



SOCIO-ECONOMIC ASPECTS OF CONTEMPORARY TRENDS IN THE DEVELOPMENT OF THE TEXTILE INDUSTRY

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Gordana Kokeza¹, Sonja Josipović², Snežana Urošević³

¹University of Belgrade, Faculty of Technology and Metallurgy, Serbia,
e-mail: gkokeza@tmf.bg.ac.rs, ORCID ID: 0000-0001-8037-5985

²University of Belgrade, Faculty of Technology and Metallurgy, Serbia,
e-mail: sjosipovic@tmf.bg.ac.rs, ORCID ID: 0000-0002-1091-4143

³University of Belgrade, Technical Faculty of Bor, Serbia,
e-mail: surosevic@tfbor.bg.ac.rs, ORCID ID: 0000-0002-6647-0449

ABSTRACT: *The intense technical and technological progress of recent decades has significantly influenced the transformation of economic activities across all sectors of business and everyday life. In many areas, this influence has been markedly positive, contributing to enhanced operational efficiency and improved living standards. However, over time, numerous adverse consequences of rapid growth and development, driven by the relentless pursuit of increased profits, have become increasingly evident. These negative outcomes primarily relate to environmental degradation, the accumulation of waste, the overexploitation of natural resources, and a general decline in quality of life. Humanity has gradually become aware that, if such trends persist, they may jeopardise not only future growth and development but also the very survival of our species. This awareness has prompted the formulation of new developmental models and strategies aimed at securing the long-term sustainable development of the global human community. This paper provides a theoretical overview of contemporary sustainable development concepts, with a particular focus on analysing key trends in the ongoing transition of the textile industry within both developed economies and developing countries. The textile industry represents a vital sector for global economic growth, especially in terms of job creation, trade enhancement, and the generation of overall added value. However, the fast-paced evolution of fashion trends, combined with global population growth and rising living standards, has intensified the environmental impact of the textile sector. Among the most frequently cited concerns are the intensive consumption of natural resources, the generation of vast quantities of waste, and substantial greenhouse gas emissions. These opportunities and challenges have positioned the textile industry as a focal point in both academic literature and developmental strategies, identifying it as a sector with substantial potential for transitioning towards sustainable, circular, and innovative production, consumption, and business models. The primary aim of this paper is to highlight the key strategic directions that have shaped the development of the textile industry over the past decade. By applying relevant indicators, the study analyses the effectiveness of the green*



transition in the textile industry across EU countries and Serbia. The findings indicate the presence of certain similarities, as well as notable differences, between the countries examined. Furthermore, the paper identifies the key barriers impeding the adoption of sustainable innovations in the textile sector. Overcoming these challenges is essential for ensuring the continued implementation of reforms aimed at further "greening" the industry enhancing its sustainability and generating not only economic, but also social and environmental value.

Keywords: textile industry, sustainability, transition, EU, Serbia.

DRUŠTVENO-EKONOMSKI ASPEKTI SAVREMENIH TRENDOVA U RAZVOJU TEKSTILNE INDUSTRIJE

APSTRAKT: *Intenzivan tehničko-tehnološki progres poslednjih decenija uticao je na promenu uslova privređivanja u svim sferama poslovanja i života. Dati uticaj u mnogim oblastima delatnosti bio je veoma pozitivan i doprinosa je unapređenju poslovanja i poboljšanju uslova života. Međutim, vremenom su došle do izražaja i mnogobrojne negativne posledice ubrzanog rasta i razvoja i stalne težnje za sve većim profitom. Date negativne posledice tiču se, pre svega, narušavanja životne sredine, gomilanja otpada, preteranog iscrpljivanja prirodnih resursa, pada kvaliteta života i sl. Čovečanstvo je postalo svesno da ako se nastavi ovakav trend može doći do ugrožavanja ne samo budućeg rasta i razvoja, već i opstanka čovečanstva. Usled toga dolazi do formulisanja novih razvojnih modela i strategija koje bi trebalo da obezbede dugoročan održivi razvoj celokupne ljudske zajednice. Predmet ovoga rada je teorijski prikaz novih održivih razvojnih koncepata i analiza glavnih trendova u pogledu sprovođenja tranzicije tekstilne industrije razvijenih ekonomija i zemalja u razvoju. Tekstilna industrija predstavlja granu privrede koja je značajna za ekonomski rast zemalja širom sveta, naročito u pogledu doprinosa otvaranju novih radnih mesta, unapređenja trgovine i ukupne dodate vrednosti. Brza promena modnih trendova i rast svetske populacije i životnog standarda uticali su na povećanje negativnog uticaja tekstilne industrije na životnu sredinu, među kojima se najčešće ističu intenzivna upotreba prirodnih resursa, stvaranje velike količine otpada i emisija gasova sa efektom staklene bašte. Navedene pozitivne odlike i slabosti uticale su da upravo ova privredna grana bude prepoznata u literaturi i u razvojnim strategijama kao sektor koji ima široke mogućnosti za tranziciju ka održivoj, cirkularnoj i inovativnoj proizvodnji, potrošnji i poslovnim modelima. Cilj rada je da ukaže na ključne strateške pravce razvoja tekstilne industrije tokom poslednje decenije. U radu, primenom odgovarajućih pokazatelja, izvršena je analiza uspešnosti zelene tranzicije tekstilne industrije u zemljama EU i Srbiji. Rezultati analize ukazuju na postojanje održanih sličnosti, ali i značajnih razlika između posmatranih zemalja. Takođe, u radu je ukazano i na prepreke koje prate primenu održivih inovacija u tekstilnoj industriji, a čije prevazilaženje je važno za nastavak sprovođenja reformi u pravcu njenog daljeg „ozelenjavanja“, odnosno unapređenja njene održivosti i stvaranja ne samo ekonomske, već i društvene i ekološke vrednosti.*



Ključne reči: tekstilna industrija, održivost, tranzicija, EU, Srbija.

1. INTRODUCTION

The textile industry represents a very significant sector of the economy seeing that it contributes to the employment growth, trade advancement, added value increase as well as the overall growth and development of national economies. However, this industry is accompanied by many negative consequences which are, among others, the result of quick changes in fashion trends, the population growth and the increase in the standard of living. The adverse effect of the textile industry is visible first and foremost in the domain of the environment and is produced by overexploitation of natural resources, generating large amounts of waste, using harmful chemicals and greenhouse gas emissions. The mentioned strengths and weaknesses have contributed to this particular industry sector being recognized in literature and development strategies as one having a large potential for transition towards sustainable, circular and innovative production, consumption and business models. The aim of this paper is to emphasize the key strategic directions for the development of the textile industry that have been implemented over the past decade, as well as to analyze relevant indicators of the success of the green transition in the textile industry in the EU countries and in Serbia. The paper will also address the challenges that are encountered when applying the concept of sustainable development and innovations in the textile industry, as well as the need for overcoming these difficulties in order to successfully continue reforms aimed at further “greening”, i.e., improving the sustainability of the textile industry by creating not only economic, but social and ecological value as well.

2. CONTEMPORARY TRENDS IN THE TEXTILE INDUSTRY

The linear economy, which until recently dominated business and long-term economic development, has led to numerous, important and far-reaching negative consequences, primarily in the domain of the environment, but also in the broader socio-economic area. The constant pursuit of maximum profit and better competitive position has resulted in the excessive consumption of natural resources and energy, as well as the quick accumulation of large amounts of waste. Enormous environmental pollution, particularly the faster depletion of natural resources than their capacity for renewal, has caused severe ecological load, as well as a decline in the quality of life. Humanity has found itself at a turning point in its survival and development which requires a fundamental change in the philosophy that will guide the future development.

In these circumstances, the concept of sustainable development has emerged as a new developmental philosophy. The main elements of this concept are the green economy, circular economy and bioeconomy. The concept of *the green economy* represents an economic process characterized by low carbon emissions, highly efficient use of resources, as well as the pursuit of optimal achievement of social goals along with the minimization



of ecological risks. There are five key courses of action within the green economy that can be identified: achieving social well-being, attaining equity in the fields of social and human rights, recognizing the limits of natural resources and protecting them, using resources in more efficient ways and applying appropriate governance processes in the socio-economic sphere [1]. In this regard, the green economy can be viewed as one of the main instruments for future sustainable development. The advantages of applying the green economy concept include the following: improved human well-being, the achievement of social equality, reduction of poverty, minimization of harmful environmental impacts, reduction of carbon emissions, prevention of pollution, a shift toward the use of renewable resources wherever possible, creation of green jobs, prevention of biodiversity loss and effective waste management.

The circular economy, as an element of sustainable development, represents an economy whose aim is to ensure that products, components and materials retain their highest possible utility and value at all times throughout the economic process [2]. It is especially important to emphasize that one of the most significant conditions for realizing long-term sustainability, in addition to the establishment of a closed-loop system, is the long-lasting, fundamental transformation of lifestyles, value systems and consumption patterns.

The United Nations' Agenda for Sustainable Development adopted for the period up to 2030 defines seventeen sustainable development goals. The implementation of the concept of the circular economy supports eight of them: responsible consumption and production, clean water and sanitary conditions, decent work and economic growth, industry, innovation and infrastructure, sustainable cities and communities, climate preservation, marine conservation and the preservation of life on land [3].

In comparison with the linear economic model, the advantage of the circular economy is that it ensures the circular flow of matter and energy. Designing production and consumption in this way could provide long-term sustainability by applying clean technologies, developing a new approach to product design that facilitates efficient reuse, as well as the application of responsible management of natural resources and energy, with a focus on renewable resources and minimal generation of waste. In this regard, it would be possible to achieve the most important goals of the circular economy – restoration of natural resources, retention of resources in use, as well as the extension of product life cycles through appropriate design that prevents products from becoming waste and allows them to continue to be used, consequently reducing environmental pollution [4].

The concept of sustainable development is based on the efforts to reconcile economic, ecological and social demands while realizing socio-economic development. The green economy, circular economy and bioeconomy play particularly important roles in the realization of the abovementioned concept, along with other elements of sustainable development that should not be disregarded [1, 5, 6]. The application of the principles of sustainable development is of particular importance for economic sectors that are the largest polluters of the environment such as: the food industry, transportation, construction and the textile industry. So, the textile industry is officially found among the sectors that are the biggest polluters of the environment. The development of the textile industry so far has been predominantly based on the principles of the linear economy, which relies on the “take–make–use–dispose” approach. Frequent changes in fashion styles, the global

population growth and the increase in the standard of living have significantly contributed to the negative environmental impact of the textile industry, which means that applying the linear model in this sector would be unsustainable in the long run.

The current linear model of textile and clothing production and consumption encourages a fast fashion culture: more lower-quality clothing, shorter delivery deadlines, more frequent production lines and collections, a growing global population and expanding middle class, declining clothing prices (compared to prices of other consumer goods), increased demand for clothing and the growth in the consumption of clothing items.

The textile industry is an economic sector in which the principles of the circular economy could be applied very successfully. Namely, seeing that the textile industry uses natural resources, particularly water and energy, very intensively and often inefficiently in the production process, and considering the fact that this sector generates large amounts of waste that are poorly managed, emits greenhouse gases and uses chemicals, microplastics and microfibers intensively, the potential for implementing a sustainable and circular development model is very high. Implementing a new economic model in the textile industry is justified and desirable because it can help solve numerous problems, primarily those related to environmental degradation. In this way, the application of the circular economy can contribute significantly to improving the efficiency of resource use, increasing business profitability, as well as reducing the negative environmental impact, consequently enhancing the overall quality of life on Earth.

In order to successfully implement the circular economy in the textile industry, it is necessary to develop new business models. These models refer to clothing rental services, designing products in ways that enable reuse and recycling (circular fashion), encouraging consumers to purchase higher-quality clothing that lasts longer (slow fashion) and, more broadly, guiding consumer behavior toward more sustainable choices (e.g. second-hand shopping, fashion library, keeping clothes longer in use). The development of a circular business model in the fashion industry is compatible with Sustainable Development Goal 12, which promotes sustainable production and consumption for both producers and consumers, as well as with Sustainable Development Goal 11, which focuses on the development of sustainable communities through Goal 9 (industrial and technological innovation). Therefore, it could also lead to the achievement of decent work and economic growth, in line with Development Goal 8, and all of this would ultimately contribute to further improvements in environmental protection (Sustainable Development Goal 13) [3]. For many years, the textile industry has been faced with challenges such as the intensive use of natural resources, the generation of large amounts of waste, inefficient energy consumption, greenhouse gas emissions, environmental degradation etc. Solving these problems requires continuous promotion and adoption of the idea of incorporating circularity into the operations of this sector. The transformation of the textile industry toward circularity would enable the long-term sustainability of its operations. This way, it would be possible to produce high-quality products while preserving their value and durability, as well as to implement material circulation processes based on the principle of “product–waste–product.”



One of the advantages of the transition of the textile industry to a circular economy lies in the fact that such a business model would contribute to reducing waste generation primarily through the reuse and recycling of materials and textile products. Consequently, the main goals of implementing the circular economy in the textile industry would be the following: increasing product durability, ensuring “circular design”, enabling the reuse and repair of existing textile products, reducing and eliminating the use of hazardous chemicals in production processes, using raw materials and energy sources more efficiently, increasing the recycled content in products, applying new technologies for production and recycling, reducing carbon emissions and improving environmental quality.

The literature that analyses sustainable transformation in the fashion industry has presented a conceptual framework that illustrates the transition from conventional to sustainable fashion. The given model is based on a comprehensive understanding of the ecological, social and economic challenges the fashion industry is facing [7, 8, 9]. The model of sustainable transition in the fashion industry emphasizes the importance and necessity of improving the environment, social progress, economic sustainability, ethical consumer behavior and principles of circular economy, which represent the key elements for starting the transformation within the fashion industry. The main components of the model are the following:

- *Input* – made up of conventional fashion, which is the result of the current state of the industry, and which is most often characterized by mass production, a huge negative impact on the environment and poor working conditions.
- *Process* – made up of the five key components: environmental improvement, social progress, economic profitability, ethical consumer behavior and circular economy principles.
- *Result* – sustainable fashion which represents a direct result of applying the mentioned improvements, which results in the products which are ecologically acceptable and ethically made.
- *Continuous improvement* – ensures that the transformation is maintained and continuously improved, and must be continuous through monitoring, evaluation, regulation, education and transparency.
- *Outcome* – sustainable transformation of the fashion industry, which promotes responsible management of resources, represents the long-term outcome of this model.

So as to apply circularity as a basic business principle, it is necessary to insist on the constant reduction and elimination of waste in the production process, which would also lead to the reduction of environmental pollution. This process requires replacing synthetic materials, chemicals, microfibers, microplastics etc. (the use of which significantly affects environmental pollution) with biological materials characterized by non-toxicity and the possibility of returning to the biosphere. This group of materials includes, for example, bioplastics, biosynthetic fibers, biomaterials such as biopolyester, biological silk etc. On the other hand, applying new technological solutions in the process of efficient sorting and recycling can also lead to reducing the use of non-renewable resources and eliminating the negative ecological effects of the textile industry. Some of the main obstacles to the optimization of textile recycling are the following [10]:

- 1) Economic cost-effectiveness: From the perspective of the economic justification of recycling in the textile industry, it should be mentioned that many types of recycled textile waste are not suitable for multiple recirculation and use, as well as that the prices of some recycled textile fibers are relatively high, which is a consequence of the high costs of the recycling process.
- 2) The composition of textile products, because basic components of many textile products make them unsuitable for recycling.
- 3) Unavailability of recyclable textile materials – the amount of textile waste which is suitable and available for recycling is extremely insufficient.
- 4) Technological limitations – lack of technologies for sorting textile waste in preparation for recycling and technologies for recycling different types of fibers.
- 5) Lack of information and limited public participation – knowledge barrier (not knowing what to recycle) and attitude barrier (lack of commitment to recycling ideals).
- 6) Poor coordination, inadequate policies and standards.

Textile waste can generally be divided into three main types according to the source of origin: post-industrial waste (by-product of clothing production), pre-consumer waste (clothing of lower quality at the place of production or in the distribution retail center, unsold goods in the retail center) and post-consumer waste generated by consumers themselves (damaged, worn or unwanted clothes) [11].

The most significant factors for improving the recycling sector are the following: *designing textile products* in such a way that the design of the product enables easy disassembly, the possibility of recycling and the use of as few different materials as possible; *the infrastructure* that enables efficient collection of discarded textiles; *the application of innovative technology* that enables efficient sorting of discarded waste; and *undertaking adequate activities* that can contribute to the growing demand for recycled textiles [5].

Applying the concept of circular economy in the textile industry would enable the creation of a completely new and different textile industry compared to the existing one, an industry which would produce high-quality, long-lasting and affordable clothing. The new textile industry would enable the preservation of the value of textile products during and after use, as well as the sale of textile products at prices which are formed in accordance with the real costs of production and which include social and environmental externalities. New technological processes that contribute to the preservation of the environment and the quality of water, air and soil would be applied in the production process, and a new “circular” design of textile products would be developed. Ecologically acceptable clothing or fashion design, which are acceptable both from the perspective of environmental protection and the protection of the health of consumers who wear the clothes, as well as workers who participate in their production, are called Eco-fashion [12]. Eco design can also significantly reduce energy consumption. Ecological clothes are the clothes which are produced from eco-friendly and sustainable resources. The process of producing ecological clothing requires appropriate management of all its stages, from the creation of designs for the environment, the procurement of raw materials, to the production of clothes,



appropriate distribution, and up to the consideration of their reverse logistics and waste [13].

Due to numerous negative consequences which are the result of the textile industry business operations, developed countries are taking appropriate measures in order to improve the social and ecological sustainability of the textile industry. These measures point out the necessity of the transition of the textile industry sector towards sustainable and circular production, consumption and business models. It is estimated that in the near future the three innovative trends could affect the textile and clothing industry [14]:

- 1) digitization of products, their design, production, distribution and retail processes, as well as the interaction of consumers/end users, factories, workplaces and supply chains;
- 2) sustainability, circularity and efficiency of resources, processes and the entire business;
- 3) new business and consumer models based on the sharing of production resources and end products, servitization, pay-per-use or subscription models, all of which lead to a collaborative or sharing economy.

It is also emphasized that in the future it will be necessary to implement a holistic business model that covers the entire production process. The circular model is emerging as a new business model. The circular business model enables businesses to create value while simultaneously increasing the efficiency of resource use by extending product life span and closing material loops in the business process. The main courses of action of circular business models are the following:

- extending the life span and resistance of the product in order to increase its durability, reusability and prolong its life cycle. The significance of these aspirations is ever greater since fast-changing fashion trends and lower product quality affect the shortening of the life span of clothing;
- optimizing resource use in order to reduce and optimize water and energy consumption, reduce harmful gas emissions and water pollution by using safe chemicals and adequate biodegradable materials. Textile companies use large quantities of water, energy and chemicals in their operations. Consequently, by introducing the principle of circularity in business, they also introduce the approach named *Access-based business models* so as to simultaneously increase the use of products and reduce the use of new materials and the creation of textile waste.
- collecting and reusing, and
- recycling and using materials.

Young entrepreneurs and consumers can play a key role in the process of developing innovative business models in the textile industry. It is precisely green (or ecological) entrepreneurship that advocates for the design and implementation of business models whose application can reduce or prevent the negative impact of fast fashion on ecological and social sustainability by introducing various types of eco-innovations [15]. Circular entrepreneurship represents a form of sustainable entrepreneurship which aims to apply the principle of circularity in business in order to protect the population and the environment. Companies whose operations are based on circularity should significantly contribute to



solving ecological problems by creating new ecologically sustainable processes, products and services.

Applying the circular economy in the textile and clothing industry is made significantly more difficult by three types of obstacles: unfavorable waste disposal practices of consumers (behavior and education), unfavorable waste disposal practices and opportunities of producers (infrastructure and processes for waste collection), as well as inadequate sorting and recycling technologies. If developing countries invested more in infrastructure for recycling and repairing, it would increase their capacity for the mentioned activities.

There are also numerous limitations and challenges in the fashion industry supply chain. These are, first of all: poor management, insufficient legislative control, lack of digitization, qualified workforce, inadequate financing, low performance, inadequate use of materials and energy, inadequate waste management, inadequate quality of resources, lack of governmental support, market demand, resistance to changing the way of thinking, management support and short-term visions [16]. The challenges and obstacles in the implementation of the circular economy can be put into seven different areas: technological, financial-economic, organizational, supply chain, institutional, consumer and social-ecological [17, 18].

Implementing innovative and circular business models is a process whose application requires the appropriate investment of human, material and financial resources. In the domain of the textile industry, this process can slow down due to the limited financial resources needed to ensure investments in the construction of the necessary technical and technological systems, then due to the underdevelopment of the circular market, the low degree of replacement of textile products produced according to the linear model with circular textile products, insufficiently developed legal regulations, the lack of professional knowledge and skills of the workforce in the area of the circular economy, as well as due to the inadequate and insufficient application of digital technologies. Obstacles to the implementation of sustainability innovations in the textile industry can be internal (high investment costs and regular business costs, lack of awareness of the need to create sustainable innovations) and external (lack of financial support from public funding sources, underdevelopment of public-private partnerships, unstable macroeconomic conditions etc.) [15].

One of the prerequisites for removing the abovementioned barriers is constructing an adequate institutional framework and infrastructure. It is also necessary to define and apply appropriate measures in order to prevent the creation of waste, as well as ensure effective monitoring of the application of the circularity principles in the textile industry with a focus on four key areas: production and consumption, waste management, secondary raw materials and competitiveness and innovation. Even though the application of the principles of green economy is necessary and required, it is shown in practice that its realization is very often a tedious and long-lasting task. This is especially true for developing countries, which do not have enough of their own resources to realize the given process in an appropriate and efficient manner, which is also true for our national economy.



As a result, long-term strategic planning and directing activities and resources rationally purposefully are necessary in this area.

3. THE CHARACTERISTICS OF THE GREEN TRANSITION OF THE TEXTILE INDUSTRY IN THE EU COUNTRIES

Business operations according to the principles of the circular economy were first implemented by highly developed countries. In the EU countries, the textile industry is considered to be one of the most resource-intensive sectors which has a great potential for the transition to innovative, sustainable and circular production, consumption and business models. Applying the circular economy in the textile industry of the EU countries should lead to the improvement of the ecological performance of textile raw materials and materials, production, consumption, management of textile waste, as well as their reduction, recycling, processing and calculation of environmental impact [19].

The most significant documents which point out the importance of the green and digital transition for the competitiveness of the textile sector, as well as the specific activities and obligations which it entails are the following: the European Green Deal (2020), the Circular Economy Action Plan (2020), the New Industrial Strategy for Europe (2020), the EU Strategy for Sustainable and Circular Textile (2022) and Strategic Research and Innovation Agenda for Textiles of the Future Partnership (2024).

The European Commission has presented a new strategy for the production of textiles in order to increase their durability, repairability, reusability and recyclability, as well as to combat fast fashion and encourage innovation in this sector. Building a sustainable and circular textile industry is defined as a new strategic direction for the future development of the textile sector in the EU countries, which aims to create a greener, more competitive and more modern textile sector with greater resistance to sudden global changes. The aim of this strategy is to build a framework and vision of the transition of the textile sector which will enable the production and sales of textile products that will be long-lasting, recyclable and largely made of recycled fibers and without hazardous substances by 2030. It is also very important that these products are made respecting human rights and environmental protection rules. The textile strategy contains the plans of the European Commission for adopting new regulations whose implementation would contribute to greater sustainability of the textile sector, as one of the largest polluters, exploiters and generators of waste in the world. The European Green Agreement aims to make the economic growth of all sectors sustainable, climate neutral, energy and resource efficient. In addition to increasing certain types of costs for its realization, the strategy of a sustainable and circular textile industry has numerous advantages such as: longer-term consumer benefits from high-quality affordable textile products, reducing the importance of fast fashion, increasing the availability of economically cost-effective services for reusing and repairing textile products. In such a new competitive, resilient and innovative textile sector, producers need to take responsibility for their products along the value chain, including responsibility when their products become waste. Textiles placed on the EU market will have to be durable, “repairable“, made mostly from recycled fibers and without

any hazardous substances. The Strategy for Sustainable and Circular Textiles of the EU defines six key measures for achieving the objectives set:

- 1) Introducing mandatory requirements for ecological design – which would enable the life span of textile products to be expanded, which would then significantly reduce their impact on the climate and the environment.
- 2) Reducing and eliminating the destruction of unsold or returned textile products, because the destruction of unsold or returned goods, including clothing, is a loss of both value and resources.
- 3) Fighting against microplastic pollution – because it is estimated that more than 50% of the fibers used in clothing are synthetic, mainly polyester, and that share is growing more and more.
- 4) Introducing information requirements and digital passports for products – containing clear, structured and accessible information about the ecological sustainability characteristics of products, should encourage textile companies and consumers to make better choices and improve communication between actors along the value chains, including producers and recyclers.
- 5) Green claims that textile products are truly sustainable – which should ensure that consumers are more accurately informed at the point of sale about the product's life expectancy, as well as the information relevant to product repair, including a reparability rating, whenever available.
- 6) Extended responsibility of producers and encouraging the reuse and recycling of textile waste – because there is a significant potential to reduce textile waste, as well as the possibility for it to continue to create value by encouraging its preparation for reuse and recycling.

A new holistic business model is presented in the literature whose application includes all the phases of the supply chain [16]. According to this model, the life span of the product can be extended through the use of alternative sources of raw materials, such as waste, thus returning to the first step in the production chain (procurement of raw materials) and ensuring the principle of strict circularity. In order to improve the existing products and processes, it is necessary to apply green operations that include production and regeneration, reverse logistics, network design and waste management [13]. The main goal of green production, which includes activities such as reduction and recycling, is to reduce the negative impact of products on the environment by using appropriate materials. Unlike green production, regeneration involves reuse and recovery of products/materials. The model emphasizes the importance of green distribution through the establishment of local stores and infrastructure that will ensure resource efficiency, while challenges must be identified to ensure sustainable production at the production stage. The key principles that should be observed when applying this model are the vision of circular eco-design, the development of a reliable environment through the provision of key metrics and the quantification of circularity, but also the transfer of knowledge to both employees and customers of the fashion industry. Advertising, rebranding and creating partnerships towards circular fashion are key, because this enables a smoother transition of the industry



towards circularity, leaving no waste behind and is in accordance with the EU legislation and strategies.

However, applying business models based on the idea of reuse, repair, recycling and circularity in the EU textile industry sector has encountered numerous difficulties, such as increasing import and stronger competition from the third-world countries, the problems coming from rising energy costs, unsustainable use of primary raw materials, low business profitability, lack of appropriate skills, aging workforce, noise pollution, damaging human health etc. In addition to the abovementioned ones, other major problems are the following: the increased prevalence of counterfeit goods, the difficulties of small and medium-sized fashion enterprises in accessing financing, the general image of the sector as an industry with low profits, low level of innovation, low salaries and dubious working conditions, which have significantly reduced its attractiveness for young workers and experts, making the employment of qualified work force problematic [20].

Applying the circular model means appropriate knowledge, experience and skills, as well as constant research and development work. So as to improve research and development and technological solutions for the circular and digital transition of the textile sector, it is necessary to: encourage innovation and research in the field of sustainable production processes and innovative technologies with low carbon emissions, provide support for the development of new digital technologies, support small and medium-sized enterprises and entrepreneurs in the textile sector to develop digital skills and to establish cooperation with the European Organizations for Standardization in order to adopt the necessary standards regarding innovative digital technologies which are significant for the textile sector.

The green transition of the textile industry also means providing the infrastructure for textile waste management (for collecting, sorting and processing of textile waste for reuse and recycling) and logistics. This requires building an infrastructure for collecting and sorting about 5 million tons of textile waste annually. The mentioned infrastructure should ensure a stable and reliable supply and use of high-quality secondary raw materials thanks to improved industrial capacities for recycled and renewable fibers and circular textile products.

The EU is one of the most significant participants in the foreign trade exchange of textiles, clothing, leather and similar products. In 2022, the EU exported the abovementioned products with a total value of about EUR 60 billion, while imports were about EUR 30 billion. The most important exporter and importer, with a share of 32% in total exports and 20% in total imports of textiles, clothing, leather and similar products in 2022 in the EU is Italy. Other than Italy, Germany, Spain, France, Portugal and Italy are important participants in foreign trade exchange (Figure 1).

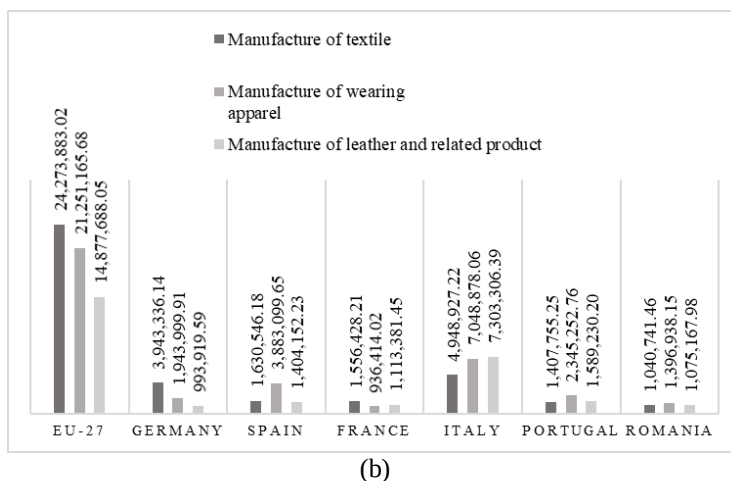
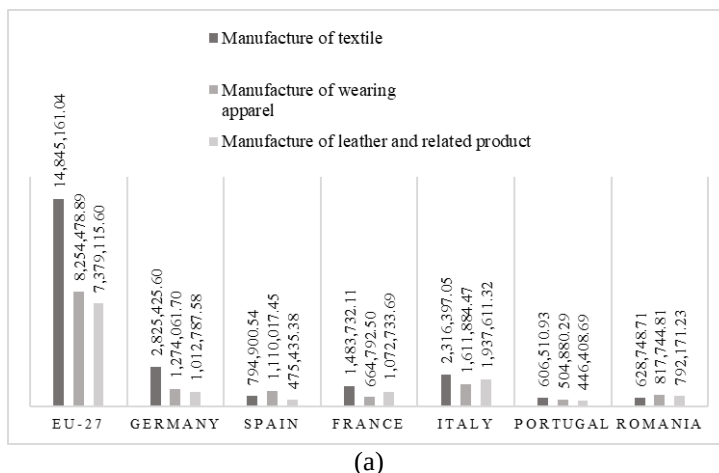


Figure 1: International trade, imports (a) and exports (b) manufacturing of textile, wearing apparel and leather and related products in 2022 for EU-27, Germany, Spain, France, Italy, Portugal and Romania, thousand euro
 Source: Author calculation based on Eurostat data

Digitization plays an important role in the sustainable development of the textile industry of the EU countries and it will be carried out using new technologies in order to enable effective monitoring of the transition of the textile industry from a linear to a circular business model: Artificial Intelligence (AI), Internet of Things - IoT, Big Data, 3D printing, Smart clothing, Digital Product Passport (DPP) etc.

Since human resources and human capital represent the most important elements of the company's capital, the realization of the circular economy means employees with



appropriate knowledge, experience, skills and competences. In the process of green transition, it is necessary to constantly invest in skills (also digital and circular) such as knowledge of circularity, processing, sorting and collecting of textiles. It is the staff who need to recognize textile waste as a resource on the market of secondary raw materials, as well as to determine how to further treat this resource and obtain a new value from it.

However, it is very unfavorable that only 13% of the employed workforce in the textile sector has high-level qualifications. This problem can be solved by permanently developing the skills that are necessary for the realization of the green and digital transition. These processes could increase the employment opportunities of highly qualified work force relatively poorly represented in the textile industry. On the one hand, the sector is struggling to attract qualified young talents, and on the other, business operations of small and medium-sized enterprises in the textile ecosystem are limited, among other things, by the lack of qualified workers. Within the EU Pact for Skills, the Commission supported the establishment of a large-scale skills partnership for the textile ecosystem to promote upskilling, reskilling and the acquisition and transfer of green and digital skills, including knowledge of life cycle assessment and value chain assessment. The goal is to increase opportunities for improvement, retraining and acquisition of new skills, which is especially important for the textile sector which represents a labor-intensive economic branch. The green transition itself, as a new business concept, implies the existence of a new professional workforce that possesses the appropriate knowledge and skills necessary for performing new jobs. The new professional profiles that are necessary are for example: circular design professionals, quality control operators, reverse logistics, waste management managers, digital designers, digital marketers, e-commerce experts etc. [1]. Consequently, the European Commission suggests constantly promoting and encouraging the improvement and adoption of existing and new green and digital skills.

4. COMPARATIVE ANALYSIS OF BUSINESS INDICATORS OF TEXTILE INDUSTRY IN THE EU AND RS

The contemporary textile industry is characterized by serious problems of unsustainable overproduction and overconsumption of the sector. Inefficient use of non-renewable resources, rapid change of fashion trends (wearing clothes several times and then throwing them away), a growing demand for lower quality clothing at a lower price, increasing production to respond to the latest fashion trends have all significantly led to the problem of unsustainability in this industry [21]. Today, clothes are made for a relatively short use, while underused clothing items are thrown away. All of the above, together with falling costs, a growing demand and consumption generated excessive growth in clothing production, which was also triggered by the growth of the world population and the expansion of the middle class, as well as the increase of the standard of living [11]. Consequently, in the following period it can be expected that production of the textile industry will continue to grow and, as it is estimated, the given growth will reach about 4% per year until 2030 [19].

According to Eurostat, in 2022, the manufacture of textile, wearing apparel, leather and related products achieved added value in the amount of € 71,497 million, which represents

a 2.98% share of the value added in the total manufacturing in EU-27. Italy achieved the highest value added (€ 28,079 million), then Spain (€ 8,235 million) and Germany (€ 7,740 million). This industry also employed 1,917,200 workers and had a 6.37% share of the employment in the total manufacturing in EU-27 (Figure 2). Italy has the largest number of employees in this sector (464,700), then Romania (274,400) and Poland (202,200). More than 90% of the companies in this industry are small enterprises which have fewer than 50 employees and which create more than 60% of the total value added of the manufacture of textile, wearing apparel, leather and related products in EU-27.

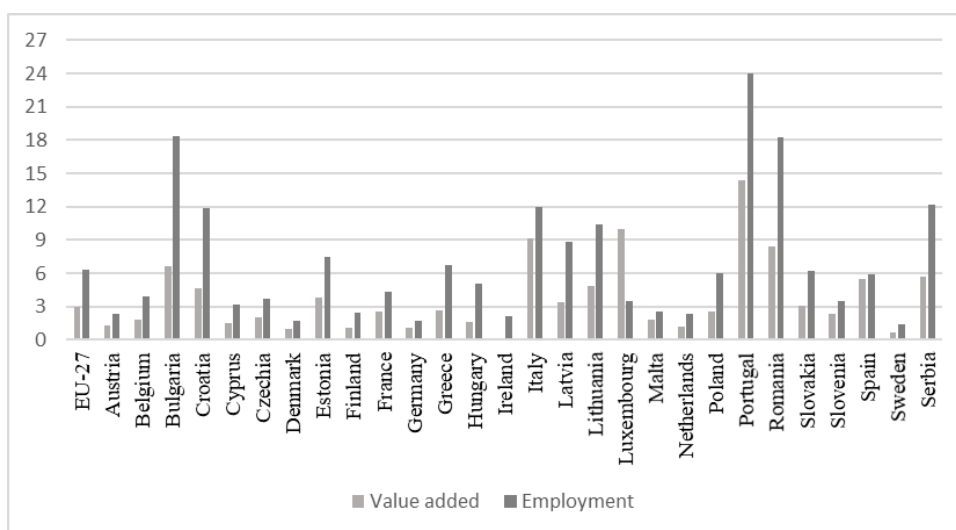


Figure 2: Value added and employment in the Manufacture of textile, wearing apparel, leather and related products in EU countries and Serbia in 2022, % of total manufacturing
 Source: Author calculation based on Eurostat data

According to the data in Figure 2, it is evident that in Portugal the added value of the industry of textiles, clothing, leather and related products was 14.34% of total value added of manufacturing in 2022. Also, compared to the EU countries, Portugal recorded the highest participation of employees in the manufacture of textile, wearing apparel, leather and related products in total employment in manufacturing, which was 24.02%.

The analysis of the textile industry in Serbia leads to the conclusion that the added value of the textile, clothing, leather and related products in 2022 was 540 million euros, i.e. a 5.73% share of the value added in the total manufacturing in EU-27. This branch of industry employed 62,500 people, which represents a 12.17% share of the employment in the total manufacturing in Serbia. Such data also point to the fact that the productivity of the employees in the textile sector in Serbia is twice lower than in the EU countries. In recent years, a negative trend has been recorded in Serbia which shows a decline in the production of the textile and clothing industry (Table 1).

Table 1: Indices of total industrial production, manufacturing and textile sector in the Republic of Serbia, 2020-2022, previous year=100

	2020	2021	2022
Industry – total	100.6	106.3	101.7
Manufacturing	100.1	105.6	101.4
Manufacture of textile	97.0	95.9	95.4
Manufacture of wearing apparel	95.2	98.2	98.6
Manufacture of leather and related products	80.7	112.2	102.0

Source: [22]

We can conclude from Table 1 that in the given period Serbia experienced a decline in production in the textile and clothing industry, which was most evident in the production of textiles and was 4.1% in 2021 and 4.6% in 2022.

In recent years, the most significant ecological problems caused by the textile industry are connected, first of all, to the generation of waste, large consumption of water, energy and chemicals, as well as to the direct emission of CO₂. It is estimated that textile production is responsible for about 20% of global clean water pollution, which is caused by the use of chemicals for dyeing and final treatments. It is also estimated that the total level of fashion waste will rise to 148 million tons by 2030, which is 17.5 kg per year per capita worldwide [11]. It is devastating that only about 15% to 20% of textiles (depending on the region) are recycled, while the rest is disposed of in landfills or burned.

According to the Eurostat, the EU textile industry generated waste of 5 kg per capita in 2022 which represents an increase compared to 2012 (Table 2). Only four EU members, Belgium, Ireland, Luxembourg and Spain, have managed to reduce textile waste levels since 2012. The top seven producers of textile waste in the EU-27 in 2022 were: Belgium, Czechia, Luxembourg, Austria, Italy, the Netherlands and Portugal (Figure 3).

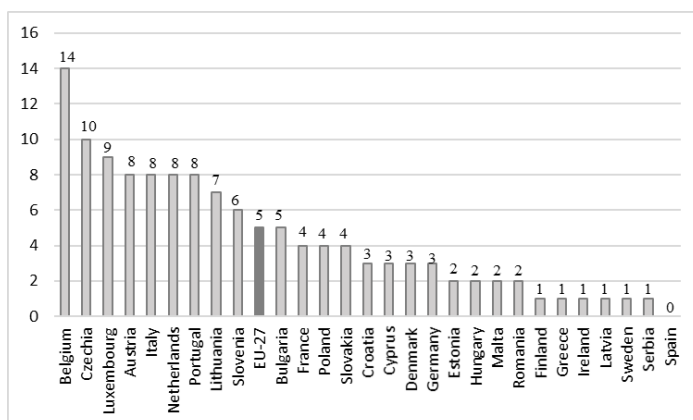


Figure 3: Textile wastes (all NACE activities plus households) in EU countries and Serbia from 2022, kg per capita,

Source: Author calculation based on Eurostat data



Table 2: Change in textile wastes (all NACE activities plus households) in EU countries and Serbia from 2012 to 2022

Country	2012 (kg per capita)	2022 (kg per capita)	Change (%)
EU-27	4	5	25% ↑
Austria	5	8	60% ↑
Belgium	16	14	-13% ↓
Bulgaria	1	5	400% ↑
Croatia	1	3	200% ↑
Cyprus	1	3	200% ↑
Czechia	6	10	67% ↑
Denmark	3	3	0%
Estonia	1	2	100% ↑
Finland	3	1	-67% ↓
France	2	4	100% ↑
Germany	4	3	-25% ↑
Greece	0	1	↑
Hungary	2	2	0%
Ireland	5	1	-80% ↓
Italy	7	8	14% ↑
Latvia	0	1	↑
Lithuania	3	7	133% ↑
Luxembourg	11	9	-18% ↓
Malta	0	2	↑
Netherlands	7	8	14% ↑
Poland	2	4	100% ↑
Portugal	6	8	33% ↑
Romania	1	2	100% ↑
Slovakia	2	4	100% ↑
Slovenia	3	6	100% ↑
Spain	2	0	-100% ↓
Sweden	1	1	0%
Serbia	0	1	↑

Source: Author calculation based on Eurostat data

According to the data from the European Environment Agency, the purchase of textiles in the EU in 2020 generated around 270 kg of CO₂ emission per person. This means that textile products consumed in the EU generated greenhouse gas emission of 121 million tons [23]. The fashion industry, which is known for environmental degradation, social injustices and ethical issues, accounts for between 3 and 8% of global greenhouse gas emissions [24].



Table 3 shows emissions of pollutants (CO₂, CH₄ and N₂O) in 2022 caused by the manufacture of textile, wearing apparel, leather and related products, as well as their change compared to 2012 for the EU countries and Serbia.

Table 3: Manufacture of textile, wearing apparel, leather and related products, change in air pollutants (CO₂, CH₄ and N₂O) in EU countries and Serbia from 2012 to 2022

Country	CO ₂ , 2022 (tonne)	Change in CO ₂ , 2012-2022 (%)	CH ₄ , 2022 (tonne)	Change in CH ₄ , 2012-2022 (%)	N ₂ O, 2022 (tonne)	Change in N ₂ O, 2012-2022 (%)
EU-27	8,120,701.71	17%	4,861.81	-19%	165.08	31%
Austria	57,589	-48%	1.17	-62%	0.29	-63%
Belgium	156,217.69	-50%	13.25	-40%	0.85	-46%
Bulgaria	59,688.34	-27%	850.08	0%	0.87	-7%
Croatia	16,257.58	9%	0.47	-28%	6.47	-21%
Cyprus	1,116.12	-22%	0.07	-36%	0.03	0%
Czechia	80,911.54	-28%	6.69	-47%	0.83	-42%
Denmark	14,978.99	-41%	0.32	-93%	0.47	-29%
Estonia	6,276.76	-86%	2.83	-70%	0.49	-70%
Finland	8,027.7	-49%	0.15	-48%	0.19	-55%
France	576,550.28	-19%	26.73	-19%	8.42	65%
Germany	1,205,636.87	54%	239.83	244%	17.42	28%
Greece	2,094.05	-76%	0.19	-80%	0.07	-74%
Hungary	47,597.14	40%	1.28	8%	0.69	25%
Ireland	38,860.6	136%	1.95	122%	0.42	180%
Italy	4,204,669.61	66%	3,292.78	-22%	79.79	70%
Latvia	10,929.03	-61%	0.46	-53%	0.14	-48%
Lithuania	26,585.81	19%	9.72	-7%	2.91	-12%
Luxembourg	295	-99%	0.01	-99%	0.01	-89%
Malta	2,748.72	392%	0.05	67%	0	-100%
Netherlands	144,353.44	-31%	21.86	-13%	1.82	21%
Poland	173,898.86	9%	6.48	-22%	1.52	2%
Portugal	606,000	-24%	39.1	-1%	26.2	71%
Romania	137,541.87	-3%	13.29	-36%	2.7	-23%
Slovakia	61,406.72	16%	2.11	-27%	1.66	-21%
Slovenia	29,635.54	-24%	0.99	-74%	0.71	-7%
Spain	431,425.18	-28%	328.47	-47%	9.53	-36%
Sweden	19,409.28	-53%	1.49	-22%	0.57	12%
Serbia	56,465.81	-49%	142.13	37%	6.69	289%

Source: Author calculation based on Eurostat data

Based on the analysis of the data shown in Table 3, we can conclude that in 2022 the manufacture of textile, wearing apparel, leather and related products in the EU generated 8,120,701.71 tons of CO₂ emission, 4,861.81 tons of CH₄ emission and 165.08 tons N₂O emission. The largest emissions were recorded in Italy and Germany, the countries with the most developed textile and clothing industry, which again points to the fact that the negative impact of this industry on the environment is still very large, but also to the necessity of intensifying the processes that lead to the sustainable development of this sector.

5. CONCLUSION

Intensive technical-technological progress in recent decades has significantly changed the economic conditions in all areas of business. In addition to considerable advantages, the development of technology has led to numerous negative consequences and the most significant ones are those connected to environmental pollution. Humanity is at a major turning point because it has been shown that this trend leads to endangering not only its future growth and development, but also its survival. So as to overcome these problems, new developmental models and strategies were formulated in order to ensure the long-term sustainable development of the entire human community. This paper focuses on the textile industry as a branch which, on the one hand, is of great importance for the economic growth of countries worldwide, and on the other in itself generates numerous, primarily ecological problems. Under such conditions, a fundamental change in the business model is necessary, a change which will make this industry sustainable in the long run. In this context, the textile industry has been recognized as a sector which has great potential for the application of a sustainable and circular model of business and development. The paper concludes that the application of the concept of circular economy in this industry would enable the creation of a completely new and different textile industry in comparison with the existing one, which would produce high-quality, long-lasting and affordable clothing and which would preserve the value of textile products during and after use and also enable the sale of textile products at realistic prices. Sustainable innovations, whose application would lead to the production of safer, more efficient, healthier and more environmentally friendly products, play an important role in the new developmental model of the textile industry. Young entrepreneurs and consumers can play a key role in the process of developing and applying innovative business models in the textile industry because green (or ecological) entrepreneurship advocates for the design and implementation of business models whose application can reduce or prevent the negative impact of fast fashion on ecological and social sustainability by introducing various types of eco-innovations.

Seeing that the implementation of innovative and circular business models is a relatively expensive process, its implementation first began in highly developed countries. Establishing a sustainable and circular textile industry has been defined as a new strategic direction for the future development of the textile sector in the EU countries with the aim of building such a framework and vision of the transition of the textile sector which will enable the production and sale of textile products which will be long-lasting, recyclable



and which will be largely made of recycled fibers and without hazardous substances by 2030.

The paper emphasizes that in the future we can expect the growth in the production of the textile industry to continue, and, according to estimates, the given growth will be about 4% annually by 2030. In Serbia, the value added in the industries of textiles, clothing, leather and related products in 2022 was 540 million euros, i.e. only a 5.73% share of the value added in the total manufacturing in EU-27. This branch of industry employed 62,500 people, which represents a 12.17% share of the employment in the total manufacturing in Serbia. Such data also point to the fact that the productivity of employees in the textile sector in Serbia is almost twice lower than the productivity in the EU countries. In recent years, there has been a decline in the production of the textile and clothing in Serbia. According to the data analyzed, we can conclude that in Portugal the added value of the industry of textiles, clothing, leather and related products was the highest with 14.34% of total value added of manufacturing in 2022. Also, in comparison with the EU countries, Portugal recorded the highest participation of employees in the manufacture of textile, wearing apparel, leather and related products in total employment in manufacturing, which was 24.02%. The data analyzed also show that the countries with the most developed textile industry (Italy and Germany) still have the highest emissions of harmful gases into the atmosphere. The realization of the green transition of the textile industry also means providing infrastructure for textile waste management, as well as the digitalization of the European textile industry in order to effectively monitor the transition of the textile industry from a linear to a circular business model.

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