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Using 3D apparel visualisation and teaching to develop new skills and possibilities

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Introduction

Industry 4.0 is predicted to change up to 50% of the work functions we know today. Some of the technologies associated with 4.0 can help drive the transformation towards a more sustainable fashion industry. In fashion, Industry 4.0 is characterised by the integration of the digital world with physical production. Technological changes today happen exponentially due to faster and cheaper computers—quantum leaps have been made in areas such as robotics, artificial intelligence, machine learning, 3D printing, and 3D visualisation. The transition to new technologies requires that fashion educators learn to instil in students a new mindset and technological skills, preparing them to work with big-data, automation, and 3D design, for instance.

The KEA innovation project 3D *Virtual Prototyping for the fashion industry* aims to investigate the relevance of 3D Virtual Prototyping tools (3D VP) for fashion and technical design students. Additionally, the project considers challenges and opportunities for Danish fashion companies by posing the research question: How can 3D virtual prototyping be implemented as a relevant technology for KEA Design students and, in the long term, for the Danish fashion industry?

Through a literature review, qualitative expert interviews, and observations of 3D workflows in large and small apparel companies, our aim is to explicate how the fashion industry works with 3D visualisation tools. Furthermore, we are interested in what skills and competencies fashion design schools should ensure that students obtain. In our research, due to new workflows regarding the implementation of 3D technologies, we see a need for 3D-targeted technological skills and a new mindset that challenge the traditional roles of fashion or technical designer.

From a student perspective, we have looked at 3D VP software providers and the opportunities and challenges they present to educational institutions in relation to software, hardware, and online services that can complement the teaching of 3D VP technologies. The companies and academics we interviewed for this project

generally believe that 3D VP technology can make a positive contribution to the sustainable transformation of the fashion industry. This article will try to shed light on this in regard to the product development process.
Our overall goal is to indicate where the apparel industry is heading with the integration of a 3D digital workflow and what new job opportunities 3D VP technology might create for fashion graduates.

Research Methods
We have conducted a literature review to map and evaluate the use of 3D VP in the fashion industry. To elucidate how the technology is being used in practice by the fashion industry, we have held qualitative interviews with software providers, designers, brands, and other stakeholders in the fashion industry, focussing on how 3D VP can function as an integral part of developing styles.

During company visits, work processes were observed with the purpose of mapping 3D VP effects. The companies interviewed represent the fashion industry widely and are located in Hong Kong, Germany, UK, Sweden, Holland, and Denmark. They represent everything from one of the world's largest clothing manufacturers to large and medium fashion companies to innovative start-ups that all tap into the possibilities of using 3D VP on a daily basis.
We conducted long-distance qualitative interviews with educational institutions that have had different experiences with integrating 3D VP into the curriculum. Those interviews provided us with knowledge about software use and competencies as well as about how teaching 3D VP can be organised.
To expand the empirical data, we participated in the PI Apparel Europe 2019 conference, where 3D VP was contextualised for the entire value chain in the fashion industry.

The project's empirical data were obtained during the period from November 2018 to October 2019.

New Workflows with 3D VP
3D VP technology is mostly implemented in large international companies or small innovative start-ups. Both types of companies work strategically with 3D technology, as they attempt to tap into the opportunities associated with digitising the value chain. Using 3D visualisation technology can speed up developmental activities by shifting physical prototyping to a virtual space, where new style developments can be tested and iterated early in the process as an aid to creating products that match the initial idea immediately, thereby minimising or eliminating the need for samples.

The majority of companies interviewed use 3D technology in the product development process to test fit, print, placement, and colour combinations; they also use it to visualise materials and, in a few cases, as a digital draping tool. Minimising the number of prototypes in the development process saves time and reduces the risk of sales samples not arriving on time. Additionally, some actors use 3D VP for approval within the company and from private label customers, buyers, and management. Integrating 3D VP across the value chain requires that entire collections be drawn in 3D, which takes time and entails a general transformation of the development process and associated workflows.

Danish United Textile Group (UTG) is an example of a company with a holistic strategic approach to implementing 3D technology. Their strategy aims to change the production company, UTG, to act more as a technology company going forward by digitising all workflows. UTG hopes to be able to cut 50% of physical samples moving forward after the integration of 3D VP (Brodie, 2019).

Furthermore, our research has uncovered a need for textile suppliers to provide digital twins of physical materials, which UTG and several other companies are working to meet together with their suppliers.

Both designers and pattern makers mentioned in their interviews that 3D visualisation offers an opportunity to strengthen products and the communication surrounding them. Compared to 2D sketches, 3D tools give designers a clearer and more accurate way to visualise their initial ideas. Richard Lindqvist from the Swedish company Atacac explains that, in his opinion, 3D VP has an additional benefit, as the technology encourages pattern cutters and designers to work more closely together (Lindqvist, 2019).
Atacac uses 3D VP through the entire value chain, from development process to sales and marketing. Atacac's business model leverages 3D technology in the creation of digital sales samples. They sell their products based on a 3D visualisation in their web shop. This is an example of a business model where the product is cheapest at the pre-order stage and subsequently increases in price. For marketing, Atacac uses 3D technology to stage products in ways that would not be possible with physical samples or models.

3D VP and the need for new skills
Our interviews with academics highlighted how important it is that students understand 2D patterns and pattern making before delving into 3D software. We have been able to substantiate

Credit: Emma Langkilde Vammen - Pattern Design PBA19

Avatars from CLO3D: Clo rendering above is student work from elective module in Fashion 3D virtual prototyping (KEA)

this finding by analysing a test workshop that students participated in at KEA in 2019. The participating 2nd-semester students had a bit more difficulty navigating the 2D section of CLO 3D than 4th- and 6th-semester students. Our analysis showed no noticeable difference between 4th- and 6th-semester students or between Sustainable Fashion and Pattern Design students, for that matter. Experience from AMFI, where 3D VP has been included in the fashion curriculum for the past 10 years, shows that students become more proficient at 2D pattern making when working with the 3D VP software. Sandra Kuijpers, a teacher and researcher at AMFI, states in her interview that, 'The nice thing is that they [students] really enhance their pattern making skills through the 3D visualisation [...]. They can really push it because the immediately can see what is happening.' Furthermore, experience shows that it is faster to work digitally with pattern making, allowing for testing more and faster (Kuijpers, 2019).

In order for 3D VP to make sense in terms of student-learning processes, the research shows a tendency for 3D VP to be included in the curriculum only after students have acquired a basic knowledge of fashion and pattern design during the first year. 3D VP offers significant advantages in the process of learning pattern making: for instance, a decrease in the time required to cut and sew test garments for fit and design assessments; in other words, it allows for faster and more individual design iterations. The software also enables new forms of garment visualisations. The transition from a 2D pattern to a 3D garment is fully animated in the 3D simulation; additionally, it is easy to explore and visualise the relationship between garment and body—different body types and sizes are aided by different maps and tools in the software (e.g., transparency tools). 3D VP can help strengthen students' understanding of several areas of fashion and pattern design in relation to understanding materials, form, fit, and print, to mention a few. Therefore, we can conclude that it is advantageous to integrate 3D VP from the 2nd semester onwards.

A surprising insight from the research was that some schools also offered 3D VP to fashion management programs, where these students had to learn how to navigate and handle files in a digital value chain. This is in line with how the company PVH Europe works to integrate and train their staff in the use of 3D VP. PVH are trying to integrate 3D VP throughout the value chain, and they want all employees to have knowledge of 3D VP.

Choosing the right software

There are several 3D VP software providers targeting the fashion industry—for example: Lectra, Browzwear, Optitex, CLO 3D, Gerber, and Tukatech. Our research does not point in a clear direction regarding the choice of 3D VP software. Many companies work with several different programmes at once. Companies that have not outsourced their pattern process prefer to use software programmes that originate from 2D CAD CAM, though often supplemented by CLO 3D.

We have observed that a preponderance of teachers and students prefer the user interface of CLO 3D. The availability of CLO 3D and its online tutorials and community are favourable features. Software prices are distinctly difficult to compare as some providers sell their software as a subscription, whereas others sell theirs for a one-time price. It has not been possible to obtain prices from all providers. However, CLO 3D has the advantage that anybody can gain access to the programme for a small fee, and students can get a 50% discount, which is a great advantage as they can continue to use CLO 3D after graduating.

3D VP as a sustainable tool

No doubt, 3D VP technology can aid in making the fashion industry more sustainable. However, it has not been scientifically proven yet, but looking at the data available from different software providers, 25–100% of physical samples can be avoided. A large German design company[1] mentioned in their interview that as early as 2022 they expect their development process to have become 100% digital (Anonymous, 2019). Nevertheless, several companies stated that they will not be able to do without physical tests, but that the goal is to move from, for example, four test samples to one physical sample. Since it takes the same amount of water to produce a single t-shirt as the average, western person will consume in a year, the positive impact of fashion companies adopting 3D technology is immense, even if only measured in water consumption.

Another positive angle is that 3D VP makes it easier to work in a focussed way with fit in relation to diverse body types or sizes, thus avoiding costly errors in production. By reducing the number of physical samples, not only water but also raw materials, transport, money, and, not least of all, time are saved. Using 3D visualisation in the development process can save time as it becomes faster to test ideas and fit as well as to get a realistic image of a given design. As the development process accelerates, the time-to-market period becomes shorter, which can help make a company's products more relevant to the end consumer, resulting in increased sales. From a sustainability perspective, 3D VP can drive the fashion industry from a 'make-to-sell' to a 'sell-and-then-make' model.

3D VP and New Business Models

The research shows examples of companies that see digital fashion as a new business area. Atacac make their digital files of 2D and 3D patterns available as shareware, which they use in their marketing to gain external customers and to create user involvement. Carlings, a Norwegian clothing company, has sold digital fashion to be 'worn' only on social media—garments that only exist digitally and costs approximately € 30 after a digital tailor has visualised the purchased item on a personal photo. The Fabricant is an American company that only produces digital fashion. They challenge what digital clothing can be, focussing on the kinds of needs that will probably arise when ordinary consumers get a digital twin (a personal avatar based on a body scan) for use on social media. Already now, international sportswear brands and fashion houses are developing digital twins of existing products that can be purchased for digital use in computer games such as Fortnite. At the PI Apparel Europe 2019 conference, blockchain was repeatedly mentioned as a way to verify the ownership of a digital product. Another example is Swatchbook, a vendor using specially developed fabric scanners to translate physical materials into a digital twin.

[1] The company in question wishes to remain anonymous.

3D VP Pilot workshop with the fashion industry.
Photo: Magnus Jølnæs Jacobsen

To help with an optimal fit, Alvanon, a fashion technology company, provide customised avatars to match a company's fitting goals, either through pre-designed digital avatars, or through a 3D body scan of the company's fitting model.

Conclusion
3D VP is being used more and more in the globalised fashion industry, and the technology has an untapped and partly unexplored potential and positive impact in a sustainability perspective. For this reason, 3D VP is a relevant technology for fashion and technical design students. As a relatively new technology within the fashion industry, it can provide new job opportunities for fashion graduates with 3D visualisation skills. These skills open up entirely new job areas such as designing digital apparel for the gaming industry and virtual garments for digital twins.

Our research clearly shows that becoming a skilled 3D designer requires a prior, advanced understanding of 2D-pattern construction, shape, and fit, as well as an understanding of the physical properties of textile materials. The positive news is that our research indicates that these competencies can be enhanced by the use of 3D visualisation software, which offers fast iterative processes. Our insights from the KEA test workshop suggest that it will be valuable for fashion students to begin with basic skills in 2D pattern construction, form and fit understanding, and material knowledge, followed by learning 3D VP, as together these may lead to a high-level of competence upon graduation.

3D VP is considered by stakeholders in the fashion industry as a tool to achieve a higher degree of digitalisation in the value chain—a form of digitalisation that enables cutting resources and time, thereby achieving a shorter time-to-market span. Additionally, in the long term, consumer involvement can be increased with the aid of digital fitting rooms (which will result in fewer returns from online sales), and a greater degree of customisation can thus be achieved. It is clear that digitalisation can create and support new and more sustainable development processes and business models that work to minimise the number of physical samples, allowing companies to focus on the sell-and-then-make model.

As the project's empirical data shows, 3D VP technology present the market with numerous advantages. However, we have also encountered challenges such as outsourced construction of 2D patterns, a current lack of digital fabric twins, and a shortage of staff with 3D visualisation skills. These are challenges, though, that companies are in the process of solving in their journey to integrate 3D visualisation.

For businesses to achieve long-term success with the implementation of 3D visualisation technologies, they must adopt a strategic, rather than an individual, approach. Any digital strategy should include the entire business. The 3D technology must be introduced to all staff groups in order to create a sense of ownership and interest. A process of positive implementation requires that companies focus on what problems the technology can best help solve, adoption time, and a new mindset for all employees. Thus, companies are advised to start small but move fast—begin with the basics, as this is the most likely way to ensure a quick return on investment. Further, companies would do well to partner with relevant stakeholders and share experiences with colleagues across the industry. Finally, we would like to emphasise that our research shows that all interviewed persons—whether they be teachers, students, or designers—regard 3D VP technology positively. ■

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