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Digital Product Passport standardization – factors, actors and institutions

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Digital Product Passport standardization – factors, actors and institutions

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Abstract

The potentials of digital technologies to support environmental sustainability and circularity of production and consumption processes have been discussed for many years. One of the initiatives that clearly has such potential is the Digital Product Passport (DPP), which has been initiated by the European Union. The paper discusses the standardization processes that will lead up to the implementation in the European Union of the Ecodesign and Sustainable Products Regulation (ESPR) that entered into force in July 2024. The paper discusses the factors, actors and institutions that affect the development of DPP standards and the barriers that the standardization processes face.

1. Introduction

Digital Product Passport (DPP) is the European Union concept for the systems and the data to be used in supply chains and to end-users with the purpose of providing and sharing data on products, eventually facilitating more sustainable products and circular economy prospects. It is a technical solution aiming at documenting sustainability data regarding the lifecycles of physical products (DS, 2024). As is explained, e.g., by Danish Standards (DS), the purposes are to improve end-to-end traceability of products in the value chains, to help consumers make informed choices, to support the availability of relevant information for companies repairing and/or recycling products, and to improve control mechanisms (DS, 2024).

DPP is thus not concerned with quality and sustainability requirements for the products themselves but with requirements on the data and information accompanying the products, and on the systems used for communicating the data. The fact that product data must be supplied can in itself contribute to incentivizing improved product quality and sustainability as information on the products will have to come out in the open, but it is not the immediate aim of the DPP initiative. The aim is to improve the provision of sustainability data on the products so that all links in the production and consumption chains will have a chance to act more sustainably and to enhance circularity.

For DPPs to have any significant effect, they must be based on minimum requirements for the product data to be communicated and shared and on standards for the systems and formats used for communicating these data. The European DPP initiative includes both of these two elements: Standardized systems and formats and minimum requirements for product data. The standards are being developed by official European standardization bodies on the basis of a request from the European Union, and the minimum requirements for product data will be issued by the European Union in delegated acts but can be further extended by the industry players affected by the product data requirements.

The European DPP arrangement to be implemented will be decentralized. There will not be any centralized databases, where it can be checked whether specific products live up to data requirements. But there will possibly be national registries providing information on where to find product data and a federated network of national registries. It is the responsibility of the individual producers to make certain that their products live up to data requirements, and the certification mechanism will be the existing European system, based on the responsibility of the individual producers to live up to requirements, though a greater emphasis on third party certification is a possibility that has been considered by the European Commission, but which industry is not interested in (DI, interview, 2024).

The paper focuses mainly on the system standardization aspects of the DPP initiative and only tangentially touches upon the data requirements. The aim of the paper is to examine the kinds of DPP standards that will be required, the standardization bodies involved, and the actors (stakeholders) who strive at influencing the standards development processes. The research question is: Which are the factors that affect the development of DPP standards and how do these factors interrelate in the standards development processes?

The European Union has taken the initiative to introduce the digital product passport. The implementation of the DPP will be supported by technical standards developed by the European Standardization Organization, following an official standardization request from the European Union. There are three official standardization bodies that the EU uses: CEN (European Committee for Standardisation), CENELEC (European Committee for Electrotechnical Standardisation) and ETSI (European Telecommunications Standards Institute). In the case of DPP, the relevant organizations are CEN and CENELEC – with ETSI TC EE (Environmental Engineering) having a liaison agreement with CEN/CLC JTC (Joint Technical Committee) 24. The international equivalents of CEN and CENELEC are ISO (International Organization for Standardization) and the International Electrotechnical Committee (IEC). These organizations also have an interest in the DPP standards development process, and some international technical committees (ISO/TC 323 Circular Economy and ISO/IEC JTC 1/SC 31 Automatic identification and data capture techniques) also have a liaison agreement with CEN/CLC JTC 24. Because of the extraterritorial aspects of DPP, an international outlook beyond the EU is required.

Every member of CEN and CENELEC can establish a so-called mirror committee at the national level. By participating in the national mirror committee, experts have the opportunity to engage in European standardization as well. Standards are developed through consensus. Consensus is a process where various stakeholders, including businesses, interest groups, standardization organizations, and governments, collaborate to develop standards. The kinds of standards that DPP will require are standards for the systems and formats for the DPP data to be communicated and shared. In an attempt to define the basic categories of standards that exist, Paul David (1987) listed three kinds of standards: Reference standards, minimum quality standards and compatibility standards. The kinds of standards that will be required for DPP will primarily be compatibility standards, and there will also be a need for reference standards. Minimum quality standards are included in a great many standards for sustainability and circularity, but DPP in itself does not aim at setting minimum quality but at communicating data on the products.

Standardization in the official European Standardisation Organisations is open to all stakeholders who wish to influence the standardization processes and the standards developed. In the paper, we examine who these stakeholders are and how they seek to influence standardization taking place. There are already stakeholders that for many years have been working with the kinds of tools and standards that will be part of DPP. This applies, for instance, to GS1 (one global system of standards), which in itself is an international standardization organization (although not an official European Standardization organization) that for many years have been developing standards supporting the efficiency of supply chains, for instance bar codes.

The purpose of the paper is to contribute to better understanding the standardization aspects of developing a DPP system. First, there is an introduction to the EU context for the sustainability and circularity initiatives that the Union has taken during the 15+ years. This is followed by a theory framework. Thereafter, there is a section describing the methodology applied. After this, a section discussing the kinds of standards that are relevant for DPP is included. Following these introductory sections, the main focus is on the standardization organizations involved and the standardization processes that have started. This includes an analysis of the different stakeholders and how they seek to influence the development of DPP standards.

2. EU context

The European Union was originally created as a community of trade partners and has continually worked on extending and deepening the economic relation among the Member States with an internal common market aim. Political and regulatory initiatives, therefore, in most cases refer to enhancing the internal market functions, also when part of the purpose is to improve developments of a social, environmental, security, etc. character. The GDPR (General Data Protection Regulation) is a good example. The primary aim is to protect data security, but when creating a common EU regulation with the same rules in all Member States, the internal market function is improved at the same time.

The treaties of the European Union (Treaty of the European Union, TEU, and Treaty of the Functioning of the European Union, TFEU), therefore, primarily refer to building the internal market. However, the protection of the environment has also been inscribed in the European Union treaties since the 1980s and sustainable development is referred to in the Lisbon Treaty (TEU and TFEU) from 2009 as one of the objectives of the EU (Domenech and Bahn-Walkowiak, 2019). The internal market and sustainability goals, in a sense, become two sides of the same coin. In order to create a common and internal market not only must common economic rules be set but also common standards for social and environmental behavior.

Over the years, this has supported a development, where EU raises the level of standards and rules in a large variety of areas, data protection, security, sustainability, etc. In the international context, EU has become a site for improving social and environmental rights as compared to most other countries and regions of the world, and the EU has also certainly seen itself in that way. The idea has been that this can also position the EU in the international competition, as other countries and

regions will be inspired and will be subject to EU extraterritorial rules pushing them in the same direction.

In the area of sustainability and circularity, the most important pillars of EU policies and regulations are concerned with ecodesign, sustainability due diligence and reporting, and planning of circular economy actions. With respect to ecodesign, the Ecodesign for Sustainable Products Regulation (ESPR), which entered into force in July 2024, is the most important recent initiative. The ESPR is the regulation which includes the DPP provisions. Regarding sustainability due diligence and reporting, the Corporate Sustainability Due Diligence Directive (CSDDD - 2024) and the Corporate Sustainability Reporting Directive (CSRD - 2022) are the prime policy decisions. In the area of circular economy planning, there are ongoing plans, where the latest is the 2020 Circular Economy Action Plan (CEAP). With the EU Green Deal of 2020, the pillars of the EU sustainability and circular economy policies have been placed on a common platform.

There is thus a whole palette of policy and regulatory initiatives in an ongoing process of strengthening environmental sustainability and circularity in the EU. Lately, however, tendencies have appeared that signal halting this process. The Draghi report from 2024, which has received backing from the European Commission, puts forward an analysis stating that the EU is losing competitiveness as compared to China and the US and recommends that more emphasis should be on creating an economic policy environment with more focus on investments and with lighter regulations. The Draghi report has been followed up by the so-called Omnibus decision from February 2025 (European Commission, 2025) limiting the scope and braking the speed of sustainability regulations with special reference to the CSDDD and the CSRD. Whether and, if so, the extent to which this will affect the ESPR including DPP is yet to be seen. However, as requirements in the CSDDD are likely to be part of the information requirements of DPP, it seems likely that the Omnibus decision may also affect the DPP initiative.

3. Theory framework

The theory framework applied in the paper is based on three streams of theory. The first stream is institutional theory in its basic form as put forward by, e.g., North (1984) and Scott (2008), where institutions are as well ‘the rules of the game’, as it was formulated by North (1984), and the organizations that build upon and further develop these rules and associated practices.

The second stream is actor analysis. Actor analyses obviously build on and are part many different social science disciplines. However, the prime inspirational science discipline in our context is actor analysis regarding public policy as it has, for example, been put forward by Hermans and Thissen (2009) and together with other colleagues from Delft University of Technology in a book (Enserink at al., first edition in 2010 and second edition in 2022).

The third stream is Actor Network Theory (ANT) as it was developed by Callon (1984), Law (1992) and others. ANT is, to a large extent, a methodology approach with an emphasis on inductive analysis. We will not in this paper perform any full-blown ANT analysis but will be inspired by the inclusion of so-called actants in addition to actors. This provides a role for technologies (in our case

standards) to be part of analyses of the interdependent factors that influence developments in a given situation.

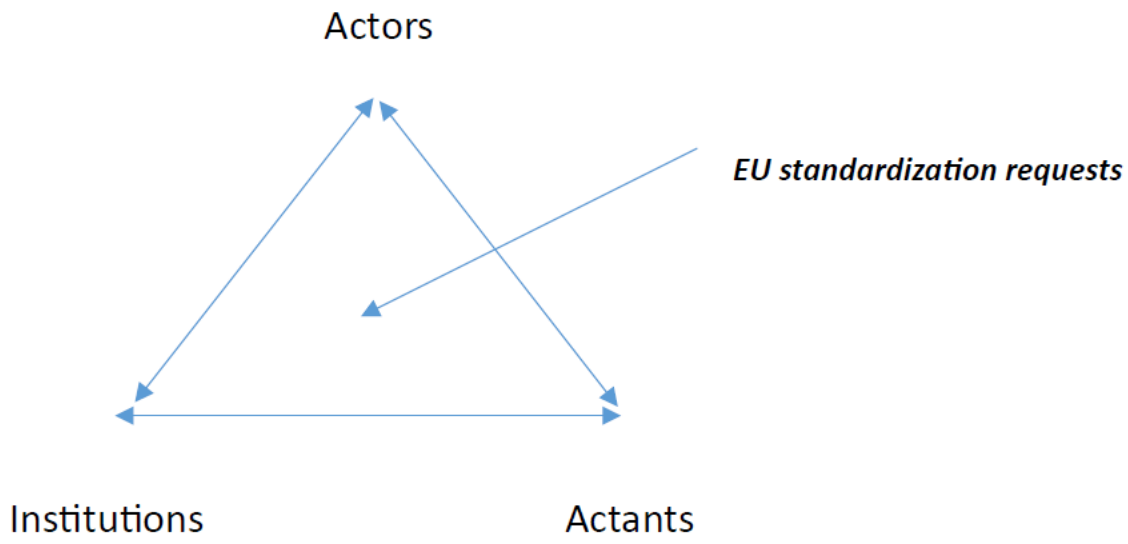
We thus have three determinants influencing how DPP standardization will develop: Institutions, actors, and actants. The institutions included in the analysis are the official standardization bodies used by the EU for standardization purposes – in the present case primarily CEN and CENELEC – and the EU as such with its requests for standardization. In other words, it is the combination of the standardization procedures instituted by the EU and the modes of functioning of CEN and CENELEC.

The actors are all the organizations that aim at influencing the standardization processes taking place in CEN and CENELEC. The official members of CEN and CENELEC are the national standardization bodies, however, these national standardization bodies engage a wide range of organizations working with standardization issues.

The actants are in this case the existing standards in the fields of sustainability, eco-design, supply chain communications, data, etc. And, there are many of them. This includes the standards that have already been developed by the official European standards bodies, but it also includes standards developed by other standardization organizations that are extensively used by industry and the standards developed by the international standardization bodies, ISO and IEC. These standards and the technological solutions using the standards must be taken into consideration when developing new DPP-related standards.

The theory framework for the analysis in the paper will, therefore, build on a triangle of influencing factors – see figure 1. Into this triangle comes the DPP requests from the EU, and the outcome will be the DPP standards developed by CEN and CENELEC, which will become European Norms (EN) in the area.

Figure 1: Analytical framework



4. Methodology

The methodology is based on documentary analysis and interviews with stakeholders involved in and/or affected by the DPP standardization processes. The documentary analysis includes the standardization request from the EU, documentary material on the upstart of the standardization processes of CEN and CENELEC, input and opinions by stakeholders, and existing DPP-related standards in the field of sustainability and circularity. Interviews have been conducted with representatives of standardization bodies (Danish Standards and GS1 Denmark), business organizations (Confederation of Danish Industry and Danish Chamber of Commerce), public agencies (Danish Business Authority and Agency for Digital Government) and a research and technology organization (FORCE Technology)[1].

Danish Standards is the national Danish standardization body and, therefore, represents Denmark in CEN, CENELEC, ETSI, ISO and IEC. GS1 Denmark is the Danish branch of the global standardization organization GS1, which focuses on developing standards for making supply chains more efficient, e.g. bar codes. The Confederation of Danish Industry is the largest general industry association in Denmark, while the Danish Chamber of Commerce is the other general business association with a primary focus on commerce. The Danish Business Authority is the agency of the Ministry of Business, and the Agency for Digital Government is the government agency with responsibilities within public digitalization initiatives. FORCE Technology is a Research and Technology Organization (RTO) within technology consultancy and service provision.

[1] The interviewees are obviously not responsible for our interpretation of their statements.

Questions addressed to and discussed with the interviewees were concerned with the factual developments of DPP standardization process and with the views of the interviewees on the progress of the ESPR including the DPP. More specifically, the standardization organizations provided insights into organizational and technical aspects of DPP standardization. The regulatory agencies gave information on EU sustainability and circularity policies, and the business organizations reported on their views on how the ESPR and the DPP is being received among their members. The contribution of the RTO was mainly on already existing business initiatives regarding product data sharing.

The fact that interviewees are all Danish is not assessed to be an issue that sidetracks the observations made. It is true that digitalization of business and other social processes has generally come further in the Nordic countries than in many other regions of Europe and that there may thus be a greater positive inclination towards implementing digital solutions. However, in essence there are no likely substantial differences around Europe between the positions of national standardization bodies, business associations and public authorities within digitalization with respect to the development of DPP. The paper does not report systematically on the interviews conducted but refers to statements made when relevant. Interviews are mainly used for background information.

The analytical framework of the paper is used to structure the analysis of the factors, actors and institutions, which affect the development of DPP standardization. First the institutions, the EU and the relevant standardization bodies and their mode of functioning, are analyzed; then, the actants, which in this context basically are the existing standards in the field, are included; this is followed by a presentation of the various actors, affecting the standardization process; and, finally, the EU standardization request is entered into the interplay between these institutions, actants and actors.

5. Types of standards

In a paper from 1987, Paul David suggested a differentiation between three types of standards: Reference, minimum quality, and compatibility standards. These types of standards are not only technical standards but all kinds of standards and norms for human behavior, products, communications, etc. Reference standards comprise metrics, currencies, etc. Minimum quality standards are concerned with establishing the lowest acceptable quality level for any kind of product or activity. Compatibility is about interoperability between systems, formats, entities, etc.

With respect to sustainability and product circularity there are a great number of minimum quality standards. However, DPP standards are not about minimum quality. They are about establishing compatibility regarding systems and formats and the data and information, which is communicated among the different links in the production and supply chains. This data and information can in principle describe unsustainable and non-circular products. In addition to compatibility standards, there is also a need for reference standards, which will make it possible to refer to the same kinds of concepts and measures in DPP communications.

Another kind of differentiation, which is often made between different types of standards deals with the concepts of *de facto* vs. *de jure* standards. De facto standards are the standards that have arisen from market developments and industrial practices that have become commonplace or have won the markets on the basis of dominant positions. De jure does not mean that such standards necessarily have a legal and mandatory status. Some de jure standards, indeed, do, often with respect to minimum quality. But most de jure standards do not have a legal and mandatory status. They can be voluntary standards, but they have been developed in standardization organizations that are recognized by public authorities. CEN, CENELEC and ETSI are examples of such organizations in the European space, while ISO, IEC and ITU are the prime examples on a global scale.

As can easily be imagined, there is a huge grey zone between de facto and de jure standards because there is a large number of standardization bodies that are semi-recognized by public authorities. In the communications area, IEEE (Institute of Electrical and Electronics Engineers) could be an example, as could, for instance, 3GPP (3rd Generation Partnership Project). But there is also a grey zone because de facto standards may and often will become part of de jure standardization processes and because de jure standards conversely can become part of de facto standards.

When considering DPP, the standards in this area will become de jure standards. They will be developed on the basis of requests from the European Union, and they will be developed by CEN and CENELEC. However, because of all the existing standards that relate to DPP, there will also be elements of the DPP standards that will include de facto standards.

6. The DPP standardization process

In this section, we will first examine the primary institutions affecting DPP standardization. The institutions dealt with are, on the one hand, the manner in which the European Union commissions standardization requests to the European Standardisation Organisations (ESOs) and the legal status of the resulting standards. On the other hand, the institutions dealt with are the ESOs themselves and their standardization practices.

This is followed by a description of the landscape of existing relevant standards in the field. This is the equivalent of technical actants according to Actor Network Theory and includes the standards from different types of organizations that are concerned with sustainability issues and with communicating information on products.

The third subsection deals with the variety of actors involved in the DPP standardization processes and/or who wish to influence the standards that will be developed.

The fourth subsection is concerned with the DPP standardization request from the European Commission. This leads up to the analytical summary subsection that aims at analyzing how the three factors (institutions, actants and actors) interrelate in in the development of DPP standards.

a. Institutions

European Union

Standards are important means for facilitating trade, and standards are, therefore, crucial elements in developing the single internal market in the EU area. However, developing and establishing standards is an enterprise that requires an enormous amount of detail and technological knowledge that is not well-suited for political processes and decisions. The EU, therefore, in 1985 instituted a procedure, entitled the New Approach, for developing European standards. The New Approach was in 2008 replaced by the New Legislative Framework. The New Legislative Framework facilitates, on the one hand, that common European standards are created and, on the other hand, that there is sufficient flexibility in the implementation of technologies living up to the requirements that these standards are based on.

The procedure entails that the implementation of decisions made by the EU in Directives and Regulations results in requests for standardization that are submitted to the ESOs for standardization development. These standards are called harmonized standards. The standardization request developed by the EU include the essential requirements that the standards must live up to. The harmonized standards developed by the ESOs do not have a mandatory status; they are voluntary for the market players and their products. However, all products taken to the European markets must live up to the essential requirements set out in legislation. Yet, these requirements can potentially be met in different manners, which facilitates flexibility and continuous innovation of products still living up to requirements. With respect to DPP, this means that DPPs (living up to DPP requirements) will be mandatory for the industries that will consecutively be included under the EU DPP requirements. However, companies using the harmonized standards can assume that they live up the requirements set out in the EU legislation. This is known as “assumption of conformity”. That said, there can potentially be other ways of living up to requirements than following the official standards developed.

The European Union has for a number of years been working on sustainability issue. In 2009, there was the precursor (Directive 2009/125/EC) for the present Ecodesign for Sustainable Products Regulation (ESPR), which entered into force in July 2024. The ESPR is part of a package of measures aiming at achieving the objectives of the 2020 Circular Economy Plan (European Commission, 2024) and the European Green Deal from 2019.

The Digital Product Passport builds on the ESPR. Chapter III (Articles 8-15) of the ESPR is concerned with different aspects of a Digital Product Passport, and the requirements listed in these articles are the essential requirements that a DPP standard will have to include. In order for the ESOs to start the standardization process, the European Commission issues an Implementing Decision on a standardization request to the ESOs. The DPP standardization request is dealt with in a subsequent subsection.

ESOs

There are, as mentioned, three ESOs – meaning European standardization organizations which are recognized as official standardization bodies by the EU (and EFTA, the European Free Trade

Association). CEN is the general European standardization organization, while CENELEC is responsible for the electrotechnical area and ETSI is responsible for telecommunications. There are certainly overlaps between the different areas of responsibility, and especially CEN and CENELEC are closely connected and occasionally and to an increasing degree work together in joint technical committees (JTCs) on standardization tasks. The overlap issue has been subject to discussion, but it has been assessed by the EU that this is not a major problem and that cooperation between the ESOs works smoothly and that the structure with the three ESOs should not be changed.

The history of ETSI differs from the history of CEN and CENELEC. CEN and the predecessor of CENELEC, CENEL, were created by representatives of ISO and IEC members from the then called European Community and EFTA countries. The decision to establish the two organizations was taken in 1960, and CEN was started in 1961 and CENELEC in 1973 with the merger of CENEL and CENELCOM. Right from the start, the reason for the creation of these two organizations was to strengthen European standardization and, thereby, trade and industrial development in the European countries.

ETSI was established later – in 1988 – by CEPT, which is the European Conference of Postal and Telecommunications administrations, in response to proposals from the EU. The reason for establishing ETSI was similar to CEN and CENELEC in the sense the aim has been to strengthen a European dimension in the field of standardization and, thereby, to improve interoperability of the European national telecommunications markets. The EU aimed at increasing its influence on telecommunications development in the EU in the 1980s with the purpose of creating a European telecommunications market instead of the separate national markets. Following the general trend of liberalization of the time, the means for enhancing a European telecommunications market was to put pressure on the EU member states to liberalize and privatize their telecommunications operations. One of the measures was to remove telecommunications standardization from CEPT, which was the organizations of the national post & telecommunications state administrations, and turn it over to a new standardization body, which much more reflected the trans-European goals for telecommunications in Europe.

In both CEN and CENELEC, the members are the national standardization bodies from 34 European countries – the 27 EU member states, the 3 EFTA countries, and 4 additional countries from Europe including the UK. While the standards developed by CEN and CENELEC are voluntary for market players, each national standardization body must replace any national standard in the field in question with new CEN and CENELEC EN standards.

The members of ETSI, on the other hand, are app. 900 organizations from all over the world including private companies, research institutions, academia, government and other public organizations. However, in all three organizations, numerous stakeholders are taking part in the standardization work. CEN and CENELEC pride themselves of 200,000 experts from industry, associations, public administrations, academia and societal organizations being part of their network. Even though the members are limited in numbers to the national standardization bodies, a large number of experts and organizations take part in the technical committees developing the standards.

CEN and CENELEC on a common website (https://www.cencenelec.eu/european-standardization/) state that app. 30% of their standards are commissioned by the EU, while the majority of standardization tasks are initiated by different stakeholders. The idea is to involve all interested stakeholders in all standardization processes – EU commissioned and others. Furthermore, the standardization processes in the ESOs are consensus-based. This means that the work in the Working Groups aim at obtaining a consensus on the content of the standards. On the formal side, there is a voting process at the end, where the standards developed are confirmed by the participating members (countries) of the Technical Committees of the organizations. But the standardization processes are consensus-based.

b. Actants

Actants as opposed to actors are the non-human artefacts (objects) that affect the developments of a system, according to Actor Network Theory (ANT). The inclusion of actants allow for studying the effects of artefacts on a development process in addition to structures, institutions and actors. Technologies can be actants, and in our case, existing standards are actants. The existing standards in the field of interoperability relating to product specifications will play an important role in the development of DPP standards. Existing standards will have to be taken into consideration in the DPP standardization process. It could be noted that standards can also be considered as institutions, but we have here preferred for the purpose of clarity to differentiate between the EU and the ESOs as institutions and the standards as actants.

In 2022, the European Commission asked an organization called StandICT to provide an overview of the landscape of existing and upcoming DPP related standards. This resulted in a comprehensive report entitled 'Landscape of Digital Product Passport Standards' (StandICT, 2023), which lists the open standards from primarily international standards development organizations that have been found to be relevant. It is stated in the report that the list may not be entirely comprehensive, but more than 200 standards have been deemed to have a relevance.

Following a taxonomy of standards in the DPP area developed by Guth-Orlowski (2021), the StandICT report differentiates between seven categories of standardization areas: 1) Data carriers, 2) unique identifiers and their verification, 3) links between physical products and their digital representation (look-up mechanisms), 4) access rights management, 5) interoperability (technical, semantic, organization) including data exchange protocols and formats and data processing, 6) data storage and 7) data authentication, reliability, integrity, security and privacy. This is clearly a much more detailed taxonomy than the Paul David (1987) taxonomy including reference, minimum quality and compatibility standards. However, as can be seen, the seven categories are primarily compatibility (interoperability) standards and secondly reference standards. The seventh category could be seen as minimum quality standards, and minimum quality standards followed are part of what one will be able to see in DPP standards but are not the focus of the DPP standards in themselves.

The StandICT report lists 42 organizations (including organizational cooperations) where relevant standards are found. The list includes the three large international official de jure standardization bodies, ISO, IEC and ITU, and the European equivalents, CEN, CENELEC and ETSI. It also includes a

range of other organizations such as the World Wide Web Consortium (W3C) and GS1, which was mentioned in the introduction to this paper. It, furthermore, includes a couple of national organizations, first and foremost the German national standards body DIN, which has developed standards with an international bearing.

Some of organizations are clearly more important than others. The most important ones are ISO, IEC, CEN and CENELEC and cooperative arrangements between these organizations.

c. Actors

The book by Enserink et al. (2022), entitled 'Policy analysis of multi-actor systems', is meant as a practical instructional guide to those who wish to perform an analysis of multi-actor systems. The book is inspired theoretically by institutional theory and Actor Network Theory and is well in line with the analytical framework of this paper. In a section on actor analysis, six steps in such analyses are provided: 1) Formulation of a problem and associated decision arena, 2) identification of the actors involved, 3) mapping the formal institutional playing field, 4) identifying actor characteristics: determining the interests, objectives, perceptions and resources of actors, 5) summarizing the interdependencies between actors, and 6) determining the consequences of these findings with regard to the problem formulation (Enserink et al., 2022, p. 83). In a brief manner, steps 1 and 3 have been looked into in previous sections of this paper, and steps 2 and 4 constitute the topic of this subsection. The concluding steps 5 and 6 are touched upon in subsequent sections.

On the basis of the standardization request from the EU, issued in a semi-final state in October 2023, CEN and CENELEC in cooperation, in December 2023, kicked off the DPP standardization development to be started in 2024. A Joint Technical Committee (JTC) was formed, entitled JTC24. The JTC24 is chaired by Thomas Knothe from Frauenhofer, and the secretariat is the German national standards body, DIN. As is emphasized in a presentation by Knothe (2024a), the data to be included in a Digital Product Passport are not part of the work of JTC24 and will be part of other standardization tasks. The scope of the work of JTC24 is the system aspects including formats for the exchange of data.

In a presentation at a Danish Standards online webinar in February 2024, Knothe (2024b) provided an overview of 'who should be interested into JTC24'. The stakeholders mentioned are the following:

- European Commission and national authorities
- Economic operators, e.g. manufacturers and importers
- DPP system and service providers
- DPP system component providers
- Partners in the value chain, e.g. suppliers, dealers, recyclers
- Standardization bodies
- Consumer organizations

In Knothe (2024a), it is stated that app. 130 experts from more than 20 CEN and CENELEC member states and app. 15 liaison requests from, for instance, US, China, Korea and Japan will take part in the work of JTC24, which is subdivided into 4 Working Groups (WGs): WG1 (strategic advisory group), WG2 (data carrier and unique identifier), WG3 (security), and WG4 (interoperability framework). There is thus a wide range of stakeholders and actors who are and will be part of the DPP standardization tasks, and in addition to the abovementioned types of interested stakeholders could be mentioned academia and research projects and NGOs working in the fields related to sustainability and circularity.

In addition to setting the terms for the standardization requests, the EU also explores (and influences) the development of DPP standards via research projects funded by the EU research programs. Two widely influential projects have been the CIRPASS project (cirpassproject.eu) and the StandICT.eu 2026 project (standict.eu).

The actors that hitherto have been the most active in voicing their opinion regarding DPP are the organizations that have and promote de facto standards relating to DPP, for instance the RAIN Alliance and GS1. Also, companies and industry associations that potentially will be service and component providers are active in positioning themselves by providing information on DPP. There is, generally, a very positive atmosphere around the prospects of DPP also among industries that will be subject to DPP rules and standards. In a position statement on the Ecodesign for Sustainable Products Regulation (ESPR), Eurochambres 'supports the introduction of an eco-design instrument that considers all aspects of the lifecycle of the product' (Eurochambres, 2022). However, in line with the concerns that are mostly put forward by industry representatives when new industrial regulations are discussed, it is also stated that 'the burden on businesses must be proportionate and the competitiveness of the European economy must not be jeopardized', that 'excessive eco-design requirements can limit the diversity of products on the market and hinder innovation', and that 'it must also be ensured that the new regulation does not impose excessive bureaucratic burdens on businesses' (Eurochambres, 2022).

These are general concerns and the overall attitude and approach to the ESPR and DPP of all actors that have spoken out until now is positive. Later in the process, there may obviously be stronger concerns when requirements will be more concrete. But currently the reactions are positive and emphasize the potentials for sustainability and circularity. The major difficulty that can presently be foreseen will be to navigate the extensive landscape of already existing standards in the field.

Among the interviewees interviewed for this paper, there is general support for the development of DPP. This also includes the industry associations representing the industries that will have to implement DPPs. The reasons put forward include support for the general idea of promoting sustainability and circularity. But it is also an important argument that there already are a great number of product reporting requirements that differ among industries and that DPPs are seen as a possibility for harmonizing and straightening out these requirements. More specifically, industry associations see potentials for new business areas for service providers in the field of DPP systems and data provision.

It should be mentioned that industries that will implement DPPs are more focused on the upcoming product data requirements than on the system standards. This was clearly expressed in the interview with the Chamber of Commerce. As long as harmonized standards for DPP systems are developed, the immediate interest is on the DPP product data requirements. This is clearly shown in the case of the textile industry, which will be one of the first industries subject to DPP requirements. There has been relatively little interest in the DPP system standards from the textile industry resulting in participation in the CEN/CLC JTC 24 DPP Working Groups (WGs). But there is interest in the upcoming data requirements.

d. Standardization request

The final standardization request from the EU came in July 2024 but the contents have been known for a longer time. In June 2022, CEN and CENELEC reacted to the upcoming request by emphasizing that they are opposed to the EU Commission foreseeing that it may adopt 'implementing acts' establishing technical specifications. CEN and CENELEC state that this would be in discrepancy with the New Legislative Framework (NLF) from 2008, where the EU will only set the essential requirements to be part og standards and not the standards themselves (CEN/CENELEC, 2022).

In the annexes to the 2024 request, the areas in which the ESOs shall develop standards are the following (EC, 2024):

- Harmonized standard(s) on unique identifiers
- Harmonized standard(s) on data carriers and links between physical product and digital representation
- Harmonized standard(s) on access rights management, information, system security, and business confidentiality
- Harmonized standard(s) on interoperability (technical, semantic, organization)
- Harmonized standard(s) on data processing, data exchange protocols and data formats
- Harmonized standard(s) on data storage, archiving, and data persistence
- Harmonized standard(s) on data authentication, reliability, integrity
- Standards on APIs for the DPP lifecycle management and searchability

As can be seen, these are standardization areas for DPP systems and formats and not for the data to be communicated. Standards for the data itself will be set elsewhere. With respect to the standards requested, the deadline is in all 8 areas 31 December 2025.

e. Analytical summary

The initiative to create DPP standards comes from the EU, based on the ESPR. The essential requirements for DPP standards are defined in this Regulation anda standardization request to the ESOs have been issued, where CEN and CENELEC are the important standardization organizations in this context. These organizations (the EU and the ESOs) and their mode of functioning constitute the institutional environment in which the standards are created.

There are already many standards in the fields where DPP standards are developed and, therefore, also many standardization bodies that have an interest in the direction that the DPP standards will take. There are also many actors that have a stake in the coming DPP standards. However, as at now, it seems that there is a general enthusiasm for the potentials of a DPP system and that decisive differences of interests have not surfaced.

It is the interaction between the institutions, actants (existing standards) and the actors that will determine the outcome of the standardization processes. Currently, it would seem that the biggest difficulty that will be met is the already existing landscape of standards that need to be taken into consideration when developing new DPP standards.

Another difficulty is the speed with which the standards are to be developed. The deadline is 31 December 2025. Taking into consideration the complexity of this standardization task and the fact that a normal timeframe for such standardization tasks is around 3 years, it would seem that the timeframe for the DPP standardization request is extremely sharp. Just when looking at the traditional timeframes for the different formal steps in the standardization procedures of European Norms (Ens) by CEN and CENELEC, it is difficult to see that the deadline can be met. Speed seems to have been the priority from the European Commission. The result may be that the standards are not entirely finalized when implementation will start or at least that, if the deadline is met, that there will have to be a 'grace period' for the industries implementing DPPs – as was mentioned in the interview with the Agency for Digital Government.

7. Conclusion

The research question addressed in the paper is: Which are the factors that affect the development of DPP standards and how do these factors interrelate in the standards development processes?

The factors are the institutions (the EU and the ESOs), the existing standards in field (the actants), and the actors being the organizations that are involved in and have a stake in the DPP standards.

The analysis indicates that the most important factors are the EU, the ESOs, and the existing standards. Up until now, the industry representatives of the industries that are going to implement the standards and the consumers that will also be crucial players in making the data and information conveyed by the DPP standards important have not yet manifested themselves forcefully.

The DPP standards are supposed to have been developed by the end of 2025, and until now the biggest challenges seem to be the timeframe and how to take the vast number of existing standards into account also considering the interest of industries that have already implemented standards that are relevant in a DPP context.

These conclusions relate to the system aspects of DPP. When looking at the product data aspects, this will be an additional challenge. One thing is to develop and agree on such data requirements, another task is to find and acquire the data and to digitize all the data. In the broader political

context, an open question is whether the direction that the EU has taken with its Omnibus proposal from February 2025 will affect the implementation of the ESPR and its DPP initiative.

A further issue is the extraterritorial character of the DPP initiative. Value chains are, to a large extent, international, and it will be a great challenge to get all the necessary data. However, when talking to stakeholders, there is a clear optimism and enthusiasm for the DPP initiative.

8. References

Callon, M. (1984) Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieuc bay, *The Sociological Review*, 32(1), pp. 196-233.

CEN/CENELEC (2022) CEN and CENELEC response to the EC on a sustainable product initiative, 22 June 2022.

Dansk Standard (2024) Det digitale produktpas, webinar on 5 February 2024.

David, P. A. (1987) Some new standards for the economics of standardization in the information age, *Economic policy and technological performance*, pp. 206-239.

Domenech, T. and Bahn-Walkowiak, B. (2019) Transition Towards a Resource Efficient Circular Economy in Europe: Policy lessons from the EU and the Member States, *Ecological Economics*, vol. 155, pp. 7-19.

Draghi, M. (2024) The future of European competitiveness, European Commission.

Enserink, B., Bots, P., van Daalen, E., Hermans, L., Kortman, R., Koppenjan, J., Kwakkel, J., Ruijgh-van der Ploeg, T., Slinger, J. and Thissen, W. (2022) Policy analysis of multi-actor systems, Eleven, Delft University of Technology.

Eurochambres (2022) Eurochambres position on the Ecodesign for Sustainable Products Regulation (ESPR), https://www.linkedin.com/pulse/eurochambres-position-ecodesign-sustainable-products-regulation-/

European Commission (2024) Commission implementing decision on a standardisation request to the European Committee for Standardisation, the European Committee for Electrotechnical Standardisation, the European Telecommunications Standards Institute as regards digital product passports.

European Commission (2025) Directive of the European Parliament and of the Council amending Directives (EU) 2022/2464 and (EU) 2024/1760 as regards the dates from which Member States are to apply certain corporate sustainability reporting and due diligence requirements, COM(2025) 80 final.

European Commission (2024) Circular economy action plan, https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

Guth-Orlowski, S. (2021) The digital product passport and its technical implementation, Medium.Com. https://medium.com/@susi.guth/the-digital-product-passport-and-itstech.

Hermans, L. and Thissen, W. (2009) Actor analysis methods and their use for public policy analysts, *European Journal of Operation Research*, 196, pp. 208-218.

Knothe, T. (2024a) JTC24 – Digital Product Passport – framework and system.

Knothe, T. (2024b) JTC24 – Digital Product Passport – framework and system, presentation at Dansk Standard (2024) Det digitale produktpas, webinar on 5 February 2024.

Law, J. (1992) Notes on the theory of the actor-network: Ordering, strategy, and heterogeneity, *Systems Practice*, 5, pp. 379-393.

North, D.C. (1984) Transaction costs, institutions, and economic history, *Zeitschrift für die gesamte Staatswissenschaft*, 140(1), pp.7-17.

Scott, W.R. (2008) Approaching adulthood: the maturing of institutional theory. *Theory and Society,* 37, pp. 427–442

StandICT (2023) Report og TWG Digital Product Passport: Landscape of Digital Product Passport Standards, EU Observatory for ICT Standardisation.

Interviews conducted:

- Danish Standards
- GS1 Denmark
- Confederation of Danish Industries
- Danish Chamber of Commerce
- Danish Business Authority
- Agency for Digital Government
- FORCE Technology