



Fraunhofer
IPK

Digital product passports (DPP) for companies

Strategies to Implement Digital Product Passports

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Management summary

More than compliance

The introduction of digital product passports (DPP) is becoming a strategically relevant issue for companies – driven by EU regulations such as the Ecodesign for Sustainable Products Regulation (ESPR) and the new EU Battery Regulation. The aim is to provide transparent, machine-readable and interoperable product and material data throughout the entire product life cycle. The implementation of DPPs offers companies added value that goes far beyond the minimum regulatory requirements:

- Efficient integration into existing systems without profound process changes
- Transparent data flows and consistent IT system landscapes
- Basis for data-based services and business models (e.g. predictive maintenance, CO₂ balance sheets, circular economy)
- Improved collaboration in the supply chain through standardized data structures

Implementation strategies

The DPP affects all stakeholders – from raw material suppliers to recycling companies – each with specific requirements in terms of data availability, quality and accessibility. A one-size-fits-all approach is not effective. What is needed are differentiated and interoperable solutions along the value chain. Fraunhofer IPK offers three scalable DPP strategies:

- Basic DPP: simple data provision to meet minimum legal requirements
- Integrated DPP: system integration in ERP/PLM/MES to increase efficiency
- Enhanced DPP: use as a platform for data-driven business models and services

Fraunhofer model

Fraunhofer IPK provides companies with comprehensive support in implementing DPPs – from strategic goal definition to technical implementation and the development of data-based business models. As an independent research institution, it combines methodological expertise, technological neutrality and industry knowledge. Fraunhofer IPK supports in three phases:

- Strategy and roadmap: defining the target vision, user stories, requirements and capabilities
- Specification and pilot testing: defining an implementation strategy and governance, specifying the proof of concept and technical requirements
- Scaling and integration: implementing the IT architecture, system integration and according services

The introduction of the DPP is not only a regulatory imperative, but also offers clear strategic leverage for digital transformation, sustainability and future-oriented value creation. Companies that pursue structured and context-specific DPP strategies at an early stage will secure sustainable competitive advantages.

Digital product passports in a business context

Motivation

Sharing material and product data throughout the entire life cycle is increasingly becoming a success factor for companies – not least due to new regulatory requirements. The Ecodesign for Sustainable Products Regulation (ESPR) and the EU Battery Regulation set out clear requirements: companies are obliged to provide product- and material-related data in the form of digital product passports (DPP). Initially, battery products are particularly affected, but many other industries will also be affected in the future. This marks a paradigm shift in product responsibility and requires comprehensive transparency along the entire value chain.

However, implementing these requirements is complex: Companies along the life cycle – from raw material extraction to manufacturing and recycling – face very different challenges and need correspondingly differentiated solutions. There is no universal “out-of-the-box” solution that equally suits the individual processes, IT systems and business models of all companies.

Implementation

The central challenge lies in developing a company-specific yet compatible approach to implementing the DPP. This requires a systematic, interdisciplinary approach that integrates technical, organizational and regulatory requirements.

As an independent institution, Fraunhofer can provide targeted support to companies in this transformation process – in an unconstrained, technology-neutral and practical manner. This white paper shows how companies can take a structured approach to the complex task of DPP implementation and which strategic and operational steps are necessary to not only meet regulatory requirements, but also to use them as an opportunity for increasing innovation and sustainability.

Added value

The implementation of a DPP is much more than just a mandatory task to meet regulatory requirements – it opens up concrete strategic and operational added value for companies. A key advantage lies in the ability to develop company-specific solutions. Instead of resorting to rigid standard solutions, lean, tailored approaches can be chosen that are precisely matched to existing processes, systems and data structures. This allows regulatory requirements to be met efficiently without placing unnecessary strain on existing processes. Companies benefit in particular from the following added value:

- Individualized and streamlined implementations make it possible to efficiently meet regulatory requirements without fundamentally restructuring existing processes.
- The establishment of own “data products” creates the basis for new internal and external applications – beyond purely regulatory purposes.
- The targeted implementation of the DPP offers the opportunity to transparently map data flows (data lineage) and optimize the integration of existing systems – an essential step towards a future-proof, consistent system landscape.
- The resulting data structures and platforms can be flexibly expanded and thus used specifically for new digital business models or service offerings.
- Last but not least, the implementation of DPPs helps to tap into digitization potentials across the entire company and beyond.
- Standardized, interoperable data structures facilitate collaboration with partners, suppliers and customers and enable new forms of value creation.

For whom the DPP becomes an opportunity

Stakeholder differentiation

The implementation of the DPP affects all actors along the product life cycle, but with different roles, requirements and strategic objectives. A unified approach is therefore insufficient – instead, differentiated strategies are necessary that take into account the respective context and contribution to the product. For example, the ESRP defines categories for which companies must provide relevant data (see figure).

Early supply chain

Suppliers – especially those in the early tiers of the supply chain – are faced with the task of providing relevant material and component data, for example on raw materials, chemical composition or manufacturing process information. This data must be traceable, consistent, machine-readable and interoperable in order to be integrated downstream into the DPP.

Manufacturing

Tier 1 and Tier 2 suppliers as well as OEMs are responsible for compiling, structuring and creating complete DPPs. They must ensure that all relevant data from the supply chain is consolidated, prepared in accordance with regulatory requirements and linked to the product. This requires both technical and organizational expertise in the areas of data management, quality assurance and system integration.

Usage

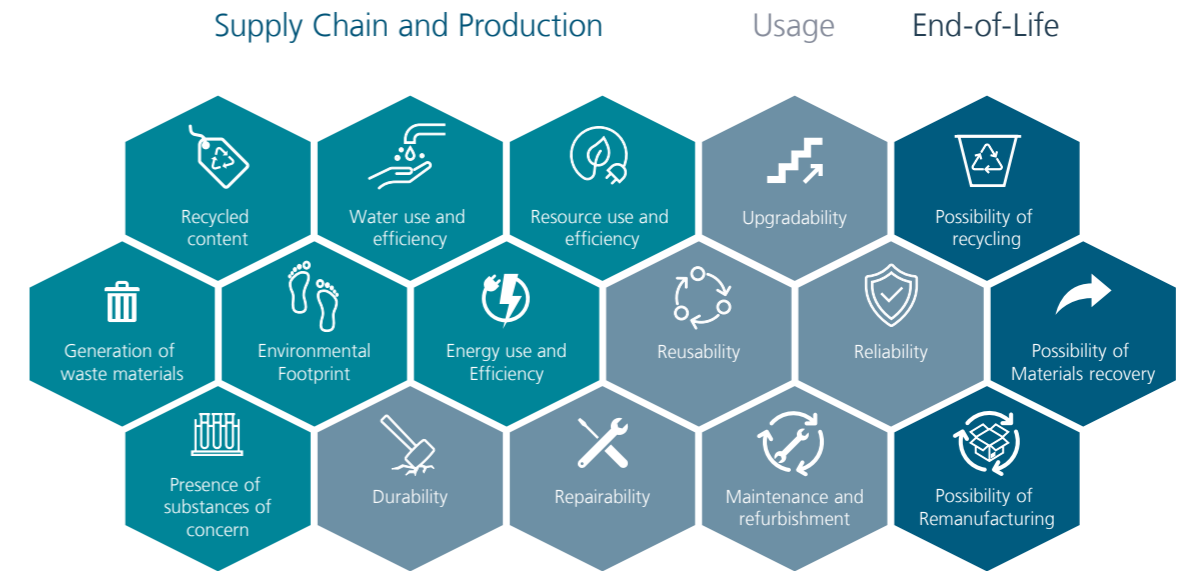
New challenges arise during the mid-of-life (MoL) phase, i.e., during the use or further processing of the product. Products can be modified, repaired, or reused. Therefore, DPP data must be updated or supplemented in order to accurately reflect the actual condition of the product. This places new demands on interfaces and data access, particularly for operators, services, or repair companies.

End-of-life

In the End-of-Life (EoL) stage – for example, at recycling plants or dismantling companies – the primary focus is on accessing existing DPP data. This data is crucial for efficiently implementing R strategies (e.g. reuse, refurbish, remanufacture, recycle), recovering materials and leveraging environmental and economic potential. EoL players therefore need simple, reliable and fast ways to use data without having to generate extensive data themselves.

Context dependency

These different requirements show that the DPP is not a standard solution – it must be designed and implemented in a role- and context-specific manner. This is the only way to ensure the necessary interoperability along the value chain without overburdening individual actors or creating inefficiencies.



DPP data categories from the ESRP (source: EU Commission)

2023	2023	BATTERIES
2025	2026	ENVIRONMENTAL VEHICLE PASS
2026	2027	IRON AND STEEL
2025	2027	TEXTILES
2027	2028	ALUMINUM
2027	2028	TIRES
2027	2028	CONSTRUCTION MATERIALS
2027	2028	ELECTRONICS
2028	2029	FURNITURE
2028	2029	CONSUMER ELECTRONICS
2030	2032	CIRCULAR VEHICLE PASS
20XX		Expected delegated act per product group
20XX		Expected mandatory implementation of passports for companies

Expected delegated acts and anticipated implementation of various product passports. For batteries, the EU Battery Regulation has already entered into force and will be valid from February 2027.

Added value of digital product passports

A strategically well-thought and scalable implemented DPP is much more than just a compliance tool: it becomes the key to sustainable value creation, greater process efficiency and genuine innovation for new business models – both within your own company and along the entire value chain.

Companies that see the DPP not only as an obligation but also as an opportunity are positioning themselves in the long term as pioneers in a data-driven and connected economy.

Strategic approaches to implementation

Fraunhofer IPK has developed three strategic approaches for implementing the DPP, which can be applied depending on the position in the life cycle, degree of digitization and strategic objective of the stakeholder. Based on a target vision, companies can develop a tailor-made implementation roadmap – from meeting minimum regulatory requirements to complete integration and the development of new business models. These three strategies provide companies with a scaling option for approaching the topic of DPP step by step – from regulatory compliance to strategic opportunity.

Basic DPP – data integration for regulatory compliance

This approach focuses on basic fulfillment of regulatory requirements through the structured provision of relevant product and material data – with minimal integration effort. It is suitable as an entry-level or transitional solution, especially for companies that primarily act as data suppliers.

Focus: Data quality, completeness, format compatibility

Target group: Primarily suppliers (Tier n), small and medium-sized enterprises, companies with limited digitalization resources

Objective: Compliance with minimum regulatory requirements through structured data provision

The basic approach focuses on creating a compliant data model that structures and provides the necessary information in accordance with regulatory requirements. The focus is on identifying and providing relevant material and product data, using already standardized data formats (e.g., XML, JSON) from associations such as Catena-X or IDTA. It requires a lower degree of integration compared to standalone applications or IT systems with a wide range of functions.

Integrated DPP – integration into IT system infrastructure

The focus is on integrating the DPP into existing IT system and data infrastructure in order to implement regulatory obligations efficiently and automatically during ongoing operations and to form the basis for expansion to multiple product groups and data analytics. To this end, the existing IT system infrastructure is used and expanded to include a DPP in order to integrate data from internal and external data sources. This strategy is particularly suitable for companies that perform multiple roles (engineering, production and sales) and want to integrate the DPP into their operational processes.

Focus: Automation, system integration, data analytics

Target group: Primarily Tier 1/2 suppliers and OEMs, companies at EoL for data consumption and data transfer, companies with widely distributed IT system infrastructure, complex processes and fragmented data flows

Objective: Efficient DPP creation through integration into existing systems (ERP, PLM, MES, IoT platforms)

In this approach, the DPP is understood as an integrated part of the IT system landscape. The data for the DPP is automatically generated, administered and provided from existing systems. The advantages here are a reduction in manual effort, greater timeliness and data quality through system-supported processes and the possibility of end-to-end traceability across system boundaries.

Enhanced DPP – full integration and new business models (data products and analytics)

This enhanced approach uses the DPP for customer-oriented data products and new business models – far beyond regulatory requirements. The basic prerequisites for this are high data quality, end-to-end system networking and strategic openness to digital innovations. In the long term, this strategy offers the highest value contribution and potential for differentiation from the competition.

Focus: Enhanced data usage, data products, value-added services

Target group: OEMs, mid-of-life operators, digital service providers and platform providers

Objective: Use of the DPP as a strategic asset for new services and business models

In the enhanced approach, the DPP is understood not only as a regulatory instrument, but also as a platform for data-based value creation. Companies use the database for their own data products, product-related digital services, advanced analysis functions for predictive maintenance, real-time CO₂ balancing as well as data flow and material flow analyses, for example to predict supply chain bottlenecks. In addition, a wide range of possibilities are opening up to transform data-based services into new business models – for example, through the use of digital twins for second-life products, product-as-a-service concepts based on transparent information about product status and service life, customer-oriented services such as sustainability rankings or closed-loop offerings based on real return data.

Evaluation of the strategic approaches

Strategic approach	Objective	Typical users	Technical requirements	Added value	Risks
Basic DPP (data integration)	Compliance with minimum regulatory requirements	Tier n suppliers, SME	Low – simple data provision via suitable data model	Rapid compliance, low implementation effort	Lack of scalability, isolated solutions, no internal added value
Integrated DPP (system integration)	Integration of the DPP into existing IT system infrastructure and scaling	Tier 1/2 suppliers, OEMs, system providers	Medium to high – integration into ERP, PLM, MES and other systems required	Efficiency through automation, consistent data, better traceability	Complexity of system integration, higher initial investment costs
Enhanced DPP (full integration)	Extension of DPP to data products and data-based business models	OEMs with a digitalization strategy, platform providers	High – data platforms, advanced analytics, AI may be required	Differentiation through services, new revenue streams, utilization of digitalization potential	High technical and organizational complexity, high stakeholder involvement required

Implementation approach

The successful implementation of a DPP requires a systematic, phased approach that combines strategic objectives, technical implementation and organizational anchoring. The following approach describes a three-phase model that supports companies in planning and implementation.

Phase 1: Target picture and implementation roadmap

This phase forms the strategic foundation for DPP implementation. The goal is to develop a shared vision, specific requirements and a realistic implementation roadmap.

Step 1: Develop a target vision

Develop a clear target vision for the use of DPP in the company, taking into account regulatory requirements, company-specific potential and strategic ambitions.

Step 2: Develop user stories and requirements catalog

Describe typical application scenarios (user stories) for various internal and external stakeholders and derive a structured requirements catalog for roles, IT systems, data and processes.

Step 3: Derive and map capabilities

Identify and evaluate the capabilities (technical, organizational, procedural) required to implement the requirements. Based on an assessment of importance and urgency, the capabilities are clustered and prioritized.

Step 4: Solution analysis and clustering

Analysis of existing and planned IT systems, tools and data sources. Mapping of these solutions into solution clusters (e.g., data sources, IT systems, business processes).

Step 5: Derive a roadmap

Develop an implementation roadmap with a time frame, prioritized milestones and dependencies based on the previous steps.

Phase 2: Design and initial implementation

The second phase is used to concretely design and validate the planned roadmap. The goal is to create an initial proof of concept in the company-specific context.

Step 1: Define the scope

Determine which product groups, data points and processes will be included in the initial DPP – prioritized according to regulatory requirements and internal and external needs.

Step 2: Develop an implementation strategy

Conduct a SWOT analysis taking into account internal and external influences. Additionally, derive the strategy taking into account capabilities, solution clusters, roadmap and SWOT analysis.

Step 3: Develop a governance model

Establish a company-specific governance model, taking existing and future developments into account. Define responsibilities, data sovereignty and roles and map them to processes and systems.

Step 4: Implement a proof-of-concept

Implementation of a proof of concept in a defined pilot area to verify feasibility, data availability and system integration. In addition, a review is conducted to determine whether the new working methods are effective within the company.

Phase 3: Scaling and integration

This phase transfers the DPP into operational use, scales the solution across the company and enables further added value.

Step 1: Develop an IT architecture

Development and documentation of a viable, scalable IT architecture for the operation and further development of the DPP.

Step 2: Roll out governance model

Roles, processes and responsibilities are established company-wide in accordance with the governance model.

Step 3: Operationalize the IT architecture

Integration of the DPP solution into the existing IT system landscape, including interfaces to ERP, PLM, MES, IoT platforms, etc.

Step 4: Test and scale

Validate the solution in live operation, gradually expanding to additional products, product groups, regions or locations.

Step 5 (optional): Expansion to include data-based services and products

Development of new user-centric services, such as product status dashboards, sustainability assessments or data-driven take-back systems (closed loops). The clear structuring into phases allows for flexible adaptation to different starting points, degrees of maturity, and roles in the product life cycle. This enables companies to not only react to new legal requirements, but also proactively create new data-based added value – for example, through internal efficiency gains, improved transparency or innovative business models.



Digital product passports throughout the entire lifecycle

Working with Fraunhofer IPK

The Fraunhofer IPK provides comprehensive support to companies in implementing the DPP – from the initial idea to its sustainable integration into the company. As an independent, technology-neutral partner, the institute contributes extensive experience at the interface of engineering, production, digitalization and sustainability. The focus is not only on meeting regulatory requirements, but also on developing tailor-made, future-viable solutions that can be integrated into existing structures while creating room for innovation.

With its sound methodological expertise, Fraunhofer IPK supports companies in defining strategic goals, developing individual requirements and deriving concrete fields of action. At the same time, Fraunhofer IPK assists in the evaluation and selection of suitable technical solutions, the development of viable governance models, the accordance to existing standards and the establishment of powerful IT architectures. The focus is always on company-specific conditions and objectives.

In addition, Fraunhofer IPK offers access to the latest research results, pilot projects and a broad network of industry, science, and standardization bodies. This enables companies not only to reliably implement regulatory requirements, but also to develop their own data-based services and discover new business models. Cooperation with Fraunhofer IPK thus creates the basis for a structured, efficient and innovation-oriented implementation of the DPP – as a building block for sustainability of competitiveness in a data-driven economy.

Imprint

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The Fraunhofer Institute for Production Systems and Design Technology IPK offers system solutions with a strong digital focus for the entire spectrum of industrial tasks – from production management, product development and manufacturing to maintenance of capital goods. We also transfer R&D solutions in production technology to areas of application outside of industry such as transport and security.



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