



ПЛАТФОРМА 2 ІНФОРМАЦІЙНІ ТЕХНОЛОГІЇ ВІЗУАЛІЗАЦІЇ В ДИЗАЙНІ

THE ADVANTAGES OF USING 3D PROTOTYPING SOFTWARE IN THE CLOTHING DEVELOPMENT

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The article analyses the impact of using 3D prototyping software in the garment design process, highlighting the quantifiable benefits in terms of time, costs, and material resources. The study synthesizes information from industry reports, demonstrating that digital prototyping significantly reduces the number of physical samples, accelerates the development cycle, and decreases textile material waste. The direct economic effects, the optimization of communication between design and production, and the contribution to sustainability are examined. The results support the systematic integration of 3D technologies in education and industry as a strategy for efficiency and competitiveness.

Key words: 3D prototyping, sustainability, cost reduction, virtual samples, textile industry.

INTRODUCTION

The garment industry is undergoing a structural transformation driven by digitalization and the integration of Industry 4.0 technologies. According to reports published by McKinsey & Company and Business of Fashion, the digitalization of the product development process is considered one of the main drivers of competitiveness growth in contemporary fashion [1].

The traditional garment development model is based on the successive production of multiple physical samples for a single prototype, each involving the consumption of textile materials, labour, international transportation, and production time. At the same time, a series of prototypes or several alternative prototypes are often developed. The garment prototype is more expensive than the mass

produced product because it requires manual work and frequently involves multiple adjustments. Ultimately, the material prototype is not always approved by the product launch committee for serial production. In the context of globalization and the pressure to reduce time-to-market, these stages become costly and often inefficient. Therefore, the development of digital prototypes at the model design stage becomes timely and strategically justified, allowing evaluation by the product launch committee prior to producing the material sample (model 0), followed by final assessment by both the launch committee and the consumer.

The integration of 3D prototyping software such as CLO3D, Browzwear, and



Optitex enables the creation of a realistic virtual garment model, simulating fabric behaviour, drape on the body, tension distribution, and structural adjustments prior to physical production. As a result, the development process is partially transferred to the digital environment, reducing technical uncertainty and financial risk.

PURPOSE

The purpose of this research is to demonstrate, through arguments supported by industry reports and academic studies, the economic, technological, and sustainability advantages of using 3D prototyping in garment product development, highlighting: cost reduction in sampling, decreased material waste, optimization of development time, and improved collaboration between design and production.

RESEARCH

The integration of 3D prototyping in the fashion industry generates measurable economic, operational, and environmental effects. The analysis of data from industry reports and sustainability studies highlights significant reductions in sampling costs, development time, and environmental impact, confirming the strategic value of digitalizing the design process.

1. Reduction of Prototyping Costs

According to industrial analyses published by McKinsey & Company and reports from companies that have implemented digital prototyping, the cost of a single physical sample can range between USD 500 and 1,000, depending on complexity, materials, and logistics [2].

Brands such as **Tommy Hilfiger** have reported an approximately 80% reduction in physical samples after implementing 3D design. This reduction generates direct savings not only in materials but also in international transport and administrative costs. Similarly, **Adidas** and **PUMA** use digital prototyping to accelerate development and reduce associated costs.

For a brand developing 100 models per season, with three physical samples per model, costs can exceed USD 300,000 per season. Reducing this to a single physical sample per model can generate savings of approximately USD 200,000. 2. Reduction of Development Time

Time-to-market is a strategic indicator in the fashion industry. According to analyses published by Business of Fashion, companies that have integrated 3D technology have reduced development time by 30–70%, depending on the level of digitalization. Digital prototyping enables instant simulation of pattern modifications, virtual fitting on a 3D avatar, online collaboration between teams located in different regions, and the elimination of physical sample transportation.

Brands such as **Fendi** and **Dior** use digital processes to validate collections prior to final production, significantly reducing traditional iterative stages [3]. 3. Sustainability Impact

The fashion industry is responsible for a significant share of global carbon emissions. According to reports published by the Ellen MacArthur Foundation [4], reducing material waste is a strategic priority in the transition toward a circular economy.

By minimizing physical stages in the development phase, the carbon



footprint associated with sampling can decrease by up to 80–90%, according to comparative Life Cycle Assessment (LCA) studies published in industrial sustainability journals.

4. Digitally Assisted Innovation and Creativity

3D prototyping has not only economic and environmental impact but also a creative one. Designer **Iris van Herpen** uses advanced digital modeling to create complex forms that would be difficult or extremely costly to achieve through traditional methods. This approach enables experimental shape exploration, innovative material simulation, and integration with AR/VR technologies for interactive presentations.

RESULTS AND DISCUSSION

An analysis of data extracted from academic studies published in peer reviewed journals that quantified the impact of 3D prototyping on CO₂ emissions, sampling costs, and development time of new garment models [1-6] reveals the following (Figure 1):

1. Environmental Impact Reduction

LCA-type studies indicate a reduction of approximately 80–90% in CO₂ emissions when digital prototyping is used instead of traditional physical samples.

2. Economic Impact – Prototyping Costs

According to the literature, the cost of a physical prototype can reach approximately USD 1,000, while a digital 3D prototype can reduce the cost to around USD 100 or less, representing savings of up to 90%.

3. Development Time Reduction

The time required for prototype development and validation can be reduced by up to 65–73% through the integration of 3D technologies into the workflow.

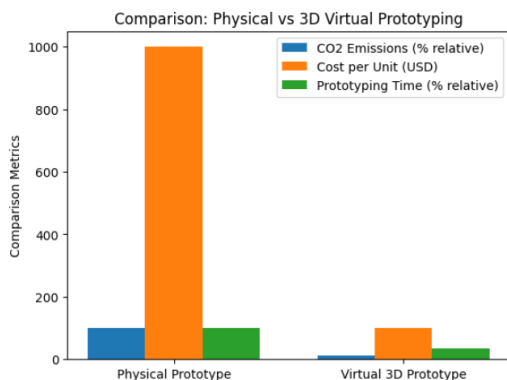


Fig. 1. Physical vs. 3D Virtual Prototyping Comparison

CONCLUSIONS

The implementation of 3D prototyping is revolutionizing the fashion industry through clear benefits in sustainability, economic efficiency, and commercial speed.



From a strategic perspective, this technology represents a pillar of competitiveness, eliminating material waste and excess samples through instant digital visualization.

By enabling data-driven decisions and optimal cross-functional coordination, 3D solutions allow brands to evolve sustainably, adapting agilely to market demands and new consumer behaviours within a globally accelerating digital ecosystem.

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ПЕРЕВАГА ВИКОРИСТАННЯ ПРОГРАМНОГО ЗАБЕЗПЕЧЕННЯ ДЛЯ 3D-ПРОТОТИПУВАННЯ У РОЗРОБЦІ ОДЯГУ

Стаття аналізує вплив використання програмного забезпечення для 3D-прототипування у процесі проектування одягу, підкреслюючи кількісно вимірювані переваги щодо часу, витрат і матеріальних ресурсів. Дослідження узагальнює дані галузевих звітів, демонструючи, що цифрове прототипування суттєво зменшує кількість фізичних зразків, прискорює цикл розробки та скорочує відходи текстильних матеріалів. Розглянуто прямі економічні ефекти, оптимізацію комунікації між дизайном і виробництвом, а також внесок у сталий розвиток. Отримані результати підтверджують доцільність системної інтеграції 3D-технологій в освіту та промисловість як стратегії підвищення ефективності та конкурентоспроможності.

Ключові слова: 3D-прототипування, сталий розвиток, зниження витрат, віртуальні зразки, текстильна промисловість.