

## Facilitating Fashion Digital Product Passports: A Review and Comparison of Digital Twin Creation Tools

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**Research Background and Rationale.** The rapid cycle of fast fashion, coupled with the tendencies toward over-consumption, is exacerbating adverse impacts on both environmental and social fronts within the textile and fashion sectors (Dickson, 2023). In response to these pressing concerns, the European Commission has advocated for implementing Digital Product Passports (DPPs) for textiles and apparel products. The initiative aims to bolster the principles of a circular economy and further sustainable development objectives by enhancing traceability and transparency across the entire lifecycle of textile products (Lehtisalo, 2023). Digital product passports are created and implemented through the concept of "Digital Twins" (Douglass, 2023). A Digital Twin (DT) involves creating a virtual copy of any physical entity to share data in real-time (Kritzinger et al., 2018). For designers, utilizing DTs to virtually test their new fashion collections eliminates the need for raw materials, reduces work time, and produces physical fashion items only when an accurate simulation of the new product is evaluated (Carvalho & da Silva, 2021). DPPs utilize digital twins to create a digital infrastructure to record product information and use cycles, contributing to sustainability and transparency in the global fashion industry.

Creating fashion digital twins involves utilizing various software tools for tasks such as 3D modeling, simulation, rendering, and occasionally AI-driven customization. Notable software solutions for 3D modeling of apparel include Accumark3D by Gerber, CLO3D, Modaris3D by Lectra, Optitex3D, Style3D, V-Stitcher by Browzwear, and Tukatech (Papachristou & Anastassiou, 2022). Recent studies and industry reports indicate that CLO3D and Style3D have begun incorporating DT-oriented technology. Clo3D, a prominent Korean 3D software company, has gained significant international recognition for its extensive market presence and influence in the virtual domain (CLO3D, 2009; Kim, 2019). The company actively implements the digital twin concept by meticulously crafting virtual replicas (Gonzalez, 2020). On the other hand, Style3D, established in China in 2015 by Zhejiang Lintex Technology (Style3D, 2019), offers virtual samples closely mirroring physical products, facilitating seamless integration with production data systems. This integration ensures the smooth transition from virtual designs to physical production, aided by fabric libraries and fabric scanners that accurately replicate real-life materials (Xiaoyan, 2023; Yuhuizi, 2023). These digital tools provide designers with a robust platform for creative product design and development and for constructing digital asset repositories for brands. Nonetheless, the comparative efficiency of these software solutions in fashion digital twin creation remains unclear. This preliminary study aims to review and compare

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the two promising tools for DPPs (CLO3D, Style3D) regarding their effectiveness in digital twin creation from a user perspective.

**Research Method.** Nowadays, videos are an integral modality for information sharing on social media. There’s a growing interest in exploring video content. Linguistic information transported in spoken parts of a video is known to convey valuable properties regarding context and emotions (Craig et al., 2021). Therefore, we collected videos about CLO3D, and Style3D for sentimental content and analysis to fulfill research purposes. A total of 34 videos were collected, with 13 about Style3D and 21 about CLO3D. The videos provide insights into user experience, satisfaction, and perceived value of both 3D software tools in real-world settings. The automatic transcription from

spoken language was obtained and then imported into NVivo for coding and thematic analysis. This study adopts both inductive and deductive approaches. The queries such as word cloud, word tree text searching, sentiment analysis, and thematic analysis were applied to the two data sets for the analysis.

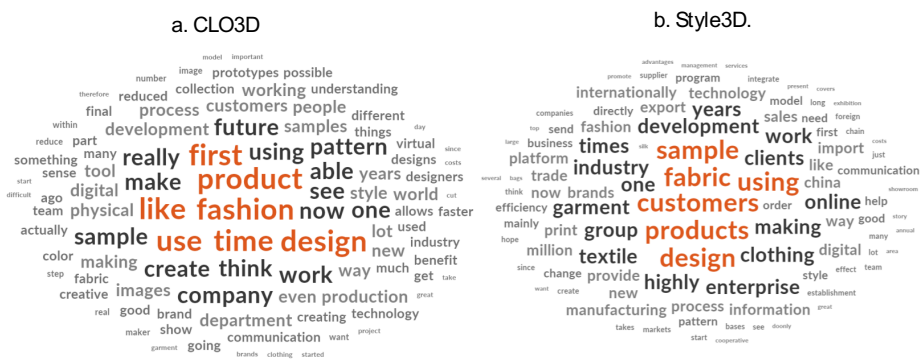


Figure 1 Word Frequency Cloud

**Findings and Discussions.** NVivo's word frequency analysis (see Figure 1) revealed distinct user priorities between CLO3D and Style3D. CLO3D users primarily focused on products, fashion, design, samples, and patterns, emphasizing fashion creation and visualization. In contrast, Style3D users emphasized supply chain integration with frequent mentions of customers, fabric, samples, products, and design. Auto-coding was utilized for both datasets, uncovering key themes. Analysis showed the main themes that emerged from the CLO3D users' experiences set were “product,” “fashion,”

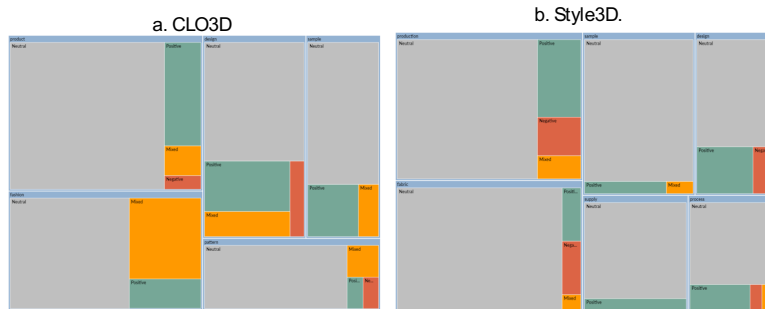


Figure 2. Hierarchy Chart of Sentiment across Main Themes  
Note: green-positive; yellow-negative; orange-mixed; gray-neutral

supply chain integration with frequent mentions of customers, fabric, samples, products, and design. Auto-coding was utilized for both datasets, uncovering key themes. Analysis showed the main themes that emerged from the CLO3D users' experiences set were “product,” “fashion,”

“design,” and “sample,” indicating that CLO3D centred on product design, development, and marketing communication. The main themes that emerged from the Style3D data set were “production,” “fabric,” “sample,” “supply,” “design,” and “process,” indicating that Style3D users highlighted production efficiency, leveraging the platform to connect with material suppliers or retail clients. Sentiment analysis drew a total of 207 sentiment references from 28 sources, with 15 out of 21 coming from CLO3D and 13 out of 15 from Style3D. Within these sentiment references, 155 were categorized as positive, with 101 references about Style3D and 54 regarding CLO3D. Findings indicated a generally more positive reception of Style3D compared to CLO3D. Hierarchy charts (figure 2) were created to examine the sentiment outcome across the identified main themes. Results indicate that both tools have room to improve.

This preliminary study suggests that both tools can contribute to the development of fashion product passports in their ways. CLO3D offers advanced simulation capabilities allowing designers to create and visualize fashion products vividly, while Style3D facilitates digitalization across the fashion value chain, particularly in fabric digitization and supply chain integration. However, this study is limited by its focus on only two tools and a single data source.

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