Digital Product Passports: Enabling Transparent Textile Supply Chains in India

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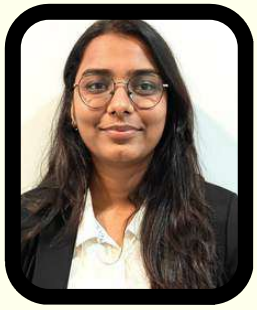

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Abstract

The global order today is increasingly complex, with frequent disruptions to global supply chains. At the same time, rising emphasis on climate action, sustainability, and the circular economy has made transparency across supply chains more important than ever. The textile supply chain in India today largely functions as a 'black box', where data on materials is either heavily dispersed, opaque, or undigitised.

In response, digital product passports (DPPs) are rapidly emerging as trade requirements, driven by regulatory developments such as the European Union's Ecodesign for Sustainable Products Regulation, which mandates product-level information disclosure. For major textile-exporting countries like India, the resultant compliance requirements for DPPs necessitate supply-chain-level preparedness to ensure competitiveness. If implemented strategically, this can also strengthen sustainability and resilience at the domestic level.

This paper analyses how DPPs can function as a critical enabler and common digital backbone that can help bring transparency in India, particularly in fragmented sectors such as textiles. A DPP stores comprehensive data on product composition, origin, environmental impact, and end-of-life handling, covering the entire lifecycle of a product. The defining feature of DPPs is product-based digitisation of information that is independent of the company, its size, or revenue. This minimises the scope for conflation of product-level environmental performance with broader corporate greening claims and enables supply-chain substitutability towards lower-footprint inputs and processes.

The paper further explores the role of DPPs in addressing critical data gaps that impede effective implementation of the extended producer responsibility framework by facilitating transparency for producers, consumers, regulators, and recyclers.

Using a systems approach, the paper carries out a readiness assessment for adopting DPPs as a policy instrument in India, including elements of comparative policy analysis, stakeholder mapping, and risk analysis. The paper ultimately proposes a roadmap for systemic DPP adoption in India—a sequenced pathway in which governance preconditions are identified for scaled implementation.

Key words: digital product passport, circular economy, circular supply chains, textile industry, resource efficiency

1. Introduction

India's textile and apparel sector is a cornerstone of its economy, valued at USD 179 billion, with exports contributing nearly 15% (Press Information Bureau, 2025b; India Brand Equity Foundation, 2022). As the sixth-largest exporter of textiles globally, India exports to over 220 countries, with major market shares in the United States (US) and the European Union (EU), accounting for approximately 47% (Press Information Bureau, 2025a; Press Information Bureau, 2025c).

With the aim of achieving an ambitious target of USD 100 billion by 2030, India has actively engaged in free trade agreements (FTAs) with the EU, which has a market twice the size of the US, to expand its global footprint. This growth aligns with the government's broader goals of net zero targets, the National Circular Economy Framework (NCEF; United Nations Industrial Development Organization, 2025), Aatmanirbhar Bharat (self-reliant India), and the '5F' framework—farm to fibre to factory to fashion to foreign—to strengthen domestic value addition and enhance India's global brand in textiles (Press Information Bureau, 2025b).

However, this growth brings significant challenges, as the textile industry largely relies on conventional resource-intensive production and a highly fragmented supply chain acting as a 'black box', where information is inaccessible. This has led to increasing regulatory scrutiny and growing demand for transparency to support circular economy practices and greater accountability across supply chains.

In this context, the digital product passport (DPP) has emerged as a transformative tool.

A DPP is defined as 'a structured collection of product-related data with pre-defined scope and agreed data management, and access rights conveyed through a unique identifier and that is accessible via electronic means through a data carrier' (CIRPASS, 2023). DPPs move beyond brand-level transparency and enable product-level information, offering granular data for individual products.

From a global trade perspective, DPPs are more than just another tool—they are a critical compliance mechanism, especially for countries that are major exporters. The EU Ecodesign for Sustainable Products Regulation (ESPR) and initiatives such as CIRPASS mandate the disclosure of product-level data (European Parliament, 2024). These regulations emerge as green trade barriers, necessitating the adoption of DPPs, where compliance with sustainability and transparency requirements will increasingly determine market access.

For India, while non-compliance can hinder global market access and impact the country's export economy, early adoption can support the transition towards a circular economy, operationalise extended producer responsibility (EPR), and promote compliance with global sustainability standards. This paper posits that DPPs can serve as a critical digital backbone to strengthen supply chain transparency in India, particularly in fragmented sectors such as textiles. It further presents a policy and institutional roadmap for the effective adoption of DPPs.

1.1 How a digital product passport works

The anatomy of a DPP includes the entire lifecycle of a product, from sourcing, manufacturing, sale, and use to end-of-life management and circular reuse (Figure 1). The first level is the product identifier layer, where a physical product is linked to its digital record through technologies such as quick response (QR) codes, radio frequency identification (RFID), or near field communication (NFC) tags.

These tags and scanners provide a unique product identity containing information related to model, batch number, serial number, and product ID. This is one of the most important layers of the DPP, as it enables traceability of a product digitally.

The next layer is the core of the DPP; it forms the central information repository. It includes key data from the beginning of product development, such as raw material origin and composition, environmental impacts, chemicals or dyes used, recycled content, user manuals, repairability, compliance certificates, and end-of-life instructions (Figure 2). This information makes the sustainability impacts of the product transparent to stakeholders and hence pushes manufacturers to adopt ecodesign principles through market regulation or competition.

DPPs highlight the importance of data sovereignty, indicating how different users report (Figure 3) and access (Figure 1) data. Consumers can verify sustainability claims, regulators can audit compliance, circular operators can access information for safe disassembly, and manufactures can update product information and monitor supply-chain data.

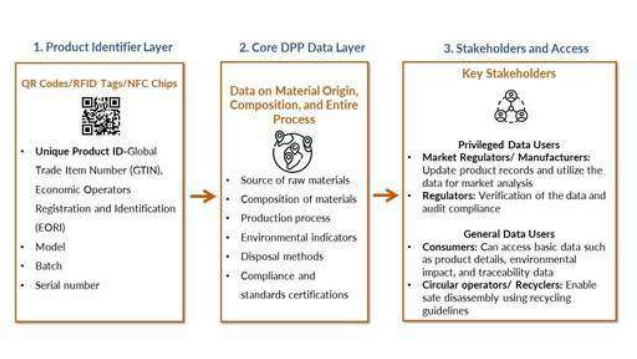

Figure 1: Core Layers of DPP (sources: The Textile Think Tank, 2025; EcoWise, 2025)

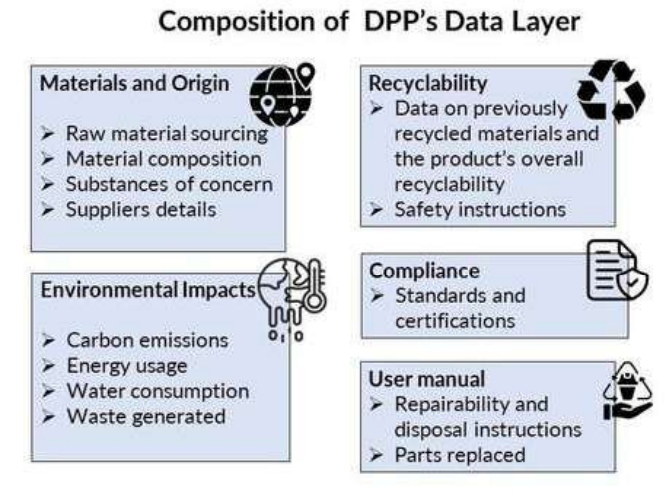

Figure 2: Anatomy of DPP (source: The Textile Think Tank, 2025)

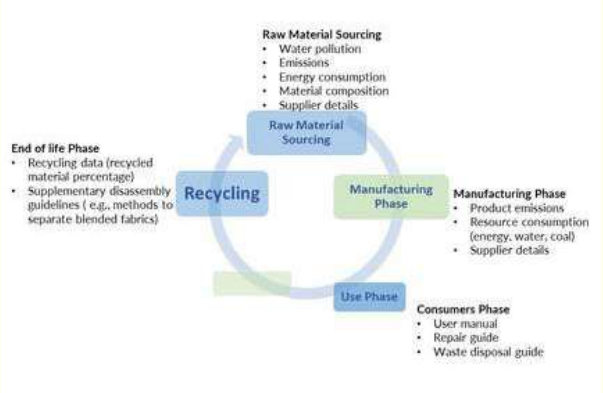

Figure 3: Data points for DPP in a lifecycle (source: The Textile Think Tank, 2025)

2. Global digital product landscape for textiles

Countries are responding to DPP mandates not only as a compliance checkbox but also as a strategic economic lever to gain a competitive edge (KPMG, 2025). The EU, one of the largest garment importers, has instituted DPP regulations and is therefore pushing other countries to align with sustainability standards. This is increasingly shaping global trade access, where exporting countries must meet strict environmental disclosure and traceability standards to enter global markets. Several countries, both exporters and regulators, are actively preparing to implement DPP or considering it to remain competitive and avoid green trade barriers (EcoWise, 2025); India has yet to take action in this space (Figure 4).

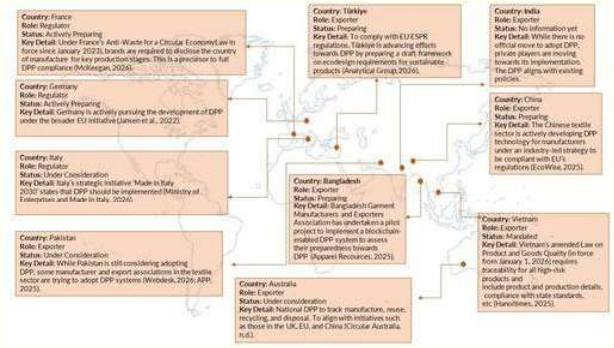

Figure 4: Global landscape of DPP

2.1 Policy landscape

The ESPR came into effect on 18 July 2024, following the 2020 Circular Economy Action Plan and the broader European Green Deal roadmap. It is a crucial component of the EU's sustainability efforts (European Parliament, 2024).

This regulation creates a legal framework for implementing ecodesign standards that products must meet before they can be sold or used. Its primary objectives are to establish sustainable products as the market standard, minimise environmental and carbon impacts throughout a product's lifecycle, and ensure that compliant goods can be traded freely across the internal market (European Union, 2024).

It replaces the previous Ecodesign Directive of 2009 and introduces major additions, including the establishment of the DPP and a framework to prevent the destruction of unsold consumer goods. It also establishes a framework for product-specific mandatory green public procurement requirements. The DPP is intended to support the broader vision of the regulation by promoting traceability, repairability, circularity, and sustainability across value chains, including textiles and apparel. While it is understood that the DPP will serve as a digital record of a product's sustainability profile, the exact criteria and requirements will remain unclear until the adoption of delegated acts (expected in 2027, with 18 months until adoption; KPMG, 2025).

2.2 Implications for India's exports

The proposed India–EU FTA is expected to benefit Indian industries, including those in the textile sector, subject to their ability to comply with the ESPR and its associated DPP mandate. The rules under the ESPR will apply to all products entering the EU market, regardless of their place of production (Haldar, 2026). This effectively requires all exporters to the EU, including India, to adopt DPP systems.

While industries operating within standardised global identification systems may be able to integrate their products through existing infrastructure with DPP systems, smaller players are likely to find compliance more difficult (Haldar, 2026). Smaller businesses will need to navigate an additional non-tariff barrier to remain competitive and retain access to export markets.

3. Implementing the DPP: Opportunities and bottlenecks

Early adoption of the DPP is increasingly viewed as a strategic advantage, as it offers improved market access and global competitiveness. The primary benefit of the DPP lies in its ability to consolidate fragmented data into a standardised digital format. Currently, data remains fragmentary and inconsistent, and the DPP addresses this gap by facilitating structured data collection, thereby promoting interoperability and operational efficiency. As highlighted earlier, this digital code contains embedded information on material specifications, recycling, and repairability, which can inform strategies for second-life use and resource recovery (Tech Mahindra Ltd, 2026). Beyond facilitating end-to-end lifecycle traceability, such datasets can serve as a foundation for EPR frameworks. Material composition details within a DPP can optimise resource efficiency and recycling processes, enabling recyclers to segregate materials effectively and thereby improve resource recovery rates. This, in turn, can help retain materials within the loop and reduce dependence on raw materials (Hakola et al., 2025). It can also support manufacturers in integrating ecodesign principles into their production processes.

While there are many benefits associated with the adoption of DPP, its implementation in India presents several challenges, including data-related, technological, institutional, and firm-level constraints, as well as gaps in stakeholder integration and governance models.

First, data collection could be difficult because of the informal nature of the textile industry and manufacturers' potential reluctance to share upstream data owing to confidentiality concerns. Additionally, maintaining and updating dynamic data within centralised platforms poses operational challenges. Variations in data formats, digital standards, and technological platforms across industries further hinder seamless interoperability across the value chain (Tech Mahindra Ltd, 2026).

Second, the absence of well-defined governance structures that allocate clear roles and responsibilities across stakeholder groups complicates implementation. Many existing studies tailor DPP architecture around region-specific legislation, with limited consideration for global applicability. This raises concerns about the emergence of fragmented regulatory regimes or 'regulatory islands' and parallel frameworks, which could be particularly problematic for industries with complex, multi-jurisdictional supply chains such as fashion (The Textile Think Tank, 2025). A nodal agency is therefore necessary to oversee the governance of the DPP system and maintain data standardisation and accountability

within operational structures. For instance, in the case of the proposed Battery Pack Aadhar (or Battery Passport), the Ministry of Road Transport and Highways functions as the apex body responsible for a centralised data system that enables compliance and monitoring (Ministry of Road Transport and Highways, 2026). A comparable institutional framework would be critical for sectors such as textiles.

Third, micro, small, and medium enterprises (MSMEs) may be disproportionately burdened by DPP requirements. Businesses with established identification systems, technical capacity, adequate workforce, and IT infrastructure may be able to integrate their products into DPP systems with relative ease. However, smaller manufacturers and recyclers may face significant operational and capital constraints. These include investments in digital systems, workforce training, and compliance requirements, which may limit their participation in such frameworks (Haldar, 2026).

Fourth, gaps persist in stakeholder integration and governance models. The role of end-users and recyclers remains marginalised in discussions on DPP, despite their importance in closing the loop. In addition, critical lifecycle data may be inconsistently recorded or updated—preventing continuity across the product lifecycle and undermining system effectiveness (The Textile Think Tank, 2025).

While these challenges are significant, they do not diminish the transformative potential of DPPs. With technological adoption, coordinated governance frameworks, targeted policy support for MSMEs, and stakeholder alignment, DPPs can unlock new opportunities for innovation, competitiveness, and regulatory compliance while accelerating the transition towards a more transparent and circular economy.

4. Implementation roadmap

The DPP requirement marks a major transition for the textile sector. A gradual rollout and built-in support mechanisms will help ease the adjustment. To remain viable in the EU, countries must proactively enable manufacturers and recyclers to upgrade their digital infrastructure and ensure thorough traceability across supply networks. The following roadmap outlines transitional arrangements and support mechanisms that India needs to put in place to implement DPPs.

I.Governance and regulatory frameworks

- Establish a nodal body (e.g. under the Ministry of Textiles, with representation from the Ministry of Environment, Forest and Climate Change and the Ministry of Commerce and Industry) to consolidate guidelines and interface with EU institutions. This would support the evolution of DPP requirements in a manner that streamlines and avoids duplication of compliance processes for Indian industries.

- Develop India-specific DPP rules for textiles following core ESPR principles while accounting for domestic production structures. This should include clear rules on data ownership and liability for incorrect or missing data.

II. Readiness assessments

- Evaluate existing capacity and systems for capturing and storing product data, supply chain information, and environmental metrics. This will help distinguish segments that can integrate quickly from those requiring additional support for data collection, process optimisation, or system upgrades.

- Engage stakeholders, including exporters, MSME clusters, industry associations, recyclers, technology providers, and logistics firms through targeted consultations to assess current practices, confidentiality concerns, data fragmentation, gaps in compliance with sustainability standards, and operational and technological capacity. These assessments should inform the design of incentive schemes, training modules, and DPP templates.

III.**Onboarding digital systems**

- The nodal agency should publish minimum technical specifications and certify or empanel a pool of technology providers, including open-source options, that offer solutions compatible with EU DPP systems. This can reduce transaction costs and ease adoption for MSMEs.

- Establish interoperable digital systems to support DPP implementation, ensuring secure management, storage, and sharing of information across the value chain.

IV. Standardisation of data

- Design standardised formats for data reporting in consultation with manufacturers and recyclers, covering product origin and composition, environmental footprint, processing methods, chemical safety information, certifications, repairability and recyclability, and end-of-life data.

- Adopt uniform data templates and taxonomies for both regulatory compliance and procurement. This will improve consistency, support interoperability, and enable automated data exchange.

V. Awareness and capacity building workshops for manufacturers and circular operators

- Issue clear guidelines and build capacity among industries and circular operators to ensure clarity in roles and responsibilities related to DPP adoption.

- Prioritise MSMEs by addressing gaps in infrastructure and operational capacity. Shared support services, such as common data-entry facilities, can help smaller firms participate effectively in DPP systems.

VI. Pilot projects

- Launch pilot projects across selected value chains that reflect the diversity of textile exports to identify gaps, test interoperability, validate workflows, and align stakeholders.

- Use pilot outcomes to refine data standards, platform design, and governance arrangements. The workflow must be iterated as per the feedback before full-scale roll-out, with particular attention to cost, ease of use, and the distribution of responsibilities.

VII. Scalability

- Introduce time-bound tax incentives or interest subvention schemes to support investments in DPP-related infrastructure, such as traceability software, tagging hardware, and training systems. Public credit guarantee schemes and blended finance instruments targeted at MSMEs can help mitigate financing risks.

- Establish shared digital hubs within textile clusters to provide services such as data entry, DPP registration, compliance advisory, and IT support. These hubs can act as key enablers for MSMEs to adopt DPPs.

Conclusion

The adoption of DPPs can strengthen India's standing as a major exporting nation by ensuring compliance with emerging EU regulations and supporting businesses operating in India. However, the DPP should not be viewed merely as a regulatory requirement but as a strategic tool to enhance transparency, competitiveness, traceability, and value chain efficiency.
DPPs also can potentially accelerate India's transition towards a circular economy.

India's circular economy could generate a market value of over USD 2 trillion and 10 million jobs by 2050 (Press Information Bureau, 2025). In addition, DPPs can support enable circular business models and expand employment in the circular operation space. Furthermore, DPP can act as an enabler for effective implementation of the EPR framework.
By facilitating better resource management and enabling circular supply chains, DPPs can contribute to broader national goals, including the 2070 net zero targets and the NCEF. If implemented effectively, DPP can help India move from compliance-driven adjustment to a more resilient, resource-efficient, and globally competitive circular economy.

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