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## PRECONDITIONS OF THE STRATEGY OF SUSTAINABLE APPAREL PRODUCTION IN UKRAINE

*The fashion industry is known to be the second most environmentally harmful industry, as it faces various issues in its supply chain and consumption. Sustainable apparel creation not only helps reduce the environmental impact of fashion but also caters to the growing demand for eco-friendly products from consumers who are becoming more mindful about their purchases.*

*To maintain a circular economy, textile sources should be used as much as possible while retaining their value. Zero-waste design is a concept that aims to eliminate or minimise fabric waste during the garment creation process. Traditional fashion design often produces significant amounts of fabric discarded due to inefficient pattern-cutting and garment construction methods.*

*In this research, the relationship between a company's cutting system and the average percentage of interlaced textile waste and the relationship between a company's capacity and the average percentage of interlaced textile waste were defined to reduce manufacturing waste. The data suggests that a company's capacity does not significantly impact the average percentage of interlaced textile waste. On the other hand, a company's cutting system appears to impact the average percentage of interlaced textile waste ambiguous. Therefore, the following definition of the relationship between a company's assortment and the average percentage of interlaced textile waste is essential in this research field.*

*Combining zero-waste design with LCA can be a base for creating a new, effective, sustainable methodology for Ukrainian sewing companies.*

*Keywords: strategy of sustainable business model, sustainable apparel production, Zero-Waste Design, Life Cycle Assessment, an average percentage of interlaced textile waste, and a company's cutting system.*

БУХАНЦОВА ЛЮДМИЛА, ЗАХАРКЕВИЧ ОКСАНА, КРАСНІЮК ЛАРИСА, ЛУЩЕВСЬКА ОЛЕНА  
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## ПЕРЕДУМОВИ СТРАТЕГІЇ СТАЛОГО ВИРОБНИЦТВА ОДЯГУ В УКРАЇНІ

*Відомо, що індустрія моди є другою найбільш екологічно шкідливою галуззю, оскільки вона стикається з різними проблемами в ланцюзі постачання та споживанні. Створення екологічно чистого одягу не тільки допомагає зменшити вплив моди на навколишнє середовище, але й задовольняє зростаючий попит на екологічно чисті продукти з боку споживачів, які стають більш уважними до своїх покупок.*

*Традиційний дизайн одягу часто призводить до того, що значні обсяги тканини викидаються через неефективні методи вирізання візерунків і виготовлення одягу.*

*У цьому дослідженні було визначено зв'язок між системою розкрою компанії та середнім відсотком міжлекальних відходів, а також зв'язок між потужністю компанії та середнім відсотком цих відходів, щоб зменшити відходи виробництва. Визначено, що потужність компанії не впливає суттєво на середній відсоток міжлекальних відходів (текстильних відходів), тобто швейна компанія малої чи великої потужності може мати високий відсоток, більше 18% та 16,8%. Це призводить до втрати значної кількості матеріалів. Тому ефективним способом управління матеріальними ресурсами є автоматизація процесів проектування, що може допомогти зменшити кількість утворюваних відходів.*

*Поєднання безвідходного дизайну з оцінкою життєвого циклу одягу може стати основою для створення нової ефективної стійкої методології для українських швейних компаній.*

*Ключові слова: стратегія стійкої бізнес-моделі, стійке виробництво одягу, безвідходний дизайн, оцінка життєвого циклу, середній відсоток переплетених текстильних відходів та система розкрою компанії.*

### Introduction

The textile and fashion industry has a significant impact on the environment. This is due to resource depletion, pollution, water contamination, waste generation, and greenhouse gas emissions. Implementing a circular end-of-life cycle for textile products is the best way to minimise this impact [1-3].

Textile products are trendy and are mostly discarded within five years. However, they comprise several layers of different raw materials and other components, making their recycling process quite complex. Fast fashion and cheap prices altogether reduce the lifecycle of textile products too short, and most of the time, textile products are used as disposables. Innovative apparel solutions that help maintain emotional bonding, fitting, adaptability, and alterability can help counter the rapid discarding of textile products.

Besides, the traditional linear fashion model is becoming increasingly risky for fashion brands. In this scenario, there are two types of internal risks: operational challenges and strategic concerns for sewing companies. There are increasing supply and sourcing risks, unsustainable manufacturing practices due to potential labour disruptions, and dependence on cheap labour, which are the key issues. Traditional business models are at risk due to the absence of sustainability and the possibility of disruption from new players acquiring market share and damaging the reputation and brand value. Moreover, employee retention concerns may arise as employees may not be satisfied with the company's environmental commitments and unsustainable production processes [3].

Organisations prioritising sustainability can gain a competitive edge by enhancing their reputation, image, and relevance among potential and existing customers. In today's market, where sustainable solutions are in high demand, fashion businesses focusing on sustainability can attract more customers. According to a survey, 69% of Vogue audiences worldwide consider sustainability to be essential when buying fashion items. Additionally, 98% of consumers believe that fashion brands must be responsible for making positive changes in the world [2].

Regarding the Ukrainian fashion industry, brands and sewing companies must adopt new sustainable practices and business models in their production as in [3].

There are a few key steps to follow to implement a sustainable growth strategy for Ukraine's sewing industry. Firstly, gathering all the necessary information and establishing contact with the relevant stakeholders is crucial. Next, groups of stakeholders should be created based on common characteristics or sustainable practices. Finally, waste reduction in garment factories can be achieved by collecting and analysing data on waste indicators from the direct stakeholders involved in Ukrainian garment production.

### Literature Review

The circular economy model considers manufacturing and environmental impact. Process traceability maintains data to identify roles and interactions. A sustainability claim can be defined as any statement or implication that suggests the following [2]:

- having a positive environmental or social impact or causing no adverse environmental or social impact;
- causing less harm to the environment or people than a previous version of the same goods or service; or
- causing less harm to the environment or people than competing goods or services.

Businesses looking to develop cost-effectively and efficiently should consider investing in new technologies or supporting their supply chain with innovative networks. Additionally, circular business models will require modern digital infrastructure [3].

On the other hand, it is crucial to identify and classify the waste materials generated during different production stages, determine the financial loss caused by such waste, and track the informal trading of these waste materials [4]. This will help to systematise and optimise the textile waste database. To achieve this, a research study was conducted, which involved collecting data from 17 textiles and apparel factories using questionnaires, materials stream mapping, and observations. As a result, a conceptual waste management model for upstream textiles and apparel manufacturing was proposed, which can potentially be applied within the circular economy framework [4].

Life Cycle Assessment (LCA) is a criterion for the resource utilisation and environmental impacts throughout the entire life cycle of a product, starting from the extraction of raw materials, their processing, the product's useful life, and the management of waste through disposal and recycling [1, 5]. The LCA method can be applied in clothing manufacturing to identify ways of reducing a product's environmental impact throughout its life cycle. Apparel entrepreneurs can utilise LCA to explore alternative sustainable design clothing solutions, such as choosing more efficient manufacturing techniques or sustainable materials, thereby reducing the carbon footprint of their products [1].

The inputs and outputs during the LCA process can vary depending on the evaluated product or service. However, the general inputs and outputs considered in the LCA process are illustrated in Fig. 1 [1].

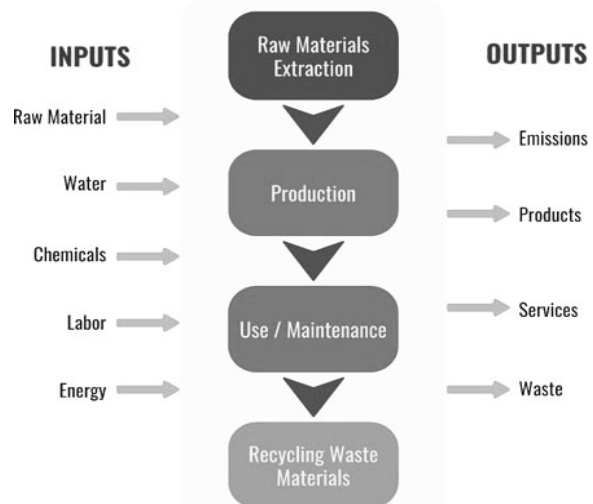


Fig. 1. Typical inputs and outputs of LCA

Adapting information about inputs and outputs for specific products helps us understand a product's overall performance by measuring the performance associated with the environment.

The steps of clothing manufacturing involve transforming fabrics into garments based on the final product design. The fabric is created by weaving or knitting and then subjected to several finishing steps to achieve the desired appearance. Cut-Make-Trim is the final stage of production, where the fabric is transformed into a garment. However, every stage of LCA significantly impacts the environment [1].

In [4], we can find four examples that demonstrate the potential reductions in greenhouse gas (GHG) emissions that can be achieved. These scenarios compare different business models, including resale, rental, repair, and remaking, all of which are related to different stages of the dress lifecycle. It's worth noting that production is responsible for 70% of the total emissions, while transport, logistics, and retail account for 5%. The use phase

contributes 20% of the total emissions, and the End-Of-Life (EoL) stage is responsible for the remaining 5% of the total emissions.

The apparel cutting and sewing stages are crucial in optimizing input parameters such as labour, energy, and waste. Thus, textile sources should be kept in a loop as much as possible while maintaining their value for a circular economy.

Zero-waste design is a concept that aims to eliminate or minimize fabric waste during the garment creation process. It can be applied to various stages such as design, pattern cutting, fabric cutting, and production [6]. Traditional fashion design results in significant fabric waste due to pattern-cutting and garment construction methods. This waste ultimately impacts the quality of water, air, and land. The purpose of the study [4] is to investigate multifunctional clothing that can be transformed into various types of garments with distinct properties and functions. By utilising a variety of elements and techniques, the design has become more versatile and flexible in terms of design conversion. As a result, the study has successfully achieved the concept of zero-waste.

For this reason, sewing companies and designers must critically evaluate their manufacturing processes to promote sustainability.

Thus, the research aimed to determine the actual average percentage of textile waste in sewing companies and its relationship with the company's activities.

### Presenting main material

A database was created with the key information about sewing companies and the actual average percentage of textile waste, in line with our project goal. We had 30 heads of sewing companies participate in the data collection process. According to the data collected, 86.7% of sewing companies in the region are located in Khmelnytskyi, 3.3% of them are in the Khmelnytskyi district, 6.7% are in the Western part of Ukraine, and the remaining 3.3% are in the Eastern part. This survey was conducted as a part of the project "Podillia Fashion Cluster: from good to the best" ("EU4Business: competitiveness and internationalisation of SMEs" program: grant agreement No. 19 dated 04/12/2023, the German federal company Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH).

According to the available data, 51.85% of sewing companies have a small capacity, 37% have a large capacity, and 11.12% have a medium capacity. The results of the research are displayed in Fig. 2 and Fig. 3.

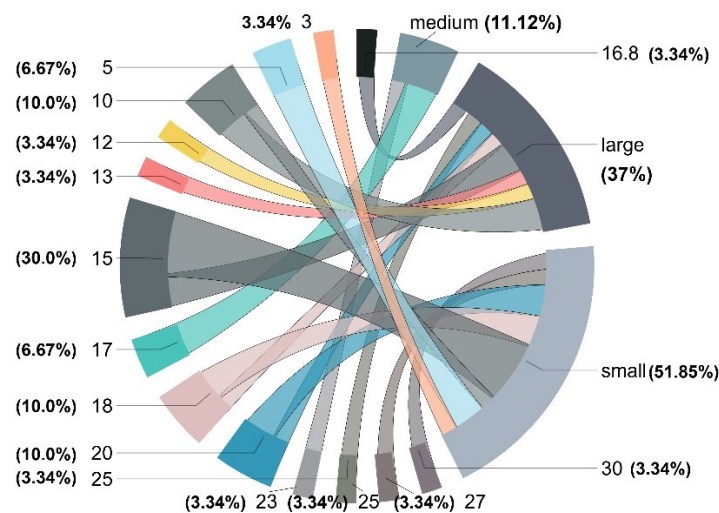


Fig. 2. The relationship between a company's capacity and the average percentage of interlaced textile waste

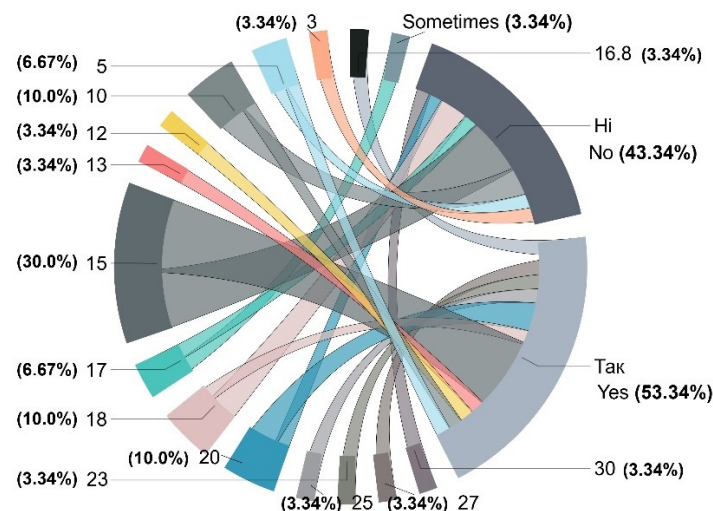


Fig. 3. The relationship between a company's cutting system and the average percentage of interlaced textile waste

The data suggests that a company's capacity does not significantly impact the average percentage of interlaced textile waste. This means that a sewing company with a small or large capacity can have a high interlaced textile waste rate, with small capacity companies having a rate of over 18% and large capacity companies having a rate of over 16.8%.

As a result, we conducted research to investigate the relationship between a company's cutting system and the average percentage of interlaced textile waste.

Based on the feedback received from 30 sewing companies, a company's cutting system appears to impact the average percentage of interlaced textile waste. However, there is still some disagreement about the extent of this impact. This means that sewing companies employing an automatic cutting system may have an interlaced textile waste rate ranging from 3% to 16.8%, with some (10%) having a rate as high as 23% to 30%. On the other hand, companies that do not use an automatic cutting system have interlaced textile waste rates ranging from 3% to 27%, with the majority having a rate between 15% and 20%.

This research shows that only 3.34% of sewing companies sometimes use an automatic cutting system. The studied companies have reported that the average percentage of interlaced textile waste in clothing production ranges from 3% to 30%. This results in a significant volume of materials being used. Therefore, an effective way to manage material resources can be to automate design processes as one of the main principles of zero-waste design, which can help reduce the amount of waste produced. Also, the following definition of the relationship between a company's assortment and the average percentage of interlaced textile waste is essential in this research field

Combining zero-waste design with LCA can be a base for creating a new, effective, sustainable methodology for Ukrainian sewing companies.

### Conclusions

Textile waste is a significant problem in the clothing production industry, with 3 to 30 per cent of cutting materials used being discarded by sewing enterprises. Unfortunately, this waste is often burned or sent to landfills, which is not sustainable. To address this issue and promote sustainable development in the sewing industry sector, it is crucial to implement effective processes for zero-waste cutting, collecting and recycling textile waste. This process will not only reduce waste but also improve resource efficiency.

Entrepreneurs in Ukraine can use Life Cycle Assessment (LCA) to make informed decisions about modifying the apparel production process while considering their environmental impact. These sustainable practices involve implementing water- and energy-efficient technology and promoting circular economy principles to reduce the environmental impact of clothing production and promote a more sustainable business model. Although LCA has certain limitations, it is still an effective tool for promoting sustainability and reducing the environmental impact of products and services.

Creating a standard database in Ukraine with the required procedures for estimating sewing companies' environmental impact is essential to communicating and implementing these sustainable practices. To implement the planned measures, it is necessary to actively involve sewing companies in cooperation to stimulate the introduction of progressive technological processes of multifunctional clothing manufacturing and reduce the amount of textile waste in the production process. These activities will be the basis for developing a strategy for expanding sustainable activities in the Ukrainian sewing industry.

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