Achieving a Sustainable Economy with Digital Product Passports

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1 Overview

1.1 Introduction

A sustainable, ideally circular economy is becoming increasingly important for the resilience of most economies, especially those with complex supply and value chains across multiple sectors. However, only a small proportion of business economies fully (or at least to a large extent) meet sustainability criteria and the opportunities for achieving strategic advantages in the market. These opportunities can only be realized with the availability of product information across sectors.

The digital product passport is a key emerging technology within a digital ecosystem to track and monitor product properties throughout business processes in a sustainable economy [8], [7].

As an example, consider supply chains in the automotive sector. This sector manifests a multitude of companies of widely varying sizes working in a cooperative, but also highly competitive, ecosystem. The raw materials necessary for a vehicle are transformed step by step into component parts. These parts are processed and assembled step by step into more complex parts until the final car assembly can be completed.

Key component types include metal parts, batteries, electronics and plastics in the chassis, engine, transmission system and body of the car. The EU Circular Economy Action Plan [8] lists Batteries and Vehicles as one of seven key product value chains in a sustainable economy. The proposed EU regulation 'Ecodesign for sustainable products' [7] builds on the existing EU ecodesign directive 2009/125/EC (for energy related products) to set design requirements for products to improve their circularity, energy performance and environmental sustainability.

The participants in a supply chain negotiate product specifications as well as terms and conditions with their own suppliers and customers. Not only legal regulations such as the Act on Corporate Due Diligence Obligations in Supply Chains [11], but also company policies require stringent documentation of the supply chain, the manufacturing process, and the products (intermediate and final). Product specifications include not only information about the manufacturer and technical information for design and configuration such as CAD diagrams, but also about the materials used to facilitate the recycling and re-use of the parts at the end of the car's or component's life.

Moreover, data on carbon and energy footprints as well as usage of chemicals and minerals and compliance with labor conventions are also required. Like a person's passport issued by a country, a product passport is designed to be a trustworthy certificate of a product's identity and key selected characteristics. The product passport is then the basis for accepting a product ("allowing entrance into the manufacturing process") and in handling the product ("what can this product do, what properties does it have and what can be done with it", in summary "its capabilities"). A *Digital Product Passport* (DPP) needs to meet at least these requirements:

- Be issued by a recognized authority.
- Reference product characteristics following agreed standards.
- Be based on validated source information without revealing all internal product details to competitors.
- Support the onward composition of products in a supply chain to form new products with their own product passport. The product passports must form a “product passport supply chain.”
- Be generated and managed with a minimum of manual interactions.

The fulfillment of these requirements is essential to implement efficient and sustainable product passports in a business ecosystem and thus achieve sustainability of the real supply chain and enable its monitoring. The supply chain participants need to be able to rely on each other and adapt to changing market needs. The proposed EU regulation ‘Ecodesign for sustainable products’ [7] also foresees introducing DPPs.

DPPs integrated into a cross-sector ecosystem can be an important source of trustworthy information for product- and company-related sustainability information. Sustainability information provides the basis for sustainability assessments of products, suppliers, and entire supply chains. A holistic approach includes legal, environmental, social and economic aspects. A circular economy aims to maximize the reuse and regeneration of materials and products in a sustainable and environmentally friendly way. A DPP is a fundamental enabler to achieve this aim as it holds all essential product information needed to inform product purchasers, as well as facilitating repairs and recycling.

1.2 Purpose

This document aims to inform and provide guidance on the implementation and management of Digital Product Passports in a supply chain network aiming to achieve a sustainable economy.

1.3 Scope

The document describes a conceptual approach to implementing Digital Product Passports within an extension of the Smart Factory Web architecture where sustainability data plays a central role. The Smart Factory Web Capability Model, the Supplier Knowledge Base and the Sustainability AI are core components in this extended architecture. The approach for two use cases is presented in Chapter 5.

1.4 Structure

This document is organized as follows:

- Chapter 2 – Motivation
- Chapter 3 – Previous Work and State of the Art
- Chapter 4 – Conceptual Approach and Implementation
- Chapter 5 – Use Case Validation and Applicability

- Chapter 6 – Conclusions and outlook
- Chapter 7 – References
- Chapter 8 - Acknowledgements

1.5 AUDIENCE

The primary audience comprises system architects and strategic planners for IT technology in companies involved with supply chain management or achieving sustainability goals for products throughout their lifecycle.

1.6 USE

The document is intended to be used by IT system architects and planners who desire a better understanding of the essential requirements and architectural approaches for the implementation of digital product passports and tracking of sustainability in a supply chain network.

2 MOTIVATION

The major goals of the DPP are to improve sustainable product production, value creation through circular business models, purchasing decisions through transparency for consumers, transparency regarding legal obligation compliance. They can only be reached when solutions for the following challenges have been established:

- Cross-industrial access to and interpretability of the DPP information.
- Clear ownership of DPP data as well as assured authenticity (possibly from a recognized issuing authority) and integrity of that data.
- Availability of a DPP over the whole life-cycle of its product.
- Verifiability of the data in the DPP.
- Compliance with GDPR (General Data Protection Regulation).

Various approaches[1] address these requirements using blockchains and modern user interfaces. These approaches are only evaluated with use cases for simple source to sink information flows from one party to another and do not support multi domain terminology. Therefore, this might not be sufficient for a cross-sector circular economy and the heterogeneous information sources, as well as the complex information flow and completion of cross-sector information management. Studies for researching this complex information management and integration while meeting the above requirements are needed. In this article, we provide results of such a study focusing on automotive production supply chains which provide the ideal use case domain due to their high complexity and cross-sector nature.

[1] E.g. *www.circularise.com*, *www.spherity.com*

3 PREVIOUS WORK AND STATE OF THE ART

The BMWK[2]-funded *Catena-X* project's objective is to achieve a continuous standardized data exchange between all participants in the automotive value chain. The Catena-X Automotive Network[3] (referred to as Catena-X) is the association publicly representing the project. Catena-X has published 4 specifications in the category Sustainability on the collection and exchange of *Product Carbon Footprint* (PCF) data [2]. This data model complies with the WBCSD (World Business Council for Sustainable Development) Pathfinder Initiative specification.

The PCF Rule Book [2] builds on the product carbon footprint standard (ISO 14067) and the life cycle assessment standards (ISO 14040 and ISO 14044) to specify which parts of the extensive and complex automotive supply chain are to be included in the calculation of a partial PCF.

The uptake of electric cars reduces the relative significance of PCF in the product use stage in relation to the previous stages, especially if green electricity sources are used. The PCF Rule Book covers only the first three stages in the product life cycle: (1) resource extraction and material sourcing, (2) production and (3) intermediate distribution and storage but does not include the subsequent stages product use and end-of-life; cf. also [23].

The product types considered include raw materials, chemicals and electronics as well as the vehicle components. A company in the automotive production network applies the specified methodology to calculate the *cradle-to-gate* (cf. Figure 3-1) PCF for all upstream supplier products entering the company and subsequently the PCF for products supplied by the company to downstream companies. The methodology takes greenhouse gas emissions in these 3 stages into account, including those resulting from energy use and transport.

The necessary exchange and combination of primary and secondary PCF data[4] is defined in a cascade across the supply chain. The exchange of PCF data involves three levels of interoperability: data, exchange actions and methodologies for measurement and calculation of emissions. Note that [2] goes beyond the current WBCSD pathfinder [PACT] to define an API for asynchronous PCF requests.

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[2] German Ministry for Economic Affairs and Climate Action (BMWK)

[3] *https://catena-x.net/en/*

[4] According to the PCF Rule Book, Chapter 6, [Catena-X-2022-SUS], primary data is a quantified value of a process, or an activity obtained from a direct measurement, or a calculation based on direct measurements. Where primary data is not available, other so-called secondary data may be used as a substitute if it meets certain requirements.

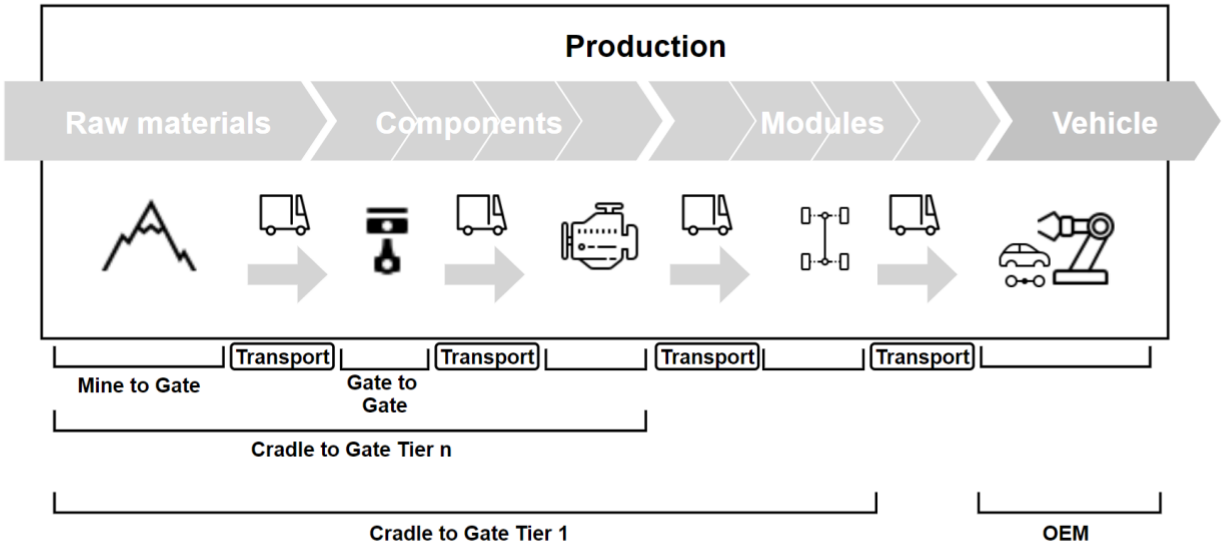

Figure 3-1: Catena-X scope, adapted from [2].

The *Global Battery Alliance* (GBA) presented a proof-of-concept battery passport at the World Economic Forum in Davos 2023; cf. also [10]. Catena-X will collaborate with GBA to provide the data backbone for the battery passport in a solution for the automotive industry.

Catena-X has also published seven documents in the category Traceability [3]. The first three of these documents TRA-001 – TRA-003 describe the identification of serialized (mass produced) parts and batches (a quantity of products produced in the same way) by considering the part IDs assigned by the manufacturer and customer as well as the serial number of the part instance in the production series. A serialized part may have several local identifiers but has a unique Catena-X identifier in the Catena-X dataspace. The documents TRA-004 – TRA-007 define the protocol to exchange notifications on quality information.

The Eclipse Dataspace Connector (EDC) is used as an underlying technology for trustworthy communication with usage policies for the quality data [1]. Company data is provided to the Catena-X network by transforming it into the Catena-X format and publishing it in the EDC. The company data is represented in Catena-X as a digital twin for each serialized part or batch. The digital twin is realized as an *Asset Administration Shell* (AAS) of Plattform Industrie 4.0 [17].

The Industrial Digital Twin Association (IDTA) is working on AAS sub-model templates to describe PCF and product related environmental data [6]. A sub-model defines the format and semantics of AAS content.

The Digital Twin Consortium (DTC) aims to develop an end-to-end model of carbon emissions in a supply chain together with a vendor-neutral solution for data sharing and reporting emissions and PCF [6]. DTC intends to include scope 3 emissions covering the logistics, raw materials and PCF of parts used in the supply chain.

The EU started the CIRPASS project in October 2022 to create a cross-sectorial product data model and DPP for the needs of the circular economy [4]. The project will propose an open DPP exchange protocol and develop use cases and deployment roadmaps. CIRPASS focuses on value chains in electronics, batteries and textiles.

Smart Factory Web commenced work in 2016 as an approved IIC testbed [14] under the leadership of Fraunhofer IOSB and Korea Electronics Technology Institute (KETI). The testbed has the goal of developing and testing standards and technologies for the flexible adaptation of production capabilities and sharing of resources in a web of Smart Factories to improve order fulfillment and enable new business models. Smart Factory Web has been applied in an ecosystem of R&D projects and has evolved into a service-based system architecture for industrial digital ecosystems, addressing the modeling of factory capabilities and products as well as intelligent information integration and search technology to build federated marketplaces or cooperation platforms, e.g. for *Manufacturing as a Service* [22, 9].

The following chapter describes an excerpt of the Smart Factory Web as applied in Catena-X and describes the base model as well as the management of supply chain sustainability information.

4 Conceptual Approach and Implementation

The Smart Factory Web (SFW) is a service-based system architecture for industrial digital ecosystems, currently applied for Manufacturing as a Service in Catena-X [20]. Here SFW supports the extraction, integration, maintenance of and search for supplier/manufacturer information such as production capabilities and products. Moreover, the product information is linked to DPP representations and references. Core services provide access to this information and allow applications to implement user journeys e.g., marketplaces or supply chain management following the one-up-one-down paradigm as a possible traceability model [5]. This shows how the SFW can be applied as an infrastructure for DPP registration, search and management as well as information integration.

The core of the Smart Factory Web architecture can be broken down into the *Supplier Knowledge Base* and services enabling other software to manage and query the knowledge in a secure manner. The Supplier Knowledge Base is the sink of information about suppliers and builds graphs by integrating this information, meaning interlinking data and semantics.

The hosting of DPPs must be clarified to be able to incorporate them into SFW. The data sovereignty and cross-sector availability requirements for the DPPs lead to the assumption that DPPs can be highly distributed. In consequence, the SFW only references DPPs (Figure 4-1) via endpoint descriptions and a unique identifier. Thus, the SFW acts as a product passport registry following the ecodesign regulation [7]. At the same time, to include DPP information in the reasoning offered by the Supplier Knowledge Base, it is necessary to be able to store copies of specific DPP information, e.g. the product carbon footprint (PCF) together with the reference. Thus, the SFW also allows arbitrary properties to be added to the DPP reference (Section 5.2).

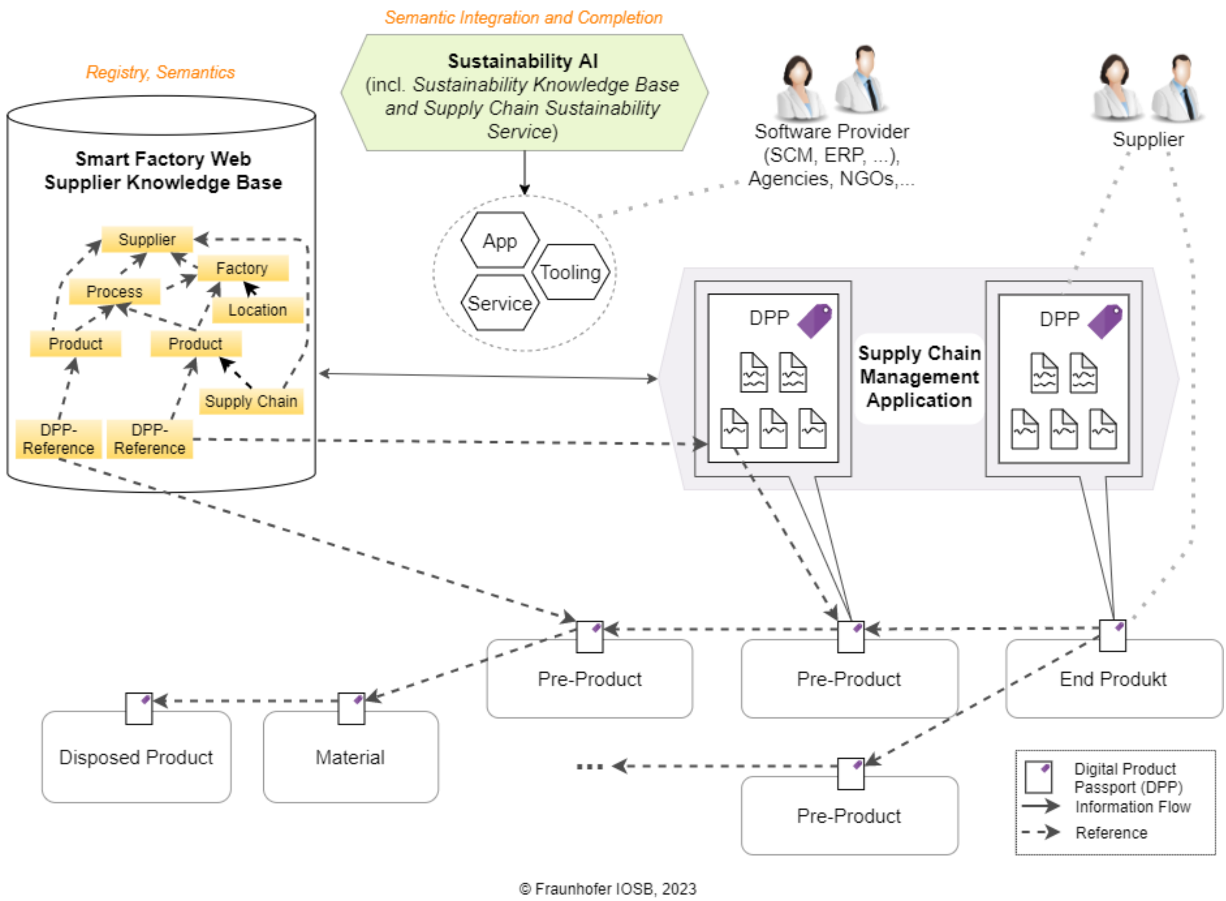

Figure 4-1: DPP architecture.

As a service-based architecture, Smart Factory Web ensures high extensibility regarding services, apps and further tools. For example, a system called *Sustainability AI* was added to integrate public sustainability information from life cycle assessment databases, non-governmental organizations, sustainability reports, and other information sources. It will be explained in more detail in section 4.2.

The Smart Factory Web - Capability Model (section 4.1) enables the machine-interpretable and semantic description of supplier information stored in the Supplier Knowledge Base. This is a graph database for storing information about enterprises and their production capabilities. It is used to search for suppliers and supply chains (networks of suppliers) within the Smart Factory Web ecosystem.

DPPs can be created, enriched or validated using information in the Supplier and Sustainability Knowledge Bases. Chapter 5 describes the two use cases addressed by the presented solution architecture for DPPs.

4.1 SMART FACTORY WEB - CAPABILITY MODEL

The SFW Capability Model [16] is industry-independent and enables the description of enterprise structures based on factories, production resources, processes and capabilities. The model is based on the work of [22] and forms the basis for the Manufacturing as a Service (MaaS) development of Catena-X. Aspects of the Capability Model were considered in the discussion paper of the "Information Model for Capabilities, Skills & Services" working group of the Plattform Industrie 4.0 [18].

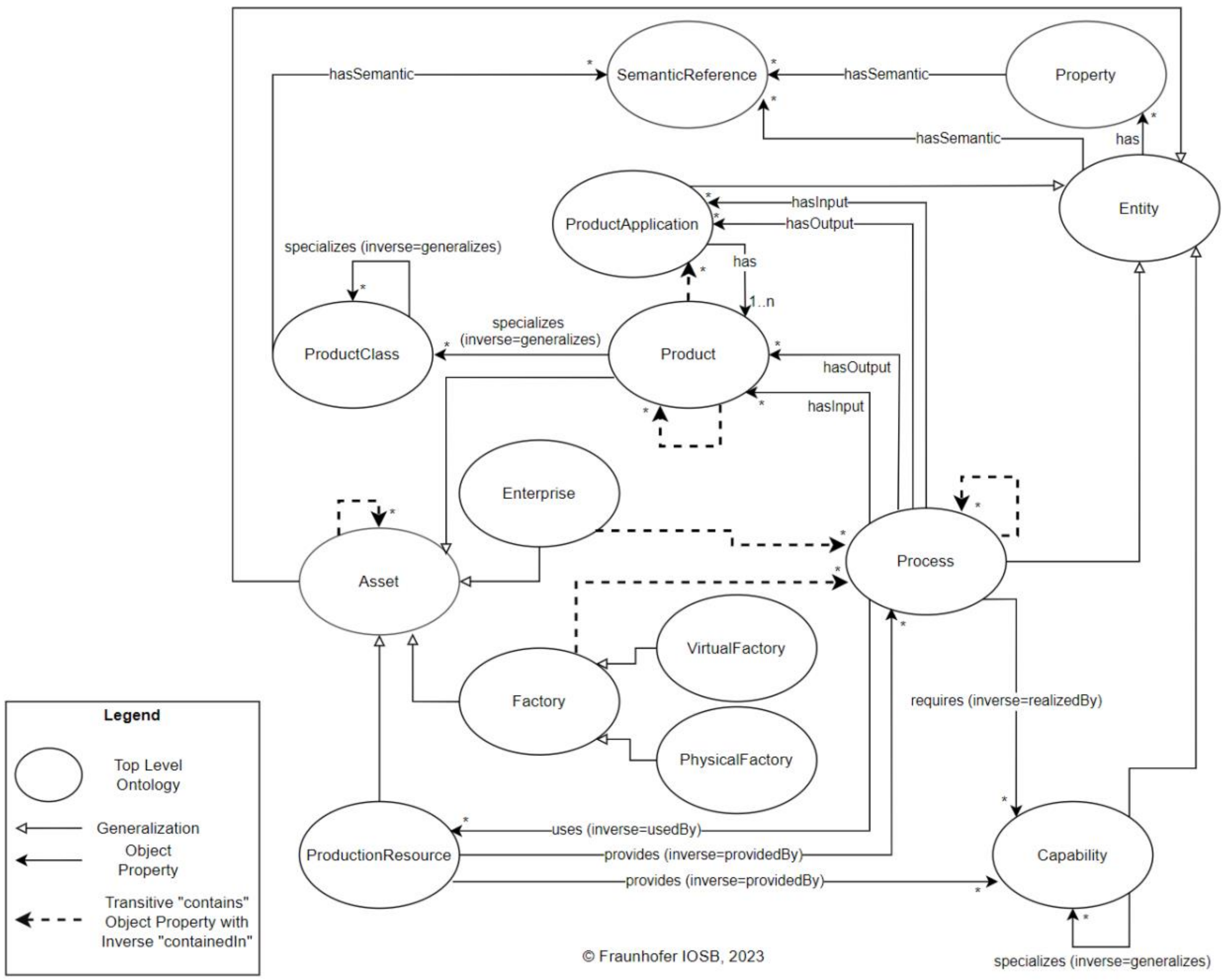

Figure 4-2: Smart Factory Web – Capability Model (Top Level Ontology).

Figure 4-2 shows the concepts and relations of the top-level ontology of the SFW Capability Model. The top-level ontology is designed to be extended and specialized by additional ontology levels. One of the main objectives of the Capability Model is the modeling of enterprises and their production capabilities, factory structures, manufacturing resources and production. These information categories can be described using the concepts `Asset`, `Factory`, `Capability`, `ProductionResource`, `Process` and their relations. The model also enables the representation of products (`Product`) on models, batches or item level, sub-products, supply chains and DPPs. Moreover, detailed information about all concepts classified as `Entity`, can be added using the `Property` and `SemanticReference` concepts.

Figure 4-3 shows the concepts and relations of the mid-level ontology of the SFW Capability Model. Significant extensions to the top-level ontology are the concepts `ProductPassport` for modeling a DPP, the concepts `SupplyChain` and `SupplyChainElement` for modeling supply chains and the concepts `HumanResource` and `Machine` for modeling production resources. A product can have exactly one DPP as shown by the cardinality in Figure 4-3. A DPP in turn has a unique identifier and can be specified by several properties.

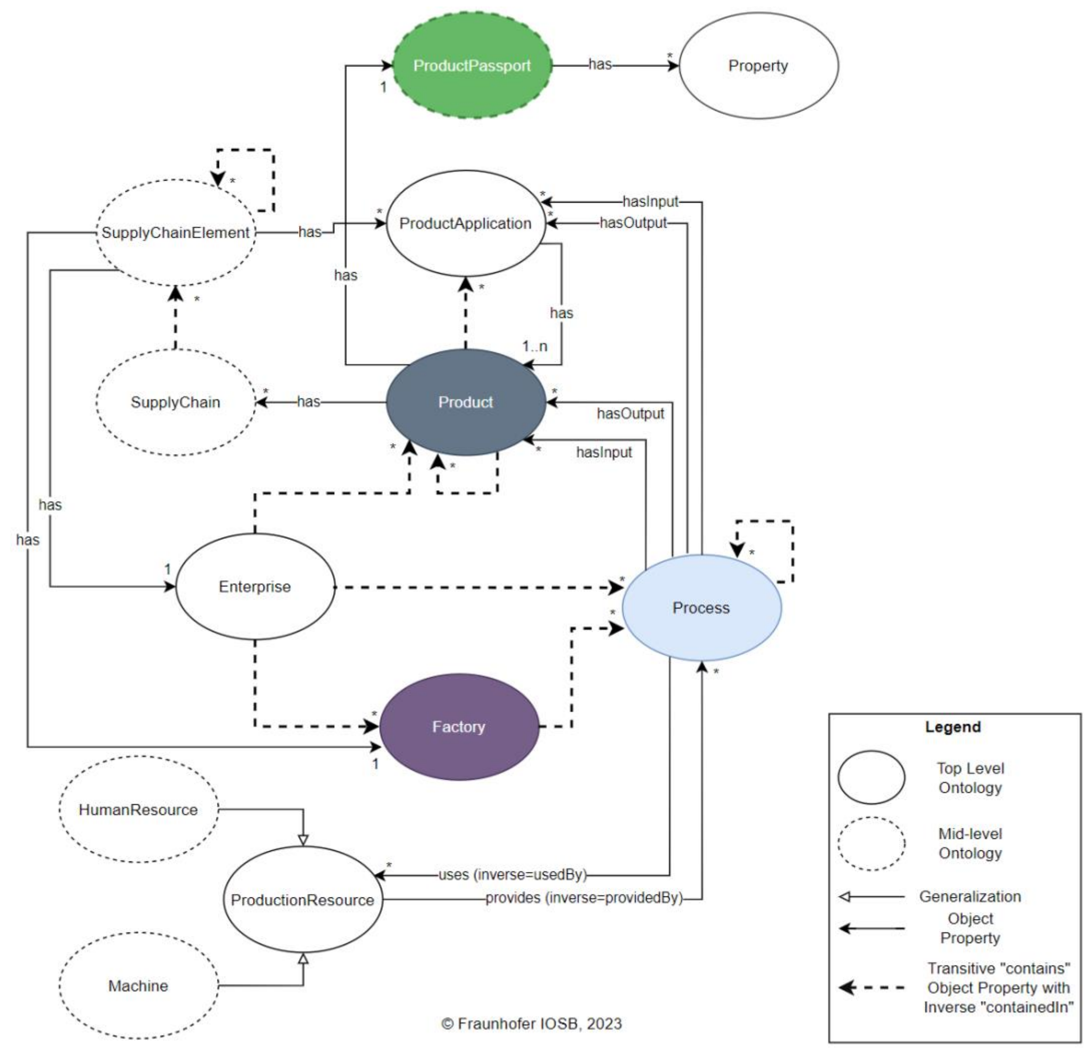

Figure 4-3: Smart Factory Web – Capability Model (Mid-level Ontology).

4.2 SUSTAINABILITY AI

Sustainability data available in remote databases or published articles and reports is difficult to access, unlinked and for the most part not comparable. For this reason, the Sustainability AI[5] has been developed. The goal of this system is to aggregate, link and extract sustainability data and to provide this comparable and transparent sustainability information for different applications and domains.

A key component of the Sustainability AI is the graph-based *Sustainability Knowledge Base* for transparent and comparable sustainability information from a wide range of industries. The database is open and suitable for retrieving sustainability information such as product carbon footprint, carbon footprint, water consumption, conflict minerals, certifications, standards and other information. Another key component is the AI algorithms required for ontology-based reasoning with OWL (Web Ontology Language).

To increase the comparability and transparency of sustainability assessments, a semantic model for transparent sustainability assessment of supply chains was developed [21]. A semantic model incorporates the meaning of data in the context of its use. The Sustainability Knowledge Base and the *Supply Chain Sustainability Service* (SCSS) are based on this semantic model [21]. Figure 4-4 shows the overall process starting from information gathering, through to data preparation and then to the provision of the sustainability data. The SCSS provides sustainability information such as the carbon footprints, information on conflict minerals, various climate scores, certifications and standards that are required for transparent sustainability assessments along supply chains.

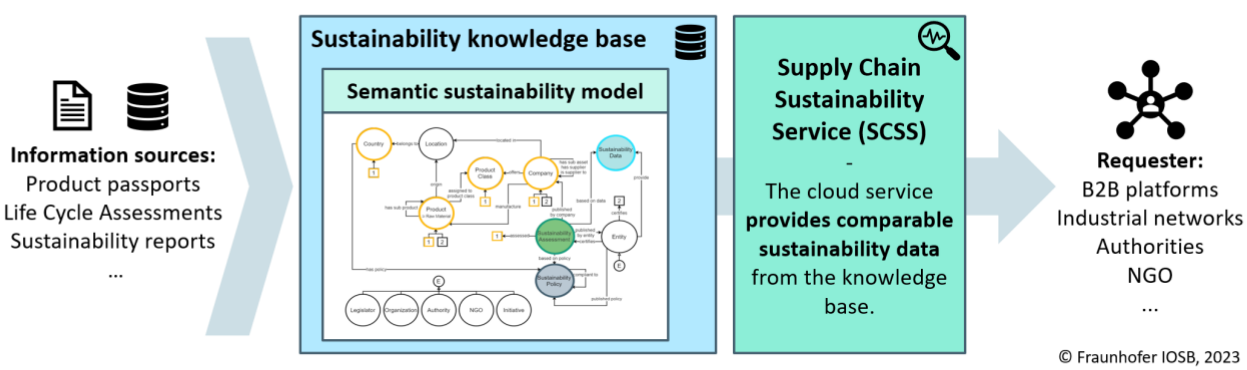

Figure 4-4: Sustainability knowledge base and supply chain sustainability service.

The Sustainability AI has the following relationships with DPP:

- Digital product passports can serve as a source of information along a supply chain.

[5] *https://sustainabilityai.com/*

- On the other hand, companies can query comparable sustainability information from the Sustainability Knowledge Base and thus expand and validate their digital product passports.

5 Use Case Validation and Applicability

The previously described concepts are discussed here and evaluated for two use cases involving a Li-ion battery supply chain in the automotive industry (see Figure 5-1). The first use case describes the derivation and flow of information between DPPs, products and processes. The second use case is about the description of supply chains with DPPs.

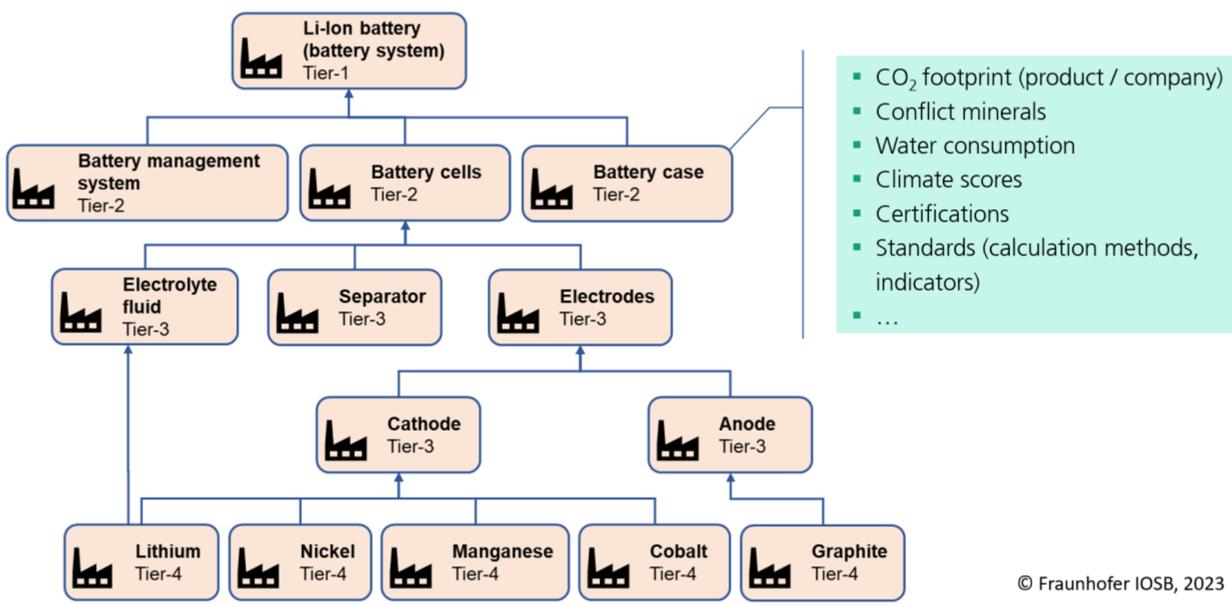

Figure 5-1: Li-ion battery supply chain.

5.1 First Use Case: Derivations from DPP, products and processes

There are various ways of deriving information for or from DPPs, as presented below. The relevant concepts for these conclusions are shown in a simplified form in Figure 5-2. The DPPs can be extended with information from the Supplier Knowledge Base. In the opposite direction, information can be obtained from the DPPs and their hierarchical structure to expand the Supplier Knowledge Base. A supplier needs to integrate its DPP management into the classic in-house Bill of Materials (BOM) and Bill of Process (BOP) management with version control of products.

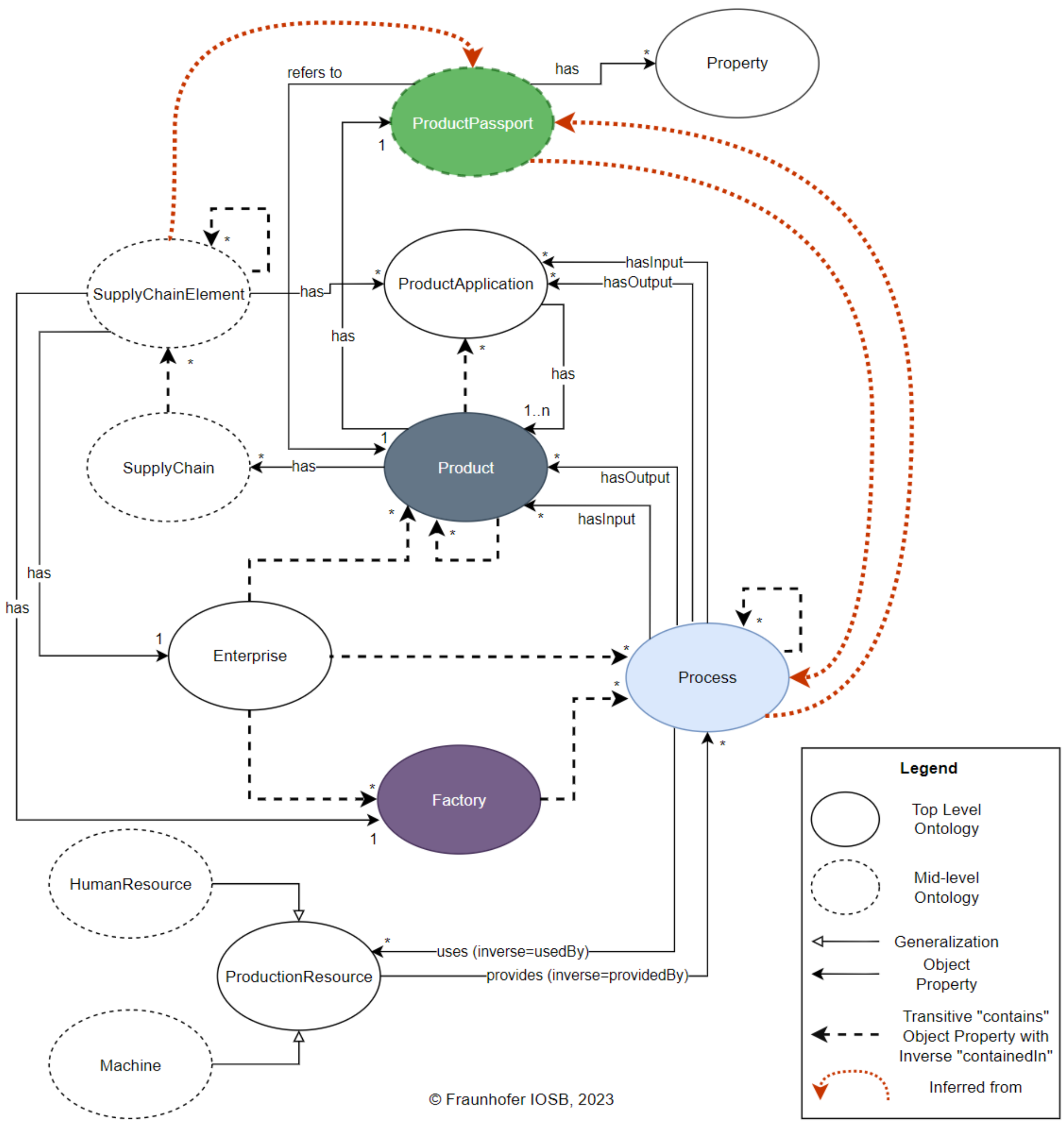

Figure 5-2: Semantic reasoning using DPP.

1. Since the Supplier Knowledge Base contains the production processes (`Process`), conclusions about the reparability and recyclability of the respective output products (`OutputProduct`) can be derived from input products (`InputProduct`), capabilities (`Capability`), production resources (`ProductionResource`) and additional process data (`Property`) modeled in the process hierarchies. For example, during recycling of electric vehicle batteries the major goals are to reduce the amount of waste generated and to maximize the reuse of components and resources. Hence, elements such as lithium and various metals must be separated, e.g. via mechanical separation or

a pyrometallurgical treatment at very high temperatures. The best separation process differs from producer to producer. By design, the Supplier Knowledge Base handles information with different levels of detail. Thus, the retrievable disassembling, recycling and reparability information differs in its level of detail accordingly.

2. The production processes (`Process`) implicitly provide information about the hierarchy of the DPPs based on the modeled input products (`InputProduct`) and output products (`OutputProduct`). Partial aspects of DPPs can be derived using this modeling option, such as missing DPPs along a Li-ion battery supply chain (Figure 5-1). This facilitates the creation and completion of DPPs along supply chains. A missing DPP for the battery cells can be derived from the ontology since the input products for a battery are known (battery cells, battery management system and battery case).

3. Inferring supply chains from DPP information is another possibility. The Supplier Knowledge Base makes it possible to infer the individual elements of the supply chain from the DPP (`ProductPassport`) and thus to infer the entire supply chain. This is possible because the DPP contains product details (`Product`), which in turn contain manufacturer information (`Enterprise`). With this modeling option, the individual supply chain elements (`SupplyChainElement`) can be derived from the DPP. As a supply chain (`SupplyChain`) consists of several supply chain elements, it is possible to derive complete supply chains (cf. section 5.2).

   Thus, missing data in the supply chain description can be filled in by the DPP and missing supply chain elements can be inferred. If the DPP for lithium is available in the exemplary supply chain for Li-ion batteries (Figure 5-1), it can be inferred that there is at least one lithium supplier in the supply chain and which suppliers are supplied with lithium. Sustainability information such as human rights, conflict minerals and country of origin can also be derived from the DPP. This sustainability information is relevant for compliance with legislation such as the German Supply Chain Act [11].

4. Processes can be derived from the relationship between DPP and sub-DPP and hence DPP hierarchies (cf. Figure 5-2), analogously to point 2. The DPP information (`ProductPassport`) describes the output product (`Product`) and the sub-DPP information the respective input products (`Product`). Thus, it can be assumed that the derived process is part of a factory (`Factory`) that owns the DPP. For example, an assembly process can be derived from thDPP for the Li-ion battery and its sub-DPP. The output product is the Li-ion battery. The input products are the battery management system, the battery cells, and the battery case (cf. Figure 5-1).

5. As described in section 4.1, each DPP has a persistent unique identifier. Given such an identifier, DPP hierarchies or supply chains as well as process descriptions in the Supplier Knowledge Base can be analyzed to find products with the same DPP identifiers and consequently link the associated products to the same DPP (i.e. an ‘equals relation’). This

solves typical redundancy and entity linkage issues and can significantly increase the comparability of products and associated processes. For example, it can be concluded that two modeled batteries are from the same production batch or even the same entity.

5.2 Second use case: Supply Chain Description based on DPP

The Fraunhofer IOSB supply chain management application (Figure 5-3) enables the administration of supply chains based on DPPs. Manufacturers can describe their products in detail by creating a DPP for their product and defining various product properties. These properties can contain static values such as the dimensions of the product or information on conflict materials. They can also contain aggregated values, such as the PCF, which is composed of the PCF of all input products and the emissions of production and transport. These values can be calculated at runtime.

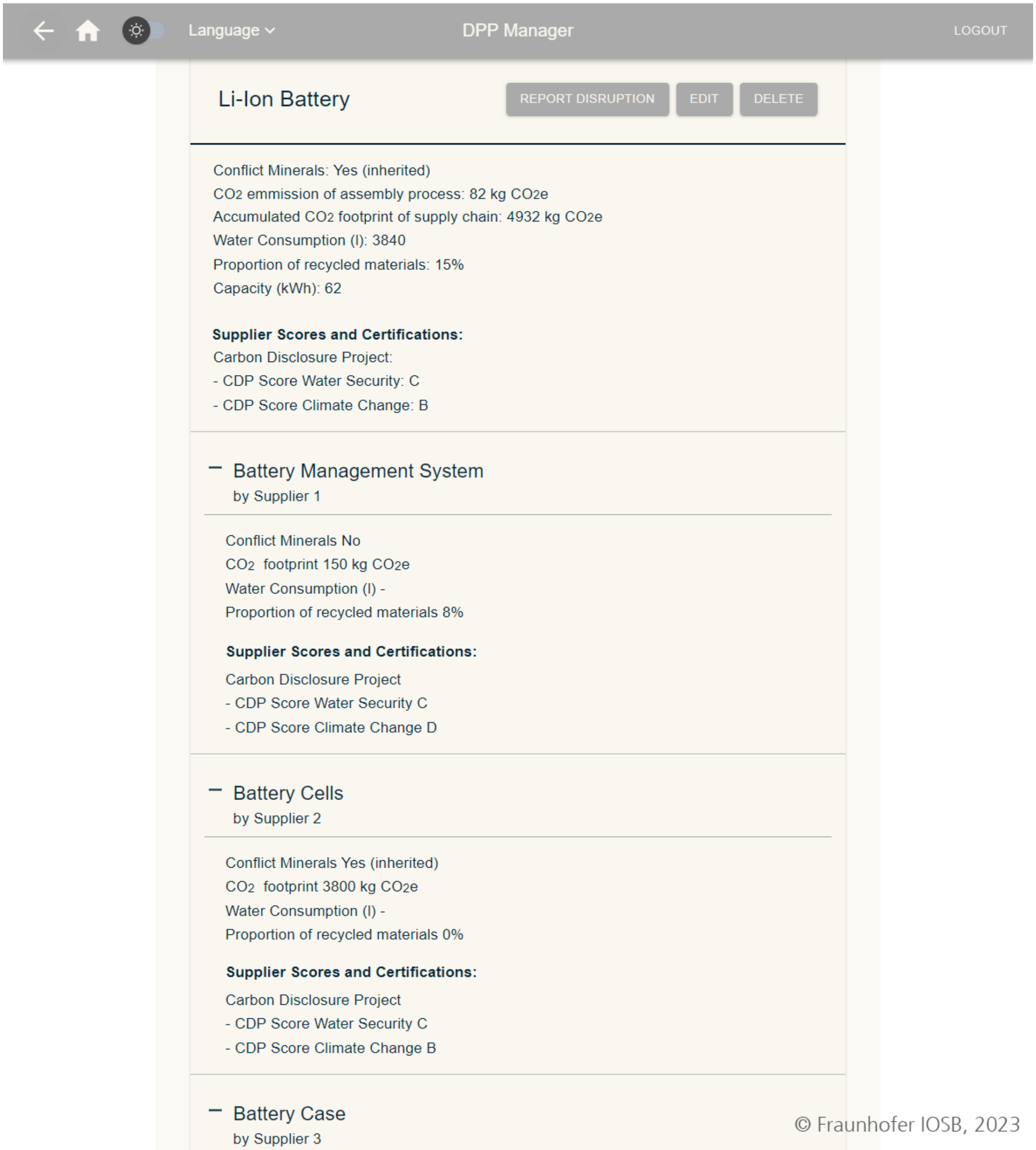

Figure 5-3: Supply chain management application.

In this use case, it is assumed for a simplifying approach that all manufacturers along the supply chain are already registered in the application and manage their DPPs there. The DPPs are referenced in the Supplier Knowledge Base and can therefore also be hosted in a distributed manner in the future.

To ensure that no trade secrets become publicly visible, it is possible to specify for each of these DPPs for which consumers it should be visible. A distinction is made between information that should be accessible only by direct customers or suppliers, and information that may be viewed by anyone. In addition, attributes can be defined to be used for aggregation along the entire supply chain, such as the carbon footprint.

Additionally, a manufacturer can assign the input products needed to produce the output product. To leave data sovereignty and management with the actual manufacturer, Sub-DPPs are only referenced using their unique ID. For this purpose, the product name or number and the manufacturer's name must be specified. The supply chain management application searches for the DPP of the suppliers for these given pre-products and sets the reference ID.

Figure 5-4 shows the supply chain of a Li-ion battery based on a hierarchy of DPPs and contains product characteristics such as carbon footprint, conflict minerals and certifications. These fictive characteristics are simplified for the purpose of demonstration. For productive use, rulebooks like those of the Global Battery Alliance (GBA)[6] or Catena-X [2] must be consulted for consolidated and obligatory characteristics.

[6] *https://www.globalbattery.org/publications*

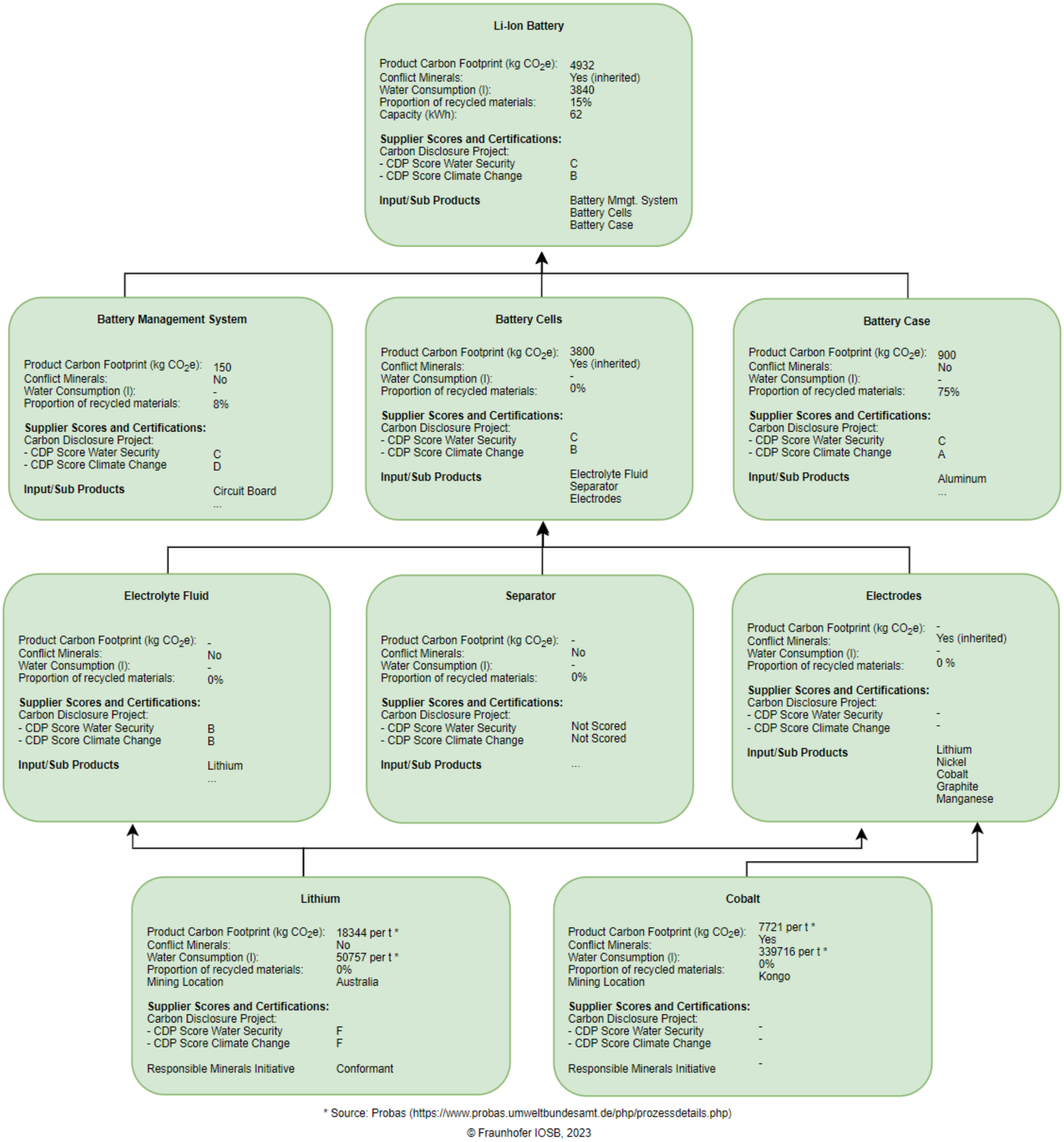

Figure 5-4: DPP supply chain.

The DPPs in Figure 5-4 include sustainability information such as conflict minerals, water use, climate scores, certifications and standards. This information represents a subset of possible DPP characteristics. The sustainability information can be queried from the Sustainability Knowledge Base, which is part of the Sustainability AI (section 4.2) and can be used to extend and validate the DPP information. The Sustainability Knowledge Base contains comparable data such as Responsible Minerals Initiative (RMI) certifications, product and company carbon footprints and

Carbon Disclosure Project (CDP) scores. In this way, complex supply chains can be modeled and conclusions can be derived along the entire supply chain and product structures. For the realization of this use case the concepts product, product passport, property and semantic reference of the SFW Capability Model have been introduced (Figure 4-2). The derivation of supply chains is possible in the following way:

- Referencing along the product hierarchy (reflexive relation `containsSubProduct`) allows one to derive the sub-products. Manufacturer information can be derived from a product or the DPP. The individual products in turn have a DPP. Based on this DPP, the dashed relation `refers_to` can be used to derive the corresponding product (Figure 5-5).

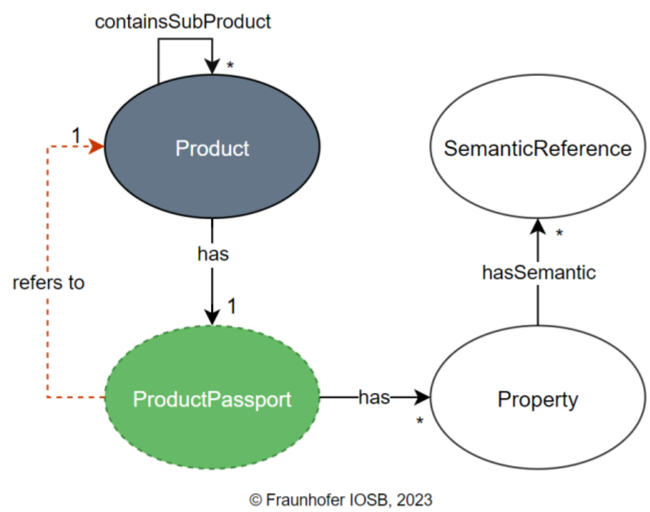

Figure 5-5: Derivation of supply chains from DPPs.

DPPs are characterized by a unique identifier and various properties. Properties can have references to semantic descriptions. Unique referencing and semantic comparability are advantages of this modeling approach.

As described previously, DPPs will not only have to be managed centrally in the supply chain management application but will also be searched and linked via external referencing to support distributed DPPs. So DPPs can be hosted by the manufacturers themselves or connected via registries.

The Supplier Knowledge Base already supports this distributed approach. However, to fully enable the distributed approach, access control and identity provisioning must be detached from the Supply Chain Management Application and the respective interfaces shall be standards compliant. In future, more and more DPPs will have standardized semantics laid down by company associations in an application domain (such as the GBA).

6 Conclusions and Outlook

This article has shown how synergies between digital product passports and supplier information of a modern Manufacturing as a Service ecosystem enable new applications and open up smart ways to integrate and complete information. The Smart Factory Web architecture has proved to be a flexible foundation for such an ecosystem and has emerged as a suitable environment for the seamless integration and extension of distributed digital product passports.

In our approach we linked information from DPPs, external sources for sustainability information as well as production and supply chain knowledge. This resulted in a number of challenges in semantic integration, the design of propagation rules for DPP information, entity linking, and the definition of currently unstandardized information fragments.

In the future, we will further deepen this approach in various pilot projects with different stakeholders from the domains MaaS, Supply Chain Management, Supply Chain Sustainability, as well as operators of digital infrastructures and risk management services to address these challenges. For this, the innovation projects Catena-X and its cross-sectoral successor Manufacturing-X [19] provide us with a valuable R&D framework.

At the same time, with the Sustainability AI, the prototype implementation of the Smart Factory Web and the various applications such as the Supply Chain Management Application and a MaaS marketplace, there is a suitable prototype technical infrastructure to test real scenarios and business models. Therefore, we will be able to present further evaluated concepts and best practices in the near future.

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Standard library, capability ‘Sustainability’
SUS-001- Product Carbon Footprint (PCF) Data Model
SUS-002- Product Carbon Footprint (PCF) Aspect Model
SUS-003- Product Carbon Footprint (PCF) Request API
SUS-004- Product Carbon Footprint (PCF) Rulebook
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TRA-002 Aspect Model: AssemblyPartRelationship
TRA-003 Aspect Model: Batch

TRA-004 Notification Process
TRA-005 Notification API
TRA-006 Data Provisioning for Release 2
TRA-007 Traceability App for Release 2
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