Digital Product Passports: Enhancing Sustainability and Transparency in the Textile Industry

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Abstract

The textile industry, one of the world's largest polluters, faces increasing pressure to adopt sustainable practices. In response, as part of its Circular Economy Action Plan, the European Union has suggested implementing Digital Product Passports (DPPs). DPPs include information on materials, origin, environmental impact, and end-of-life options, acting as a thorough digital record of a product's lifecycle. By enhancing supply chains' sustainability, traceability, and transparency, this invention has the potential to completely transform the sector. Not with standing its potential, issues including high implementation costs, a lack of standards, and privacy concerns about data still exist. This study examines how DPPs can support sustainability in the textile sector, lists their advantages, and discusses the obstacles to their broad use.

Key words: digital product passport, sustainability, circular economy

Introduction

Across its production chain, the textile industry has a major impact on the environment and society, making it the second most polluting sector in the world. The industry is experiencing stakeholder pressure to enhance sustainable practices. In an effort to enhance the environmental performance and sustainability of supply chains and operations in key major industries, the European Commission has proposed legislative acts. By 2050, the Commission wants the EU to have a fully circular economy, which will entail a number of operational and technological requirements for companies that want to keep selling tangible goods in the European market (Alves, L. *et.al.*, 2022). The key element of a transition to a more sustainable lifestyle is the adoption of circular economy principles. The circular economy requires "the generation of waste to be minimized and the value of products, materials, and resources to be maintained in the economy for longer durations" (European Commission, 2015). On the other hand, the textile industry now functions along a linear value chain. This indicates that although a large number of new textiles are released onto the market annually, only a small portion of the current textiles are recycled, repaired, reused, or repurposed (Saari, L. *et.al.*, 2022). A significant amount of resources are used to make clothing that is discarded into landfills or burned within a short lifespan. With considerable changes to operations, behavior, and supply chains, the circular economy breaks with the linear production model resulting in a further advancement in sustainability. As a result, it is positioned as a key solution in the textile industry's transition (Alonso-Muñoz et al., 2022; European Commission, 2023).

Digital Product Passport (DPP)

To help the textile industry overcome these obstacles, the EU has proposed the Digital Product Passport (DPP) as a major initiative under its Circular Economy Action Plan (Jaeger, B., and Myrold, S, 2023). The idea of the DPP represents a digital record of a product's data from production to disposal. They work by integrating technologies like QR codes ("data carriers"), which, when scanned, grant access to a wealth of information about the product's history, composition, usage recommendations, environmental impact and more. It is expected that the DPP will be essential to improving product traceability, encouraging sustainability, and enabling a circular economy.

DPP connects the dots between traceability and transparency. This invention could increase product transparency by collecting and distributing data via information and communication technologies. In order to "electronically register, process, and share product-related information amongst supply chain businesses, authorities, and consumers," the European Commission (EC) defined the DPP as a product-specific data set that can be

electronically accessible through a data carrier. A product's origin, composition, repair and disassembly options, and how its many components can be recycled or disposed of at the end of its useful life are all covered by the DPP. (Wuppertal Institute and University of Cambridge Institute for Sustainability Leadership (CISL, 2022).

The DPP expands the amount of information provided on product labels in a dynamic and complementary manner for the textile industry. By 2022, throughout Europe, only the mandatory information i.e., composition and care instructions will be required whereas the country of manufacture and other information will not be. With access to comprehensive details on the origin, composition, repair and disassembly options, and products at the end of their life, DPP could increase the amount of information available, as this would facilitate maintenance, repair, resale, rental, disassembly, and recycling and there by promoting the circularity of products.

Digital Product Passports (DPPs) in Textiles

It is currently difficult for stakeholders to share product-related data, and manufacturers, for example, manufacturers have limited access to examine how their products are processed in the end-of-life phase. Additionally, consumers are not informed about the items' effects on the environment or the possibility of recycling them (Plociennik, Pourjafarian, Nazeri, et al., 2022). DPP's necessary data might be used to better identify, monitor, and manage resources along a product's intricate value chain and encourage sustainability performance, and eventually assist customers in making sustainable choices (Deloitte, 2022).

With a market valuation of $1.53 trillion in 2022, the global textiles sector is massive. The global COVID-19 pandemic caused uncertainty in the fashion and apparel industries, which resulted in an industrial recession between 2020 and 2021. However, the industry's annual compound growth rate, or CAGR, for 2023–2030 is 7.5%, indicating sustained future growth. Since the world's clothing output doubled between 2000 and 2015, there has been a growing demand for the final items that need to be manufactured using textiles. Due to the forces of supply and demand, "fast fashion" companies proliferated, creating a steady flow of inexpensive apparel. This led to the creation of inferior products that were intended to be thrown away and replaced rather than recycled or reused. Globally, an estimated 92 million tonnes of textile waste are produced each year. That figure is expected to increase to 134 million tonnes per year by 2030. This directly contributes to climate change and is a sign of a linear economic framework. The predicted average quantity of resources needed to make textile items in the EU in 2020 is as follows:

9 m^3 of water 400 m^2 of land Raw materials weighing 391 kg. The production of textiles contributes more greenhouse gases to the industry's carbon footprint than both foreign travel and maritime freight put together. The production and cultivation of cotton, which accounts for 38.9% of the sector's raw material needs, releases 220 million tonnes of carbon dioxide annually. For years, critics, legislators, and environmental organizations have criticized the industry and its long-standing policies because of the above statistics. In order to address these concerns, there has been a noticeable change in business practices and consumer patterns as companies and consumers have begun to realize the harm that textile manufacturing and consumption in its current form are causing to the environment (Anonymous, 2024).

Categories of information contained in the DPP

Throughout a product's lifecycle, a Digital Product Passport (DPP) offers complete transparency and traceability by integrating 16 critical categories of data. It begins with the product description, which contains size, color, target market, and season. In addition to providing information on how materials like recycled fibers are handled, the composition category complies with EU requirements by listing the items used, their percentage, and their place of origin. Monitoring production phases, from the procurement of raw materials to the manufacturing process, as well as transportation information to assess the environmental impact, improves supply chain transparency (Alonso-Muñoz, et.al., 2022).

Additionally, the DPP keeps records of compliance, audits, and certifications that back up the brand's statements, which helps prevent misleading consumers. While social impact information, which covers labor standards and due investigation on human rights, adds ethical value, environmental impact data assists customers and brands in making

well-informed decisions. Products made from animal resources, such leather or wool, are impacted by animal welfare considerations (Xu, X., *et al.* 2021)..

The DPP include guidelines for final disposition, maintenance, and repair services in order to promote circularity. To ensure consumer safety, medical impact data is documented, especially with reference to hazardous substances. For more openness, brand data are now available, including information on production volumes and cost structures, as well as history, governance, and sustainability pledges. Lastly, the product's traceability is improved via usage feedback and post-purchase tracking of repairs or resales, enabling its longer lifespan. This thorough information enables consumers and brands to adopt more ethical and sustainable textile industry practices (Baxter, J. 2021).

Benefits of Digital Passports for Textiles

Traceability and Transparency

DPPs provide full transparency, allowing consumers to verify sustainability claims, such as whether a garment is made from organic cotton or produced under ethical labor conditions (UNECE, 2023). This transparency builds trust between brands and consumers. Additionally, brands can use DPPs to showcase the entire lifecycle of their products, from raw materials to finished goods, creating accountability throughout the supply chain. Businesses can also ensure their suppliers are adhering to social and environmental regulations, reducing risks of unethical practices like forced labor (Xu et al., 2021).

Enhanced Recycling and Circularity

DPPs assist in developing a circular economy by gathering information about a product's materials, repair history, and recyclability, which guarantees that clothing can be recycled effectively when its useful life is up. This information promotes sustainable consumption by supporting end-of-life management, which facilitates material sorting and reduces textile waste for recycling facilities (European Parliamentary Research Service, 2023).

Regulatory Assistance and Compliance

DPPs will become crucial for firms doing business in Europe with the implementation of the EU Digital Product Passport Directive. By offering the required paperwork and information on the sourcing of materials, production procedures, and environmental effects, DPPs will assist producers in adhering to these new rules (European Commission, 2023).

Lifecycle Assessment (LCA) Data

Manufacturers can do Lifecycle Assessments (LCAs) using the comprehensive data kept in DPPs. Brands can reduce carbon emissions, maximize resource utilization, and create more sustainable products by examining the entire lifecycle of their products (UNECE, 2023).

Challenges in Implementing Digital Passports for textiles

First, integrating digital technologies like blockchain, IoT, and RFID into existing supply chains can be expensive and complex, particularly for smaller businesses or those in areas with limited technological infrastructure. These technologies are crucial for ensuring the traceability and transparency of product data throughout the supply chain, but setting up the infrastructure to manage DPPs can be prohibitively expensive for smaller players in the industry. Data privacy and security are also major concerns because sensitive information about sourcing, materials, and manufacturing processes is stored in digital systems, ensuring that security of this information is critical (Maselkowski, S., and Romero Montoya, J. 2024).

Another major hurdle is the lack of standardized protocols and regulations across different regions and industries. The textile industry, which often operates across global supply chains, needs a unified framework to ensure that DPPs are implemented consistently. Without standardization, it becomes difficult for companies to comply with various regional regulations and harmonize their practices. Furthermore, in developing countries where much of the textile manufacturing takes place, the adoption of DPPs may be slower due to economic constraints and limited access to digital technology. These barriers highlight the need for global cooperation and support to ensure equitable implementation of DPPs (Legardeur, J., and Ospital, P. 2024).

Conclusion

In order to improve sustainability and transparency in the textile sector, digital product passports are a revolutionary step. DPPs can facilitate improved resource management, increase circularity,

and assist customers in making knowledgeable, environmentally responsible decisions by providing comprehensive product information throughout its lifecycle. Significant social and environmental benefits could result from the integration of DPPs, which would also ensure ethical labor standards and reduce waste. However, a number of obstacles stand in the way of widespread adoption, such as the expense of incorporating cutting-edge digital technologies, worries about data privacy, and the absence of a single, worldwide framework. Notwithstanding these obstacles, DPPs are expected to be very important to the textile sector in the future, especially if laws like the EU Digital Product Passport Directive come into being. Governments, businesses, and stakeholders must work together for adoption to be effective.

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