

Designing Digital Product Passports

A Data Commons Approach for a More Sustainable Economy

Executive Summary

Digital Product Passports (DPPs) are key to summarize and share product-level sustainability data in order to enable resource efficiency and sustainability optimization at a systems level. Currently, multiple (and often competing) initiatives develop different DPP ecosystems which are not interoperable among each other. This leads to the emergence of data silos which limits scalability. If we are to create functional, efficient, and interoperable DPPs, principles that govern their development need to be derived. This whitepaper summarizes a workshop hosted by the SINE Foundation, Einstein Center Digital Future, and Systemiq. Together with post-doc students and industry experts, it discussed a set of core questions that need to be answered for successfully designing DPPs. These questions apply the Data Commons concept established by the SINE Foundation to the creation of DPPs and shall help experts and practitioners to develop a thriving DPP ecosystem.



Digital Product Passports

The ability to collect, process, structure, and use data can lead to a competitive advantage, both in terms of economic success and sustainability. The potential of a green and digital transition has been recognized by industry and policy-makers alike. Companies leverage information flows to create value and reduce environmental externalities, but still retain data mostly within company boundaries.

At the same time, it becomes increasingly evident that data can enable systemic resource efficiency and sustainability optimization only if they are available to different value chain participants. Individual and aggregated data about products and their lifecycle behavior needs to be shared to enable automation of processes, control of material flows, reduction of transaction costs, and new circular business models along entire value chains. The use and exchange of meaningful data across company boundaries and product life cycles are key to close information asymmetries and thus unlock the sustainability and economic potential of the Circular Economy. The shared data also enable supply chain transparency on sustainability parameters like the Product Carbon Footprint or Responsible Supply Chain Due Diligence for effective management of environmental and social externalities.

Policy-makers react and incorporate stringent sustainability requirements into regulations (e.g. Ecodesign for Sustainable Products Regulation (ESPR) and Battery Regulation on product-level, Corporate Sustainability Reporting Directive on company-level) that take upstream and downstream (Scope 3) externalities into account. A key tool for monitoring these requirements on product level is the Digital Product Passport (DPP). A DPP is a compilation of data attributes describing a product, its components and materials, and providing information on sustainability indicators, composition, use, repair, reuse and recycling (e.g. for batteries, textiles, or buildings). Enabling the collection and exchange of meaningful and verified data attributes requires digital ecosystems that are capable of connecting different stakeholders along complex value chains. While the implementation follows a regulatory push, commercial companies and public-private partnerships recognize the value adding potential of shared value chain data. Industry-led initiatives (e.g. WBCSD) are working on exchange systems that enable secure and automated exchange of company-specific and product-level data. Other initiatives such as the Global Battery Alliance, Battery Pass or CIRPASS aim at creating first DPP pilots.

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Status Quo

Competing DPP Pilots Lead to Multiple Problems

At the moment, there is no current agreement on the specific data format of the DPP or on how product data should be collected and curated. In the EU alone, there are at least 76 projects already under way that provide competing EU DPP formats[1]. Comparable DPPs are also being developed abroad, for example by manufacturers such as Tesla. It is to be expected that the number of DPPs will continue to grow enormously in the future, once new regulations such as the EU's ESPR require all products to feature a product passport.

Challenges

In view of this multitude of different DPPs, it is problematic that the ESPR only provides vague details. Secondary legislation (delegated or implementing acts) will describe the technical specifications in more detail. Without a harmonized framework, the various DPP initiatives will likely develop their own data ecosystems that are not interoperable with each other. This way, a fragmented landscape of new product data silos will emerge and cause various challenges that limit scalability:

→ Impeding data aggregation: The integration of DPP-level data for different product categories and industry verticals must be possible along global supply chains and especially in circular value chain systems, e.g. to calculate the total environmental footprint of a product. This can be hampered by different data formats.

→ Lock-in effects: If a company has chosen a DPP with a special format, the conversion costs can be very high. It may be necessary to collect other data, change data formats, or re-verify data through costly external auditors.

→ Exploitation and data misuse: DPP organizations can turn into gatekeepers for small companies, without whom no market access is possible. Especially when combined with lock-in effects, DPP organizations can charge high fees for members and enforce unfavorable terms such as data use rights that threaten producers' data sovereignty.

→ Market failure: Powerful economic actors could create their own DPP ecosystems to exploit their monopoly position, impose requirements on small suppliers, and avoid competition.

→ Impeding technological progress: Rigid data requirements imposed by DPP organizations can result in additional costs for the development of new product groups.

Goals

The goal should be to have a landscape of different DPPs that share a common framework and thus enable at least four use cases:

1.) Automated and reliable data integration
2.) Comparison and aggregation of different DPPs
3.) Easy set up of new DPP ecosystems
4.) Easy change between different DPP ecosystems

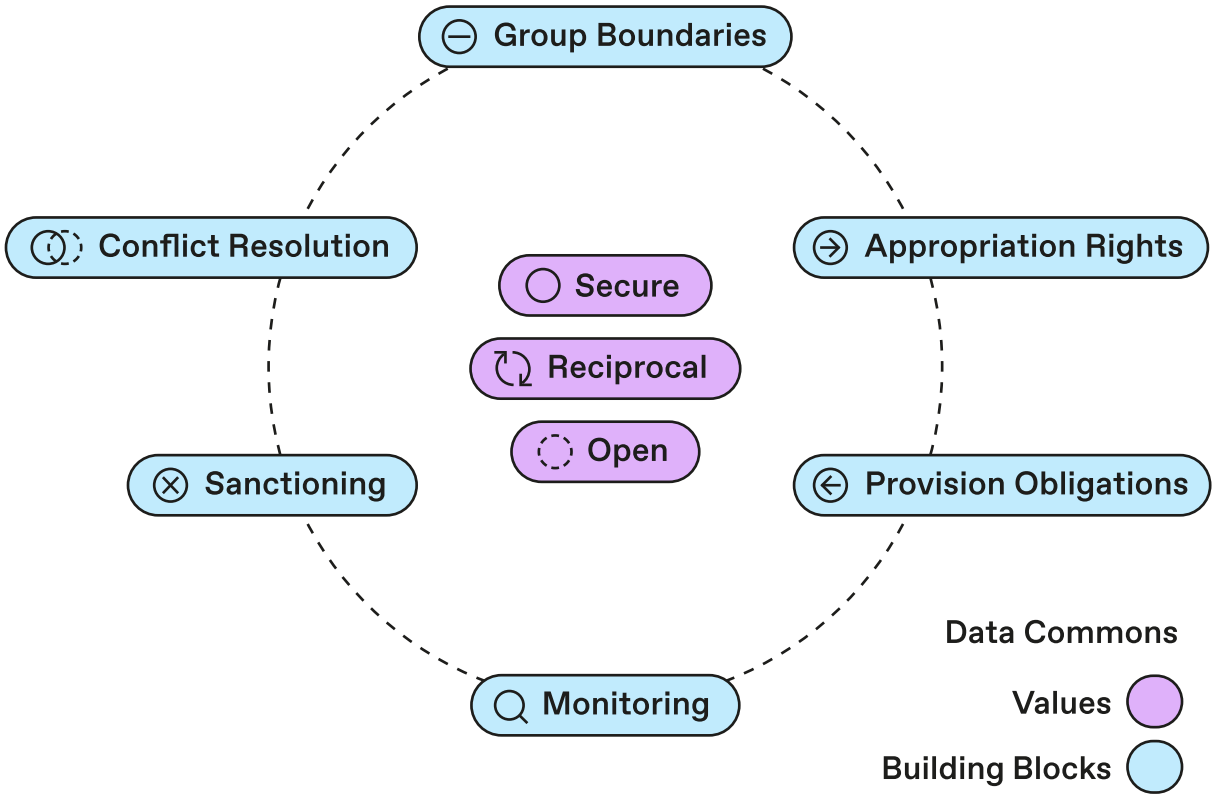
Only if the existing challenges can be overcome and all four use cases can be realized, DPPs can contribute to meaningful impact reporting and ultimately lead to a more sustainable economy.

[1] Jansen, M., B. Gerstenberger, J. Bitter-Krahe, H. Berg, J. Sebestyén, J. Schneider. 2022. Current approaches to the digital product passport for a circular economy. Wuppertal Paper 198. Wuppertal: Wuppertal Institute. https://wupperinst.org/a/wi/a/s/ad/7852

Data Commons

The Data Commons Framework

There is no one-size-fits-all solution for these emerging DPP systems as they need to incorporate various existing databases and platforms along various value chains. To create functional and efficient DPPs, principles that govern their development need to be derived. The following questions derived by SINE Foundation, Einstein Center Digital Future and Systemiq need to be answered for successfully designing DPPs and avoiding the problems described above. These questions apply the Data Commons concept established by the SINE Foundation and published together with Deutsche Bank, Systemiq and TLGG in a previous whitepaper.



Secure

To decrease transaction costs of data sharing and reduce the effort for all stakeholders, the DPP may provide cryptographic measures to ensure that the data is secure when being exchanged and worked on. Latest innovations in cryptography allow computation or analysis of combined data without the different parties revealing their private input. Sensitive data must not be exposed at any time.

Reciprocal

All connections among stakeholders contributing to the DPP need to rely on reciprocal relationships and mutual benefits. Stakeholders need to have a clear incentive to participate. The autonomy of smaller companies needs to be protected.

Open

The formation of new data silos must be prevented. To avoid new data silos, DPPs must be designed as open and interoperable ecosystems. There are open interfaces with certain minimum requirements for technical and semantic interoperability, so that companies can transfer their product data from one DPP ecosystem to another without incurring high costs. If necessary, intermediaries can be used to translate the product data from one DPP format to another.

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Use Case

Carbon Accounting for DPPs

Comparable, accurate and standardized carbon footprint data, especially Scope 3 emissions, will move to the center stage of regulatory and stakeholder reporting. With this change, company-specific (primary) data along the value chain will become increasingly important as only specific and actual emission hotspots can enable operational steering of GHG improvements. Exemplarily looking at the supply chain emissions (cradle-to-gate), current approaches to Life Cycle Assessments (LCA) focus on a retrospective request of data, looking back from the company performing the LCA into the supply chain. This increases the transaction costs of collecting primary data end-to-end. Upstream data aggregation and exchange with each actor adding Scope 1 and Scope 2 emissions to received materials and components will decrease transaction costs as well as increase reliability, accuracy and insights into decarbonization efforts. This upstream data aggregation approach is envisioned by leading initiatives aiming to enable company-specific carbon data sharing along value chains (e.g. PACT, GBA, and Catena-X). For this approach to materialize, interoperable data exchange systems need to be developed, in compliance with the Data Commons values.

Reciprocal

Only when all stakeholders gain a clear benefit (e.g. benchmarking of sustainability metrics) from reporting company-specific carbon footprints, investment in the respective data exchange system and operational reporting will take place along the supply chain. Clear incentives to create this ecosystem and to provide high-quality data could result from sharing the benefits of improving the carbon footprint.

Secure

Company-specific carbon footprint data may provide insights into the respective production processes of companies (e.g. based on energy content). This is particularly true for process-specific activity data. Emerging exchange systems therefore must secure sensitive data and only report carbon footprints on an aggregated per unit level or use advanced homomorphic encryption technologies.

Open

To effectively and efficiently obtain and share carbon footprint data along the supply chain, an exchange system will need to be able to communicate with a variety of existing systems (e.g., MES / ERP systems for energy consumption). For this, concurring calculation methodologies and data formats need to be applied.

Key Questions

Questions to be Addressed for Successful Digital Product Passports

The following questions allow us to address the core values within each building block of the Data Commons in order to design a successful ecosystem for DPPs.

◯ Group Boundaries

Identity: Who is part of the Data Commons related to the DPP?

Sovereignty: What do stakeholders need to know about other stakeholders?

Relationships: How are the different stakeholders related to each other?
Do hierarchies or power relationships affect the relationship of certain stakeholders?

Onboarding: How can a stakeholder join the Data Commons related to the DPP and at what costs?

Portability: Can the DPP data be used somewhere else? Can data from a different DPP be re-used?

Coalitions: How can the Data Commons integrate existing and new initiatives and systems?

⊖ Provision Obligations ⊕ Appropriation Rights

Use Case: What is the business value that can be created on top of the DPP?
What data is needed for this use case?

Collective-Choice Arrangements: How can the stakeholders be involved in the rules definition and decision-making for the DPP?

Data Use: For what purposes may the data be used and analyzed?
How should data be made available and to whom?

Data Benefits & Costs: Who benefits from the shared data? What are the sharing costs?

Data Protection: What are the sharing risks for each stakeholder?
How can data be protected within the ecosystem?

Data Standards: What standards ensure accessibility and reliability of the data?

Data Provenance: What do stakeholders of the Commons need to know about the data origin and its changes?

Data Exchange Protocol: How can data flow between different IT systems?

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Monitoring

Data Quality: How can high data quality be ensured?

Fraud: What could fraudulent behavior look like?
Why would a stakeholder be motivated to do that?
How can stakeholders be prevented from fraudulent behavior?

Monitoring Costs: Given the complexity, how can the DPP keep monitoring costs low?

Members' Involvement: How can the stakeholders be involved to interact in the monitoring?

Sanctioning Conflict Resolution

Power Balance: How can misbehavior of a powerful player in the value-chain be sanctioned?

Speed & Costs: How can quick conflict resolution at low costs be ensured?

Outlook

The Need for Harmonization

Despite the complexity of such a Data Commons for DPPs, Ostrom's assertion holds: Given the free rider problem, clear group boundaries are needed to create a stable governance structure that stewards the DPP data ecosystem as a commons. To this end, DPPs need to develop participation models that represent legally binding relationships while keeping switching costs low (e.g. licensing models).

The transformation to a landscape of open DPP ecosystems must be paved in particular by political measures. In terms of regulation, the European Union must use the right to access the European market as a lever to establish new DPP requirements worldwide. In view of the lack of sanctionability at the global level, the requirements must also be anchored in bilateral and multilateral trade agreements. Furthermore, permanent monitoring and coordination of the various DPP initiatives is necessary, especially in the initial phase, in order to assess the real needs on the ground. From a financial perspective, this requires a permanent institution instead of individual, temporary project funding. We call on all initiatives working on DPPs and data ecosystems to reflect on these questions and the principles of Data Commons. The SINE Foundation, Einstein Center Digital Future and Systemiq aim to contribute further to this increasingly important topic.

About

About this Whitepaper

On January 24, 2023, the Einstein Center Digital Future, the SINE Foundation and Systemiq conducted a workshop with PhD students and postdocs from various fields to discuss the question of how to design successful digital ecosystems. We thank all participants for their fruitful contributions and look forward to continuing the discussion.



Authors

The Einstein Center Digital Future (ECDF) is the center for digitization research in Berlin. The ECDF is a project based on a large-scale public-private partnership (PPP) between more than 30 companies, organizations, and all four Berlin universities. Its scientists have been conducting research in the core areas of Digital Infrastructure, Digital Health, Digital Society as well as Digital Industry and Services.

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The SINE Foundation is a think and do tank founded by academic experts and progressive entrepreneurs. SINE designs and implements the foundation for lasting data collaboration — delivered as ready-to-use governance tools and open-source software.

The neutral non-profit foundation supports global organizations to identify, initiate and maintain use cases for data collaboration within complex multi-stakeholder environments (e.g. in the Partnership for Carbon Transparency).

For more information, see this video, our homepage, or our latest publication on Data Commons.

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Systemiq, the system-change company, was founded in 2016 to drive the achievement of the Sustainable Development Goals and the Paris Agreement, by transforming markets and business models in five key systems: nature and food, materials and circularity, energy, urban areas, and sustainable finance. A certified B Corp, Systemiq combines strategic advisory with high-impact, on-the-ground work, and partners with business, finance, policy-makers and civil society to deliver system change. Systemiq has offices in Brazil, France, Germany, Indonesia, the Netherlands and the UK. Find out more at www.systemiq.earth

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