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ONTO-DESIDE

DELIVERABLE

D2.7 Standardisation plan v1

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Project summary

Circular economy aims at reducing value loss and avoiding waste, by circulating materials or product parts before they become waste. Today, lack of support for sharing data in a secure, quality assured, and automated way is one of the main obstacles that industry actors point to when creating new circular value networks. Together with using different terminologies and not having explicit definitions of the concepts that appear in data, this makes it very difficult to create new ecosystems of actors in Europe today. This project will address the core challenges of making decentralized data and information understandable and usable for humans as well as machines. The project will leverage open standards for semantic data interoperability in establishing a shared vocabulary (ontology network) for data documentation, as well as a decentralized digital platform that enables collaboration in a secure and privacy-preserving manner.

The project addresses a number of open research problems, including the development of ontologies that need to model a wide range of different materials and products, not only providing vertical interoperability but also horizontal interoperability, for cross-industry value networks. As well as transdisciplinary research on methods to find, analyse and assess new circular value chain configurations opened up by considering resource, information, value and energy flows as an integral part of the same complex system. Three industry use cases, from radically different industry domains, act as drivers for the research and development activities, as well as test beds and demonstrators for the cross-industry applicability of the results. The developed solutions will allow for automation of planning, management, and execution of circular value networks, at a European scale, and beyond. The project thereby supports acceleration of the digital and green transitions, automating the discovery and formation of new collaborations in the circular economy.

Project start date and duration: 1st of June 2022, 36 months

Project consortium

No	Partner	Abbreviation	Country
1	Linköping University	LiU	Sweden
2	Interuniversitair Micro-Electronica Centrum	IMEC	Belgium
3	Concular Ug Haftungsbeschrankt	CON	Germany
4	+Impakt Luxembourg Sarl	POS	Luxembourg
5	Circularise Bv	CIRC	The Netherlands
6	Universitaet Hamburg	UHAM	Germany
7	Circular.Fashion Ug (Haftungsbeschrankt)	FAS	Germany
8	Lindner Group Kg	LIN	Germany
9	Ragn-Sells Recycling Ab	RS	Sweden
10	Texon Italia Srl	TEXON	Italy
11	Rare Earths Industry Association	REIA	Belgium

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Table of Content

Acronyms

AFIRM	Apparel and Footwear International RSL Management
API	Application Programming Interface
ASTM	American Society for Testing and Materials
BIM	Building Information Modeling
CAS	Chemical Abstracts Service
CE	Circular Economy
CEN	European Committee for Standardization
CMR	Conflict Minerals Regulation
CSV	Comma-separated values
CTA	Consumer Technology Association
DPP	Digital Product Passport
DID	Decentralized Identifier
EAN	European Article Number
ECVP	Environmental Claim Validation Procedure
EPD	Environmental Product Declaration
EEA	European Environmental Agency
eIDAS	electronic Identification, Authentication and Trust Services
ESPR	Ecodesign for Sustainable Products Regulation
EoL	End-of-Life
ErP	Energy-related Products
EU	European Union
GDPR	General Data Protection Regulation
GHG	Greenhouse Gas
GRS	Global Recycled Standard
GTIN	Global Trade Item Number
HS	Harmonized System
ID	Identifier
ISBN	International Standard Book Number
ISO	International Organization for Standardization
ISO/DIS	International Organization for Standardization/Draft International Standard
ISO/IEC	International Organization for Standardization/International Electrotechnical Commission
ISO/WD	International Organization for Standardization/Working Draft
IT	Information Technology
JSON	JavaScript Object Notation
LCA	Life Cycle Assessment
OIDC	OpenID Connect
OWL	Web Ontology Language
PAS	Publicly Available Specification
PCDS	Product Circularity Data Sheet
PCF	Product Carbon Footprint
PCR	Product Category Rules
PEF	Product Environmental Footprint
POP	Persistent Organic Pollutants
REACH	Registration, Evaluation, Authorisation and restriction of Chemicals
RoHS	Restriction of Hazardous Substances Directive
RCS	Recycled Content Standard
RDF	Resource Description Framework
RDFS	Resource Description Framework Schema
RSL	Restricted Substance List
SHACL	Shapes Constraint Language

SQL	Structured Query Language
UN CPC	United Nations Central Product Classification
UNECE	United Nations Economic Commission for Europe
URI	Uniform Resource Identifier
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute
WEEE	Waste Electrical and Electronic Equipment
WP	Work Package
XML	Extensible Markup Language

Summary

This report provides an overview of the legal context and standards related to three domains of the Onto-DESIDE project (ontology, decentralized data sharing, and circular economy (CE)) with a focus on three industrial sectors (construction, electronics and textile). These domains, inherently interconnected in the project scope, have implications for its operational framework. The methodology employed for the overview of standards and legislation includes scope definition criteria selection, collection and analysis of legislation and standards.

A clear distinction is made between standards influencing the project framework and those related to specific data attributes. Standards for the project framework have a greater potential to shape the platform development, impacting its overall structure and functionality, e.g. through direct reuse of technical components. Standards related to data attributes serve an informational purpose when creating the content of, for instance, the ontologies.

Various European Union (EU) legislations indirectly impact data sharing domain. Notably, the European Commission's European Strategy for Data establishes a culture of data openness and accessibility, the General Data Protection Regulation (GDPR) emphasizes transparency and consent in any data sharing involving personal data, and the Open Data. The Public Sector Information Directive (2019/1024) promotes the sharing and reusability of public sector data. These regulations indirectly influence the open-source data sharing ecosystem, enhancing data openness, reusability, accessibility and ensuring a safer digital space for users.

In terms of the technological standards, from the overview in this document, it can be noted that the underlying assumptions of the project, i.e. the technologies already pointed out in our workplan, are well aligned with the standards landscape in semantic interoperability and technical interoperability. However, there are several options related to identifiers, data quality, security etc. that are still to be explored further by the project in the next project iteration. Even further, the main challenge will be for the ontology network of the project to cover and be compatible with the broad landscape of standards (some of which are still emerging) and legislation of the CE area.

Within circular economy legislation, this analysis reveals a considerable impact from the Proposal for Ecodesign for Sustainable Products Regulation (ESPR) legislation. Notably, this legislation imposes ecodesign requirements that intricately link with data attributes related to materials and products. The alignment between these attributes and the legal landscape indicates a proactive stance toward compliance. Furthermore, chemical regulations, particularly REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) and RoHS (Restriction of Hazardous Substances Directive), appear as pivotal aspects, mandating compliance evidence as core data attributes.

Standards in the circular economy domain reflect their importance as data attributes defined in the demonstration use cases. Notably, 16 international and European standards directly pertain to environmental performance, covering areas such as carbon footprint, recycled content calculation, Environmental Product Declarations (EPD), and ecodesign requirements for energy-related products. An upcoming standard on traceability of rare earths in magnets further enhances the breadth of coverage. While still under development, the standard ISO 59040 on PCDS will play an important role to harmonizing data exchange across value chains. The standard provides a general methodology for improving the accuracy and completeness of circular economy related information. In addition, it specifies a list of data attributes to describe the circular economy aspects of products.

Additionally, the report identifies six representative standards within product classifications, contributing to standardized approaches for product categorization and interoperability. The report also shows that in business-to-business interactions, voluntary declarations and certifications carry substantial weight. These requirements stem from both legislative mandates and industry norms. The report identifies also emerging standards on the circular economy, which address the topic from a system perspective. Earlier standards cover limited aspects related to the circular economy, mainly focusing on environmental performance measurement, recycled content, or data sharing for hazardous substances compliance.

While standards serve as indispensable guides for environmental performance, their current scope might fall short in covering information necessary for End-of-Life (EoL) management. Stakeholders seek not only standardized approaches but also insights into available EoL methods, associated costs, and relevant technologies for by-product management, repair, and refurbishment. This comprehension is important in empowering stakeholders to make informed decisions for sustainable and economically viable EoL strategies.

In the second version of the report, the initial standards overview will be expanded by including emerging standards, establishing a plan for project ontologies, and anticipating future standardization needs, ensuring broader industry adoption and compliance.

1 Introduction

The Work Package (WP) 2 of the Onto-DESIDE project aims to achieve generalization across three project domains (ontology, decentralized data sharing, and the principles of a circular economy) and three use case domains (construction, electric and electronic equipment, and textile). It ensures that the project addresses a comprehensive set of requirements that not only meet the specific needs of all these use cases but are also sufficiently versatile to be applicable in other industries.

One of tasks of the WP2 is to formulate a standardization plan and to identify the standardization needs. The review of standardization and legislative context is pivotal in addressing the multiple topics addressed in Onto-DESIDE: development of ontologies and data-sharing platform in the context of circular economy. The development of ontologies necessitates modeling a diverse array of topics, e.g. materials and products as well as actors and processes, ensuring both vertical interoperability within industries and horizontal interoperability across different industry networks. This requires compliance with established standards in modelling and data sharing.

The review of legislation and standards is crucial for the development of a data sharing platform as it ensures legal compliance, data security, and interoperability. It helps create a framework that promotes trust among users, facilitates cross-industry data exchange, and supports the platform's alignment with industry best practices and regulatory requirements.

In the context of circular economy, the review of the legislation is necessary for guiding and enforcing sustainable practices, while standards offer guidelines and benchmarks for implementing effective and consistent methodologies. The utilization of three industry use cases also necessitates a comprehensive understanding of industry-specific standards and regulations.

1.1 Objectives of task 2.4

The objective of the Task T2.4, Standardisation, is to 1) map the existing standards landscape, both for the overall project domain, as well as the specific use case domains (construction, electronics and textile), and 2) develop a standardisation plan for the project outcomes.

The task consists of two iterations, each serving a distinct purpose.

1) **The first iteration** aims to provide a comprehensive overview of existing standards that the project will align with and leverage. This includes standards within the project domain, such as ontology, decentralized data sharing, and circular economy. Additionally, the first iteration covers specific use cases related to construction, electronics, and textiles. Furthermore, an introduction to the legislative context is also provided to ensure a comprehensive understanding of the legal framework within which these standards operate. The identified standards are analyzed for their alignment with relevant EU regulations and policies.
2) **The second iteration** of the task expands the initial overview of standards by incorporating emerging ones and developing a standardization plan for the project ontologies and protocols. The inclusion of emerging standards aims to facilitate the adoption and utilization of the project outcomes in various industry domains. Furthermore, the second iteration will analyze future standardization needs and outline a roadmap for achieving standardization beyond the project timeline.

1.2 Report purpose

This report presents the outcomes of the first iteration of T2.4. The objective of this deliverable is to present the findings of a comprehensive state-of-the-art analysis that examines current legislation standards and standards and their implications for the project. The standards can be either mandatory and/or voluntary requirements, and they should be applicable to both the overall project domains and the specific use case domains.

1.3 Contribution of partners

+Impakt Luxembourg Sàrl (POS), as the task lead, conceptualized and coordinated task members' efforts, gathered relevant information on legislation and standards, conducted in-depth analyses of the findings, as well as wrote and edited the report. POS provided the review of legislation relevant to the circular economy and data sharing (Section 5 in the report), as well as the review of standards linked to the circular economy (Part 6.3). Additionally, POS examined the implications of these findings on the project and summarized in the concluding remarks.

Linköping University (LIU) focused efforts on the ontology project domain. LIU collected, reviewed standards in this area, together with a first analysis of their relevance and applicability to the project.

imec (IMEC) focused efforts on the decentralized data sharing domain. IMEC collected, reviewed and analyzed the associated standards in terms of their relevance and applicability to the project.

2 Methodology

2.1 Research methodology

The methodology for the overview of standards and legislation involves a structured approach to ensure that standards selected for the project are relevant, widely accepted, and aligned with industry best practices and legal requirements. The steps are outlined as follows:

- Definition of the scope of the review based on project domains: ontology, decentralized data sharing, and circular economy.
- Definition of criteria for selection and characterizing of pertinent standards.
- Identification of the relevant legislation and its impact on the review.
- Collection and documentation of standards according to the defined criteria

The overall scope of the standard review is delineated by project domains, which encompass ontology, decentralized data sharing, and the principles of a circular economy. The specific focus topics for the standards review are determined by considering the functional and non-functional requirements established in Work Package 2 (WP2) and documented in Deliverable D2.1. Functional requirements derive from sector-specific user stories, which serve as a basis for defining the necessary functionalities. Deliverable 3.1 also built upon these functional requirements, elaborating a comprehensive list of topics relevant to ontological requirements. For the current deliverable, the list from D3.1 is reviewed to ensure that the scope encompasses all necessary aspects. In addition, non-functional requirements outlined in D2.1, such as security, reliability, and data integrity, are also included in the review scope. These requirements describe the operational capabilities of the Open Circularity Platform and are important considerations for the standard review process.

It is necessary to make a clear distinction between requirements directly linked to the project domains or platform development and those linked to the specific data attributes outlined in the requirements. Although standards for both categories will be collected, they have different degrees of influence on the project's trajectory.

Standards aimed at the broader project framework have a higher potential for shaping the platform's development. For example, they may provide essential guidelines and parameters impacting the platform's overall structure or functionality. Conversely, standards associated with data attributes primarily serve an informational purpose within the platform. These standards come into play during the creation, measurement, or communication of product-related information. While invaluable for ensuring data accuracy and consistency, they do not directly impact the development of the platform itself. They play a supportive role in maintaining the quality and reliability of data within the platform's ecosystem.

The understanding of the legal framework relevant to the scope is essential for incorporating current trends and information in the data sharing platform. It also illuminates which standards bear mandatory implications. Additionally, a review of the legislation encompassing the circular economy, particularly within the domains of construction, electronics, and textiles, contributes to mitigate the potential impact of subjectivity stemming from user stories. These stories, although invaluable for understanding business needs, and requirements, can reflect industry's vision and perspectives. However, the holistic approach ensures that the scope of the review remains aligned with the larger framework of circularity, environmental management, and regulatory compliance.

To create a structured overview and delineate relevant, widely accepted standards aligned with industry best practices and European legislation, specific criteria have been chosen for categorization and description:

1. Relevance: The standards should address the key aspects of the project domain - ontology, decentralized data sharing, circular economy. They should be also applicable to industry use cases – construction, electronics and textile.
2. Adoption and Acceptance: this criterion reflects if standards are widely recognized and accepted within the industry, if they are endorsed, or mandated by professional associations or regulatory bodies as best practice in the field.
3. Compatibility: this criterion verifies if standards align with other relevant standards (same field and other project domains), to verify if its integration impacts the interoperability across different related topics.
4. Regulatory and Legal Requirements: any standards adopted to support legal requirements? do standards align with any applicable laws, regulations, or compliance requirements?

Moreover, to ensure the inclusivity of relevant standards, case study experts from the project consortium contributed by reporting on standards deemed important in industry practices. This enriches the understanding of the standards landscape, encompassing standards from three project domains, established industry norms and developments, thereby fostering standards integration in the project.

For the identification of pertinent standards and legislation different sources are used, including but not limited to:

- ISO (International Organization for Standardization) for globally recognized and accepted standards.
- CEN (European Committee for Standardization) for standards pertinent to the European context.
- National Standardization Bodies for standards established by individual national bodies, reflecting regional considerations.

- Global Reporting Initiative is used for sustainability reporting standards and guidelines.
- European Union Law Portal for EU regulations and legal frameworks.
- European Environmental Agency (EEA) for environmental information reported by the member states.
- American Society for Testing and Materials (ASTM) for standards relevant to specific industries and testing methodologies.

Finally, collected standards are presented in an overview table structured according to the defined criteria.

2.2 Specific focus topics for the standard review

This part provides the description of topics that resulted from functional and non-functional requirements. The topics are developed per each of the project domains and assigned accordingly.

2.2.1 Ontology and Decentralized Data Sharing

In Figure 1, we outline the focus standardization topics as a horizontal hierarchical tree (from left to right, high-level to low-level topics), categorized according to the European interoperability layers[1] (i.e. Technical interoperability, Semantic Interoperability, Organisational Interoperability, and Legal Interoperability), and subcategories are introduced where relevant (e.g., the subcategory of Cybersecurity consists of topics 'Standardized access mechanism' and 'cybersecurity by default').

In terms of the ontology and data sharing frameworks, i.e. the technical areas of the project, these mainly fall below the semantic and technical interoperability categories. As can be seen in the figure the semantic interoperability deals both with ontologies, i.e. about the modelling of the concepts and relations that hold in our data, but also their relation to data models, i.e. how we can use the ontologies and standard formats to represent and share data in way that preserves semantic interoperability. And as the figure shows, that is then the connection to the technical interoperability layer, where ontologies and data models are used to technically allow data sharing and interpretation to happen.

In addition to the ontologies and data models, there is of course additional elements to the technical side of interoperability, i.e. there is also a need for unique and global identifiers, and protocols to transfer and query data in a decentralized setting. Further, data quality is an essential aspect to its use, and a layer of security is needed to both ensure the data integrity and provenance, but also confidentiality and privacy, for instance. These topics are further researched (see Section 4) to make sure the Open Circularity Platform and its related ontologies considers all relevant standards.

[1] https://joinup.ec.europa.eu/collection/nifo-national-interoperability-framework-observatory/solution/eif-toolbox/6-interoperability-layers

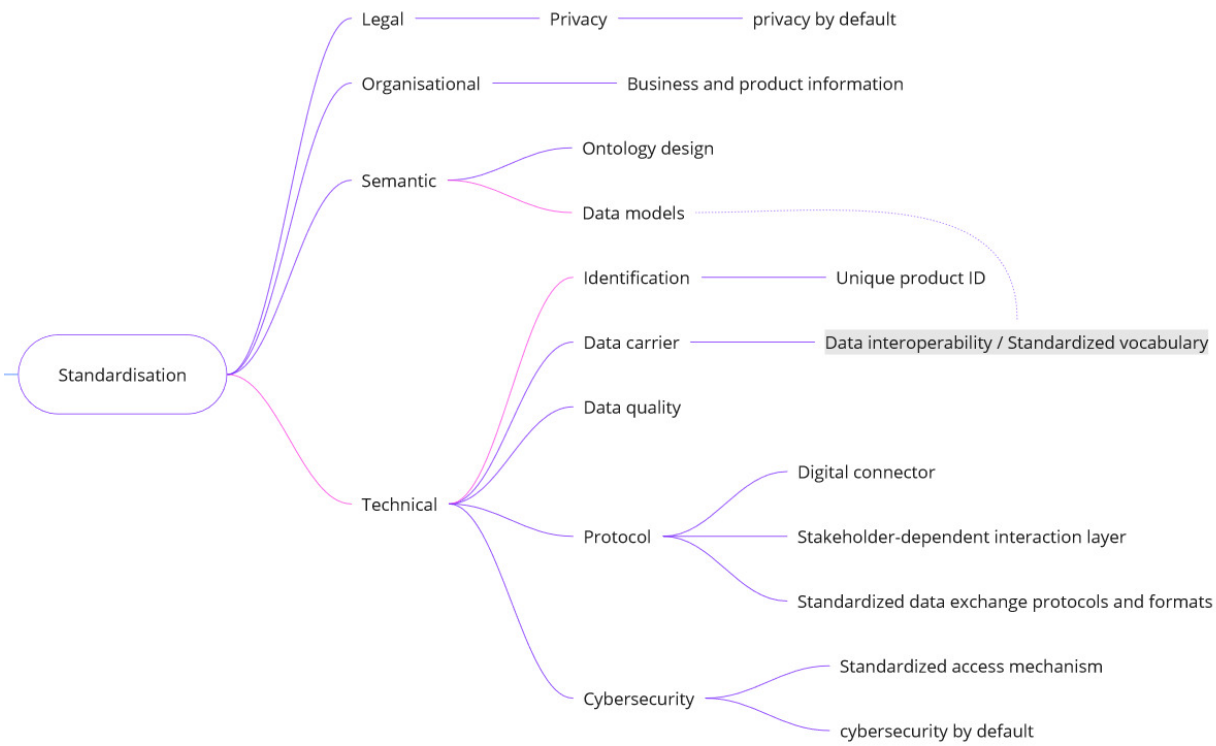

FIGURE 1 CATEGORIZATION OF THE FOCUS TOPICS ACCORDING TO THE EUROPEAN INTEROPERABILITY LAYERS.

2.2.2 Circular economy

The requirements outlined in the user stories have been categorized based on type of information for communication mentioned in user stories. The requirements related to the circular economy domain mentioned in the user stories are summarized in Figure 2. It is important to note that these requirements are not directly related to the development of the platform but are instead focused on data attributes that may be handled by the platform. These requirements are grouped accordingly:

- Product information
- Product composition
- Environmental Performance
- Circular economy product aspects.

Attributes for product information are sector-specific, with some commonalities. For instance, in the textile sector, key attributes include the type of fiber (fabric, yarn, trim, etc.), specific detype, color, and the country of origin of raw materials. Conversely, for electronic and electric equipment, critical information encompasses material and chemical composition, disassembly details, and the origin of raw materials. In the construction sector, vital product information includes dimensions, quantities, and pricing.

The category Product Composition encompasses data attributes about materials and substances used in a product, hazardous substances, critical raw materials, recycled content, and renewable content.

Environmental performance is a shared concern, either expressed as a willingness to communicate current performance or to gather data from suppliers. This aspect is measured using diverse indicators or tools, such as carbon footprint, sustainability assessment, life cycle assessment.

The category of Circular Economy Product Aspects encompasses various essential requirements to ensure sustainable and environmentally friendly practices throughout a product's life cycle. These requirements are crucial for promoting a circular economy, where products are designed with longevity, recyclability, and responsible end-of-life management in mind. Some examples within this category include information on End-of-Life (EoL) options and associated costs and information on the quantity and location of post-consumer products.

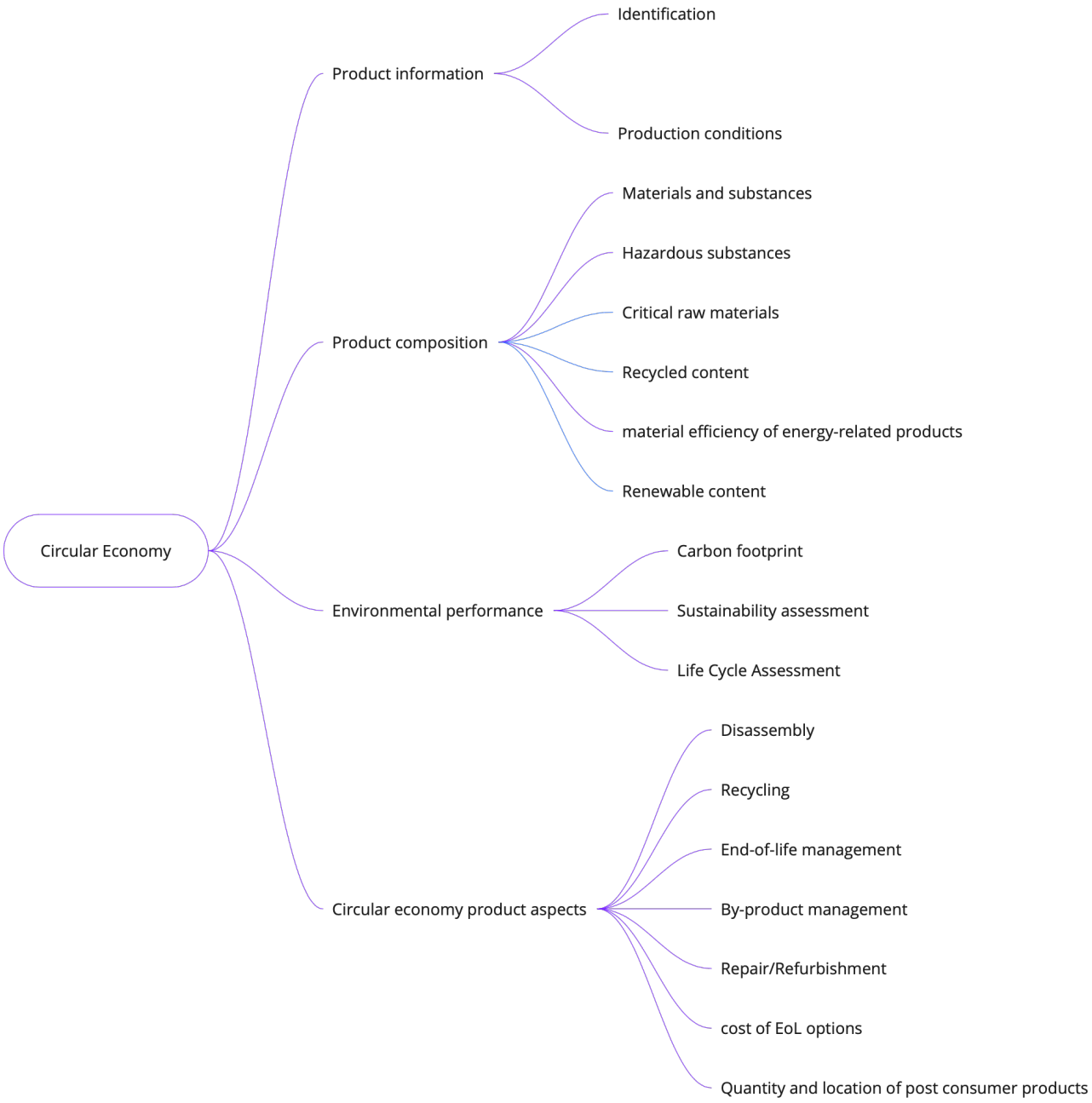

FIGURE 2 SUMMARY OF THE OVERVIEW CATEGORIZATION RELATED TO CIRCULAR ECONOMY

3 Legal framework

3.1 Legislation related to decentralized data sharing

The legal context related to ontology, decentralized data sharing platforms, and circular economy primarily centers around the latter. However, several legislation and policies within the European Union (EU) are indirectly linked to decentralized data sharing in a broader context:

- The European Commission's **European Strategy for Data** aims to establish a unified space for data in the EU, encouraging data sharing and the development of data spaces across various sectors. This initiative is designed to benefit businesses, researchers, and public administrations by fostering a culture of data openness and accessibility.
- **General Data Protection Regulation** (GDPR) governs the processing and transfer of personal data, emphasizing transparency and consent. While not specifically tailored for decentralized data sharing, GDPR creates a context for any data sharing involving personal data, promoting transparency and ensuring privacy protection.
- **Open Data and Public Sector Information Directive** (2019/1024) aims to promote the sharing and reusability of public sector data across the EU. It encompasses provisions related to the accessibility and reusability of datasets and refers to GDPR, reinforcing the importance of data protection and privacy in the context of open data initiatives.

These regulations indirectly influence the decentralized data sharing ecosystem by promoting data openness, reusability, and accessibility, thereby contributing to a safer digital space for users.

3.2 Legislation related to Circular Economy

Regarding the circular economy, relevant legislation can be categorized into two main groups: regulations that establish the framework for product data sharing and transparency, and regulations applicable to product data.

3.2.1 Regulation setting the framework for product data sharing and transparency

The **European Green Deal** is the policy framework setting the overarching sustainability goals for various policies and measures within the European Union. A key component of this framework is the **Circular Economy Action Plan**, which outlines specific initiatives, targets, and legislative proposals to accelerate the transition to a circular economy. This plan promotes sustainable resource use, circular design, waste reduction, and recycling.

The **Ecodesign Directive** is a regulatory framework that supports the Circular Economy Action Plan by integrating sustainable design principles into product development. Currently, the Ecodesign Directive sets mandatory ecological requirements for energy-using and energy-related products sold in Europe. It covers over 40 product groups (i.e. boilers, lightbulbs, TVs and fridges) and includes requirements related to product durability, reusability, upgradability, reparability, energy and resource efficiency, recycled content, remanufacturing, recycling, carbon and environmental footprints, presence of substances that inhibit circularity and information requirements such as Digital Product Passports.

The Proposal for **Ecodesign for Sustainable Products Regulation** (**ESPR**) builds upon the Ecodesign Directive to enhance its scope and impact. Expected to come into force in mid-2024, ESPR aims to

accelerate the transition to a circular economy by improving product sustainability, reducing environmental impact, and enabling transparency and traceability throughout the product lifecycle. ESPR seeks to broaden the range of covered products and establish product-specific eco-design requirements. These requirements, specified in delegated acts, are likely to encompass material composition, recycled content, avoidance of harmful substances, durability, repairability, recyclability, and assessment of environmental footprint. The regulations will include both performance requirements and information requirements accessible via a Digital Product Passport (DPP) (Figure 3).

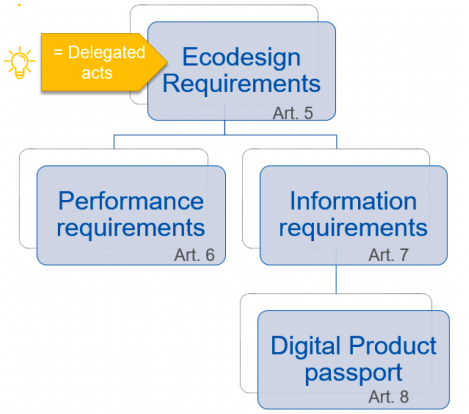

FIGURE 3 KEY ASPECTS OF THE ESPR (SOURCE: EU COMMISSION)

In the project context, the ESPR has significant implications. Firstly, it could necessitate the integration of Digital Product Passports (DPP) within the textile sector, and it also underscores the importance of communication and information sharing throughout the supply chain across all sectors.

ESPR, becoming mandatory for certain sectors (likely the textile industry will be the next after batteries), sets a precedent that can motivate other relevant sectors to proactively engage in ESPR implementation. These sectors may choose to voluntarily participate in data-sharing platforms, such as the Open Circularity Platform.

The implementation of ESPR mandates data-sharing platforms to fulfill crucial roles, including ensuring information accessibility, demonstrating compliance and reporting, and enabling lifecycle monitoring, as detailed in Table 1.

TABLE 1 ROLES OF DATA-SHARING PLATFORMS IN THE CONTEXT OF ESPR IMPLEMENTATION

Topic	Description	Platform functionality	Material/product data attributes
Information accessibility	repository of information related to a product's requirements	Ability to store different data formats	NA
Compliance and Reporting	Demonstration of compliance	Ability to store and visualize confirmations of compliances	List of compliances representative for each use sector
Lifecycle Monitoring	The capability for updating the product status by entities other than the original manufacturer	Rights to data access and update	List of ecodesign requirements

3.2.2 Regulations applicable to product data

3.2.2.1 Chemical

This part describes chemical regulation related to construction, electronic and electric equipment, and textile. The necessity to communicate compliance with REACH is a common requirement across all three sectors, while RoHS legislation is specific for electronic and electric sector.

REACH Regulation (EC) No 1907/2006 (Registration, Evaluation, Authorization, and Restriction of Chemicals) is the European Union regulation that addresses the use and potential harm of chemical substance. It aims to protect human health and the environment from the risks posed by chemicals. It covers a wide range of products, including electronics, textiles, and construction products.

REACH covers construction products that involve the use of chemicals during manufacturing, installation, or treatment. This regulation has implications for electronic and electric equipment as these products often contain various chemicals and substances. For textile products REACH applies to chemicals used in the production, treatment, or dyeing of textiles.

REACH Regulation (EC) No 850/2004 on Persistent Organic Pollutants (**POPs**) addresses persistent organic pollutants, bioaccumulate through the food chain, and pose risks to human health and the environment. It is relevant to construction, electronic and electric equipment and textiles since this regulation focuses on reducing or eliminating of POPs production, use, and release.

Regulation (EU) 528/2012 on **Biocidal Products** concerns the placing on the market and use of biocidal products, which are used to protect humans, animals, materials, or articles against harmful organisms like pests or bacteria. The regulation aims to ensure a high level of protection for humans and the environment. Biocidal product may be used in construction (i.e., wood treatment), electronic and electric equipment (in products that may come into contact with moisture) and textile.

Restriction of Hazardous Substances (**RoHS**) Directive (2011/65/EU) restricts the use of certain hazardous substances in electrical and electronic equipment. It aims to reduce the environmental impact of these products by limiting the use of substances like lead, mercury, cadmium, and others.

3.2.2.2 Sourcing

Conflict Minerals Regulation (CMR) requires EU importers of tantalum, tin, tungsten, and gold to source from responsible and conflict-free sources only.

3.2.2.3 Waste

The WFD, Waste Framework Directive, sets the basic concepts and definitions related to waste management, including definitions of waste, recycling, and recovery. It establishes a five-level waste hierarchy (prevention, preparing for re-use, recycling, other recovery and entails the producers' obligation to take back and dispose of returned end-of-life products. The directive also includes special provisions for hazardous waste, waste oil and biowaste. The recent Proposal (2023/0234) amending waste directive, focuses on textile waste and food waste, aiming to prevent them and reduce their associated impact. Specifically, the implementation of separate collection for textiles is proposed by no later than 01.01.2025.

The Chemicals Strategy for Sustainability – Towards a Toxic-Free Environment (COM(2020) 667) plays a pivotal role in addressing the issue of safe recycling. In the pursuit of transitioning to a circular economy, it underlines the importance of non-toxic material cycles. To pave the way for this transformative journey, the strategy outlines specific actions for the European Commission: enhanced information availability

concerning the chemical content, reduction of substances of concern, review of REACH regulations for recycled materials and supporting innovation in the textile sector.

The "Waste Electrical and Electronic Equipment (WEEE) Directive (2012/19/EU)" represents another critical legislative instrument. This directive establishes a robust framework governing the collection, recycling, and recovery of waste electrical and electronic equipment. It serves as a critical component in ensuring the responsible management and disposal of electronic waste, aligning with broader sustainability objectives and the transition to a circular economy.

These legislative and strategic initiatives reflect the shift in the way chemicals and waste management are approached.

3.2.2.4 Product labeling

As a requirement for compliance verification a need for communication on certification was expressed. Certification is the process of attesting or confirming that a product meets specified standards or criteria, often verified through assessment and documentation. The regulatory landscape within the European Union (EU) significantly influences the way products are labeled, designed, and managed. The Energy Labelling Regulation lays down a framework that applies to energy-related products placed on the market or put into service in the EU. It provides requirements for the labelling of those products and product information regarding energy efficiency, the consumption of energy and of other resources by products during use. Parallelly, the Energy-related Products (**ErP**) Directive reinforces these efforts by imposing ecodesign requirements on products, aiming to enhance their environmental performance. Additionally, the Regulation (EU) **1007/2011** focuses on textile products, streamlining fiber composition labeling to facilitate recycling processes and empower consumers with critical information about the composition of textile items.

The **European Union Ecolabel**, a voluntary label linked to Regulation (EC) No 66/2010, is another example of environmental compliance efforts. This label system considers several environmental aspects, including chemical usage, quality, and best production practices. For the textile industry ecological criteria for the award of the EU Ecolabel for textile products are set out in the decision 2014/350/EU with the respective amendment (2017/1392/EU).

4 Current Landscape of Standards

4.1 Overview of standards related to ontology

To represent ontologies, there is today one main family of standards that is used by both the academic community and industry, which is the semantic web stack of standards published by the W3C. W3C standards define an open web platform for application development. The web has the unprecedented potential to enable developers to build rich interactive experiences, that can be available on any device.W3C develops technical specifications according to the W3C Process, which is designed to maximize consensus, ensure quality, earn endorsement and adoption. This set of standards includes the Resource Description Framework (RDF) specification for data representation on the Web[2], RDFS[3] as a schema language for RDF data, as well as OWL[4] as an ontology language. There exist a few alternatives for ontology representation, such as Common Logic (ISO/IEC 24707:2018) and a number of older

[2] https://www.w3.org/TR/rdf11-concepts/
[3] https://www.w3.org/TR/rdf11-schema/
[4] https://www.w3.org/TR/owl2-overview/

languages, but none of these are directly compatible with current Web technologies, such as Uniform Resource Identifiers (URIs) for data identification, and also not immediately compatible with the data sharing platform of the project, hence, they have not been considered for use in the project. Consequently, building RDFS/OWL ontologies, for describing RDF data is an underlying assumption of this project.

However, when it comes to standards related to model content itself, i.e. standard ontologies, or ontologies as formal representations of other existing standards, this is a more open question. The W3C have also standardised a set of core ontologies, where the ones most relevant for this project are ORG[5] for modelling organisation structures, and PROV-O[6] for modelling data and vocabulary provenance. In addition, two areas needed by the project are also representations of time and space, where the W3C and other organisations have also done some standardisation efforts. For time concepts, there exists a Time ontology from W3C, which is currently a draft proposed for standardisation[7], which will be reused for the ontologies in the case when simple datatype properties are not enough. Similarly, for locations there is an ISO standard (ISO/TS 19150 with several sub-parts) providing guidelines for modelling geographical information in ontologies, and concrete standard ontologies for representing concepts, such as the OGC GeoSPARQL ontology[8] and the W3C basic geo vocabulary for coordinates in WGS84 (not a standard, but commonly used, and available from the W3C[9]). The OGC GeoSPARQL standard supports representing and querying geospatial data on the Semantic Web. GeoSPARQL defines a vocabulary for representing geospatial data in RDF. GeoSPARQL is designed to accommodate systems based on qualitative spatial reasoning and systems based on quantitative spatial computations. Related to this, there are also some schemas that lie at the border between representation and content, such as SKOS[10] for modelling knowledge resources, and Dublin Core (ISO 15836-1:2017) for metadata, which are also used for ontologies and datasets, and which the project reuses for metadata of entities in the ontologies, and the ontologies themselves.

In addition, although not a recommendation (i.e. standard) but rather a working group note, there are also guidelines for ontology publishing[11] that the project should adhere to. In particular, they specify principles for publishing ontologies, regarding their URI identifiers, resolvability etc., which relates also to the FAIR publishing of ontologies, which is an essential set of principles for the project as well.

4.2 Overview of standards related to decentralized data sharing

For decentralized data sharing we review the current technical interoperability standards, categorizing them into Identification (making sure all elements are correctly identified), Data carrier (making sure all data can be exchange in a machine-interpretable format), Data quality (making sure the data is fit for use), Protocol (making sure applications can communicate with each other), and Cybersecurity (making sure all data exchange are safe and trustworthy).

[5] https://www.w3.org/TR/vocab-org/
[6] https://www.w3.org/TR/prov-o/
[7] https://www.w3.org/TR/owl-time/
[8] https://www.ogc.org/standard/geosparql/
[9] http://www.w3.org/2003/01/geo/wgs84_pos#
[10] https://www.w3.org/TR/skos-reference/
[11] https://www.w3.org/TR/swbp-vocab-pub/

4.2.1 Identification

Individual resources in the network must be uniquely identified. Multiple standards across use cases exist, e.g. **ISO/IEC 15459-1:2014** for individual transport units, the **Global Trade Item Number** (GTIN) as overarching barcode standard (encompassing, among others, ISBN and EAN), and the **CAS Registry Number** for chemical components. To technically exchange these identifiers in a standardized way, we can make use of Uniform Resource Identifiers (**URI**) or Decentralized Identifiers (**DID**). In the project, since it relies heavily on web technologies and standards, URIs will be one of the main identifiers used for data elements. We will then investigate further what product identifiers to cover, but this more a question on the modelling side.

To specifically identify actors within a network, available standards include **eIDAS**, DIDs, or the **Solid WebID Profile**. So far, the project is investigating the use of WebIDs, due to the use of the Solid ecosystem as our basic platform.

4.2.2 Data carrier

In the context of this project, since we are focusing the data sharing and not the connection to the physical product, we are here discussing data carriers assuming that the context is digital data sharing rather than physical data carriers, such as QR-codes or barcodes.

Existing data is structured in many different formats (e.g. tabular, hierarchical) and serializations (e.g. CSV, XML, JSON). The Resource Description Framework (**RDF**) is a graph-based data structure that has multiple serializations (e.g. **RDF/XML**, **JSON-LD**, **Turtle**), which is a W3C standard[12] since 1999. This flexible framework allows us to structure and integrate data from any use case in an interoperable way.

4.2.3 Data quality

Data quality is typically defined as 'fit for use': does the data at hand fit the use case or application that needs to handle that data? The Shapes Constraint Language (**SHACL**) is a standard to define data shapes on top of RDF. To then make sure that, when using the data, this data is not altered, accreditation standards such as **Verifiable Credentials** can be used to structure data envelopes that contain the actual data and a signature to verify that the exchanged data is genuine and unaltered.

4.2.4 Protocol

The exchange of industry data and services is standardized according to **ISO/IEC 27070:2021**. To digitally expose existing data sources (typically not in RDF), first, a data mapping needs to be done. This can be achieved using the RDB to RDF Mapping Language (**R2RML**), or its extension the RDF Mapping Language (**RML**).

Then, a standardized data exchange protocol is needed. The Solid specifications (specifically, the **Solid Protocol**, the **Solid Application Interoperability** standard and the **Solid Notifications Protocol**) provide a RESTful protocol to publish unstructured, semi-structured, and structured data via a uniform API, based on the **Linked Data Platform** standard.

This generic protocol allows for generic information exchange and should be employed into use-case specific exchanges. For example, the SPARQL Query Language (**SPARQL**) is an RDF-based query

[12] https://www.w3.org/TR/rdf11-concepts/

language and protocol (like **SQL** for relational databases) that can be applied on top of the generic Solid protocols, and which is a W3C standard. Also, the **Verifiable Credentials API** specifications can be applied on top of the Solid protocols, which makes it a good candidate for use in the project. The Verifiable Credentials API, albeit under development, is the only API standard currently available that focuses on decentralized accreditation, compared to a plethora ad-hoc custom implementations. Adhering to this standard makes our platform not only interoperable with Solid, but potentially also across other decentralized data sharing ecosystems.

4.2.5 Cybersecurity

Information security standards follow the **ISO/IEC 27000 series**. For secure authentication in a Solid ecosystem, the **Solid OIDC** specification is standardized. This is an extension to the **OpenID Connect Protocol**, to make use of WebIDs and allow free choice of identity provider. Authorization is provided using the **Web Access Control** or **Access Control Policy** standards.

4.3 Overview of standards related to circular economy

4.3.1 Product information

Standards related to product information are representative for data attributes related to materials, rather than the impact on the project or the development of the platform. Standards for classifying different types of products play a crucial role in ensuring interoperability, safety, and regulatory compliance in the industry. These standards help categorize various products, which can vary significantly in terms of characteristics, intended use, and other relevant criteria. Here are some examples of standards for classification systems:

- **Building Information Modeling (BIM) Standards** : provide guidelines and classifications for digital representations of construction products, aiding in efficient design, construction, and management of building projects. Examples of standards include BS 1192, PAS 1192-2, 3, 4 and 5, BS 8536-1, ISO 12006-2:2015.
- International Classification of Goods for Customs Purposes (**HS Code**): the Harmonized System (HS) is a standardized classification system used by customs authorities to categorize products, including electrical and electronic equipment, textiles and construction products.
- **UN CPC** (United Nations Central Product Classification): global standard for classifying products and services. It includes a section for electrical and electronic equipment, offering a systematic classification based on product types, categories related to textiles, covering various textile products, fibers, yarns, fabrics, etc, and categories related to construction materials
- Consumer Technology Association (**CTA**), publishes standards for consumer electronics, including various types of audio and video equipment.
- **ISO 2076 – Man-made fibres – generic names** specify generic fiber names and definitions.
- **ASTM** Darn: Standard terminology related to fibers and textiles.

4.3.2 Product composition

The requirements emphasize the necessity to demonstrate the composition and compliance across various aspects of the product content. This includes providing information regarding the origin and conditions of material production, adherence to hazardous substances regulations, and the incorporation of recycled content in products.

Within the textile industry, the 'Restricted Substance List' (RSL) administered by the Apparel and Footwear International RSL Management (**AFIRM**) is a recognized reference used to ensure the compliance with specific restrictions on the use of hazardous substances.

In the context of energy-related products, **IEC 62474** is a standard that addresses material declaration for products used in the electrical and electronic industry. It provides a framework for reporting substances and materials, aiding transparency in the supply chain. **EN 45558:2019** presents a comprehensive standard that outlines a general method for declaring the use of critical raw materials in energy-related products. It plays a significant role in acknowledging and addressing the importance of critical material use.

The study identified an upcoming standard **ISO/WD 17887**, focusing on the traceability of rare earths within the supply chain, specifically from separated products to permanent magnets. This standard aims to establish a management system for identifying the origin of materials that contain rare earths. It will contribute to the tracking of these materials through the supply chain, bridging the gap between suppliers of rare earth oxides and producers of permanent magnet. As for material efficiency aspects of energy-related products **EN 45559:2019** details methods for providing this data attribute, a critical consideration in sustainable product design and development.

Standards for recycled content in products and materials can be categorized into two main groups The first group include those standards that focus on the methodology for calculating the recycled content indicator and are reviewed below. The second group covers standards related to declaring the value of this indicator. Recycled content is important data attribute often included in standard product data sheets, alongside other technical and environmental data. Currently, the method used to calculate recycled content and the point at which a material is considered recycled are discussed. For instance, according to **ISO 14021** it is “the proportion, by mass or percentage, of recycled material present in a product, packaging, or product component. Recycled content comprises materials recovered from pre-consumer or post-consumer sources, reprocessed for use in the production of new products”. However, in the NEN workgroup on circular textiles, experts agree that, concerning production waste, only unavoidable production waste can lead to the classification of materials as recycled. When production waste can be reintroduced into the same process, it is not considered recycling but rather optimal material utilization within an economically efficient operation. This concept is outlined in the standard **NTA 8195:2020**[13]**.**

Other examples addressing recycled content in various industries are:

- **EN 45557:2020** provides a general method for assessing the proportion of recycled material content in energy-related products
- **ASTM Recycled Content Standards**: ASTM International develops industry-specific standards for recycled content in various products, providing guidelines for manufacturers and consumers.

Manufacturers can self-declare the recycled content; however, they must be able to provide evidence regarding primary and recycled materials used in the manufacturing process. ISO 14021 provides guidelines for self-declared environmental claims, including those concerning recycled content, and specifies the necessary information and methodologies to substantiate such claims. Additionally, there are certifications for recycled content offered by various organizations and certification bodies, including:

- **Global Recycled Standard (GRS)**

[13] Source : OVAM (2021). Ecodesign criteria for consumer textiles

- **Recycled Content Standard** (**RCS**): developed by Textile Exchange, RCS is used for certifying recycled content in textiles and apparel products.
- **Post-Consumer Recycled Content**: voluntary standard with third-party certification.
- **Environmental Claim Validation Procedure (ECVP) for Recycled Content -** authenticates recycled content of products (post-consumer, pre-consumer, closed-loop or total), providing third- party validation. It was applied across various industries, including electronics, and batteries.

For the platform the possibility to incorporate and demonstrate the compliance with these standards and underlying legislation will help to enhance transparency and trust within the supply chain.

4.3.3 Environmental performance

Environmental performance standards reflect essential data needs highlighted within user stories. The below standards detail methodologies for calculating various indicators related to environmental performance. Companies seeking to communicate their environmental efforts can adhere to these standards.

One significant environmental performance indicator frequently addressed in user stories across diverse use case sectors is the carbon footprint. Despite ongoing efforts for standardization, there exist several standards for quantifying greenhouse gas (GHG) emissions associated with different scopes and types of products. Here are some of the most notable standards applied at the product level:

- **ISO 14067**: this standard was developed to enhance GHG reporting transparency and comparability internationally, making it a recognized global reference for conducting Product Carbon Footprint (PCF) assessments. ISO 14067 aligns with existing Life Cycle Assessment ISO standards (14040-14044) and PAS 2050, but can have insufficient detail.
- **PAS 2050** (stands for "Publicly Available Specification 2050"): widely acknowledged and applied on an international scale, PAS 2050 is a standard established by the British Standards Institute for calculating product GHG emissions.
- **GHG Protocol Product Standard**: created by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) in October 2011, this standard aligns with PAS 2050. The key distinction is that the GHG Protocol Product Standard includes specific requirements for public reporting, enhancing transparency in GHG emissions associated with products.
- The Product Environmental Footprint (**PEF**): approach recommended by the European Union (EU) for conducting Life Cycle Assessment (LCA) studies. PEF necessitates the calculation of 16 impact categories. However, some legislative proposals suggest utilizing this method, primarily focusing on climate change as the sole indicator for reporting carbon footprint.
- **ISO 14064** Series: Comprising a set of standards, ISO 14064 provides comprehensive guidelines for GHG accounting and verification. ISO 14064-1 outlines principles and requirements, ISO 14064-2 covers quantification and reporting for projects, and ISO 14064-3 focuses on the validation and verification of greenhouse gas assertions.
- **EN 15804**: European standard that provides guidelines and requirements for conducting environmental product declarations (EPDs) for construction products. It encompasses a set of required environmental impact indicators, with climate change being one of them. All these indicators must be calculated and reported as part of the standard. Specifically, the climate change indicator allows for the quantification of the carbon footprint associated with the studied product.

Industrial partners emphasize the significance of an **Environmental Product Declaration** (EPD) in furnishing transparent and comparable information regarding a product's environmental performance throughout its life cycle. An EPD is a Type III declaration as per ISO 14025, signifying that it's not a standard. However, EPDs are grounded in recognized standards for Life Cycle Assessment (LCA), encompassing ISO 14040 and 14044. These standards guide the assessment of environmental impacts from the product's entire life cycle. Additionally, ISO 14025 provides the framework for creating EPDs. The Product Category Rules (PCR) is standardized LCA-related copyrighted document helping to create a high-quality EPD for the product category. The PCR provides the instructions for how the LCA should be conducted. It sets out system boundaries, functional unit, use phase and end-of-life options, impact categories to be assessed.

In the construction sector, **ISO 21930**, delineates the fundamental principles, specifications, and requirements necessary for the development of EPDs for construction products, services, as well as construction elements and integrated technical systems employed in various construction projects. This standard ensures that EPDs for construction-related items follow consistent guidelines, allowing for comparisons.

4.3.4 Circular economy product aspects

This category encompasses requirements related to a circular economy, where products are designed with longevity, recyclability, and responsible end-of-life management in mind. The report identifies several emerging standards on the circular economy, which address the topic from a system perspective. These standards are significant for the project's context as they establish the vocabulary and offer precise definitions for key aspects.

- **ISO/DIS 59020** Circular economy — Measuring and assessing circularity
- **ISO/DIS 59004** Circular Economy – Terminology, Principles and Guidance for Implementation
- **ISO/DIS 59010** Circular Economy — Guidance on the transition of business models and value networks
- **ISO/DIS 59014** Secondary materials – Principles, sustainability and traceability requirements
- **ISO/DIS 59040** Circular economy - Product Circularity Data Sheet (PCDS)
- **CEN/TC 248/WG 39** Circular Textiles Chain - Requirements and categories.
- **ISO 5157:2023** Textiles - Environmental aspects – Vocabulary (Published) - terms and definitions used in the textile value chain related to environmental and circular economy aspects including design, production, retail, use and reuse, recycling processes, repair and disposal.

While still under development, the standard ISO 59040 on PCDS will play an important role to harmonizing data exchange across value chains. The standard provides a general methodology for improving the accuracy and completeness of circular economy related information. In addition, it specifies a list of data attributes to describe the circular economy aspects of products.

There are other standards relevant to the assessment of various aspects related to sustainability, durability, remanufacturing, recyclability, recoverability, and material efficiency of energy-related products. They have emerged from the standardization request made to European standardization organizations concerning ecodesign requirements, specifically focusing on material efficiency aspects for energy-related products to support the implementation of the Ecodesign Directive 2009/125/EC:

- **EN 45552:2020** outlines a general method for assessing the durability of energy-related products.

- **EN 45553:2020** provides a general method for assessing the ability to remanufacture energy-related products.
- **EN 45555:2019** encompasses general methods for assessing the recyclability and recoverability of energy-related products.
- **EN 45556:2019** provides a general method for assessing the proportion of reused components in energy-related products.

There are several standards related to End-of-Life (EoL) management, particularly in the context of sustainability and environmental responsibility. These standards provide guidelines and best practices for managing products, materials, and waste at the end of their useful life and can be followed by the industries interested in the improvement of efforts in this stage, either from managerial or technological perspectives. Some of the key standards in this area include:

- ISO 15270 provides guidelines for the process of recycling materials from products at their end of life.
- EN 50625 Series: Collection, logistics & treatment requirements for WEEE (Waste Electrical and Electronic Equipment): This series of European standards provide requirements for the collection, logistics, and treatment of electronic waste (WEEE), focusing on appropriate EoL management for electrical and electronic equipment.

In addition to overarching standards related to EoL management and sustainability, no specific sector- and technology-specific standards is identified addressing information requirements or unique challenges and practices within various industries.

4.3.5 Summary of standards related to circular economy

Table 2 presents an overview of the collected standards dedicated to the circular economy domain, encompassing key aspects such as product information and composition, environmental performance and circular economy aspects.

TABLE 2 SUMMARY OF STANDARDS RELATED TO CIRCULAR ECONOMY

Categories	Sub-categories	Reference standards	Sector scope
Product information		Building Information Modeling (BIM) Standards: BS 1192, PAS 1192-2, 3, 4 and 5, BS 8536-1, ISO 12006-2:2015	Construction
		International Classification of Goods for Customs Purposes (HS Code)	Cross-sector
		United Nations Central Product Classification	Cross-sector
		Standards of Consumer Technology Association	Electronics
		ISO 2076	Textile
		ASTM Darn	Textile
		European Union Ecolabel	Textile
Product composition	Product ingredients	IEC 62474	Electronics
	Material efficiency	EN 45559:2019	Electronics
	Hazardous Substances	AFIRM	Textile
	Recycled content	ISO 14021 NTA 8195:2020	Cross-sector
		EN 45557:2020	Electronics

		ASTM Recycled Content Standards	Industry-specific
	Critical Raw Materials	EN 45558:2019	Electronics
Environmental Performance	Greenhouse Gases emissions	GHG Protocol Product Standard ISO 14064 ISO 14067 PAS 2050 EN 15804	Cross-sector
	Environmental impact	Product Environmental Footprint Product Category Rules ISO 14040 ISO 14044 ISO 14025	Cross-sector
		ISO 21930	Construction
Circular economy aspects		ISO/DIS 59020 ISO/DIS 59004 ISO/DIS 59010 ISO/DIS 59040 ISO/DIS 59014	Cross-sector
		CEN/TC 248/WG 39 ISO 5157:2023	Textile
		EN 45552:2020 EN 45553:2020 EN 45555:2019 EN 45556:2019	Electronics

Additionally to the identified standards, the industrial partners of the project emphasized the significance of adhering to standards in environmental and quality management. Particularly, they stressed the widespread recognition of quality management certification within the industry:

- ISO 14001:2015 Environmental management systems - Common environmental management certification.
- ISO 9001:2015 Quality management systems — Requirements.

Texon highlighted that these certifications ensure trust throughout data management. The associated certification is viewed as a positive point when choosing stakeholders, significantly enhancing trust and reliability.

4.4 Limitations of the analysis

For the technical standards landscape we have, as a starting point, taken the fact that certain standards are already pointed out by the project, i.e. the project focuses on testing and evaluating the use of OWL ontologies over RDF data shared through Solid. Hence, we have not analysed any alternatives to these standards, but rather merely mentioned our use of them, and identified the complementing standards that may be able to extend our platform and ontologies to cover the needs of the Circular Economy.

5 Conclusion

The deliverable provides an overview of the legal context and standards within three key project domains – ontology, decentralized data sharing, and circular economy.

The review of circular economy related legislation highlights a significant influence of the upcoming Extended Producer Responsibility (ESPR) legislation and its potential ecodesign requirements on data attributes associated with materials and products. Remarkably, these data attributes closely align with the legal landscape, demonstrating a proactive approach to compliance. In this context, chemical regulations, specifically REACH and RoHS, also demonstrate high impact, necessitating evidence of compliance as a core data attribute.

Exploring standards for decentralized data sharing shows a clear fit for Solid-related standards, usable in a business-to-business setting such as Onto-DESIDE. Similarly, for ontologies the technical standards are coherent with the technology choices already set in our work plan, however, the challenge here lies in the content of the ontologies. On one hand we should comply to and reuse existing standard ontologies, but also make sure that the concepts and relations in the ontologies built comply with the standards related to the circular economy domain.

Exploring standards within the circular economy domain, it becomes evident that these standards, while not directly dictating project execution, intricately reflect essential data attributes underscored within the user stories. The review identified 16 standards of relevance to environmental performance, encompassing aspects such as carbon footprint, recycled content calculation, Environmental Product Declarations (EPD), material efficiency, ecodesign requirements for energy-related products, and an upcoming standard on traceability. While still under development, the standard ISO 59040 on PCDS will play an important role to harmonizing data exchange across value chains. The standard provides a general methodology for improving the accuracy and completeness of circular economy related information. In addition, it specifies a list of data attributes to describe the circular economy aspects of products.

Within the spectrum of product classifications, six representative standards are highlighted. Although the list of classifications provided is not exhaustive, its incorporation into data attributes holds a crucial role in promoting interoperability and ensuring a standardized approach in categorizing products.

In business-to-business communication, voluntary declarations and certifications hold significant weight. Particularly, in the textile use case, compliance with various topics, including the origin and conditions of material production, compliance with chemical regulations, and recycled content, is vital, driven by both legislative and industry contexts.

While standards serve as indispensable guides for environmental performance, they might fall short in covering the comprehensive information necessary for End-of-Life (EoL) management options. Stakeholders are in need of not only standardized approaches but also access to updated, comprehensive information on available EoL methods, their costs, and the technologies pertinent to by-product management, repair, and refurbishment. This holistic understanding is essential in enabling stakeholders to make informed decisions that balance environmental and financial considerations, ensuring sustainable and economically viable EoL strategies.

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