



ПЛАТФОРМА 2 ТЕНДЕНЦІЇ РОЗВИТКУ АРТ І ФЕШН-ДИЗАЙНУ

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ORGANIZATION OF MANUFACTURING PROCESSES THROUGH SUSTAINABILITY REQUIREMENTS

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One of the current trends is the organization of manufacturing processes through sustainability and durability requirements. In the modern era, digitization has become central to almost all aspects of our lives, including the fashion industry. Given the rapid technological changes and increased access to the Internet, the fashion field has gone through a significant transformation, adopting digitization to innovate and adapt to new market demands. In order to identify the impact of digitization on the sustainability characteristics and to propose recommendations for the management of the manufacturing processes, the analysis of the technological process of manufacturing and developing the clothing product was carried out. The paper presents a study to improve manufacturing processes by using simulation and digital prototyping, 3D printing, data analysis and artificial intelligence, but also e-commerce and online stores.

Key words: *management, digital simulation, circular economy, reuse.*

INTRODUCTION

The clothing industry, although it is growing at the same time due to the fast-fashion phenomenon, is one of the most polluting industries. For example, the textile industry's carbon emissions are double that of international air flights and shipping combined. The consumption of natural resources is also intense: just one T-shirt consumes more than 2000 liters of water for manufacturing [1, 2]. According to the reports of the United Nations Environment Program (UNEP), the fashion industry contributes about 10% of global carbon pollution, considering that the production chain is long and complex, starting with agriculture and the petrochemical industry, followed by fashion production, logistics and retail [2]. Low-paid labor, the use of child labor in developing countries, more than 170 million children around the globe are forced to work in fabric production and clothing factories has led to a drop in the price of products. The fall in clothing prices over the last 20 years and the excessive consumption of clothing products supported by social media and promoted by the demonstration of new products for which or launched about 50 micro-seasons per year replacing the previous four seasons,



have contributed that the the world's biggest brands Adidas, Versace, Chanel, H&M, Gap, Cucci, Saint Laurent, Nike, Prada and Stella McCartney to commit to reducing the emissions and waste they produce.

Statistical data mention that 30-40% do not find their way to a wardrobe and only 8% are recycled, the rest being incinerated or sent to the landfill [3]. The Sustainable Clothing Action Plan (SCAP) was founded in the UK in 2007. Led by Wrap (Waste & Resources Action Programme), over 300 leading organizations and brands, including Nike, Adidas and Marks & Spencer, have signed up to the SCAP plan. [2] The European Union has set itself the goal of reaching a net level of emissions equal to zero by 2050. In this context, Brussels has established that until 2030 the products imported to the EU market must have a long life, be recyclable, largely made of recycled yarns, without dangerous substances and products that comply with social and environmental norms. [4] They also encourage a circular economy and fast fashion giants such as: H&M, Primark, Inditex (Zara), Boohoo, Shein, invite customers to donate worn clothes from any brand in exchange for a discount on purchases [3, 4]. Several brands producing luxury clothing such as: Ahluwalia, Bogdar, Bode, Calmo etc. with supporting the sustainable character of fashion focuses on the use of organic materials, 100% biodegradable, vintage and recycled textiles, but also the rational planning of the wardrobe (avoiding overproduction by making the most popular models and products) and sustainable production processes aimed at reducing textile waste. One of Romania's national strategies is opting for the circular economy by: creating a system for collecting, sorting and valorizing used clothing; stimulating producers to ensure a closed circuit and supporting consumers to repair and reuse products; the introduction of the digital passport of the product and the introduction of legal requirements on eco-design [1].

PURPOSE

The aim of the study is to analyze the design stages of garments and establish the possibilities of reducing waste and/or environmental pollution by introducing digitization systems in the stages of development, manufacture and sale of clothing products that today are accessible and meet sustainability requirements.

RESULTS AND DISCUSSION

The circular economy strategy, reducing the use/reuse of polyester or non-degradable materials, followed by fashion entrepreneurs who propose the life cycle of clothing described by the route of the consumer's wardrobe that would bring zero waste imposes the stages: production of raw material, weaving, durable design, production the clothing, delivery, buying, wearing, reusing (fig.1).



Fig. 1. The life cycle of clothing in the principle of "zero waste"



As raw materials considered sustainable, we can mention: organic cotton, for which no chemicals are used in cultivation; organic flax; ramy (nettles) – a weed that grows without fertilizers and herbicides, but is difficult to process; hemp – a durable, unpretentious crop that does not require a large amount of agrochemicals and water. Newer sustainable textiles: lyocell – made from eucalyptus wood, looks like silk; SeaCell Active – a mixture of cellulose and seaweed, the material is enriched with silver, which gives it antibacterial and antifungal properties; modal – made of chlorine-free beech wood; pinatex – the material is similar to leather, it is made from pineapple leaves; orange fiber (fiber of orange, silk of orange) – made from pomace that remains after squeezing orange juice, etc. [5].

Fashion is not only a form of expression, but also a way to express our emotions and beliefs. As we spend more and more time in virtual environments, our interest in fashion will only increase. It is estimated that by 2030, the digital fashion market could reach the value of 50 billion dollars [6]. Digitization is a process of transforming real-world processes and activities into digital formats using computer technologies [7]. In fashion, digitization can be used to innovate and streamline processes, as well as improve the customer experience. Here are some ways in which digitization can be applied in the fashion industry:

- Computer Aided Design (CAD): The use of specialized software to create digital models and sketches replaces the traditional manual drawing process. This allows designers to quickly and efficiently create and modify designs, test colors, textures and patterns in the virtual environment.
- Simulation and virtual prototyping: Information technology enables the virtual simulation of materials, textures and design, reducing the need for physical prototyping. This helps save time and costs associated with new product development and testing.
- 3D printing: 3D printers are used to create prototypes and samples of fashion products, but also to produce custom pieces or unique accessories.
- Virtual Reality (VR) and Augmented Reality (AR): The use of VR and AR in fashion allows customers to experience products in the virtual environment before purchasing them.
- E-commerce and online stores: Digitization has revolutionized the way fashion products are marketed and sold. Online stores give customers access to a wide range of products without having to physically go to a store. They also offer the ability to customize and tailor the shopping experience to each customer's preferences.
- Data analytics and artificial intelligence (AI): The use of AI and data analytics technologies can help fashion brands better understand their customers' preferences and behavior, anticipate market trends and make more informed decisions about design, production and marketing strategies.

The value chain for the production and marketing of clothing items proposes to us for analysis the following important stages from the point of view of cost calculation and the direct elaboration of the clothing product: storage of raw materials; developing the concept of the model; development of design documentation; launching the technological line and sewing/making the pattern; finishing – packing and storage, etc. [8]. The tailoring and sewing of clothing



products made within enterprises through digitization and computer-aided design, simulation and virtual prototyping work contribute to the considerable reduction of waste. We will visualize in figure 2 a narrow segment of the manufacturing technological process. Table 1 will present the analysis of the work required to be carried out within the technological process of developing the model concept and design documentation using digital and manual systems.

Table 1

Analysis of the model concept development process
 and design documentation using digital 2D/3D and manual systems

No	Technological process stages	Manual realization		Made using CAD systems	
		instruments	Waste	instruments	Waste
1	2	3	4	5	6
1. Elaboration of the concept of the model					
1.1	Elaboration of the sketch, selection of materials	designer	textiles, etc.	software for graphic design, digital textile library PC	- textiles, etc.
1.2	Analysis/diversification of chromatic solutions	designer	paper, etc.	PC, software for graphic design	-
1.3	Analysis/diversification of textures	designer	paper, etc.	PC, digital textile library	-
1.4	Analysis/diversification of concepts	designer	paper, etc.	software for graphic design, digital textile library PC	-
2. Development of design documentation					
2.1	Development of the BP and the MP	Graph paper, line drawing tool kit, centimeter tape	paper, etc	PC, 2D/3D software for fashion design	-
2.2	Development of the template set	Graph paper, line drawing tool kit, centimeter tape	paper, cardboard etc.	PC, 2D/3D software for fashion design	-
2.3	Elaboration of layouts and their verification	Sewing machines, irons, textiles, scissors, sewing thread, needles	Textile materials, sewing thread	PC, 2D/3D software for fashion design	-
2.4	Making the model prototype	Sewing machines, irons, textiles, scissors, sewing thread, needles	Textile materials, sewing thread	PC, 2D/3D software for fashion design Sewing machines, irons, textiles	textile paper, etc.
2.5	Promotion of the model	Mannequin, Camera	The model prototype	PC, 2D/3D software	prototype

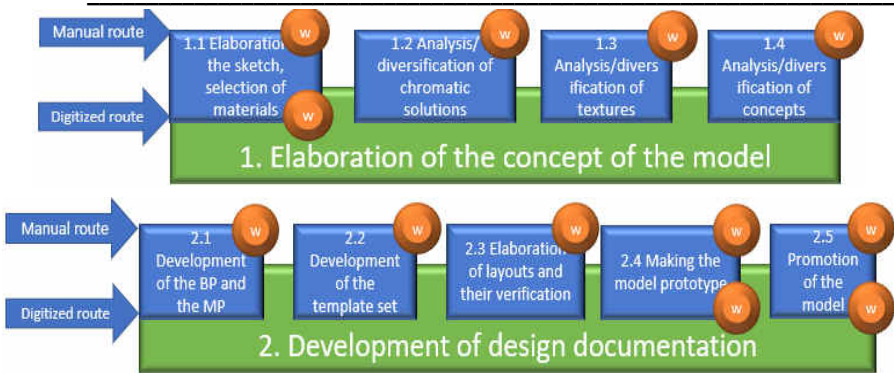


Fig. 2. Visualization of the manual and digitized path of the development of the concept and the design documentation of the model and the presence of waste in stages [developed by the authors]

CONCLUSIONS

Responsible waste management is one of the basic issues of the fashion industry. The continuous digitization process in the field of clothing offers businesses a considerable advantage by offering innovative, attractive and time-efficient technologies. Today, digital technologies are a necessity for entrepreneurs in all fields, even more so in the field of fashion. Automated clothing design systems as well as 3D digital clothing visualization technologies considerably reduce the time and material consumption required for the development of work documentation. Today's final consumer requirements are much more sophisticated and are characterized by preferences for Eco products adapted to current aesthetic requirements. Green technologies, Eco-innovative solutions and various practices for environmental protection adapted to the fashion field currently involve:

- ✓ recycling of waste from garment enterprises;
- ✓ recycling used clothing products as an aesthetic and physical aspect;
- ✓ the use of natural materials such as organic linen, hemp, silk, organic cotton, nettles, wool, etc., easily degradable materials, but also possible to produce in the country;
- ✓ digitization of the processes of development/design of clothing products;
- ✓ adapting the artisanal technologies for the production of materials and garments to the needs of mass consumption or/and the creation of versatile models that do not lose their relevance;
- ✓ adapting electronic commerce to consumer requirements with the possibility to try on the virtual model before it is made.

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ОРГАНІЗАЦІЯ ВИРОБНИЧИХ ПРОЦЕСІВ ЧЕРЕЗ ВИМОГИ СТІЙКОГО РОЗВИТКУ

Одним із актуальних трендів є організація виробничих процесів через вимоги стійкості та довговічності. У сучасну епоху цифровізація стала центральною для майже всіх аспектів нашого життя, включаючи індустрію моди. Враховуючи швидкі технологічні зміни та розширення доступу до Інтернету, сфера моди зазнала значних змін, прийнявши оцифровку для інновацій та адаптації до нових вимог ринку. З метою виявлення впливу цифровізації на характеристики стійкості та надання рекомендацій щодо управління виробничими процесами було проведено аналіз технологічного процесу виготовлення та розробки одягу. У статті представлено дослідження щодо вдосконалення виробничих процесів за допомогою моделювання та створення цифрових прототипів, 3D-друку, аналізу даних та штучного інтелекту, а також електронної комерції та онлайн-магазинів.

Ключові слова: управління, цифрове моделювання, економіка замкнутого циклу, повторне використання