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GLOBAL EXPERIENCE OF APPLYING THE CIRCULAR ECONOMY MODEL IN LIGHT INDUSTRY

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Abstract
The fashion and textile industry are one of the most polluting industries in the world. This article provided an overview on how the circular economy is currently being implemented within the textile and fashion sector. The environmental footprint of the light industry at various stages of the product life cycle was examined. A detailed analysis of literary sources on the implementation of the circular economy model was carried out. The peculiarities of the circular economy model in the textile industry are determined. Some of the most successful examples of the transition to circularity in light industry are considered. By focusing on existing practices, challenges and opportunities, we identified the necessary skills and competences needed to support the transformation of fashion companies towards a circular economy.

Keywords: *light industry, circular economy, ecological footprint, economic effects, ecological pollution.*
JEL Codes: *A12; L67.*

Introduction

The concept of a circular economy arose in response to the need for sustainable growth in the face of increasing pressure of production and consumption on the world's raw materials and the environment. Commodity's production and consumption rapid growth has led to a situation where economic systems based on the classic linear model (characterized by the product's limited-service life) couldn't longer ensure their restoration and rational consumption. Societal demand for scarce resources is continuously increasing, and valuable resources used for food production, infrastructure and housing construction, consumer goods production, and energy supply are subject to disposal after primary use, leading to environmental degradation. This leads to a steady increase in the value of metals, minerals, fossil fuels, feed and food, as well as clean water and fertile land around the world. In particular, in the European Union, the non-renewable consumption of resources reaches almost 15 tons per year per person, and each resident generates more than 4.5 tons of waste per year, almost half of which ends up in landfills (European Commission, 2019). The linear economy, which is based exclusively on the exploitation of resources, is no longer able to meet modern requirements for high-quality resource recovery. Thus, the Fourth Industrial Revolution proposed a model of continuous resource recycling, which focuses on reuse, reconstruction and recycling of materials and finished products.

Light industry plays a fundamental role in the people's well-being, as it provides clothing, footwear and other textile products, and also creates jobs for millions of people worldwide, contributing to economic growth. The textile production and consumption system are highly globalized: millions of producers and billions of consumers are distributed globally in highly linear value-added chains that include raw material extraction, production, transportation, consumption and disposal after use (The European Topic Center, 2019).

In 2019, the total revenue of the global fashion industry sector, which employs about 300 million people, was USD 525 billion with a growth rate of 19.6% (Fig. 1).

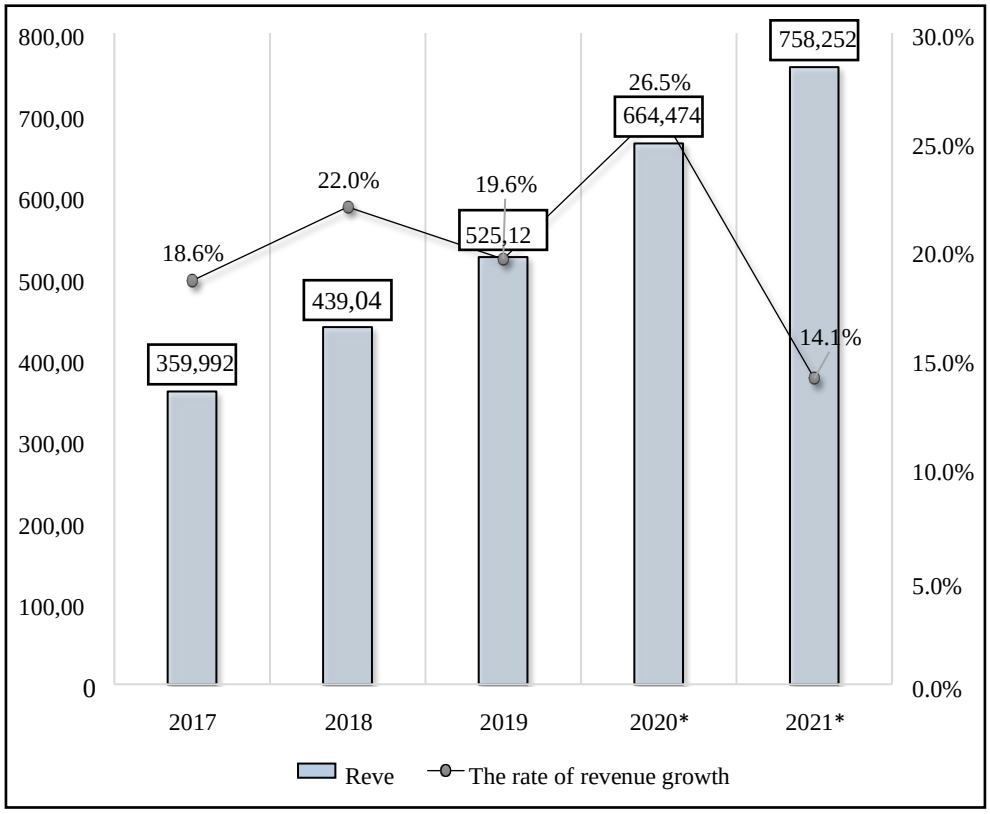

Figure 1. Revenue dynamics of the fashion industry and its growth rates from 2017 to 2021, (USD million, %)

**Source: built by the authors based on McKinsey&Company and the BoF the State of Fashion 2020 Report.*

The share of revenue generated by online commerce was 20% and would continue to grow in the near future, especially thanks to the regions of East and Southeast Asia. This situation is related to the growth of the middle class in this region and less developed trade infrastructure. One of the leading trends in the growth of online sales is the direct integration of shopping functions into social networks, which allows you to inspire and sell quickly ("Shopify") (McKinsey & Company, 2020).

The leaders in terms of revenue in 2018 were such companies as Nike ($2,980 million), Inditex (USD 2,910 million), LVMH (USD 2,316 million), TJX Companies (USD 1,669 million), Kering (USD 1,513 million), Hermès (USD 1,311 million) (Fig. 2).

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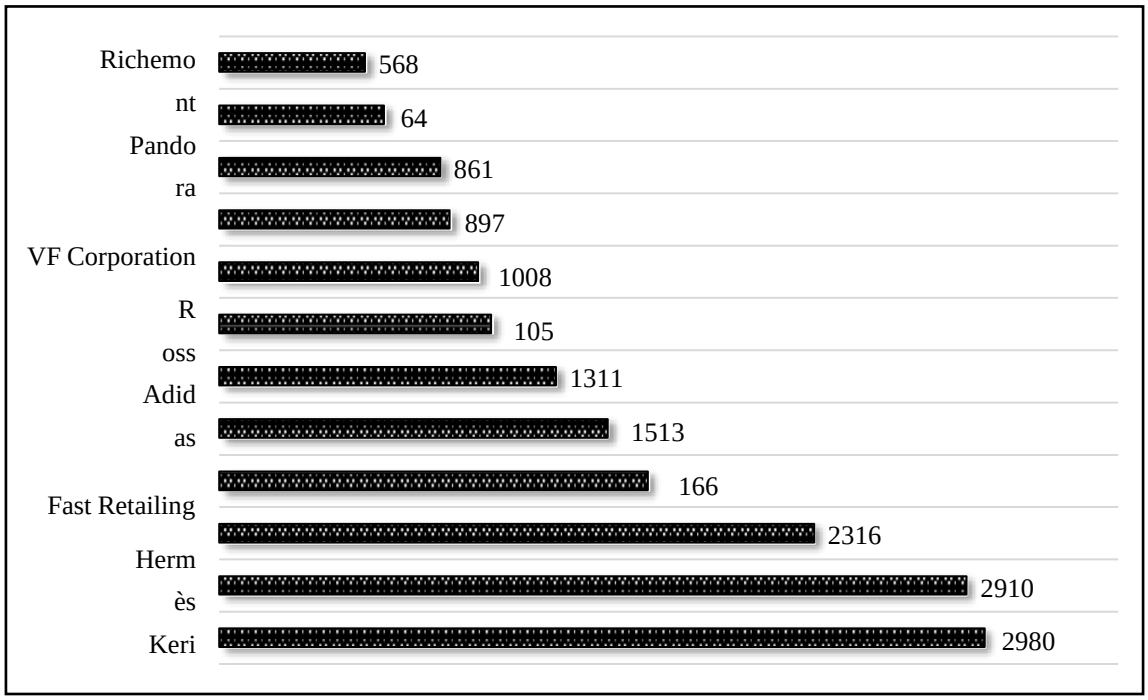

Figure 2. Leading companies in the fashion industry by revenue in 2018, (USD million)
**Source: built by the authors based on McKinsey&Company and the BoF the State of Fashion 2020 Report.*

The US industry with a nominal sales volume of more than USD 450 billion is one of the largest and one of the most environmentally damaging in the world. The environmental problems of this industry are usually related to the use of energy, water and chemicals, direct emissions of CO2 and solid waste.

According to the Erasmus+ report "Circular Economy in the Textile and Footwear Industry", it is predicted that CO2 emissions in this industry will increase by 60% to 2.8 billion tons per year by 2030 (Design4Circle, 2019).

The new vision and purpose of the textile industry today is to create and implement models focused on sustainability, renewables and circularity, which provide benefits for business, society and the environment.

The research aim and object

The purpose of the article is to analyze both the indicators and the dynamics of the current state and trends in a global light economy.

The object of research is a set of relations between the world economy agents concerning the implementation of the circular economy model in light industry. The subject of the research is the peculiarities of the development of the global circular economy model in light industry.

Analysis of recent research and publications

Scientific discussions on the circular economy mainly cover the issue of obtaining environmental and social benefits. Particular authors consider the economic utility issues of introducing the circular economy paradigm at the level of companies (Bocken et al., 2016).

Even minor improvements in production enterprises can significantly contribute to the achievement of the advantages of the circular economy (Tymoshenko and Dronova, 2018). At the same time, these studies did not analyze the incentives for manufacturing companies to change their own business models, nor to encourage old or new ecosystem partners to change theirs to achieve transformation. Analysis of the enterprises' business model transition from sales to payment for use is of

particular interest. This cost-effective business model requires production to cooperate with service partners, third-party suppliers, customers and even other suppliers in order to profitably deliver the new business model (Zvarych, 2019). Malolitneva (2019) considered various aspects of changing roles and responsibilities when implementing circular purchases. However, it remains insufficiently disclosed how a company can organize changes in the business model at the ecosystem level to achieve transformation to the circular economy paradigm.

Roleders, Oriekhova and Zaharieva (2022) emphasized that three levels of transition processes to a circular economy could be divided: the efficient use of materials; product life extension; smart production and use of products. Extended producer responsibility (EPR), a model in which packaging companies are responsible for the final life of materials, is extremely important for the circular economy policies to promote sustainable material management, recycling and reduction in the environmental impact. Manufacturers can influence change by making products and packaging more durable so that materials can be reused, recycled or reintegrated into the new product design (Roleders, Oriekhova and Sysoieva, 2022).

The role of modern production practices was considered in a series of works addressing demographic sustainability. The positive impact of R&D productive spending associated with the circular economy's approach has been proved statistically (Kozlovskyi et al., 2020; Pasichnyi and Nepytaliuk, 2021).

H. Stål and H. Corvellec (2018) showed that the fact that the customer pays for the use of products, and not for tangible goods or services, makes it possible to free up funds for the production of own products and services, guaranteeing the customer a certain result or a given volume of production at the customer's plant. However, in these studies, the issues of functional results of the circular economy were neglected. The manufacturer creates a direct incentive for cooperation within the ecosystem and reduces the costs of the life cycle of design, development, manufacture and maintenance of products by charging customers for the use of certain products (McDowall et al., 2017; Visnjic, Neely, Jovanovic, 2018). However, in the study of this business model, researchers do not reveal the aspects of environmental, social and economic benefits of all participants of the production ecosystem. In addition, the understanding of how advanced services drive resource efficiency and the transformation to a circular economy is still lacking. In order to reduce costs for design, development, manufacturing, maintenance, use and processing, the manufacturer needs to cooperate closely with other ecosystem partners who participate in each of these activities (Serhiienko and Yevdokimov, 2017). Stakeholders, including the customer, take on new roles and responsibilities, thereby changing their own business models. In the studies of T. Lahti, J. Wincent and V. Parida (2018) it is shown that the transition to a circular economy not only increases the focus on service, but also affects the organization of entire ecosystems. Although recent studies have begun to recognize the need to understand how an industrial ecosystem based on a circular economy can be described and organized, the patterns of ecosystem organization and the specific pathways of ecosystem transformations are still not fully understood. Thus, although research widely explains and confirms the importance of ecosystem transformation, the logic of changing enterprises according to business models based on the logic of the circular economy is poorly articulated.

Material and methods

The methodological basis of the research is the fundamental provisions of the model of the closed cycle economy. The indicators and dynamics of the current state of functioning of the circular economy in light industry are investigated and analyzed, methods of logical and historical, quantitative and qualitative analysis, statistical methods, and methods of comparative analysis were applied.

The data of the Ellen MacArthur Foundation, "McKinsey & Company", and relevant Internet sites served as a factual and statistical basis.

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Results

Longer wearing of clothing, efficient recycling of textile waste and its reuse as raw materials can significantly reduce the demand for end products and fibers. Textile and clothing companies can no longer ignore the fact that the current linear model of the economy has become dysfunctional, as evidenced by the limited supply of raw materials and resources and the increase in disposal costs, which indicates a decrease in the capacity of landfills.

The additional economic opportunity of the transition to a circular model in the textile industry is estimated at USD 560 billion. To realize this opportunity, new business models and collaboration along the value chain (production, marketing, after-sales service, etc.) are applied to preserve resources in the cycle of use (Worldbank, 2022).

The new vision and goal of the textile industry today is to create and implement models that focused on sustainability, renewability and circularity, which provides benefits for business, society and the environment. In such a system, clothing, textiles and fibers retain their highest value during use, and after use are re-entered into the economy without ending up as waste. These goals can be achieved by introducing various business models, namely technologies for the production of alternative materials, digitalization, clothing rental, etc. The main governing principles for the new models in the textile industry's circular economy system are:

- prolonged life cycle of goods at the stage of consumption and use due to the high quality and rethought concept of trends;
- use of safe and renewable energy sources;
- popularization of the secondary market;
- recycling and upcycling of used clothes for new ones (Worldbank, 2022).

In addition, the circular system must be socially fair and evenly distributed, so that the added value is shared among all participants of the textile ecosystem. Workers in all parts of the value chain must benefit from safe and fair working conditions, fair wages, gender equality and inclusion. And finally, the environmental and social costs of materials and production processes should be reflected in the prices of textile products (The European Topic Centre, 2019).

The circular model of the economy in the textile industry has the following features:

1. Production and provision of access to high-quality, affordable, customized clothing. In the new textile economy, everyone has access to the clothes they need and when they need them. New business models give customers more flexible access to the clothes they want, even from the premium and luxury classes. The clothes are designed and manufactured in high quality, are durable and provide different functionality – customized, modified clothes, etc.

2. Fixation of the entire value of the product during use and after. Much longer use of clothing allows you to fully determine its value. When clothes can no longer be used, recycling them into new clothes allows you to capture the value of materials at different levels. To be able to capture the value of all materials after the garment is no longer usable, it is necessary to ensure that it meets the criteria of recycling technology.

3. Use of renewable energy sources and renewable resources. The use of renewable energy sources reduces dependence on resources and increases the sustainability of the entire system. Materials that are necessary for the production are stored in a closed-loop system, and if necessary, they come from renewable resources.

4. Reflecting the true value (ecological and social) of materials and production processes in the price of products. In the conditions of the circular economy, the price clothing reflects the full costs of its production, including negative environmental and social consequences. Such costs are first analyzed and reflected in the reports of companies, and ultimately – in the prices of products.

5. Restoration of natural systems and cessation of environmental pollution.

Extraction of resources takes place by regenerative methods that restore natural capital (Worldbank, 2022).

In order to enable consumers to make informed choices and increase the demand for sustainable fibres, easy access to simple and standardized information about the social, environmental and climate qualities of products, and which is monitored by independent and reliable sources, is needed. Therefore, the promotion of sustainability in the entire value chain is voluntarily initiated by various subjects of the textile industry (The European Topic Center on Waste, 2022).

The Global Fashion Agenda (GFA) is a non-profit organization founded in 2016. It is a leadership forum that promotes industry collaboration on sustainability in fashion, offering management and support to help industry leaders transform the way the fashion industry produces, sells and consumes goods and services. GFA was previously known as the Danish Fashion Institute, founded in 2005. Since 2009, the organization has held the Copenhagen Fashion Summit and, in cooperation with the Boston Consulting Group, publishes the annual report "Pulse of the Fashion Industry" with the index "The Pulse Score" (Global Fashion Agenda, 2022). The index was developed with the aim of identifying key patterns of environmental and social impact of the fashion industry. The index is determined on a scale from 1 to 100, with values above 70 signaling a high level of sustainability (The European Topic Center on Waste, 2022).

Thus, in 2019, the value of the index was 42 points, which is 4 points more than in 2018 (38) and 10 more than in 2017 (32). These indicators indicate that the fashion industry improved its social and environmental impact last year, but at a slower pace than in 2018. Despite this, the fashion industry is still far from sustainable, as companies are not implementing new solutions with sufficient speed to offset their negative environmental and social impacts (Global Fashion Agenda, 2019).

In 2019, all market segments of the fashion industry showed an increase in "The Pulse Score", namely the premium segment increased by 2 points to 53 due to collaborations with subjects of fashion and other industries, for example, agricultural, as did "Stella McCartney" using a renewable farming model using organic cotton, supporting the fight against grassland desertification in Mongolia, etc. (Stellamccartney, 2022). The average price segment, including sports, occupies the largest market share (47%) and increased by 2 and 1 points to 49 and 67, respectively. The index for the entry-level price segment increased by 8 points to 49, especially due to the medium-sized companies that have integrated sustainable development into their corporate strategies. Sustainable brands have the best indicator (80 points), as sustainable development and focus on the implementation of the circular economy model is embedded in the company's DNA.

By implementing a closed loop model, companies are experimenting with different natural ingredients and formulas to replace traditional materials. It will be appropriate to consider some of the most successful examples of the transition to circularity in the fashion industry.

The pioneer of the application of the circular economy model in the textile industry is the British designer Stella McCartney and her eponymous brand. One of the brand's developments is regenerated cashmere "Re.Verso", which is made from cashmere waste in Italy. According to the company's environmental profit and loss statement (a monetary valuation of a company and analysis of its environmental impact, including its business operations and supply chain from the cradle-to-gate model), the use of this alternative material reduces the environmental impact by 92% (Thecurrentdaily, 2022).

American direct-to-consumer brand Everlane, which aims to sell clothing with transparent pricing, has developed its own sustainable material, namely a fleece called "ReNew", which is made from recycled plastic bottles. The brand also plans to start producing all synthetic fabrics from plastic water bottles and recycled materials by 2021. After the introduction of the technology, it is planned to recycle 100 million bottles within 5 years.

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In 2015, the Adidas company began to cooperate with the non-profit organization Parley for the Oceans, which is engaged in catching and processing waste from the ocean. Such collaboration has become a structural element of the brand's sustainable development strategy. The collaboration resulted in a sneaker made entirely from recycled ocean plastic waste and illegal deep-sea fishing nets. The Parley x Adidas Ultra Boost model gained particular popularity, as it became more accessible to the public in terms of price. Each pair of such shoes contains 11 plastic bottles, so the company processes about 55 million bottles a year.

In August 2018, direct-to-consumer footwear brand Allbirds announced the launch of a new biodegradable and environmentally friendly shoe sole, SweetFoam. The new material, which consists of a base of sugar cane, is an important advance in the industry, as it is the first ever carbon-neutral green alternative to the traditional EVA (ethylene vinyl acetate) sole material. The first product created with the help of this innovation were flip-flops called “Sugar Zeffers”. In addition, the company “Allbirds” made this technology available to everyone, thus inspiring its introduction into production on a wider scale (Thecurrentdaily, 2022).

In August 2019, sportswear brand Reebok launched its first ever line of biodegradable sneakers as part of its Cotton + Corn initiative. The release of this product was part of the brand's overall goal to reduce the company's environmental footprint by using biodegradable products biologically. This pair of shoes is made with a cotton upper and a bioplastic sole, an alternative material derived from corn. It is also the first pair of shoes certified by the USDA as containing 75% bio-based material.

Sustainable brand “Reformation”, based in Los Angeles, has been creating clothes using leftover fabrics for many years. In addition, in the manufacture of underwear, the company uses various steel fabrics, such as recycled lace, ecological mesh fabric and Lenzing's patented fabric derived from cellulose (“Lenzing TENCEL”).

For its new “Plant Bae” direct-to-consumer collection, the brand “Aday” used “SeaCell” fabric, made from seaweed from the coast of Iceland. Every four years, the algae is harvested and spun into fabric together with lyocell (a textile fiber obtained chemically from cellulose). This technology was also used by Falke for the production of socks and Lululemon for sportswear.

In 2017, the Italian luxury brand Salvatore Ferragamo, in collaboration with the orange Fiber company, created a capsule collection made of a new innovative material obtained from the remains of orange peel. This material is quite sufficient for a full-fledged introduction into production: according to the Ministry of Agriculture of Italy, waste from juice production annually creates up to 700,000 tons of orange peels.

In April 2018, the German brand “Hugo Boss” released a collection of shoes made using pineapple leaves that imitate the texture of leather. The material used is called Piñatex; it is obtained from pineapple leaves, which have no purpose in farming. Thus, the creation of textiles from this material provides local farmers with additional income (Thecurrentdaily, 2022).

Another successful model for implementing the circular economy is the rental model, which provides the consumer with access to a variety of clothing while reducing the demand for new production. A successful example is a company like “MUD Jeans” – a Dutch sustainable brand that complies with the principles of the circular economy. Nearly 40% of this brand’s jeans consist of recycled material. The main business concept of the company is to rent clothes to consumers for one year, and after the rental period, the jeans can be exchanged for another pair, returned for recycling, upcycling or further use. Also, the rental agreement includes free unlimited repair services (Mudjeans, 2022).

“Rent the Runway” is an online platform for renting designer clothes and accessories. Customers can rent the company's clothing for

4 or 8 days for 10% of the retail price through its own platform "RTR Reserve". There are also monthly subscription options that allow you to rent clothes either "unlimited" or 4 times a month for less (Renttherunway, 2022).

One of the latest technologies to reduce the environmental footprint of textile production is virtual clothing. The digital format of clothing minimizes waste during production and shipping. One of the leaders in this field is the international retailer "Dress-X", founded in 2019 in San Francisco by Ukrainians Daria Shapovalova and Natalia Modenova. The idea of "Dress-X" is that there is no need to consume less clothing if it can be done in another way that leaves a much smaller footprint on the ecological situation. CO2 emissions from the production of digital clothing are 97% lower than from the production of physical clothes. The production of digital clothing saves an average of 3,300 liters of water per unit of clothing, which is enough for human consumption for 3.5 years at 2 liters per day. Dress-X also donates 1% of sales revenue to the No More Plastic Foundation. In addition, the company's commercial activities are oriented towards the UN Sustainable Development Goals, namely 9 (Innovation and infrastructure), 12 (Responsible consumption), 13 (Combating climate change) and 17 (Partnership for sustainable development) (Ellenmacarthurfoundation, 2022).

Thus, the ecological footprint of the fashion industry varies in intensity depending on the stage of the product life cycle: fiber production, processing, dyeing, transportation, consumption, disposal, etc. (table 1):

Table 1. Ecological footprint of the fashion industry at different stages of the product life cycle

Environmental issues	Life cycle stages that are affected
Energy consumption	Man-made fiber production, yarn production, finishing, washing and drying processes of clothes at the stage of use
Water consumption and chemicals	Fiber growing, wet pre-treatment, dyeing, finishing and washing
Solid waste	Disposal of goods at the end of their life cycle, production of textiles and clothing
Direct CO2 emissions	Transportation through global supply chains

**Source: compiled by the authors based on data from the Journal of Cleaner Production.*

All these negative effects on the environment can be reversed. Moreover, these changes have already begun, thanks to the replacement of the linear economy model with a circular one.

A set of skills and competences that are perceived key to possess in order to transition to a more circular economy was identified. The necessary skills to master when engaging in circular economy practices in the textile industry were summarized (table 2).

Table 2. Overview of major skills and competences for a circular textile economy

Themes and focuses	Skills and competences
CIRCULAR VALUE CHAIN	
Materials and resources	- Finding the right suppliers of ecological materials - Acquiring new knowledge to process reclaimed material
Ecodesign	- Adopting, mastering and implementing eco-design skills - Zero waste manufacturing
Manufacturing and recycling	- Reverse thinking - Applying new technologies to support ecofriendly and circular (re)manufacturing - New business models - Servicizing
Retail and consumption	- Green marketing skills
TRANSVERSAL COMPETENCES	
Sustainability and environmental management	- Sustainability - Environmental management

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User centered approach	- Cocreation - Trust and transparency - Personalization
Entrepreneurship	-Creativity -Innovation
Systems thinking	-Collaboration and networking

We should address the skills gap following a circular value chain approach, addressing issues at the materials and resources base, at the design stage, at the manufacturing stage, while offering a business foundation on how to create shared value in the sector without harming the environment. Circular economy is rooted in complex systems and requires taking a holistic approach encompassing various dimensions. Translated into skills and competences, training curriculums in circular economy should emphasize whole systems thinking, embracing materials and resource knowledge, sustainability management skills throughout the life cycle of products while offering business and marketing foundations for implementing successful innovations meeting user needs.

Conclusions

The textile industry is a major waste generating industry. The circular economy model in the textile industry is characterized by such features as the production and provision of access to high-quality, affordable, individualized clothing, the fixation of the entire value of the product during and after use, the use of renewable energy sources and renewable resources, the reflection of the true value (environmental and social) of materials and production processes in the price of products, restoration of natural systems and cessation of environmental pollution.

Our current system for producing, distributing, and using clothing is mainly based on a linear, take-make dispose model. High volumes of nonrenewable resources are extracted to produce clothes that are often used for only a short period, after which the materials are largely lost to landfill or incineration. This linear system, puts pressure on resources, pollutes and degrades ecosystems, and creates significant societal impacts at local, regional, and global scales, while leaving out economic opportunities untapped.

In order to depart from linear economy, it is essential to start designing and producing textile and clothes of higher quality and providing access to them via new business models to shift the perception of clothing from being a disposable item to being a durable product.

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