
Digital Product Passports for Circular Economy: A Systematic Literature Review

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Abstract: The circular economy (CE) is increasingly promoted as a systemic approach to achieving sustainability across industries and societies. Within this transition, the European Union is advancing regulation under the Ecodesign for Sustainable Products framework that will require most products placed on the EU market to introduce the Digital Product Passport (DPP) as a policy and technical instrument designed to provide detailed product information to support reuse, recycling, and resource efficiency across product lifecycles. Despite strong policy momentum, research on DPP is dominated by policy reports and grey literature rather than theory driven academic studies, which remains fragmented. This research adopts a systematic literature review to address how existing studies define and implement DPPs across sectors and identify outcomes, theoretical bases, and knowledge gaps. By doing so, this research aims to provide a cross-sector synthesis and conceptual framework for future research.

Keywords: Digital product passport; circular economy; sustainability; systematic literature review; data governance; interoperability; supply chain transparency; socio-technical systems; lifecycle

1 Problem

The circular economy (CE) is increasingly promoted as a systemic approach to achieving sustainability across industries and societies. Within this transition, The European Union is currently advancing regulation under the Ecodesign for Sustainable Products framework that will require most products placed on the EU market to introduce the Digital Product Passport (DPP) as a policy and technical instrument designed to provide detailed product information to support reuse, recycling, and resource efficiency across product lifecycles (European Union, 2024). The instrument is intended to provide standardized information on product origin, material composition, environmental impacts, and end of life handling. DPPs are therefore positioned as key enablers of circular economy implementation by providing stakeholders across value chains with structured lifecycle data (Kruger et al., 2025; Adisorn et al., 2021).

Despite strong policy momentum, research on DPP is dominated by policy reports and grey literature rather than theory driven academic studies, which remains fragmented. Definitions and conceptualizations of DPPs vary across sectors with limited alignment. Given this fragmented knowledge base, a structured review synthesizing definitions, methods, and theoretical perspectives across sectors is necessary to support both academic research and policy development.

2 Current understanding

Academic publications on digital product passports have surged since 2021, even though the first conceptualization came from 2017 in the construction sector under the term material passport. Recent empirical work identifies the absence of common standards and frames DPPs as mechanisms to enable lifecycle transparency and reporting across value chains (Plociennik et al., 2022; Adisorn et al., 2021). In this sense, DPPs are increasingly conceptualized as data infrastructures intended to support circular decision-making across product lifecycles and moving far beyond simple digital labels or repositories of product information.

Building on this perspective, recent work has begun to frame DPPs as enabling infrastructures within broader industrial and circular ecosystems. Rather than serving solely as manufacturer-controlled information containers, DPPs are understood as coordination mechanisms that connect multiple actors, systems, and lifecycle stages through shared data architectures (Langley et al., 2023). To address this complexity, some scholars have adopted systems-oriented perspectives that conceptualize DPPs as ecosystem-level infrastructures requiring interoperability across organizations, lifecycle stages, and digital systems (Jansen et al., 2023). These studies emphasize that realizing the circular economy potential of DPPs requires shared semantic models, governance arrangements, and common conceptual foundations to coordinate diverse stakeholder interests and reduce conflicts in implementation (King et al., 2023; Kebede et al., 2024).

Systems thinking research further attempts to unify fragmented interpretations by defining DPPs as ecosystem level infrastructures, emphasizing interoperability across product lifecycles, organizations, and value chains (Jansen et al., 2023), and highlighting the need for shared conceptual foundations to reduce stakeholder conflicts (King et al., 2023).

Despite this emerging conceptual development, the literature remains fragmented. Most empirical studies focus on sector-specific applications, particularly in batteries, textiles, electronics, and construction, with limited comparison across industries. As a result,

knowledge remains dispersed across sectoral silos, and there is little consensus regarding what constitutes a DPP, what data should be included, or how DPP systems should be governed. Comparative research suggests that while implementation barriers vary by industry, challenges related to standardisation, interoperability, and governance recur across sectors (Kruger et al., 2025). The state of knowledge therefore lacks a comprehensive map of themes and conceptual frameworks across sectors. Existing studies frequently draw on circular economy principles (Adisorn et al., 2021) and technical frameworks such as the Asset Administration Shell (Kuhn et al., 2025) or blockchain architectures (Abreu et al., 2025), yet engagement with broader organisational, innovation, or socio-technical theory remains limited.

3 Research question

This research-in-progress seeks to provide such a synthesis by addressing two questions:

RQ1: How do existing studies define and implement Digital Product Passports across different business sectors?

RQ2: What outcomes, theoretical bases, and knowledge gaps are evident in Digital Product Passport research?

4 Research design

The study adopts a systematic literature review (SLR), Scopus was used as the primary database due to its broad coverage of interdisciplinary scientific publications. The search strategy was developed to maximize field coverage using the following query: TITLE-ABS-KEY (((("digital product passport") OR (digital NEAR/3 product NEAR/3 passport) OR "material passport" OR "C2C passport" OR "circularity passport" OR "cradle to cradle passport" OR "resource passport" OR "lifecycle passport" OR ("data passport") OR ("information passport") OR ("DPP" AND passport)) AND (circular* OR sustainabl* OR recycl* OR reus* OR refurbish* OR remanufactur* OR "life cycle" OR lifecycle OR LCA OR traceab* OR transparen* OR compliance)). The initial search identified 366 records, with earliest literature dated from 2017. The cut off date of the search was September 2025.

First screening of title, abstract, and keyword was conducted to remove irrelevant studies, such as studies where DPP was only mentioned but not a subject of analysis, resulted in 98 articles remaining. Afterwards, our full-text screening resulted in 51 articles being included for detailed analysis. Backward reference searching of included studies was conducted to identify additional relevant publications, but no new studies were identified. Grey literature and policy reports are noted and provided contextual information but were not analysed in depth as a unit of analysis in this study. The process is visualized in figure 1.

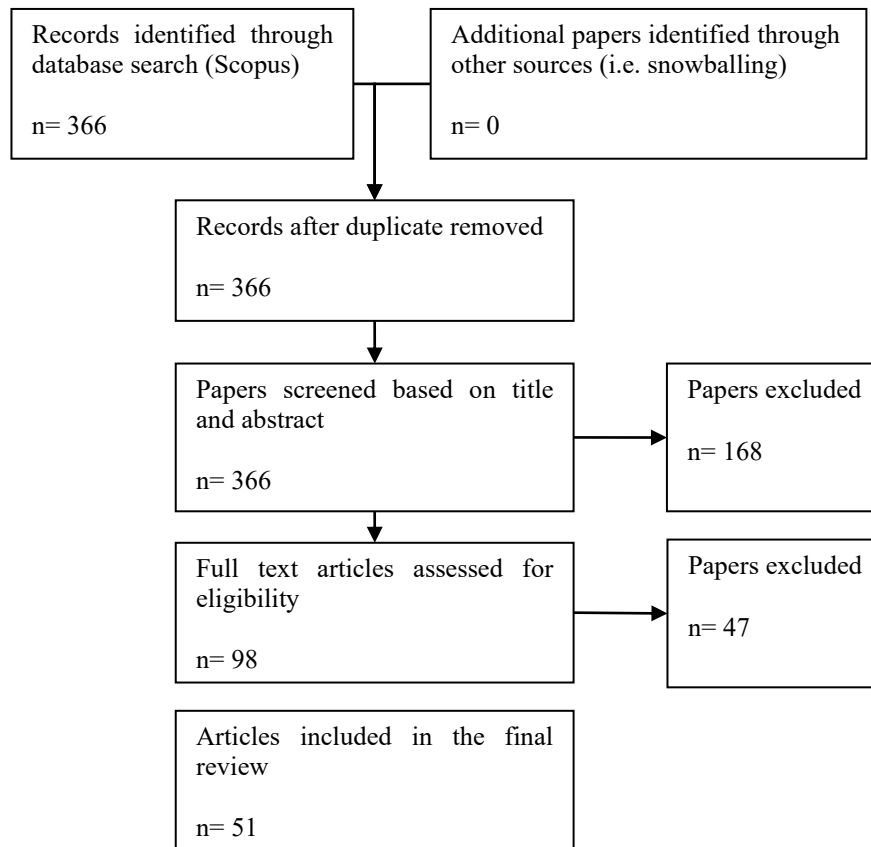


Figure 1 PRISMA flow chart. Source: Authors

Each article will be coded for sector (e.g. textiles, batteries, electronics), geographical scope (Europe, global), research method (conceptual, qualitative, quantitative, mixed methods), theoretical lens (if any), and primary focus (definition, requirements, implementation, governance, socio-technical issues). The data will be analyzed thematically to identify patterns and gaps. Codes are compared across sectors to identify candidate mechanisms, such as regulatory pressure, standard-setting, stakeholder coordination, data-sharing routines and trust-building, that may explain how DPPs move from product information systems to circular economy infrastructure.

5 Expected findings

Although the analysis is ongoing, preliminary observations suggest several emerging themes.

First, regulatory drivers appear to dominate the development and diffusion of DPP research. Much of the literature frames DPPs in relation to evolving European regulatory initiatives, particularly under the Ecodesign for Sustainable Products Regulation, positioning the DPP as a policy instrument intended to enhance transparency, traceability, and compliance across value chains (Chaudhuri et al., 2025; Boung and Severengiz, 2025; Belova et al., 2025), which suggests that regulation currently functions as a

primary catalyst for DPP adoption, with industry and academic attention strongly shaped by anticipated compliance requirements.

Second, definitions of DPPs remain inconsistent across the literature. Some studies describe DPPs narrowly as manufacturer-generated information containers designed to document product composition and lifecycle characteristics, while others adopt broader conceptualizations that frame DPPs as shared infrastructures for inter-organisational coordination and circular ecosystem management (Ducuing and Reich, 2023).

Third, the literature remains heavily focused on technical implementation issues. Most studies address questions related to data structures, system architectures, identifiers, storage models, and information carriers, often proposing technical solutions for DPP deployment (Jung et al., 2024). By contrast, organisational and behavioural dimensions remain comparatively underexplored. In particular, limited attention has been given to the incentives, capabilities, and governance arrangements required for firms to contribute data, maintain data quality, and participate in shared passport systems. Preliminary evidence suggests that technical feasibility alone is insufficient, and that stakeholder trust and incentive alignment may be determinants of implementation success (Adisorn et al., 2021; Jæger and Myrøld, 2023).

Fourth, interoperability and standardisation emerge as central challenges in the literature. While technical studies frequently discuss interoperability in terms of semantic models, ontologies, and data architectures, the findings suggest that interoperability constitutes an institutional and organisational challenge, as different standards define responsibilities, legitimate data formats, and participation rules differently within DPP ecosystems (Kebede et al., 2024; Jansen et al., 2025; Morellini et al., 2025). The development of interoperable DPP systems therefore depends on both technological solutions and governance mechanisms capable of coordinating stakeholders across sectors and value chains.

Fifth, although numerous sector-specific pilot studies demonstrate technical feasibility in industries such as electronics, textiles, footwear, agriculture, and construction, these pilots also risk reinforcing fragmentation if developed in isolation. Without cross-sector harmonisation, sector-specific solutions may produce incompatible architectures and standards, thereby undermining broader interoperability and scalability (Chaudhuri et al., 2025; Paolucci et al., 2025; Kruger et al., 2025).

Finally, the literature demonstrates limited engagement with theories from fields such as innovation management, organisational studies, and socio-technical transitions. Existing research is rich in technical aspects and more applied design requirements, but comparatively weak in theoretical explanation. This indicates that future research should move beyond descriptive and technical analyses toward theory-building efforts.

6 Contribution

The expected contribution of this research lies in providing the first cross-sector synthesis of digital product passport literature and outlining a conceptual framework for future theory building of the field as a whole. The authors aim to clarify the state of knowledge and highlight under-explored areas, as from preliminary findings DPP is still in its infancy and under-theorized, to provide a research agenda that encourages the integration of DPP into the fields of innovation management, systems thinking and sustainability science through the mapping definitions, methods and theoretical lenses.

7 Practical implications

Despite its focus on academic literature, the review has practical implications. Understanding how DPPs are conceptualized and implemented across sectors can help companies anticipate regulatory requirements and design interoperable systems. Policymakers will benefit from insights into common data requirements and stakeholder concerns, which can inform harmonized standards and reduce compliance costs. Moreover, by highlighting the potential of DPPs to enhance supply chain transparency and support circular business models, the review can encourage organizations to view DPPs beyond merely as compliance tools.

For practitioners, the emerging literature suggests that DPP implementation should not be approached just as a technical system integration challenge. While technical choices regarding identifiers, data carriers, and storage architectures remain important, successful implementation appears equally dependent on organisational readiness, governance structures, interoperability arrangements, and clearly defined access rights across participating actors (Chaudhuri et al., 2025; Boung and Severengiz, 2025; de Diego and Gutierrez-Aguero, 2025). This implies that DPP initiatives must be managed as socio-technical transformation efforts requiring cross-organisational coordination, capability development, and governance design alongside technical deployment.

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9 Areas for feedback and development

As a research-in-progress submission, the paper would benefit from feedback on three areas.

First, the authors seek feedback on the proposed theory-building angle. In particular, should the emerging framework be grounded primarily in innovation management, socio-technical transitions, ecosystem orchestration, data governance, or a combination of these perspectives?

Second, feedback is welcome on whether the review should retain a broad cross-sector scope or develop deeper sectoral comparison between industries such as batteries, textiles, electronics and construction.

Third, the authors seek suggestions on how to present the preliminary themes without over-claiming from an ongoing review. The next development step is to refine the conceptual framework, validate the theme structure and make the link between coded evidence, theoretical constructs and future research questions more explicit.