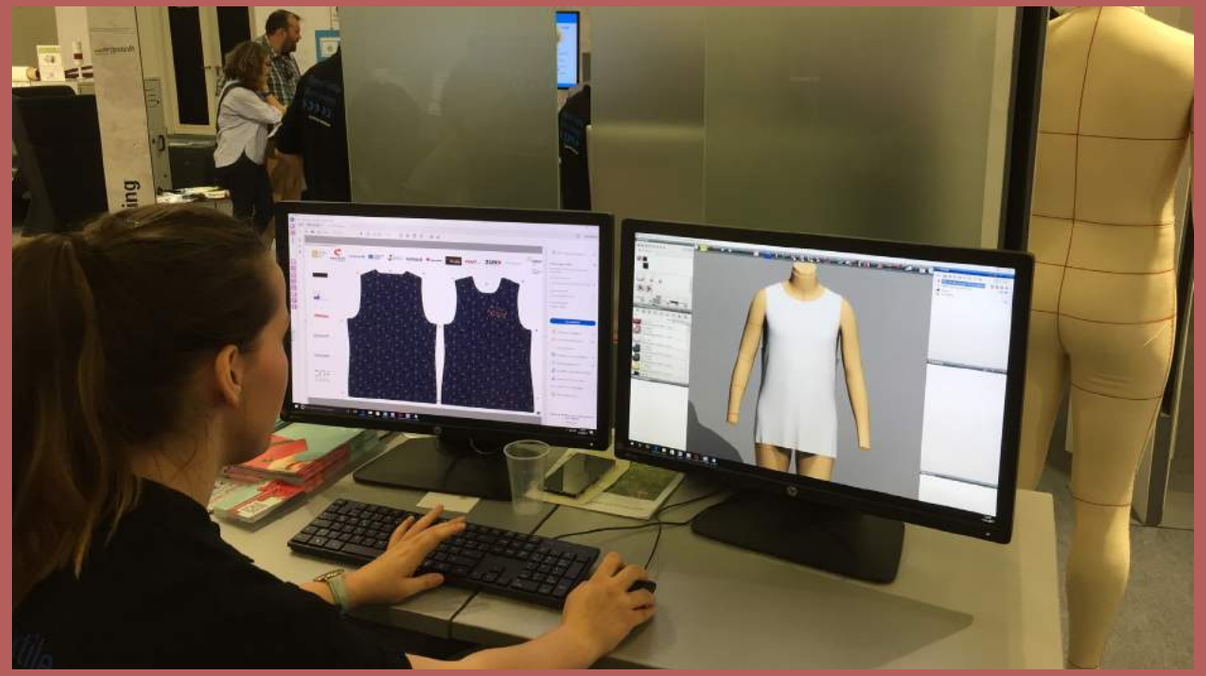
3D ANIMATION / VISUALIZATION SOFTWARE

In recent years, various 3D animation software providers have been focusing on the apparel industry, and they can be integrated into CAD/CAM systems. The 3D features have the potential to disrupt the current design and manufacturing process.

The software allows designers and pattern makers to communicate virtually and three-dimensionally and eliminates trial and error in physical sampling processes by visualizing the exact fit on a virtual dummy. Virtual material libraries allow the designer to visualize garments with material properties that replicate actual fabrics. Data from body scanning can be used to create a 3D avatar and makes individual preferences, customization and made-to-measure production possible.

It also offers great potential for small businesses as the physical sampling phase can be skipped and virtual showrooms might emerge.





1.4 PRELIMINARY FINDINGS

The interviews with technology providers indicate that there is a potential for developing the use of digital technologies in the fashion industry. Several companies mention small-scale manufacturing as an area with growth potential where digital technologies could be implemented. They also mention new business models based on new technologies that will help small companies succeed. The use of new technologies to create more sustainable production in the fashion industry is also a focus in this project. Small-scale and customer-driven design could provide new business models that reduce overproduction and ensure alignment between design and consumer, thereby reducing the amount of post-consumer discarding.

One of the barriers that several companies focus on is the lack of skills and competences in new technologies. This appears to apply to the fashion and textile industry as well as other industries. This concern puts education at the centre of a transition into new technology and presents an opportunity for new designer roles. Developing educational programmes that target fashion and textile production would help create specific knowledge within the industries instead of adopting existing approaches from engineer-dominated industries. In relation to sustainable development, the deep understanding of the possibilities provided by digital technologies is essential.

3D PRINT

3D printing is a technology that has existed for almost thirty years in engineering with mainly industrial use. The technology has been available for smaller household printers only since 2009. The investment cost for such a printer are around 2000 EURs. Since then, the market has been booming and also more and more software for 3D design processes is emerging.

There are different methods of 3D printing and many different materials can be used as filaments, from recycled plastics to fibres made of bamboo. 3D printing is an additive manufacturing process adding material layer by layer until the object is finished. The printing process varies depending on the technology used. The process can be based on a digital design followed by printing where plastic material is melted and laid down onto a print platform or large industrial machines that use a laser to selectively melt powder at high temperatures. Traditionally, 3D print has been used within engineering, but now it is starting to be used within fashion, for example for shoe and accessory design. The technology provides possibilities for complex shapes and accurate designs as well as possibilities for customization. Production and prototyping costs for companies are lower because no tools are needed and expensive molds can be replaced by the 3D model. There is also less material waste because of the additive process. However, at this point, there is a limitation of colours, and it is also still a challenge to print soft and flexible materials, which can be used in clothing design.

1.5 DISCUSSION

In conclusion, a short reflection on the information and insight presented in this report is necessary. The data material for this report has some obvious limitations as it is based on relatively short interviews with a small sample of companies. In order to present a comprehensive overview, more interviews are needed. Secondly, the findings are based on the accounts from producers and manufacturers of digital technologies alone. This creates a bias as the companies are likely to see potential for their products where other players may have a more critical view on the potential and indeed the need for new technologies. However, the main purpose of the report is to initiate a discussion around the topic and suggest directions for the industry on company level as well as wider institutional level.

The findings above were presented to a number of representatives from the Danish fashion industry taking part in a workshop organized by the project partners. The second part of the report describes the feedback and reflections offered by the participants and concludes with a discussion of the findings.

DIGITAL TEXTILE PRINT

Digital printing is well-known and not a new technology for many applications; it is for example used in the graphical industry. We also all have a digital inkjet printer at home. But within textiles, digital printing has yet not emerged. By using the 'drop on demand' of digital inkjets, the technology offers a huge flexibility for design compared to analogue technologies like screen or rotary printing. Digital printing makes it possible to produce fewer items at lower cost.

Digital textile printing technology has been known and used for several years, but it is only in recent years that this technology has really made its entry into the fashion and lifestyle industry. The market share for digital textile printing is around 5%, but the annual growth in this market is more than 30%. Leading hardware brands are for example Mimaki, Roland, Canon and Epson.

Digital textile printing is a flexible and sustainable way to manufacture and design textile products. Online access to IOT makes it possible to give the end customer access to the design process and to be directly involved in designing and customizing the end product.

2.1

The second part of this report presents the findings of a workshop conducted in January 2018. The purpose of the workshop was to gauge the existing level of knowledge and interest in the industry and to get direct feedback on the impact of international changes as the industry players see it and discuss the opportunities for implementing digital technologies.

The workshop was organized by VIA Design and Design School Kolding and brought together 24 participants from a variety of large and small Danish companies and institutions. During the workshop, the organizers presented the findings from the interviews with technology providers and gave the participants an overview of what Industry 4.0 is and what kind of solutions the new technologies propose for the fashion and textile industry. Afterwards, the participants were divided into three groups to answer a list of questions on the applicability of digital technologies, existing knowledge, and barriers and opportunities. Each group had the same questions, but due to the combination of participants, the discussions moved in different directions.

Below is an overview of the discussion topics, the concerns raised and the perceived opportunities and barriers for the Danish industry. The topics are compiled from notes taken by the group convener and details from additional notes taken in the groups have been added.

SEWING ROBOTS

Sewbots, or sewing robots, handle fully-automated production processes of products like shoes, T-shirts or bed linen. The first sewbots were introduced by SoftWear Automation Inc., which in 2017 launched LOWRY, a robot built with machine vision and computing technology to automate fabric handling. SoftWear Automation received a grant of USD 1.26 million from the Wallmart Foundation and CTW Venture Partners. The emphasis of LOWRY is on T-shirts and jeans. Automation in the clothing manufacturing process is rapidly developing, and a sewbot can produce a T-shirt more than 2 times faster than a worker.

Fully-automated factories have the potential to disrupt the speed at which we produce clothing in the future as well as where we produce clothing. The will increase productivity, bring production facilities closer to the consumer and at the same time reduce mistakes and the need for human resources. However, it leaves us with the question of what this will mean to the many factory workers in developing countries.

2.2

Overall, the discussions centred on the following topics: Whether the Danish textile industry uses digital technology today, digitalization as a strategic driver, Big Data, in-sourcing of design and production, customization, knowledge, need and applicability, education and competences and cost.

2.2.1
Use of digital technology:

The reason why Danish companies are not front runners in this area is the size of the companies: the investment seems to be too large and the cost of developing the technologies too high. It is the same in every industry. But where exactly are Danish companies technological leaders? Even with sewing robots, there are plenty of international examples. The Danish companies usually accept new technologies when the purchasing price is lower. As one participant said: 'We live in a welfare society with high living standards and high wages; nobody is hungry enough to be front runners.'

However, several companies use PLM-systems today, and there is a huge interest in looking into the possibilities of 3D printing even though this technology is currently not used in the textile and footwear industry in Denmark. There is also a huge interest in digital printing, making customization possible as well.

In connection with the discussion about in time production made possible by the implementation of new technologies, especially on staple products, an SME participant stated that: 'We have a large inventory, so we can deliver quickly. Of course it requires a lot of logistics, but it works.'

'The companies designing these new technologies are industry giants. They can allocate sufficient money to innovation.'

On the other hand, the digitalization can be implemented quickly, and the companies may be willing to invest more now that the last crisis is over.
However, Denmark is characterised by many very small companies, and the larger ones who can take the lead do not yet focus on digitalization.
'We don't have the mindset to optimize our production any more because we have oursourced our production!' And therefore we do not focus on the possibilities in digitalization and Industry 4.0. To bring this back, we need to reinvent production competences.

2.2.2
Digitalisation as a strategic driver:

'As digitalization makes new business models possible, we will see new players coming in. It will be much easier for new players to come in'.
-'In a few years, app solutions will play a major role in the fashion value chain.'

-'The fun orders / products will come when we have the possibility to produce smaller series and do not have a limitation on order size that make it possible to produce more than 100,000 pieces'.

'Maybe we will see corporative digital production facilities where small companies can buy production capacity'. Some see digitalisation as a game changer: 'Virtual design will play an important role in a few years from now and this will reduce the number of prototypes.'

'And you have the possibility to sell directly from your virtual design'

'All parts of the value chain will be challenged by the new technologies!'

'It will give the end customer the possibility of influencing the design. It may not mean that it will be 100% customized, but at least the customer can influence the collection design.'

Hummel has already implemented this concept for childrenswear and provide parents with an opportunity to influence a new collection. This creates customer loyalty.

In connection with strategic and competitive advantages, a participant from a workwear company described how digital solutions would help with speed and flexibility, especially in low volume production. Also, as digital solutions promise to minimize waste and transport, they represent an opportunity to conserve resources and save money. Another participant mentioned the opportunity for creating competitive advantages by giving the company the option of creating unique products.

Big data: Many of the participants have noticed from the presentations that Industry 4.0 technologies are dependent on big data. One company representative argued that: 'We deal with what is in there, but we have no overview'. It is necessary to create big data from the correct data. If the correct information is not available, then the big data will not be correct. As a participant described it: 'There might be a difference between 'small big data' and 'big big data. ''Big data requires streamlining, and this is incredibly costly.'

Also, Amazon and other big platforms providers collect a lot of data: 'But the hit rate is still not optimal. We are still in the infancy of algorithms'. However, some see a possibility for Danish companies to use 'data mining' for preparation of usable data. 'But to use big data, it is necessary to know and to manage small data.'

'I don't think we have a problem getting access to data, but we lack the competences to find and use the right data.' 'But do you think companies are willing to share their data? Today, the companies are not even willing to share their list of suppliers!'

To use the digital transformation, it is important that everybody in the value chain shares their data. In this way, you will make the chain bigger and more valuable.

Another issue was mentioned in relation to application of big data: 'One thing is using big data to create the right measurements and clothing, but if the customer has a different idea of which size they are, the measurements will not help create a better fit. Big data need interpretation.'

In-sourcing of design and production: One participant proclaimed: 'I think it is possible that the pattern design will come back to Denmark'. 'Like short delivery time, size and fit are important parameters for brand loyalty'. 'Companies and customers would be more confident to share their data with a Danish / European production facility'.

'Environmental issues can also be the driver for in-sourcing!' 'It will be a win-win situation to take back production, and it will be much easier to implement circular economy!'

Customization: The demand from customers was addressed in the discussion of customization and individualization. The problem of how to organize and manage customizing was taken up with several participants expressing reservation and caution. –'But either way, this is what the customer will demand'. It was mentioned that the opportunity for customization has always existed in the form of tailoring, but no other participants mentioned this. The demand for customization was further discussed as a participant raised the issue that, perhaps, this need for individualization has been overstated. Another participant followed up by saying that: 'For most people, clothing is a matter of keeping warm and clean'. Consumers pick out what is at the top of the pile. This participant raised the issue of disposable clothing, which may eliminate the use of design altogether, and asked the question: 'Will there even be a textile fashion industry?'

A participant mentioned a recent report from Nordea showing a decrease in fashion consumption, but a rise in the consumption of services. This started a discussion where one participant asked this question: 'Perhaps the diminishing consumption of clothing also means people would rather just wear their favourite clothes?' 'Maybe digital technologies could be used to 'reproduce people's favourite clothes?' 'This could be a new business model!' one participant said.

Knowledge: A number of different points were made in relation to the topic of knowledge: from what it takes to utilise the technology to knowledge about what the technology means to the company or the designer.

Besides direct knowledge, the collaboration between sectors inhibit knowledge sharing:

'It is a challenge to the implementation that engineers and designers do not speak the same language.'

'We need knowledge about production. We have to reinvent the technical skills to benefit from Industry 4.0.'

There was a long discussion about where the competences should come from:

Some believe competences should start developing already in primary school as the basis for working together starts there: 'It's important to teach the young people to use technology in creative processes and to be able to use both hemispheres and make them work together'.

Also, IT people, engineers and creative people have to be coupled to learn to understand each other, and to learn from each other.

It was argued that the Danish fashion industry still needs a very deep professionalism and deep skills in a specific, narrow area, but everyone needs to look wider to benefit from the new world of possibilities'.

Need and applicability: During the discussion, questions about whether the Danish industry needs the technology were raised – and especially what the industry needs. One of the reasons why digital technologies have not been implemented to a higher degree in Denmark is that outsourcing is nearly 100%. Since there is very little domestic production technology, there is not much reason for technological innovation. At the same time, there is plenty of interest from smaller companies for local, small-scale production.

Current developments in fashion consumption were discussed as the participants returned to the report on declining fashion consumption. The report was seen as an argument for the implementation of digital solutions to support greater customization and better retail experiences. Another participant argued, however, that customers still expect the same low price as they have gotten used to in fast fashion industrialized mass production. It was then stated that Adidas, in their recent project 'Speedfactory' initiated to create smaller production of customized products, did not expect the products to become more expensive. 'That's why they haven't really started selling the products yet' was a counter argument raised.

The possibility of creating local domestic production through digital solutions gave rise to discussions of the need and opportunities for that. Especially the opportunity for small-scale production of size-sensitive work wear was mentioned as an example.

A concern was raised in relation to employment: As more production is automated, it is likely that more people will become unemployed. Another participant argued that he was sure new jobs would be created. However, an independent designer participating raised the point that the automatization of production creates an important political debate about the issue of employment. Another participant, the CPO of a Danish SME, stated: You can't stop change'.

But the opportunities of digitalization were also challenged by the experience that some participants had in relation to sewing: –'One thing is producing the textiles, such as knit, another thing is the assembling'. Sewing the pieces together – the processing – is still costly, and this could still lead to outsourcing.

Education and competences: In every group, the need for new competences was identified. It was mentioned that even in primary school there should be more focus on crafts-based learning.

With outsourcing of production, a lot of know-how has been outsourced. As a participant argued, integrating technology that allowed production to return to Denmark could create a migration of competences.

A new role for designers will include the development of new competences. Some of the factual knowledge about price levels, for example about materials, will be formalized and available online.

Arguing that "not everyone is creative", a participant addressed the concern that with individual customization, the need for design competences will diminish. There will still be a role for designers to play as many will choose to leave the design part to the professionals. Another participant added: 'You will still need to know something about technical qualities, for example, and about combining different materials'. Otherwise, 'there is a risk that everything will look the same'.

The importance of understanding what digitalization means to design was raised. A participant said that working in 3D programmes and other digital technologies changes the design process, which it is relevant to acquire knowledge

about. As a participating design student argued, the way design education is put together at the moment seems extremely outdated: 'Instead of learning how to use a pencil, we should be learning how to use digital technologies'.

One of the requirements from educational institutions was more scouting and experimenting. Institutions should be more aware of developments and have more workshops focusing on experimenting.

One participant mentioned that the new entrepreneurs entering the labour market want to combine different professions. 'But we also need IT competences. Many companies have outsourced their IT. We have to combine these competences with the competences held by designers and production technicians'.

Cost: Several participants discussed the cost and the perceived cost of acquiring new technology. 'Maybe it could be a benefit for the Danish companies that they have outsourced their production. Now they don't have any investment in an outdated production and can use their investment money for new digital technologies'. If companies are willing to invest, there is a possibility to get some production back to Denmark, one pointed out.

A Danish fashion company representative said 'we would love to, but the price isn't right. As long as we can buy a product cheaper elsewhere, it doesn't work'.

Besides these overarching themes, many other issues were discussed. One that resonated broadly with the participants was the issue of industry culture: At the moment, there is not a culture of sharing. Companies will need to trust each other to share data and collaborate on production. Another issue was that of support: There were scattered calls for different types of support for the implementation, either crowdfunding or government support. The support could take the form of economic support, information support or knowledge support.

2.3 SUMMARY PART 2:

In general, the participants in the workshops showed great interest in the promise of digitalization, and the discussions clearly showed curiosity and optimism. Some reservations came to the fore in relation to the current need for entirely new production and business models, and some had concerns about the cost of the transition.

However, there seemed to be consensus around the prediction that Industry 4.0 will become a reality, and the question is whether Danish companies will take the role of front runners. Historically, as several pointed out, Danish companies adapt once new technology becomes mainstream. But either way, the industry will need leaders who want to champion Industry 4.0 just like some leaders did with sustainability.

As almost all production is outsourced in the Danish industry, the need for new technology is not seen as a pressing issue. But it can be very dangerous just to wait as the digital technology will change the entire design and production value chain and bring totally new opportunities.

3 OVERALL SUMMARY

The overall aim of this report was to present an investigation into the possibilities and barriers for a transition to Industry 4.0 in the Danish fashion industry. The investigation was carried out by identifying the dominant technology providers, interviewing them about current involvement and opportunities and gauge the Danish industry players' responses to the information. The first part showed that the technology providers have plenty of solutions to offer that may create new opportunities for the industry. Small-scale manufacturing is seen as an area with growth potential where digital technologies could be implemented. Additional new business models based on new technologies will help small companies succeed. Small-scale and customer-driven design could provide new business models that reduce overproduction and ensure alignment between design and consumer, thereby reducing the amount of post-consumer discarding and creating more sustainable production in the fashion industry.

One of the barriers that several companies focus on is the lack of skills and competences in using new technologies. This appears to apply to the fashion and textile industry as well as other industries. This concern puts education at the centre of a transition into new technology and presents an opportunity for new designer roles. Developing educational programmes that target fashion and textile production would help create specific knowledge within the industries instead of adopting existing approaches from engineer-dominated sectors. In relation to sustainable development, the deep understanding of the possibilities that digital technologies provide is essential.

As is seen in section 2.3, the opportunities that the technology providers see correspond to a large degree to the response from the industry representatives. There were some concerns, however, about the speed with which the transition should happen. There were also some concerns about the overall need, at least for some technologies, in a country that is almost completely devoid of production and of the current costs.

4 DISCUSSION

As a frame for the findings presented above, we, the authors, offer a brief reflection on the purpose and applicability of the report. The report functions as a strategic investigation rather than a balanced research paper. As discussed in section 1.5, the interviews conducted were with companies promoting the technologies, which naturally affects their perspective on the need and application of new technologies. As the interviews were then presented to the participants in the workshops, this optimistic perspective created a frame for the discussion. This procedure reflects the opinion of the authors that the application of an Industry 4.0 paradigm is important for the Danish industry. Therefore, the report does not present critical perspectives on the matter beyond what the participants raised in the workshop. This approach corresponds with the aim of the report, but we would like to suggest that further critical research is initiated in this field to address the reality of design, manufacture and production for Danish fashion companies in the transition to Industry 4.0, especially in relation to new business models, customisation, made-to-order, insourcing and the sustainable potential.

Perspectives

What can we expect in the future?

Significant innovation in the field of sewbots is carried out by the large brands. Recently, we have seen both Adidas and Wallmart invest heavily in innovation and sewbots. In 2017, Amazon also filed a patent for 'stitch on demand' to sew clothing after an order is placed.
www.youtube.com/watch?v=b6vKFjlLcys

The technologies are here – 3D scanners are becoming cheaper, the quality of phone scanning is improving and other technologies are being upgraded. By bringing these technologies together and integrating them, we can create a fully-automated mass customization system. This calls for close cooperation between production and brands, but it can reduce overproduction and the waste of resources associated with excess stock; a just-in-time production and collaboration system may represent the future of the fashion and footwear industry. In a few years, each store might have their own sourcing line to adopt to individual needs and sizes?

This report and workshop is an activity in Lifestyle & Design Cluster with following partners:

Lifestyle & Design Cluster

VIA University College

design skolen kolding