

Research paper

More Than Legislation: The Strategic Benefits and Incentives for Companies to Implement the Digital Product Passport

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Abstract

Digital Product Passports (DPP) are recognised as a crucial component in advancing the circular economy as well as the EU's strategic autonomy and supply chain security. DPP aims to provide all stakeholders with extensive information about a product's makeup and environmental footprint during its production, usage, and end-of-life stages, encouraging sustainable product design, reusability, repairability, and waste reduction. However, we argue that exploring the incentives for businesses, particularly the strategic advantages that could motivate businesses to adopt DPP, beyond mere compliance is necessary.

This study develops the concept of DPP as a strategic capability by contributing with a framework for developing new DPP services that 1) strengthen companies' relationships with their customers, 2) sustain and accentuate the companies' values and competencies, and 3) generate new competitive advantage in the market. The framework for developing new DPP services is tested in the furniture company Fritz Hansen A/S to illustrate the strategic advantages and incentives to adopt DPP, that these services generate. The study indicates that developing DPP services could be a way to speed up the implementation process.

Keywords: Digital Product Passport · Product longevity · Strategic Durability · Circular Economy · Value proposition · Strategic Fit

1. INTRODUCTION

The Digital product passport (DPP) is identified as a vital step for an effective circular economy (Adisorn et al., 2021), particularly pushed by policy development at the level of the European Union (EU) as part of the European Green Deal (European Commission, 2019) and the Circular Economy Action Plan (European Commission, 2020).

DPP is characterised as a means of gathering product and material data to support product durability, reusability, upgradability, and reparability. In the proposal for a new Eco-design for Sustainable Products Regulation, which is grounded on the existing Eco-design directive, it is stated that:

The new 'Digital Product Passport' will provide information about products' environmental sustainability.

This information will be easily accessible by scanning a data carrier, and it will include attributes such as

durability and reparability, the recycled content, or the availability of spare parts of a product. It should help

consumers and businesses make informed choices when purchasing products, facilitate repairs and

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recycling, and improve transparency about products' life cycle impacts on the environment. The product passport should also help public authorities to better perform checks and controls. (European Commission, 2022, p xi)

DPP aims to provide all involved actors with a better understanding of a product's composition, the environmental impact of the production and use phase, and the recycling options at the end of the product lifecycle (Plociennik et al., 2022). For example, the EU Battery Regulation stipulates that the digital battery passport must contain a wide range of information. This includes basic details about the battery and its manufacturer, compliance records and certifications, the carbon footprint of the battery, due diligence in the supply chain, information on the materials and composition of the battery, measures for circularity and resource efficiency, as well as data on the battery's performance and longevity (European Parliament, 2023)

One of the main opportunities that DPP represents to the circular economy is a more consistent and precise flow of information about products, resources, and processes. This will make it possible to quantify circular initiatives (Bianchini et al., 2019), which again is expected to lead to further adoption and scaling of circular initiatives in the industry (European Commission, 2019).

Moreover, the principles of a circular economy and DDP could be utilised to lessen the EU's strategic dependency on crucial products, components, and raw materials that, for the moment, rely on vulnerable value chains and instead help foster production diversity and investment in Europe (European Commission, 2021). The Critical Raw Materials Act suggests broadening the import sources and enhancing local extraction, processing, and recycling to reduce the risk of supply interruptions (European Commission, 2023a). Baldassarre et al. (2023) further suggest that the industry stakeholders and alliances working with R&I on strategic technologies not only focus on the circularity of Li-ion cells but on all critical products, in particular hydrogen electrolyzers and fuel cells.

EU's current trade strategy focuses on open strategic autonomy, which means that it aims to balance economic interdependence with the need to manage risks (Gehrke, 2022). DPP can be seen as a crucial element in the EU's strategic autonomy and ensures that the EU can act without being dependent on other countries – in strategically important policy areas, ranging from defence policy to the economy, and the capacity to uphold democratic values (European Parliament, 2022).

DPP promotes a system-independent approach within blockchain-based information systems that ensures privacy, traceability, transparency, and trust in global supply chains. The advanced standardised data structures in the DDP create a reliable information flow. This means that the data is organised consistently and predictably, making it easier for different systems to communicate with each other. This is crucial for the smooth operation of supply chains, where information needs to flow seamlessly from one end to the other (European Parliament, 2022). Koppelaar et al. (2023) emphasise the role of blockchain in enhancing transparency and security in the supply chain. In summary, fast and successful implementation of the DDP is important for the EU both in a strategic autonomy supply chain security- and in an environmental perspective.

1.1 Definition of DDP

So far, an applicable DPP approach is still missing (Adisorn et al., 2021), and there are ongoing discussions about the degree of the required information to achieve circularity (see, e.g. Eppinger et al., 2021; Walden et al., 2021). Moreover, the definition of the role and goal of DPP varies from one field to another. For instance, in the field of architectural construction, the DPP is mainly seen as a means to inform the design phase and end-of-life stages (Aguiar, 2019; Cai, 2019), whereas other areas of research such as product development and engineering view DPP more broadly and focuses in particular on its role in the use-phase, where stakeholders both within and outside the products' value chain need possibilities to interact or exchange information (Berger 2022, Walden 2021, Römph, 2019). This could, for instance, be information that will ease or engage customers in repair activities (see, e.g. Nazli, 2021; Philp and Nepomuceno, 2020; Diddi and Yan, 2019; Sung, 2015; Haase and Lythje, 2022) or other ways to preserve the product's value (Haase et al. 2024; Jensen et al. 2021; Jensen et al., 2023).

What is common, though, across the different areas of research is that DPP is a digital interface that provides information to a particular group of stakeholders, fostering environmentally sustainable decisions or work practices

in several life stages (Reich et al., 2023; Capelleveen et al., 2023). Hence, DPP becomes a way to collect information from all phases of the product life cycle to optimise design, production, use, and end-of-life actions (see, e.g. Adisorn et al., 2021; Luscuere, 2017; Berger et al., 2022, Walden et al., 2021 Honic et al., 2019; Atta, 2021).

1.2 Positioning and Research Question

Currently, the DPP requires that information is developed collaboratively by multiple stakeholders throughout the supply chain (Capelleveen et al., 2023; King et al., 2023). While the environmental benefits are very clearly pinpointed in both research and at the policy level of the EU on how DPP will increase the closing and slowing resource loops, ambiguity still exists among companies regarding the purpose of DPP and especially the reasons for sharing data and the strategic benefits in such context (King et al., 2023). Many companies still view the DPP as an administrative burden of their businesses.

In line with King et al. (2023), we argue that there is a need to investigate the incentives for companies and especially the strategic benefits that could engage companies to adopt such open architectures, spend more resources in sharing data, and integrate or rethink their solutions within a wider ecosystem. Presently, this focus is highly overlooked in the discussions on DPP.

In this paper, we unfold the strategic potential of DPP beyond the need for compliance by proposing a framework for developing new DPP services. The new DPP services aim to make the implementation of DPP more attractive to companies, thus speeding up the implementation process, and not only a legal requirement implemented purely for compliance.

Accordingly, this paper contributes with a new perspective on DPPs, namely how companies, through DPP services, can strengthen their value proposition towards the customer and, thereby, their market and competitive positioning. The research question explored in this paper is the following: How can we make the concept of DPP strategically relevant to companies?

The paper is structured as follows: First, we will address the methodological aspects of the paper. Next, we review the concept and framework of strategic durability (which holds insights into how products and services are created with a strategic fit to a given company), and based on this, we will conceptualise a framework for developing new DPP services. After this, the framework for creating new DPP services will be tested in a study with the furniture company Fritz Hansen A/S to qualify its ability to promote the strategic advantages and motivations for adopting DPP. Finally, we discuss how the strategic perspective on DPP is also relevant for other industries and suggest possible future research avenues to be explored.

2. METHODOLOGY

The research in this paper is based on the Design Science Research (DSR) approach, which several authors argue can be relevant in the context of information systems such as the DPP (Hevner et al., 2004; Nunamaker et al., 1991; Peffers et al., 2007; Takeda et al., 1990). DSR creates scientific knowledge and inquiry around innovation efforts, frameworks and tools by creating and evaluating an artefact through empirical work (Pfeffers, 2007)

DSR can be described in the following steps: 1) identify the problem, 2) define objectives for a solution, 3) design and development, 4) demonstration, including experimentation, simulation, case study, or proof, 5) evaluation and 6) communication (Peffers et al., 2007). In the following sections, the DSR process of this study will be reviewed.

2.1 Problem Definition

This study focuses on the problem of companies' lack of incentive to implement DDP beyond compliance. As unfolded in the introduction, many companies still view the DPP as an administrative burden for their businesses and find it hard to identify the strategic benefits of the DDP. At the same time, DDP can play a significant role in ensuring the EU's strategic autonomy and supply chain security and in advancing the circular economy with all the environmental benefits it provides. Hence, identifying how to make the concept of DPP strategically relevant to companies is important and could potentially speed up the implementation of DDPs.

2.2 Objectives for a Solution

The objective of this research project is to support companies in developing ideas and concepts for such new DDP services that will clarify how DDP becomes a strategic tool for companies and thereby encourage further actions towards implementation of it. The present definitions and conceptualisations of DPP are rather limited in addressing companies' potential motivation for DPPs and their role in driving its implementation. However, DDP architectural data infrastructure could provide companies with the possibility to offer new types of services that, for instance, could strengthen their value proposition to the customers or improve their position in the market.

2.3 Design and Development

The objective is addressed by creating a framework for the development of new DDP services in companies. The framework is based on the theory of strategic durability (which will be unfolded in Chapter 3). The strategic durability theory is selected because it focuses on slowing resource loops as well as ensuring a long-lasting fit between companies and their products, customers, and markets. The strategic durability theory is highly relevant to use as the kernel theory for the new DDP services framework (Walls et al., 1992). Kernel Theories can be applied in several different ways (Möller et al., 2022), however, since the development of products and services has some of the same basic elements, the mechanism used in this specific case is called deriving. According to Möller et al (2022). The derive mechanism:” refers to kernel theories being used as a source to extract an object of interest directly. Subsequently, a suitable kernel theory is selected from which authors directly derive, for instance, meta-requirements and design principles.” (p. 7)

Accordingly, this paper applies a deductive approach in that “existing theory is seen as applicable in some new setting” (Fischer and Gregor, 2020, p. 21). In this case, the theory of strategic durability is seen as applicable in the DPP context as a means for companies to explore their strategic potential. The type of theoretical adaption is a “minor modification” (Grover and Lyytinen, 2015), as only minor changes to the strategic durability theory are made to make it fit within the new context of DPP.

By applying the strategic durability theory to the conceptualisation of new DPP services, the assumption is that the framing of DPP changes from a legal instrument to an integrated part of the company's value proposition, market, and competitive positioning. For instance, for companies that are already manufacturing durable goods (see, e.g. Haase et al. 2023), new DDP services provide the companies with the possibility to create products with a stronger value proposition in comparison with products with a shorter lifespan. For companies that are manufacturing products with short lifespans, the new DPP service is an asset to document the company's compliance efforts towards customers and authorities. The framework for creating new DPP services addresses a company perspective and, more specifically, the value proposition that companies offer their customers, along with their competitive positioning. The framework is designed for the strategic level of the company, including CSR.

2.4 Demonstration

The framework for new DPP services has been applied in a study with the furniture company: Fritz Hansen A/S. The furniture industry was selected for demonstrations for multiple reasons: (1) The furniture sector is a major manufacturing industry in Europe (Rame et al., 2023) (2) The furniture industry faces challenges in sustainability, digitalisation, and competitiveness; and DDP may be a key to advancing the circular economy in this industry (Barbaritano et al., 2019). (3) The furniture industry is representative of the many B2B and B2C companies across the EU that must implement the DDP, even though their products rarely hold critical components or raw materials with strategic dependency challenges. Besides Fritz Hansen A/S, the study also included representatives from two other furniture companies: Skagerak A/S and Overgaard & Dyhrmann. The specific companies were included to ensure relevance and applicability in markets ranging from middle to high-end luxury brands.

The demonstration was conducted in a study with a mix of qualitative and action research approaches (Sanders & Strappers, 2012 Swan, 2002). In practice, the demonstration of the framework was part of a one-year-long process engaging academics and sustainability/business managers from three furniture companies. This process was organised through a number of meetings and workshops. In Frits Hansen A/S, there was a main point of contact who collected reports and internal data and invited different internal stakeholders from the company for the different workshops/meetings to ensure substantial domain knowledge was available. In the meetings, an action research approach (Nielsen and Svensson, 2006) was applied. One of the three researchers would be the main facilitator, and

the others would participate along with the company participants. This was done to avoid the creation of a superficial situation and interaction. All researchers collected meeting notes, and after each meeting, meeting minutes with key decisions- and action points were created.

During the process, there were also idea- and concept-development workshops, where the collected knowledge and insights from the process were transformed into new DDP service concepts. This workshop aimed to develop a set of new DDP services that both focused on 1) information to share with customers during the use phase and 2) interaction with a network of distributed manufacturers around the world that would allow for local maintenance, repair, and refurbishment services. In this process, the researchers remained observers and facilitators to ensure that the company's knowledge and perspectives were dominant.

The company participants engaged in the workshop assignments, and the researchers observed and documented the workshop with notes. The outcome of the workshop was documented with meeting minutes and through the writing and illustrating of the framework. Further, the outcome of the workshops was documented in a research application and shared presentation to the board of the Danish National Innovation Foundation. Both sets of documentation were approved by the companies.

2.5 Evaluation

The demonstration of the framework was followed up by an evaluation comparing the objective of the framework with the actual results of using it (Peffer et al., 2007). The goal of the evaluation was 1) to assess whether the framework supported the companies in developing ideas and concepts for new DDP services and 2) to promote the perception of DDP as a strategic tool for the companies and thereby encourage actions towards implementation of it.

In the idea- and concept-development workshop, the framework for creating new DDP services was orally evaluated. This evaluation concerned the framework's efficacy, usefulness, accuracy, performance, understandability, etc. (see Prat et al., 2015). As a response to this, minor adjustments to the framework were created and implemented. In particular, the introduction to the framework (understandability) and the process for idea development (usefulness) were adjusted.

After the development of the research application, the framework and process were also evaluated on the ability to add new knowledge to the companies' knowledge base and the degree to which it was capable of accommodating changes (Hevner et al., 2018). This evaluation was conducted by comparing the focus, questions and actions identifiable in the first meeting minutes to those later in the process. Moreover, contact with the companies continued after the creation of the research application, firstly to follow up on the internal commitment to this and, secondly, to identify any other type of actions concerning the DDPs within the organisations.

The main conclusion on this was firstly that the Framework for new DDP services added new knowledge to the companies' knowledge base by introducing the end-user or customer perspective to the DDP and facilitated the discussion of using the DPP for solving existing problems, e.g. related to implementing circular distributed production (see section 4.)

Secondly, it was found that the framework for creating new DDP services accommodated change in all three furniture companies. In the period after the workshops, the top management of the three companies approved that the companies could find the needed co-funding to participate in the application for the Danish National Innovation Foundation. A project where all the companies committed to implementing the new DDP service concepts developed during the process. Moreover, in the case of Fritz Hansen, this study also led to a follow-up pilot project on the new DPP services. Currently, some of the services are tested with one of Frits Hansen's customers (see: <https://www.fritzhanzen.com/en/inspiration/projects/danish-crown>).

2.6 Communication

Communication about research outcomes was initiated both during and after the research process. First of all, the outcomes were introduced to several companies during the application process, to the Danish National Innovation Foundation in both the application as well as in a project interview, and finally, the outcomes were presented and discussed with the academic community at the PLATE (Product Lifetime and the environment) in Helsinki, Finland in 2023.

3. FRAMEWORK DESIGN AND DEVELOPMENT

In this paper, we ask the question of how the DPP can be strategically relevant to companies and, more specifically, how new DPP services can create strategic benefits for the company and thereby intensify the adoption of DDPs. To achieve this, we create a framework for developing new DDP services based on the strategic durability theory (Haase and Laursen, 2022).

3.1 Strategic Durability and the Strategic Fit Map

The essence of the strategic durability theory is that it employs a strategic view of producing durable products and services. Specifically, it suggests that products and services should maintain a long-lasting strategic fit to the company's customer, market, and core competencies/values. This means that a product or service must address the long-term needs of the company's customers, create enduring competitive advantages in the market, and hold strategic significance for the company. If the strategic fit is not long-lasting, neither will the product be. In their book, Haase and Laursen (2022) describe strategically durable products as products that:

- 1) Have a long-lasting strategic fit for the customer.

A strategic, durable product creates a long-term fit between the product and the company's customers. In opposition to traditional user-oriented design processes that mainly seek to create a fit between a product and the customer in the purchase situation by fulfilling impulsive emotional and social aspirations or needs (Laurel, 2003; Merholz et al. 2008, Ulwick, 2005), strategically durable products solve long-term problems for the customer and address needs, wishes and aspirations, that are relevant now as well as in the future.

- 2) Have long-term competitive advantages in the market.

Whereas traditional strategic business literature addresses the need for competitive advantages such as cost leadership or differentiation (Hooley et al., 2020; Porter, 1980), strategic durability theory adds the dimension of longevity to the product-market fit. Strategic durability points to the importance of long-term competitive advantages for the company, typically in the form of unique offerings or differentiating features that are long-lasting and hard to copy or imitate.

- 3) Are relevant to the company in the long run

Strategic durability addresses the importance of creating a long-term fit between the core competencies, strategic strengths, and values of the company and the product (in line with the works of Buijs, 2012; Haase & Laursen, 2019; Curedale, 2013; Collins and Porras, 1996).

In summary, strategically durable products must both fulfil long-term customer needs, create long-term competitive advantage in the market, and be strategically relevant to the company in the long term. This is also illustrated in "the strategic fit map" (see Figure 1).

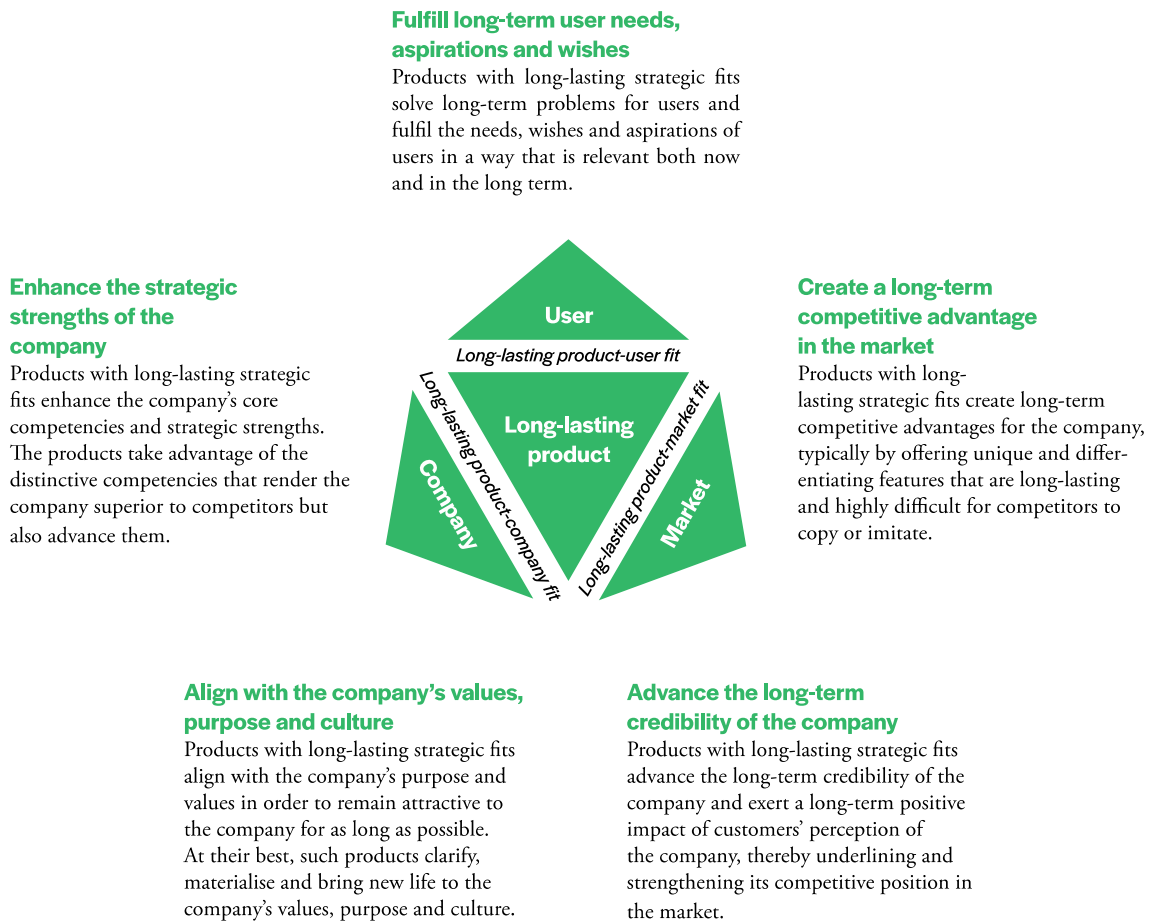


Figure 1: A Product With Strategic Durability Has Long-Lasting Strategic Fits to the Customer, the Market, and the Company (Haase and Laursen, 2022, p. 59)

3.2 Framework for Developing New DDP Services (Design Principles)

The strategic durability theory consists of design principles and design strategies for developing long-lasting products. The design principles are reviewed above in the strategic fit map.

The first step in creating a framework to support the development of new DPP services was, therefore, to translate the design principles in the strategic fit map into a set of action-oriented design principles (Chandra et al., 2015) for DDP services. To do so, we viewed the new DDP services as a “product” in itself that needs to create a long-term fit for both the user, the market and the company. Figural speaking, we exchange the “long-lasting product” at the centre of the strategic fit map (reviewed in Figure 1) with the new DDP service.

The action-oriented design principles for developing new DDP services are summarised below and illustrated in Figure 2:

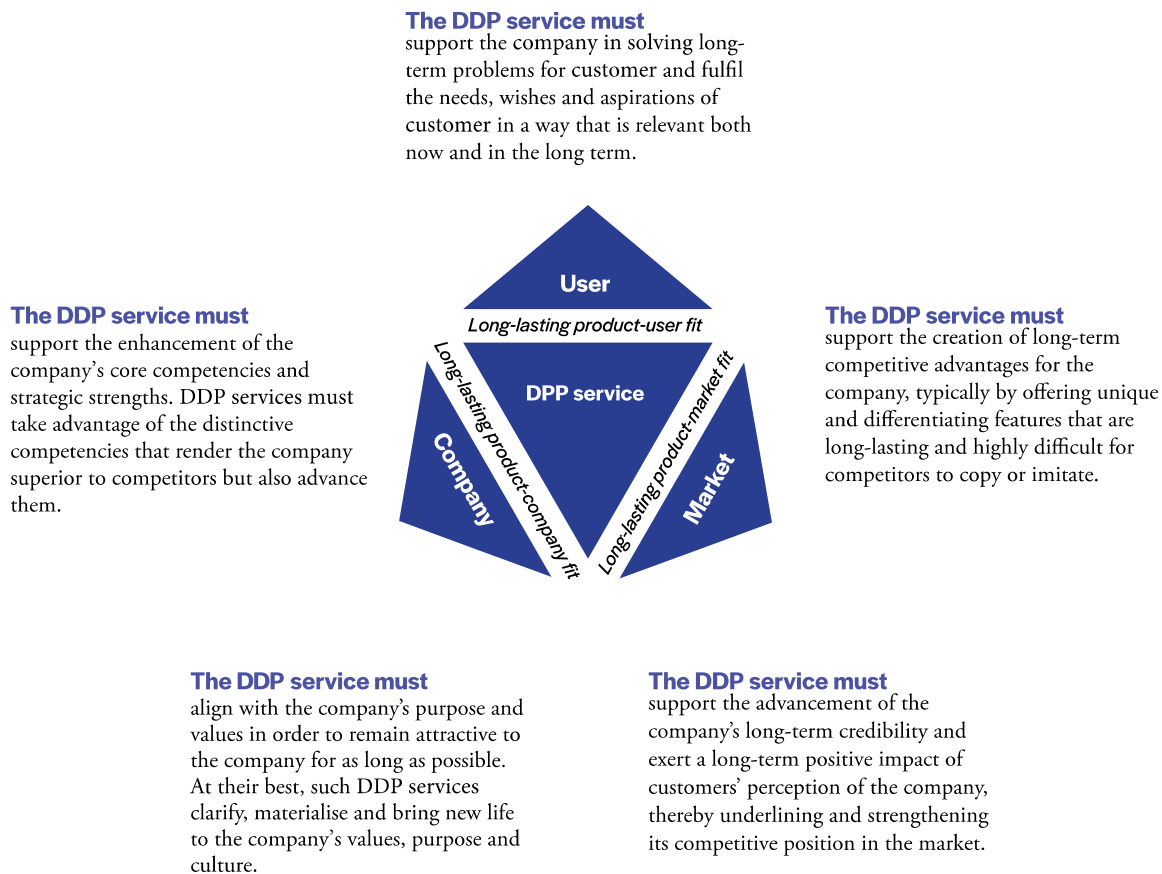


Figure 2: Framework for the Development of New DPP Services

3.2.1 Design Principle for Value Concerning the Customer

First of all, the new DPP service must support the company in fulfilling the long-term needs, aspirations, and wishes of the customer. To accomplish this, the DPP must include unique features that become an important part of the company's value proposition. For instance, DPP services can provide trustworthy documents on the longevity of products or deliver unique lifetime stories (e.g. ownership records) to the customer, which can help strengthen the customer-product attachment and thereby resist the obsolescence of the product (see the Fritz Hansen case for an example in section 4).

3.2.2 Design Principle for Value Concerning the Market

Secondly, the new DPP service must support the company in creating a long-term competitive advantage in the market and advance the long-term credibility of the company. This means that the DPP should include differentiating features that would be difficult for competitors to copy and affect the customers' perception of the company in a positive and sustainable direction (see section 4 for an example).

3.2.3 Design Principle for Value Concerning the Company

Finally, the new DPP must support the enhancement of the company's strategic strengths and competencies and align with the company's long-term core values, purpose, and culture. This means that internal processes in the company (such as production or specific technologies) need to be long-term relevant for the company (see section 4 for an example).

3.3 Framework for Developing New DDP Services (Design Strategies).

The next step in the creation of the framework for new DDP services was to select and adjust design strategies from the strategic durability methodology relevant to the area of DDP (Haase and Laursen, 2022). Three strategies were identified as relevant, namely: 1) Leveraging objections, 2) Foreseeing future mismatches, and 3) Extending product value.

3.3.1 Leveraging Objections (Company Focus)

The focus of the leveraging objections strategy is on identifying the reasons why some of the products or services in the current portfolio have a weak strategic fit with the company and then using the derived knowledge as the starting point for creating new DDP services. The team must pay attention to all the objections that have been raised both inside and outside the company and then identify the reasons behind these. For example, does the company have long-term ambitions that the DDP could help fulfil? Are there strategies that continue to fail but that DDP could make successful? Are there production or service obstacles that DDP could help solve? The aim is to leverage these types of insights as a starting point for developing new DDP services. Therefore, it is important to pay attention to the objections raised in the different departments of the company and actively search for the harshest critics of as well products, production, processes, etc. Those critics provide insights into elements with weak fit or mismatch with the company company's strategic strengths, core competencies, values, purpose and culture and, therefore, potential for gaining support from the strategic management (Knudsen & Haase, 2019). The design strategy called Leveraging objections can be divided into the following steps: 1) identify objections and strategic mismatches, 2) develop new DDP service ideas and concepts to approach these, 3) test if and how these concepts can be relevant to the users and the market as well (to ensure complete strategic fit).

3.3.2 Foreseeing Future Mismatches (User Focus)

The focus of the 'foreseeing future mismatches' strategy is to identify potential mismatches between what the user will find attractive in the future and what the company is currently offering and then use the derived knowledge as the starting point for new DDP services. In the process associated with this strategy, it is important to pay attention to emerging changes in users' needs, behaviours and expectations, which might lead to a strategic mismatch between users and the company's offerings in the future. This can, for instance, be achieved by talking to sales managers, marketers and other individuals who are actively engaged in promoting or selling the company's offerings. Another option is to map changes in technology, lifestyle and society or identify digital services that have either initiated behavioural changes or been particularly good at capturing such changes.

Based on these findings, it is possible to develop new DDP service ideas to address the emerging needs, behaviours and expectations of users and, thereby, ensure the company's future relevance. When pursuing the Foreseeing future mismatches strategy, there are three key steps: 1) identify emerging changes in users' needs, behaviours and expectations, 2) develop DDP service ideas and concepts to address these, 3) test if and how these concepts can be relevant to the company and the market as well (to ensure complete strategic fit).

3.3.3 Extending Value (Market Focus)

The focus of the strategy 'extending value' is to design new DDP services that extend the value of existing products or services. Continuous improvement of technology, products, services etc., means that companies continuously fear that competitors become able to offer the same level of quality, the same set of features or the degree of same performance as they do, but at a lower price. Hence, the focus of this strategy is to find ways to extend the value of the company's current offering Through new DDP services. This can be done by, for instance, identifying the emotional or social values the DDP services can provide to users and customers. By mapping the value that both the company's existing products and competitors' products provide to customers during their lifetimes, it is possible to identify areas where the customer experience can be improved as well as where functional, personal or social value can be added. Moreover, it is relevant to identifying areas where current offerings create unwanted experiences, interactions, emotions or social perceptions (e.g. things that make the user create workarounds, things that make the user feel incompetent, annoyed, irritated or uncomfortable or things that may create a negative perception of the user from the perspective of other people). Moreover, it is relevant to examine whether the company's offerings can create value for an extended group of stakeholders.

The design strategy called extending value can be divided into the following steps: 1) identify ways to extend the value of the company's offerings through DDP services, 2) develop these into DDP service concepts, 3) test if and how these concepts can be relevant to the company as well (to ensure full strategic fit).

4. FRAMEWORK DEMONSTRATION: THE CASE OF FRITZ HANSEN FURNITURE

The next step in the development of the framework for creating new DPP services is testing and demonstration in its practice. As explained in the methodology section, this was conducted in a study with Fritz Hansen A/S. The design principles and design strategies of the DDP service framework were applied in a facilitated process, resulting in the development of new DDP service concepts. In this paper, the outcome from this process is presented to illustrate the strategic advantages and incentives to adopt DPP, the work with the framework created. But before this, there is first a short introduction to Fritz Hansen A/S to contextualise the outcome.

4.1 Fritz Hansen A/S

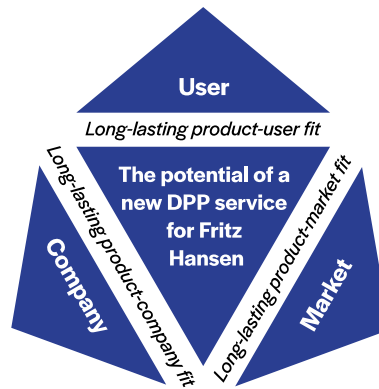
Fritz Hansen A/S is a well-known Danish company producing high-end luxury furniture, lighting, and home accessories designed by Danish and international designers. The company has a long and rich history of crafting iconic and lasting products such as Arne Jacobsen's Egg, Swan, and Series 7 chairs. Core values are premium quality, expert craftsmanship, and high-end materials. Fritz Hansen has made different initiatives to keep their products alive for as long as possible, such as refurbishment programs and takeback systems. Some products in their refurbishment process are more than 50 years which proves the longevity of their products. The following sections unfold the new DPP conceptualisation with examples from the case company Fritz Hansen A/S (summarised in Figure 3).

Ownership documentation

The DPP includes information about who is the owner of the specific product. This would make the product a safe investment for Fritz Hansen’s customers because it would hamper thieves to resell stolen products. Another benefit would be the story that comes with a used product. For instance, it could increase the value of a chair that has lived at a famous location or at an interesting person.

Copyright protection

The DPP is a possibility to protect core competencies in the company and copyright on their products. Today, production, repair and refurbishment services are located in Denmark to ensure the high-quality development and protect copyright. However, with the new DPP, Fritz Hansen could share and scale their core competencies to international partners and at the same time protect their copyright with the DPP.



Product lifetime information

The DPP would support the creation of unique and differentiating features by including information about maintenance, repair and restoration. For instance, the user could verify that a chair is repaired or restored at an authorized partner with approved fabrics or other materials.

Copyright protection

Copyright protection is furthermore a possibility for Fritz Hansen to enhance the company’s core values on longevity as the process of keeping their products alive is both more convenient for the customers and sustainable for the planet.

Product lifetime information

Information about the product’s lifetime would support the advancement of Fritz Hansen’s long-term credibility as a company and thus strengthen their competitive positioning in the market.

Figure 3: The Strategic Potential of the New DPP Service in Fritz Hansen A/S

4.1.1 Ownership Documentation (Customer Value)

In the specific case of Fritz Hansen, one of the long-term problems that were identified from a customer perspective was the risk of having their products stolen. In such a case, a main benefit of the DPP could be data on “ownership documentation”, which includes information about who is the owner of that specific product. This would make a Fritz Hansen product a safe investment for their customers because it would hamper thieves from reselling stolen products. Another benefit of “ownership documentation” would be the story that comes with an older used product. For instance, it could increase the value of a chair that has lived at a famous location or with an interesting person.

4.1.2 Product Lifetime Information (Market Value)

Besides ownership documentation, Fritz Hansen also sees the potential that the new DPP services can support the creation of unique and differentiating features by including information about maintenance, repair, and restoration. For instance, the customer could verify that a chair is maintained, repaired, or restored at an authorised partner with approved fabrics or other materials, just like a service manual for a car that includes information about previous owners’ care. This will also serve as a tool for secondhand sales at auctions to prove validity and track product

history. Information about the product's lifetime would furthermore support the advancement of Fritz Hansen's long-term credibility as a company and thus strengthen its competitive positioning in the market.

4.1.2 Copyright Protection (Company Value)

Finally, the DPP is a possibility for Fritz Hansen to protect their core competencies in the company and copyright on their products. Today, production, repair, and refurbishment services are in Denmark and Poland to ensure high-quality development and to protect their copyright. This means that if products are to be repaired or restored, they need to be shipped to Denmark, which is neither a sustainable solution nor a convenient solution for a customer settled in Asia, for instance. However, the current challenge for Fritz Hansen is that if their core competencies are shared, there is a risk that products easily get copied. But with the new DPP, Fritz Hansen can share and scale their core upholstery competencies to international partners without being afraid that their copyright is violated without their knowledge. Today, Fritz Hansen differentiates original products from copies, certified refurbishment from uncertified, and therefore, they are highly protective of this. In the future, the new DPP services can provide each produced chair with a unique passport number and thereby make it possible to differentiate original products from copies and certified from uncertified refurbishment.

This initiative is furthermore a possibility for Fritz Hansen to enhance the company's core values on longevity as the process of keeping their products alive is both more convenient for the customers and sustainable for the planet.

5. DISCUSSION AND CONCLUSION

The purpose of this paper was to employ a strategic perspective on DPP to investigate the incentives and especially the strategic benefits that could engage companies to adopt the DPP, aside from compliance. As companies are one of the key stakeholders in ensuring the successful implementation of DDPs, it is significant that these are motivated to invest time and resources in, e.g. organising and sharing their product-sensitive data. The study indicates that developing DPP services is a way to make the DPP strategically relevant to companies, which leads to a faster implementation process.

The paper contributes to a framework for developing new DPP services that can strengthen companies' value proposition to their customers and improve their competitive position (see Figure 2). In this study, we have further tested the framework for DPP services in a study, to explore the competitive and strategic potential of DPP in a company setting. This testing shows substantial potential for using the framework to develop DPP services in practice, thereby making DPP strategically relevant to the company. In particular, the test shows that the framework for developing new DDP services:

- Support the companies in fulfilling the long-term needs, aspirations, and wishes of their customers (for instance, ownership documentation that will hamper thieves from reselling stolen products, like in the Fritz Hansen case).
- Support the companies in creating long-term competitive advantage in the market and advance the long-term credibility of the company (for instance, authorised maintenance, repair, and restoration documentation to serve as a tool for secondhand sale at auctions or to prove validity and track product history, like in the Fritz Hansen case).
- Support the enhancement of the companies' strategic strengths and competencies and align with the company's long-term core values, purpose, and culture (for instance, allowing companies like Fritz Hansen to share and scale their core upholstery competencies to international partners without being afraid that their copyright is violated without their knowing because the new DPP services can provide each produced product with a unique passport number and thereby make it possible to differentiate original products from copies, and certified from uncertified refurbishment).

5.1 Implications for Research

Many researchers praise the concept of DDP. For example, Canciani et al. (2024) highlight the potential for enhanced supply chain transparency. Psarommatis (2024) and Ajdinovic et al. (2024) further emphasise the benefits of the passport in enhancing sustainability and transparency in manufacturing.

This paper contributes with a new perspective on DPPs, namely how companies, through DPP services, can strengthen their value proposition towards the customer and, thereby, their market and competitive positioning. Though several researchers argue that stakeholder involvement and data sharing are crucial for DDPs' successful implementation (Jansen, 2023, Canciani, 2024) and that a multi-stakeholder perspective is needed (Pourjafarian, 2023), only a few studies address the question of business motivation for implementing the DDP, beyond compliance.

The study provides companies with a framework for developing new DPP services based on strategic durability theory (Haase & Laursen, 2022). In line with the arguments of Grover and Lyytinen (2015), we believe that the use of the strategic durability theory in the context of DDPs will create the novelty and foresight needed to drive the development of DPP forward. However, this is only possible if some of the other present obstacles related to the DDP are tackled as well. For the moment, the implementation of DDP faces several challenges that need to be solved shortly. These include the need for a common digitalisation system interoperability and privacy concerns (Pourjafarian, 2023), the development of a generic DPP system design, and the integration of absolute - and social sustainability (Panza et al., 2023).

This study might also be of value to the goal of strategic autonomy and supply security in the EU (European Parliament, 2022). For instance, we assume that several companies could be motivated to develop new DDP services for their customers to prove or showcase the resilience of their supply chain. Likewise, new DDP services may be developed to categorise and handle dual-use technologies (technologies that can be used for civil purposes but that, under certain conditions, may cause a security concern, e.g. thermal imaging, drones, etc.) Today, companies and universities are documenting and handling dual-use technologies in time-consuming hand-held processes. However, we propose that new DDP services can help document the security levels in each step of the supply chain, as well as identify problematic use or application issues at the customer (for instance, security concerns that may arise when multiple technologies can be accessed together) and for setting up appropriate safety measures (e.g. limited personal access or security clearing).

Similarly, the specific results from Fritz Hansen presented in this paper may also inspire solutions in the critical resource industries. For instance, 'ownership' documentation may be used to avoid hibernation and ensure the efficient recycling of critical raw materials, e.g. smartphones. Likewise, product lifetime information, e.g. repair and refurbishment, may soon be strategic important information for customers in the green energy industry, e.g. solar panels, where circularity for the moment is limited.

As discussed in the European Solar PV Industry Alliance's PV Passport report (2024), the implementation of digital product passports (DPPs) in the solar energy sector will enhance both traceability and sustainability. However, adding new DDP services that provide product lifetime information, to the DDP standard information on materials, manufacturing processes, and environmental impact of solar panels will facilitate even better lifecycle management and recycling efforts.

These examples of how new DDP services can support strategic autonomy and supply chain security also point to the wide range of application areas for the DDP service framework developed in this paper.

In the context of battery technology, Berger et al. (2023) suggest multiple sustainable product management (SPM) information for the DDP e.g. 1) DPP users would be able to get information about the chain of custody 2) DPPs could provide early information feedback loops and thus support consideration of circularity and sustainability aspects in the product design 3) DPPs could enable suitable value retaining strategies (e.g., repair and maintenance, refurbishment, repurposing) by providing in-use data. The development of such SPM information could have been supported by the DDP service framework.

Still, research is in its initial phase, and the testing of the framework is limited to a single demonstration with Fritz Hansen. Hence, there are multiple assumptions to be tested and evaluated in future research. For example, to what extent the framework for new DPP services can be used to make DPP strategically relevant in multiple companies and across various industries? Likewise, it must be tested whether the framework needs further adjustment to be used in B2B or public procurement settings. Aside from this, it is also relevant to test whether the DPP services are only suitable for durable products or whether it is relevant to products with shorter lifespans as well. For instance, we assume that for businesses that are already manufacturing durable goods, the strategic durability theory may help them to view DPP as a possibility to provide their products with a stronger value proposition and with new long-term competitive advantages in comparison with products with a shorter lifespan.

For businesses that are manufacturing products with short lifespans, we assume that DPP services may be relevant to document the company's efforts towards slowing and closing resource loops as well as customers as authorities. Moreover, we foresee that when DPPs are legally mandated, this will cause significant shifts in some companies' business models - especially short-lived products, necessitating certain industries to adapt and perhaps be more inclined to explore new DPP services. Therefore, it would be interesting to explore other ways to make DPP strategy relevant to companies in the future. At a more general level, there is an ongoing discussion on how to communicate the DPP information to a multitude of stakeholders in a product's lifecycle (customers, manufacturers, recyclers, etc.) and on which platform to access information (Plociennik et al., 2022), and this is relevant to explore in future research on DPP services as well.

5.2 Implications for Business and Policy

For business, this paper provides a framework for developing new DDP services that can be applied before having the DDP infrastructure in place and as a test of whether DDPs can provide strategic benefits to the company. Besides the framework, the paper also contributed with inspiration and examples. The paper illustrated how the new DPP service has supported Fritz Hansen in identifying the strategic relevance of DPP as a company. In the process, Fritz Hansen's motivation was particularly driven by a strengthened market position that the ownership documentation and distributed manufacturing possibilities would provide. However, from an environmental standpoint, these services could foster a stronger bond between the product and the consumer, leading to resistance and delay of product obsolescence and, consequently, further slowing of resource loops. As den Hollander et al. (2017) argue, the first set of strategies for slowing resource loops must focus on resisting obsolescence (e.g. through product attachment, reliability, and trust), and when this is no longer possible, obsolescence must be postponed (e.g. via reuse and upgradability), and finally, obsolescence must be reversed (e.g. through repair, refurbishment, etc.).

While the furniture industry exploration shows the great potential of the new DPP services, exploration of DPP services could be highly relevant for other industries as well. We hope that this study will inspire other companies and industries to find the strategic benefits of the DPP that could increase value for the customers, the market, and the company to make the implementation of DPP attractive and meaningful in practice. Thereby, the implementation of the DDP could be pushed by companies rather than legislation, and new levels of compliance could be reached faster.

Likewise, the ambition of this paper has also been to challenge policymakers to rethink the legislation to include considerations on how to motivate companies beyond compliance, e.g. by offering parts of the DDP directed towards the company-customer relationship or interaction (or what Plociennik et al., refers to as "lifecycle status"). Moreover, the specific case of Fritz Hansen also points to the need for customers and after-sales service providers to be able to document their life-status information, such as repair, maintenance, etc., in the DDP. This information would reveal important customer behaviour perspectives that are not presently part of the Eco-design for sustainable product regulation (EU Commission 2022),

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AUTHOR CONTRIBUTIONS

Louise Møller Haase: conceptualisation, analysis, methodology, writing, editing, and reviewing.

Line Sand Lythje: analysis, writing, editing, and reviewing.

Esben Bala Skouboe: conceptualisation, editing, and reviewing.

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DECLARATIONS

Competing interests The authors declare no competing interests.

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