

Resource Efficiency in Innovative Textile and Clothing Industry Ecosystems: Evidence from Western Balkan Countries

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Abstract

An innovation ecosystem consists of the interaction of multiple actors, the development of stable relationships, and the use of flexible instruments to create an optimal environment for innovation. In the textile and clothing industry, innovation ecosystems rely on original approaches to achieve resource efficiency and boost productivity despite financial and technical constraints to adopting new technologies. Innovation in the textile and clothing industry is expected to enhance resilience, improve transparency, and foster sustainability. In this paper innovative practices in the textile and clothing industry refer to sustainable operational practices adopted in manufacturing to obtain environmentally friendly ready-to-wear goods. This paper aims to assess, based on accounting data and previously determined evaluation criteria, the degree of resource efficiency in textile and clothing manufacturing enterprises in the Western Balkan countries. Predetermined indicators used in this paper include online inventory of raw materials, digital tracking of environmental benefits, digital manufacturing operations, amount of investment in renewable energy resources, and online tracking of customer orders. This paper evaluates sustainable practices based on accounting data for at least 150 large textile and clothing manufacturing enterprises in the Western Balkan region. The accounting data is used to measure efficiency financial ratios such as asset turnover, investment turnover, and inventory turnover to discover new development paths of digital transformation, sustainable growth, and the overall innovation path of the industry. This paper concludes that sustainable practices promoted by clothing manufacturing enterprises foster an environment of continuous learning and growth by increasing their working capital, obtaining higher labor productivity, and opening new channels for technological innovation.

Keywords: digital ecosystems; accounting data; sustainable growth; environmentally friendly; building resilience

1. Introduction

The contemporary textile and clothing industry is embracing innovation and technological advancements, including automation. Machinery and equipment are getting more complex, with robotics and digitalization applied in several operations in the industry (Hasan et al., 2019). These changes lead to the rearrangement of processes and new alternatives in the efficient use of resources, oriented toward sustainable production and a lower environmental footprint. This, in turn, aids industry players in adapting to shifting customer demands, encompassing everything from price, quality, and quick delivery times to the use of biodegradable raw materials and circular economic tactics (Heinze, 2020)

Despite recent digitalization and automation, the textile and clothing industry remains one of the most environmentally damaging industries. Every stage of the value chain in the industry, from the selection of raw materials to the final disposal of garments, adversely affects the environment to a certain degree. Even though several solutions are available including policies, actions, and technologies, the industry remains behind in obtaining resource efficiency along its value chain (Khoitkulov, 2021).

In the present state of the industry, the textile and clothing industry accounts for approximately 26 percent of the budget allocated globally for carbon emission, thereby causing a rise in temperature of 2 degrees Celsius by 2050. Currently, this industry is accountable for 3-10 percent of global carbon emissions. As such, it becomes mandatory for the industry to address new resource efficiency strategies oriented towards green production and circular business models, significantly reducing the global environmental footprint (Nimkar, 2018). Resource-efficient strategies encompass, among others, the utilization of environmentally friendly raw materials such as organic cotton, lyocell, and renewable yarn, the utilization of waterless dyeing (which requires minimal water consumption), and the utilization of sustainable packaging (made from recycled materials). Among circular business strategies widely applied in the textile and clothing industry are subscription-based clothing (clothing rental), secondhand clothing, etc. (Sikander et al., 2021).

The environmental impact of the textile and clothing industry on climate change is estimated to increase by 49 percent by 2030. The identification of energy-intensive processes along the value chain of the industry (e.g., spinning and weaving) can shape the transition path toward the use of renewable energy, thereby reducing the environmental impact of the sector (Shiwanthi et al., 2018). Additionally, the efficient use of resources can be complemented by utilizing eco-friendly raw materials to reduce a good portion of the negative impact along the value chain (Ikram et al., 2021). For example, oil-based synthetic fibers can be replaced with low carbon footprint plant-based materials, and polyester fiber which has double the carbon footprint of that of a cotton shirt can be substituted with natural

and organic fibers, a necessary action for better resource efficiency in the textile and clothing industry (Gönlügür, 2019).

This research aims to determine the level of resource efficiency of textile and clothing enterprises, which is a prerequisite for the creation of innovative regional ecosystems. The evaluation of resource efficiency is conducted utilizing financial statement analysis and the values obtained through the calculation of financial efficiency ratios. The results obtained for enterprises in the sample have led to conclusions and policy recommendations.

2. Sustainable ecosystems in the textile and clothing industry

Sustainable production practices are attractive across different industries. Adhering to eco-friendly methods mainly results in a rise in customer demand for recyclable merchandise produced from renewable energy sources. Sustainability in industrial manufacturing is the use of environmental, social, and circular business models that create long-term value and use resources efficiently (Zhang et al., 2021). Industries in manufacturing are using the principles of fixing, reusing, remaking, recycling, redesigning, and reducing to offer sustainable goods and services that people want a lot (Svensson et al., 2016).

The textile and apparel industry plays an essential role in enhancing production processes by identifying innovative organizational and economical strategies to ensure the ongoing implementation of established procedures geared toward resource effectiveness (Todeschini et al., 2017). These new methods allow for the rational use of existing resources, the creation of new and more environmentally friendly raw materials, and the placement of competitive goods in the market to satisfy the increasing customer demand for sustainable products (Muthu, 2018). According to the literature, there are several ways textile and clothing manufacturing enterprises can generate innovative goods and new fashion lines according to sustainable development goals (Kozłowski et al., 2018). One way is to diversify capital investments, ensuring the re-equipment of manufacturing facilities with modern technologies. Diversification of investment lowers production costs and increases profits, accelerating asset turnover in enterprises (Ferro et al., 2019).

The textile and clothing manufacturing industry possesses a cost-operating structure that is dominated by raw materials, accounting for approximately 85% of its total production. This dominance necessitates periodic evaluation of the capabilities of organizations in the management and utilization of available resources to achieve production effectiveness (Ikram et al., 2021). The creation of sustainable ecosystems requires efforts from all parties involved in the value chain of the textile and clothing industry (McNeill and Snowdon, 2019). Brands and retailers push manufacturing enterprises to achieve sustainable operations in every production stage. Manufacturers need to make sure that suppliers of raw materials use sustainable practices, so they can make goods that meet customer demands for sustainability (Hayat et al., 2020).

Allowing sustainable practices in the textile and clothing industry will lead to more circular value chains (Khan and Qianli, 2029). The decisions made during the designing stage have a major weight in the creation of circular value chains due to the high costs and high environmental footprint that can be generated from inappropriate design. Consequently, circular ecosystems require designers with a mindset toward a circular fashion. The design process also influences the buying and consumption habits of customers, influencing their preference for eco-friendly fashion (Pande and Adil, 2019).

3. Textile and clothing industry in the Western Balkans

Over the past few decades, the textile and clothing industry has gained significant competitive advantages, including superior quality, innovative product design, low manufacturing expenses, and expeditious delivery times. The exploitation of these advantages has geographically shifted the location of production from developed to developing countries, including the Western Balkan ones (Lenzo et al., 2017). The relocation of production has occurred through subcontracting or outsourcing of various segments of the value chain to countries in the Western Balkan region, mainly due to the low operating expenses (Oelze, 2017).

The Western Balkan countries are highly competitive in the textile and clothing manufacturing industries. The region offers international brands and retailers with low labor costs coupled with relatively high productivity, thereby making it one of the primary suppliers in the international and European markets (Kacani, 2020). The region has also responded well and has embraced global developments in implementing more efficient operating procedures to ensure resource efficiency and short delivery times. Most regional manufacturers have worked with buyers and suppliers to exchange data, especially in Albania and Serbia, and some have used advanced automated technology, especially in Albania and North Macedonia (Corovic et al., 2020).

The textile and clothing manufacturing enterprises in the Western Balkans still require several modifications to ensure their long-term viability amid the ongoing changes in the textile and clothing manufacturing sector (Kacani, 2017). On the operational side, enterprises need to improve inventory control systems, especially in improving forecasting of order demand, provision of full package services to scale up in the value chain, and gradual implementation of circular manufacturing models. The textile and clothing manufacturing industry holds a significant proportion of the exports of Western Balkan nations, indicating a rising trend in the volume of exports and exchanges in international trade (Marchi et al., 2018)

The rapid expansion of textile and clothing industry exports from the Western Balkan countries, particularly to the European market in the past decade, has heightened the significance of regional manufacturing enterprises as subcontractors of leading European

firms in the industry (Gligorijevič and Čorović, 2020). The growth and competitiveness of the industry in the region are important because it shows a level of resource efficiency that can be used to create sustainable and circular ecosystems (Kosti et.al, 2018).

4. Methodology

In literature, performance in an enterprise refers to its ability to use its resources ranging from human, financial, material, and capital to obtain social and economic goals. Performance in enterprises is measured in spatial, temporal, qualitative, and quantitative terms. Concerning performance in enterprises, the objective of this paper is to measure resource efficiency based on quantitative data obtained from the financial statement analysis of the 150 textile and clothing manufacturing enterprises that currently operate in the Western Balkan countries (Kacani and Shaqiri, 2023).

Regarding accounting data, there are many criteria to evaluate the resource efficiency in an enterprise, however, for this paper priority is given to financial ratios that are used to measure enterprise efficiency. These financial ratios measure the ability of the enterprise to use its assets and competence to manage its current and medium-term liabilities. In this paper efficiency financial ratios are measured for three years and include: (i) asset turnover, (ii) investment turnover, (iii) inventory turnover, (iv) receivables turnover, and (v) payables turnover. The formula for how to calculate these financial ratios is presented in Table 1.

Table 1. Financial ratios used to measure resource efficiency:

No.	Financial ratio	Formula	Indication
1	Asset turnover	Asset Turnover = Total Sales / Average Total Assets	Asset turnover ratio measures the value of sales or revenues generated relative to the value of its assets.
2	Investment turnover	Revenues / (Stockholders' Equity + Debt)	The investment turnover indicates how effectively an enterprise uses its resources to generate revenues.
3	Inventory turnover	Inventory turnover = Cost of goods sold / Average Value of Inventory	The inventory turnover ratio shows how many times an enterprise has sold and replaced inventory during a given period. An enterprise can divide the days in the period, typically a fiscal year, by the inventory turnover ratio to calculate how many days it takes, on average, to sell its inventory.
4	Account Receivables Turnover	Account receivables turnover = Net Annual Credit Sales / Average Accounts Receivables	The accounts receivables turnover ratio measures the number of times an enterprise collects its average accounts receivable. It measures the efficiency of an enterprise in collecting outstanding balances from clients and managing its line of credit process.

5	Account Payables Turnover	$\text{Account Payable Turnover} = \frac{\text{Supplier purchases}}{\text{Average Accounts Payable}}$	<p>The accounts payable turnover ratio is used to quantify the rate at which an enterprise pays off its suppliers. It indicates how many times an enterprise pays off its accounts payable during a given period.</p>
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Source: Author's presentation

An analysis of the asset turnover ratio indicates that a higher ratio is generally more desired, as it indicates that the enterprise is more efficient in managing its resources and in generating sales or revenues. A lower numerical value of the ratio reveals that the enterprise cannot use its assets efficiently (Kacani et al., 2022). The values of this financial ratio vary among different industries. Consequently, to obtain meaningful results, the asset turnover ratio is advisable to compare its values across enterprises of the same industry. In addition, the investment turnover ratio is a quantitative indicator that measures the ability of an enterprise to generate revenues using the debt and capital that has been invested to support a specific business model. A high rate means that the enterprise is using its resources more effectively. On average, this ratio has a value between 75% to 100% while a more conservative one is below 50% (Kacani and Shaqiri, 2023).

To continue, most enterprises target an inventory ratio between five and ten, indicating that inventory is being replenished monthly. In this case, enterprises tend to obtain a balance between the items in stock and a reduction in frequent orders (Tsai, et al., 2020). Moreover, high values in the receivable turnover ratio reveal that the enterprise has a high degree of quality customers who make quick payments. A high receivables turnover ratio indicates that an enterprise efficiently collects its receivables as customers quickly clear off their outstanding payments. A high receivables turnover ratio might also indicate that an enterprise operates on a cash basis. On the other hand, a low ratio shows that an enterprise is experiencing liquidity issues as customers take longer to pay off their debts (Vazquez-Brust and Plaza-Ubeda, 2021).

Furthermore, the accounts payable turnover ratio indicates how many times an enterprise pays its accounts payable in a given timeframe. The ratio measures the speed at which an enterprise pays its suppliers. A decreasing turnover ratio indicates that an enterprise is taking longer to pay off its suppliers than it took in previous periods. When this ratio is increasing, the enterprise is paying off suppliers at a faster rate than in previous periods. An increasing ratio means that an enterprise has a good degree of liquidity, with plenty of cash available to pay off its debt promptly (Yasin et al., 2016).

In addition, several criteria were used to determine which enterprises will be part of the sample composition. Among the criteria used are: annual turnover of over 2 Million/EUR; provision of full package services; a staff of over three hundred employees; at least three major international brands as their customers; exports to the European, American, and Asian

markets; percentage of recyclable raw materials used in the manufacturing of finished goods; at least two major investments on digital operations; at least one major investment in the use of renewable energy sources in manufacturing. The main characteristics of the sample size are presented in Table 2 (Zamani, et al., 2018).

Table 2: Main characteristics of the sample with textile and clothing manufacturing enterprises in the Western Balkans

No.	Selection criteria	Occurrence in the sample size
1.	Turnover of over 2 million/EUR within the last three years.	<ul style="list-style-type: none"> 63% of enterprises in the sample have a turnover of over 2.5 million /EUR. 29% of enterprises have a turnover of 3 million/EUR. 8% of enterprises in the sample have a turnover of around 4 million/EUR.
2.	Operation mode under the full package	<ul style="list-style-type: none"> All enterprises in the sample offer full-package services. Only 13% of enterprises offer additional services including design and marketing of finished products.
3.	Over 300+ employees	<ul style="list-style-type: none"> 78% of enterprises have over 350 employees. 22 % of enterprises have over 400 employees.
4.	Exports in the European, American, or Asian markets.	<ul style="list-style-type: none"> 13% of enterprises export only to the European market. 66% of enterprises export both to the European and American markets. 21% of enterprises export to the European, American, and Asian markets.
5.	Shareholders from Western Balkan countries	<ul style="list-style-type: none"> 31 of the enterprises have shareholders from Albania. 21 of the enterprises have shareholders from Bosnia Herzegovina. 19 of the enterprises have shareholders from Kosovo. 18 of the enterprises have shareholders from Montenegro. 28 of the enterprises have shareholders from North Macedonia. 33 of the enterprises have shareholders from Serbia.
6.	More than 3 international brands.	<ul style="list-style-type: none"> 79% of enterprises work with 5 international brands. 14% of enterprises work with 7 international brands. 7% of enterprises work with 10 international brands.
7.	Percentage of recyclable raw materials used in manufacturing.	<ul style="list-style-type: none"> 64% of enterprises use only 20% of raw materials that are fully recyclable. 29% of enterprises use only 25% of raw materials that are fully recyclable. 7% of enterprises use above 30% of raw materials that are fully recyclable.
8.	Several investments in information and communication technologies to digitalize operations.	<ul style="list-style-type: none"> 72% of enterprises have made up to three major information and communication technologies investments to digitalize operations. 26% of enterprises have made up to five major information and communication technologies investments to digitalize operations. 2% of enterprises have made more than five major information and communication technologies investments to digitalize operations.
9.	Use of alternative energy sources	<ul style="list-style-type: none"> 64% of enterprises are considering switching to alternative energy sources. 25% of enterprises are in the process of switching to alternative energy sources. 11 % of enterprises have already implemented and operate under alternative

		energy sources.
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Source: Author`s calculation

5. Main results

Based on the formula for calculation of financial ratios and the information generated from sample characteristics this section presents the main results of the paper. To start with, the sample is dominated by an asset turnover value that is less than one (89%). This clearly shows that assets in enterprises of the textile and clothing industry are underused, as most of them do not possess the ability to use their assets effectively (Kacani, 2020). The results indicate that only a limited number of enterprises (13%) have an asset turnover ratio that is higher than one. Enterprises within this category are the ones that have made the highest number of investments in information and communication technologies, work with more than five major international brands, and use over 30% of recyclable materials (Zhang et.al, 2021).

A similar scenario occurs with the investment turnover ratio, which despite the tight selection criteria of enterprises is lower than two for most enterprises in the sample. An investment turnover of over two is observed in enterprises that have made on average more investments in information and communication technologies and are already operating under alternative energy sources. This indicates that both the type of investment and a manufacturing business model with the provision of operations extending beyond those included in the full package modality make these enterprises more capable of efficiently using their resources. Also, the results of the inventory turnover ratio fall into the same trend (Corovic et.al, 2020).

Most enterprises have a value of around two indicating that they replace inventory twice within a given period. The highest inventory ratio values of three and above are observed in enterprises that work with seven or more international brands and that operate simultaneously with the European, American, and Asian markets. Frequent changes in the inventory occur because brands vary in their order timetable and the required delivery times to the market they operate. The values of the inventory turnover ratio reveal that its measurement mostly depends on the customer orders rather than on the type of operations provided by the enterprise (Kacani et.al, 2022).

When considering receivables and payables the values indicate consistent results with no high variations among enterprises. All enterprises use digital accounting systems, significantly reducing the time for receiving and making payments. Also, the inventory is linked to the accounting system, informing on real-time the finance department in the enterprise of the orders placed and received, better tracking both receivables and payables

(Ikram et.al, 2021). Overall, the values of financial ratios indicate that by improving their technological transformation textile and clothing enterprises can further improve the technical complexity of their exported goods, improve the efficiency in the use of raw materials, diversify the types of energy required in manufacturing, and improve overall returns on investments (Heinze, 2020).

In addition, acquiring and increasing fixed assets like new machinery and equipment targeting cleaner production can improve the asset turnover ratio. Assets for cleaner production increase the complexity of technology available in the enterprise improving the composition of capital and labor input, facilitating adoption of advanced manufacturing processes, and speeding up technological transformation. The technological transformation will encourage textile and clothing enterprises to carry out technological innovation to reduce the costs of pollution coming from industry operations, improve manufacturing productivity, and obtain a higher degree of resource efficiency to be reflected in the values of financial ratios (Gligorijević and Ćorović, 2020).

Conclusions and policy recommendations

The application of sustainable practices in the textile and clothing industry can upgrade the overall performance of enterprises in the industry, driving them toward cleaner production and a higher industry turnover. Implementation of industry-sustainable practices and adoption of environmentally friendly rules and regulations can improve industry coverage of cleaner production practices. Sustainable practices can significantly improve the quality and complexity of manufactured goods, multiply exports to existing markets or new ones, and enhance international competitiveness (Sikander et al., 2021). Implementation of such practices has multiple wins for enterprises in the textile and clothing industry as it encourages enterprises to use alternative energy resources, to adopt in manufacturing principles of circular economy, and to manufacture more environmentally friendly goods. By doing so, enterprises in the textile and clothing industry can improve their internal efficiency in resource utilization and encourage within the enterprise a culture of continuous technological innovation (Tsai et al., 2020).

The textile and clothing enterprises operating in the Western Balkan countries that have initiated investments in information and communication technologies that use renewable energy resources and possess a more diversified customer portfolio. These are the ones with the best performance in financial ratios. These enterprises have higher asset turnover, better use of resources, and a higher degree of efficiency (Kacani and Shaqiri, 2023). Sustainable practices in the regional textile and clothing industry are promoted by these enterprises. They foster an environment of continuous learning and growth by increasing their working capital,

obtaining higher labor productivity, and opening new channels for technological innovation (Ikram, 2022).

The continual learning approach adopted by these organizations to implement technological advancements is more advantageous for sustained export competitiveness, based on the principles of the circular economy. Such behavior is a precondition to further increase investments in research and development and to carry out internal independent innovation coming from a higher degree of resource efficiency (Khoitkulov, 2021).

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