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TOWARDS CIRCULAR CONSUMPTION

Facilitating circular consumer actions
through a Digital Product Passport-enabled
service platform



**Towards Circular Consumption - Facilitating Circular Consumer Actions
through a Digital Product Passport-Enabled Service Platform**

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Preface

Being surrounded by designers who have a high sense of purpose can be challenging at times, especially if the desire for uniqueness and world-changing impact drives us to shout one impressive designer title greater than the other. I asked myself how should we designers lead the change on humanity's most pressing problems. What kind of designer do I need to be to play a part in that?

After gaining experience in design work at a global corporation and in a smaller agency, I have found my next design experiment. Instead of jumping on a big corporate ship and trying to manoeuvre it with a graduation project, let's be on the small dinghy that is quicker and can inspect new routes. I wanted to work on something that I steer towards my vision of a desirable future - not someone else's. An interview with Indy Johar from Dark Matter Labs (Justyna Green, 2024) on how designers can shape the world we live in convinced me to use this thesis as an experimentation space to think, act, and decide more entrepreneurially.

"[...] this is the big shift: moving from mediums to outcomes. [...] You start to realise you need integrated capabilities. [...] you have to be a design-entrepreneur. [...] You do not only describe the design, but you craft it." - Indy Johar in a podcast of Justyna Green (2024)

This is my way of contributing to a better world, which may inspire fellow students to combine scientific rigour with a tangible outcome. An outcome that they can take forward independently, instead of depending on organisations to pick it up.

That explains my approach in my thesis. But why this topic?

Throughout my previous work experiences and time at the TU Delft, I was surrounded by organisations, coworkers, and fellow students who push for sustainability initiatives. They were all driven by the hope to create a future worth living for them and the next generations. Unfortunately, ideas often remained initiatives, marketing lighthouses. I was stuck with the question: What if acting circularly became effortless and economical? What if circularity became the baseline requirement for products instead of a marketing slogan? Wouldn't that automatically steer towards consuming products that are better for the planet and your pocket? I know these are far-fetched dreams. However, when I heard about the ESPR and the Digital Product Passport, I felt enthusiasm. I felt potential for it to change the way we consume. How? I had a vague feeling, but I did not exactly know yet.

Let's dive into it together!
Enjoy reading!



Tim
Delft, 11.04.2026

Abstract

The European Union's transition to a circular economy demands that consumers shift from linear consumption habits towards value-retaining actions such as repairing, reselling, and recycling products. While EU citizens acknowledge that environmental issues affect their daily lives, this awareness has not translated into proportional circular action. A key enabler in bridging this gap is the Digital Product Passport (DPP), introduced through the Ecodesign for Sustainable Products Regulation (ESPR). The DPP creates a digital record of product-specific information accessible via a data carrier on the product. This thesis investigates how DPP-enabled services can facilitate consumers to act circularly in the European circular economy, moving beyond the DPP as a standalone information tool towards the service ecosystem it enables.

Following a design-entrepreneurial approach, this research employs a Double Diamond methodology combined with a Lean Startup approach. The first phase establishes the problem space through three research activities. First, a circular consumer journey framework maps consumer actions across the purchase, use, and post-use phases. Second, an analysis of the ESPR defines the functional data capabilities of the DPP ecosystem for service creation, supplemented by eight expert interviews. Third, a semi-systematic literature review identifies 17 consumer barriers across all phases of the circular consumer journey. These barriers are translated into consumer pain statements and their relevance validated through a consumer survey (N=887). The survey concludes with three service opportunity areas that offer the greatest potential for DPP-enabled service intervention.

The second phase synthesises these findings into tangible service concepts through iterative ideation and co-creation workshops. Five DPP-enabled service concepts are prototyped as experience scenarios and tested with ten consumers. The interviews revealed that the three strongest concepts, ProductWallet, RepairMatch, and SimpleSell, share a common dependency on verified, centralised product information. This prompted a pivot from isolated services towards a consumer product lifecycle platform: the DPP Repository. At its core sits a personal product repository where consumers store their DPPs. Integrations with repair networks and resale platforms enable lifecycle services that leverage this data to reduce effort across the circular consumer journey.

To explore viable business models, a mapping workshop generated five DPP Repository variants, each tested through lightweight experiments. The experiments revealed that a B2B2C information marketplace between consumers

and brands shows the strongest signals for viability. This led to the development of Keep It, a two-sided platform where consumers register products and share lifecycle data in exchange for brand rewards and post-purchase services, while brands gain a direct consumer channel, circular service distribution, and aggregated product lifecycle insights. A clickable prototype was developed and validated with three DPP early-mover brands. The validation signals that the platform has the potential to address the pain of lacking post-purchase consumer connections and can provide a missing piece in making DPP investments commercially viable.

This thesis contributes a practical, consumer-centred perspective to the predominantly theoretical and technology-focused DPP discourse. It further expands the scientific discussion by exploring the service ecosystem the DPP can create for consumers. The thesis concludes with next steps to build Keep It as a start-up, beginning with pilot partnerships and consumer adoption testing.

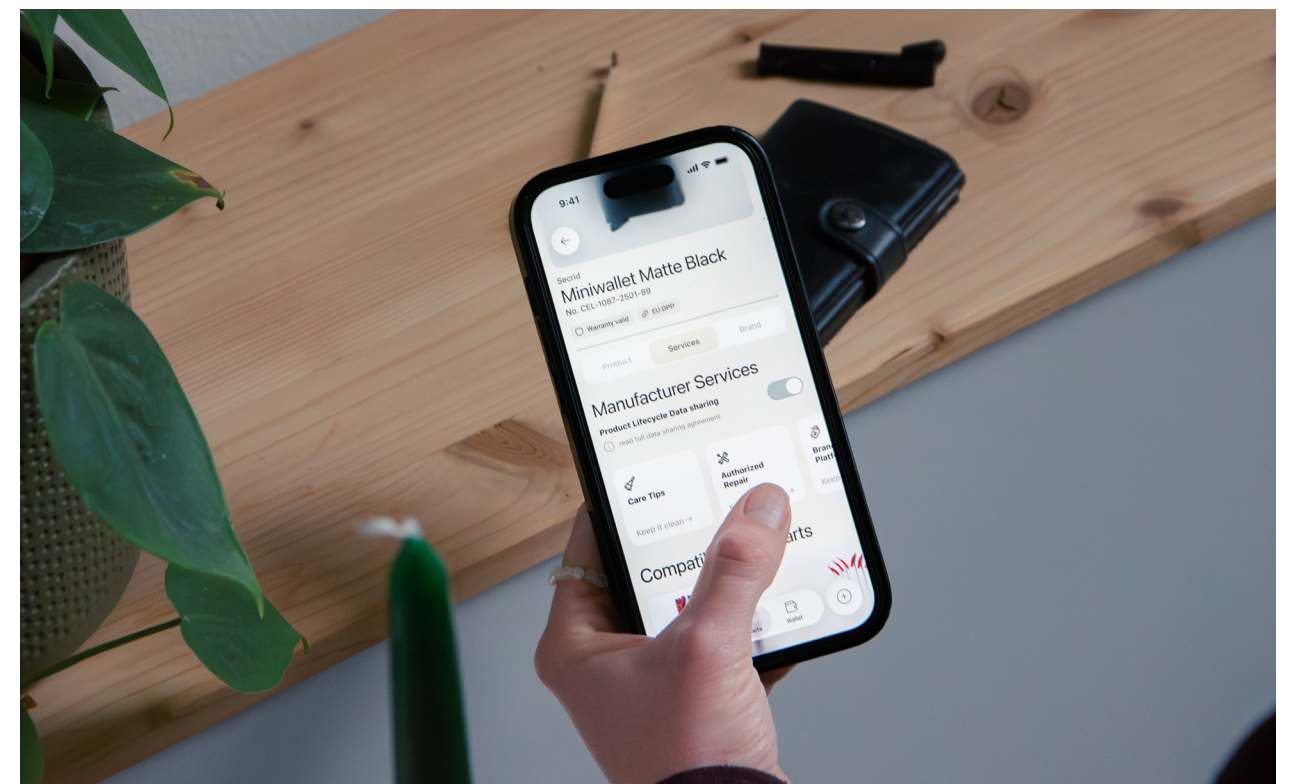


Figure 1: A DPP-enabled consumer app Keep It - example of repairing a wallet

Contents

1. Introduction	12
2. Project objective	16
2.1 Research problem	17
2.2 Project scope	20
2.3 Project outline	22
3. The circular consumer journey	24
4. The capabilities of the EU DPP ecosystem for service creation	28
4.1 The DPP ecosystem defined by the ESPR	29
4.2 Expert perspectives on DPP-enabled consumer services	36
5. Service opportunity areas along the circular consumer journey	40
5.1 Consumer barriers to circular consumption	41
5.2 Translating consumer barriers into circular consumer pains	47
5.3 Service opportunity areas based on the relevance of circular consumer pains	50
6. Consumer-centred DPP-enabled consumer services	56
6.1 Designing DPP-enabled service concepts that reduce consumer pain	57
6.2 Testing consumer desire for DPP-enabled service concepts	67
6.3 A revised consumer service: The consumer DPP repository	74
7. A viable DPP-enabled service MVP	78
7.1 Business model mapping	80
7.2 MVP selection experiments	85
7.3 MVP development	96
7.4 MVP validation	118
7.5 Venture outlook	122

8. Final remarks	126
8.1 Contributions	127
8.2 Limitations	129
8.3 Future work	131
8.4 Personal reflection	133
8.5 Acknowledgements	135
9. References	136
10. Appendix overview	144

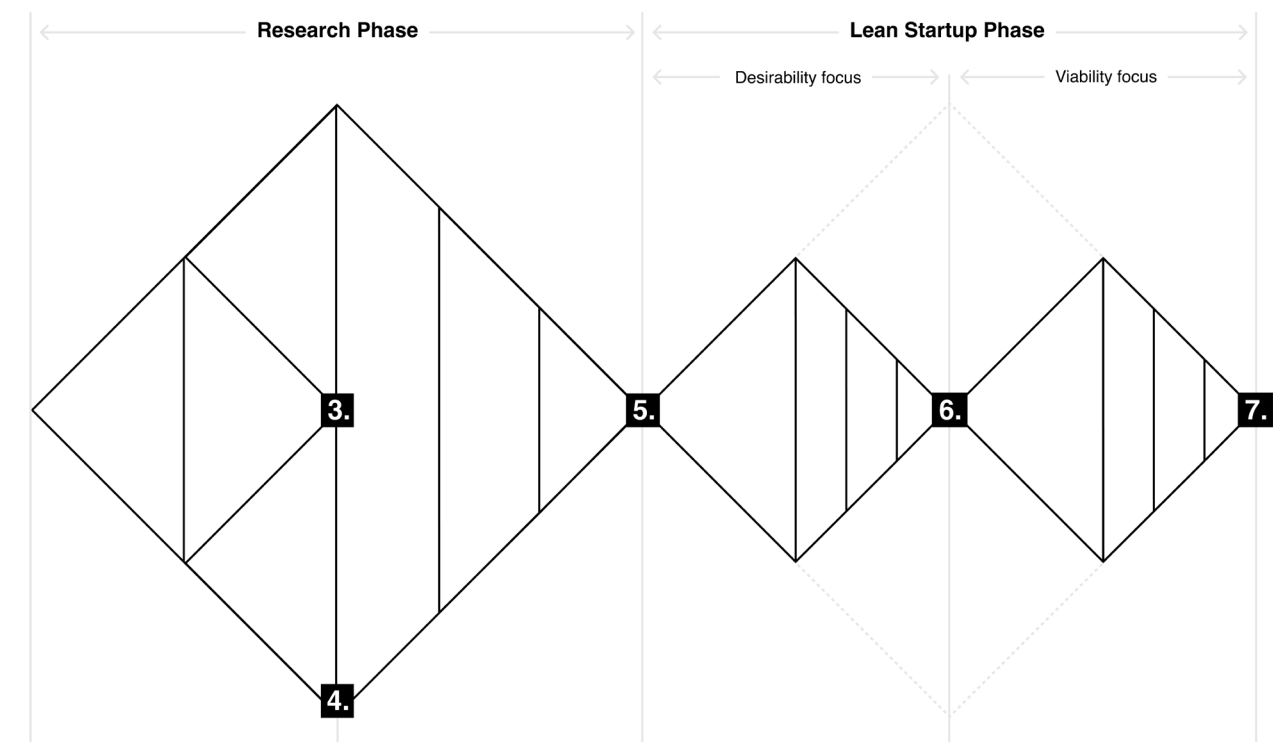


Figure 2: Main chapters linked to the thesis project timeline

Abbreviations

This list defines the abbreviations used throughout this thesis. Abbreviations that appear only within a specific chapter are defined at their first mention in that chapter.

AI	Artificial Intelligence
API	Application Programming Interface
B2B	Business to Business
B2G	Business to Government
B2B2C	Business to Business to Consumer
B2C	Business to Consumer
CE	Circular Economy
CEAP	Circular Economy Action Plan
DPP	Digital Product Passport
EC	European Commission
ESPR	Ecodesign for Sustainable Products Regulation
EU	European Union
GS1 DL	GS1 Digital Link (URI-based identifier standard)
MVP	Minimal Viable Product
SaaS	Software as a Service
SKU	Stock Keeping Unit
UI/UX	User Interface/ User Experience
UN	United Nations

Glossary

This glossary defines the key concepts and terminology used throughout this thesis. Terms that are not defined globally in the glossary are defined in the subsequent chapter.

Brand	The market-facing identity of a manufacturer under which products are sold to consumers.
Circular action	A consumer effort that retains product value from a circular economy perspective: such as repairing, reselling, donating, or recycling a product.
Circular consumer journey	The framework used in this thesis that maps circular consumer actions onto three consumption phases: purchase, use, and post-use.
Circular consumption	An umbrella term for all circular consumer journey phases.
Circular Economy (CE)	An economic model that aims to decouple economic growth from resource extraction by keeping products, components, and materials at their highest value for as long as possible (Kirchherr et al., 2023).
Circularity	The degree to which products, materials, or practices align with circular economy principles. Used in this thesis as a descriptive quality (e.g., a product's circularity, circular actions).
Consumer	The overarching term used in this thesis for the individual who performs circular actions along the consumer journey
Customer	The consumer in the role of a purchaser.
DPP-enabled service	A service that leverages data accessible through a Digital Product Passport to create value.
Linear economy	The prevailing take-make-dispose model in which products are manufactured from virgin resources, used, and discarded as waste.
Manufacturer	The economic operator responsible for producing a product and, under the ESPR, for issuing and registering its Digital Product Passport.
Sustainability	A broad principle that seeks to meet present needs without compromising the ability of future generations to meet their own. It spans environmental, social, and economic dimensions.
User	The consumer in the role of interacting with a product or digital service

1. Introduction

In 2050, the UN forecasts the global population to grow to around 9.7 billion inhabitants. By that time, material resources equivalent to three planets would be needed if we do not change how we consume (United Nations Department of Economic and Social Affairs, 2025). As the use of the Earth's resources grows, the global environmental impacts also increase. The extraction of resources, the process of manufacturing, and the premature or incorrect disposal of products have been identified as drivers of climate change, global air pollution, and biodiversity loss (UNEP, 2024). In order to decouple economic and population growth from increased resource extraction, the European Union (EU) has recognised the need to transition to the Circular Economy (CE).

To drive this transition, the Circular Economy Action Plan (CEAP) (European Commission, 2020) was introduced as part of the European Green Deal (European Commission, 2019). The CEAP structures a policy framework to increase product longevity, repairability, and material recovery. Its underlying logic relies on products circulating at their highest value and materials remaining in the economy as long as possible (Kirchherr et al., 2023).

A major inhibitor in the transition to the CE is the lack of information for citizens and economic operators to make more sustainable decisions and perform value-retaining actions (see Figure 3). For instance, the lack of information transfer between manufacturers and waste recovery companies regarding material composition, recyclability, or toxicological characteristics is decreasing the efficiency of resource recovery operations and thereby inhibits the adoption of circular business models (Adisorn et al., 2021). Another example is the lack of information about the repairability or durability between manufacturers and consumers. This plays an important role in their decision to replace or repair a product (European Commission, 2018). A legislative pillar in the CEAP to tackle this information asymmetry is the Ecodesign for Sustainable Products Regulation (ESPR) (European Commission, 2024b). Within the ESPR, the Digital Product Passport (DPP) is introduced as a technological concept to share information along the product value chain and throughout its entire life cycle.

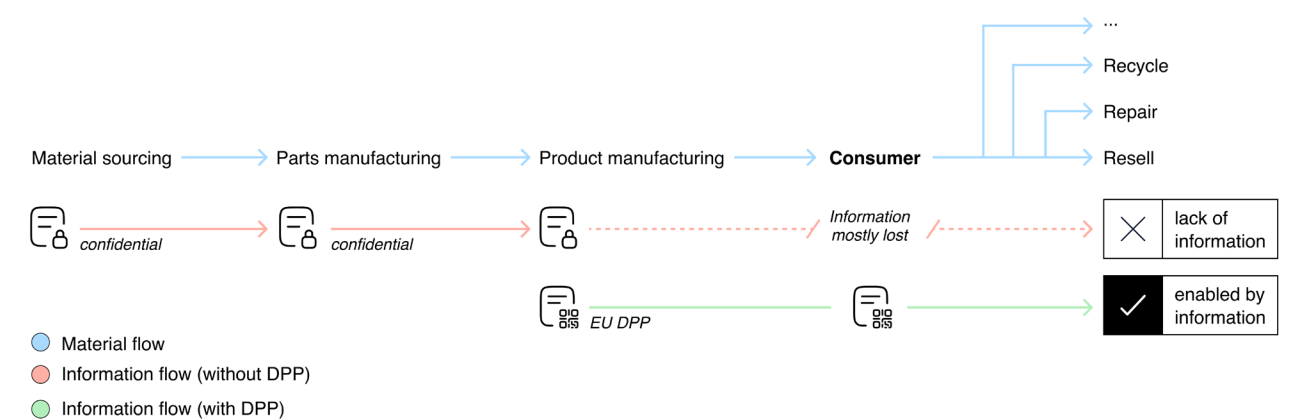


Figure 3: Simplified information flow along the product value chain (adapted from European Commission (2022))

At the baseline, the DPP is a digital record of a product that includes product-specific information (see Figure 4). The manufacturer issues the digital record and makes it accessible to all actors along the product value chain via a data carrier (e.g., a QR code) on the product or its packaging. The DPP may include information about the manufacturer, the product ID, materials and their sourcing location, environmental impacts, digital manuals, safety instructions, or updated repair events and ownership changes. While voluntary DPPs already exist, the first mandatory rollout is planned for 2026 for batteries and 2027 for textile products, furniture, and toys. The full deployment of the ESPR to almost all products sold on the European market is expected by 2030.

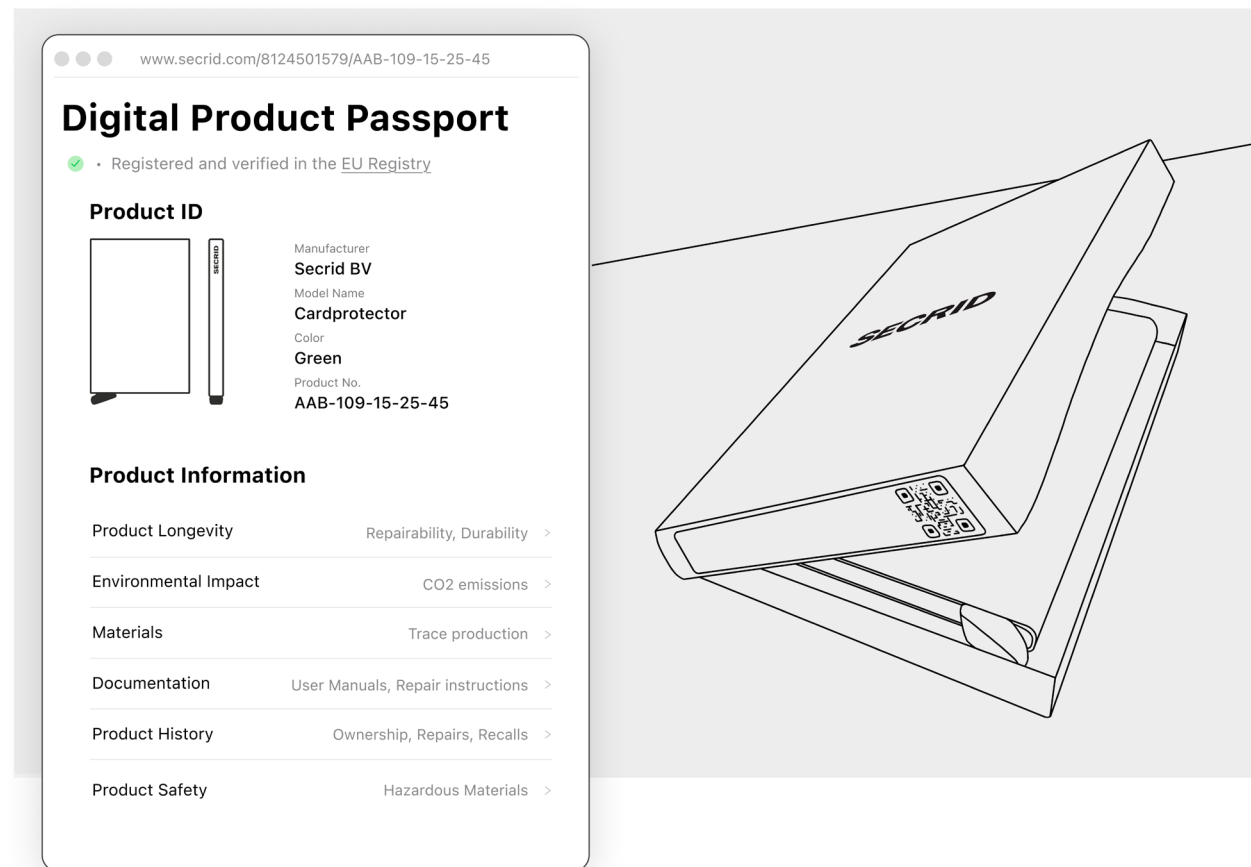


Figure 4: Secrid wallet as an example product with a Digital Product Passport mock-up

However, simply providing actors, such as consumers, with access to this information may not be sufficient to drive the circular transition. While the private product end-consumer (hereinafter referred to as “consumer”) can review this information, the complexity and volume of data “dumped” on them risk an information overload. Moreover, consumers may not even access the information if they are not interested. To address these issues, the European Commission (EC) suggests that the data in the DPP can be leveraged to build consumer-centred services that actively facilitate the consumer’s journey in the CE. That way, information paralysis can be mitigated and consumers supported in circular decisions (European Commission, 2022, pp.63-64).

2. Project objective

2.1 Research problem

The DPP's technical architecture (e.g., Langley et al., 2023; Voulgaridis et al., 2024) and regulatory design (e.g., Adisorn et al., 2021; Ducuing & Reich, 2023), as well as its challenges and opportunities for economic actors (e.g., Haase et al., 2025; Van Capelleveen et al., 2023), have received significant scientific discourse. In contrast, consumer studies in the context of DPPs have stayed underexplored. Neither the consumer value of viewing a DPP nor utilising its data through DPP-enabled consumer services have seen much scientific attention.

The effect of this gap continuing to stay underexplored is twofold: (1) It increases the risk that DPP investments from the EU and manufacturers result in technically functional DPPs which lack widespread consumer adoption. (2) Opportunities might be missed to utilise DPP data for services that increase the ability of consumers to consume in a circular manner and therefore support the EU circular transition.

The consumer value of the DPP itself largely depends on the regulatory design laid out in the ESPR and accompanying delegated acts. Standardization bodies and working groups (e.g., Catena-X, 2025; CIRPASS 2, 2025) are collaborating with the European Commission to define and develop the first version of the DPP. Exploring the consumer value of the DPP itself would therefore likely result in regulatory design guidelines and recommendations. In line with the design-entrepreneurial approach of this thesis, a more practical and opportunistic design space evolves around third-party services that utilise the data in DPPs to create value for the consumer (see Figure 5).

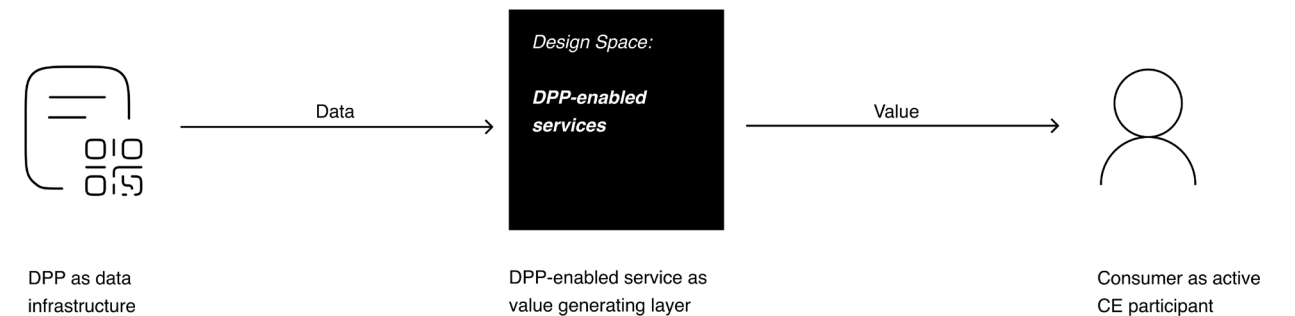


Figure 5: DPP-enabled consumer service design space

While 78% of EU citizens agree that environmental issues directly affect their daily lives (European Commission, 2024a), the awareness has not translated into proportional circular actions (Populytics, 2022). The Dutch Behavioural Strategy for Citizens and the Circular Economy explicitly attributes this to the significantly higher cognitive and physical effort required for circular actions compared to linear consumption habits (Dutch Ministry of Infrastructure and Water Management, 2023). This suggests that DPP-enabled services must focus on mechanisms that reduce friction and increase the consumer's ability to act.

Adding to the research landscape by providing a tangible service concept, this thesis explores the consumer value not through the DPP as a standalone information provider, but through the service ecosystem it enables, by asking:

RQ1: How can DPP-enabled services facilitate consumers to act in line with the European circular economy?

To create actionable work packages and define intermediate results, the main research question (RQ) is dissected into five sub-questions:

RQ 1.1: What actions do consumers perform on the circular consumer journey?

Consumer actions favoured from a circularity perspective differ from linear consumption. This chapter concludes with a framework adapted from literature that maps specific consumer actions on their respective consumption phase. The resulting circular consumer journey establishes the foundation for where DPP-enabled services can add value for consumers.

RQ 1.2: What are the functional data capabilities of the DPP system available for the service creation?

This question addresses the prevailing uncertainties that surround the DPP. Based on a study of the ESPR, the capabilities of the DPP ecosystem are defined. This ensures that the service ideation is grounded and not purely speculative. The legislative insights are supplemented with eight expert interviews and field notes from two DPP conferences.

RQ 1.3: What pains do consumers experience on their circular consumer journey?

To design a meaningful service, it is essential to understand the friction points that consumers currently experience during circular consumption. Leveraging the existing empirical research, a semi-structured literature review was conducted. The gathered barriers inform a consumer survey that identifies the most relevant consumer pains. The survey concludes with an opportunity landscape mapped on the circular consumer journey that summarises which consumer pains offer the most significant potential for DPP-enabled services to create value.

The fourth sub-question bridges the hitherto analytical approach and synthesises the insights into tangible service concepts by asking the design question (DQ):

DQ 1.4: How can DPP-enabled services resolve consumer barriers?

In multiple ideation rounds, the consolidated knowledge is synthesised into service concepts that are either triggered by the DPP capabilities or the consumer barrier. These concepts embody the assumption that a specific data-enabled service can decrease a consumer pain. To test this assumption, a subset of five concepts is prototyped and validated with ten consumers in interviews. The insights from the interviews inform the convergence towards one DPP-enabled service concept to proceed with.

The last design question complements the so-far desirability-focused approach with a viability perspective by asking:

DQ 1.5: How can the prioritised service concept be transformed into a MVP that balances market desirability, viability and the current DPP deployment timeline?

A business model mapping workshop generated a set of actors and value generation mechanisms around the prioritised service concept. To select a business model for a minimum viable product version (MVP), rapid experimentation was performed. The business model which shows the strongest signals based on market desirability, viability and feasibility given the current DPP deployment timeline, is further developed. To test a subset of assumptions that appear critical to the selected MVP, a clickable prototype is created and presented to stakeholders. Lastly, entrepreneurial recommendations and next steps are laid out.

2.2 Project scope

Although a tight scope is beneficial for research depth, this thesis sets out to be as general as possible regarding the targeted consumer segment and the targeted product category. Focusing too early could prematurely converge the outcome into a niche solution, without considering the breadth of opportunities. This flexibility is also supported by the entrepreneurial approach, as it allows for quicker experimentation and easier concept pivots. Nevertheless, a few boundaries are drawn to distinguish and position (see Figure 6).

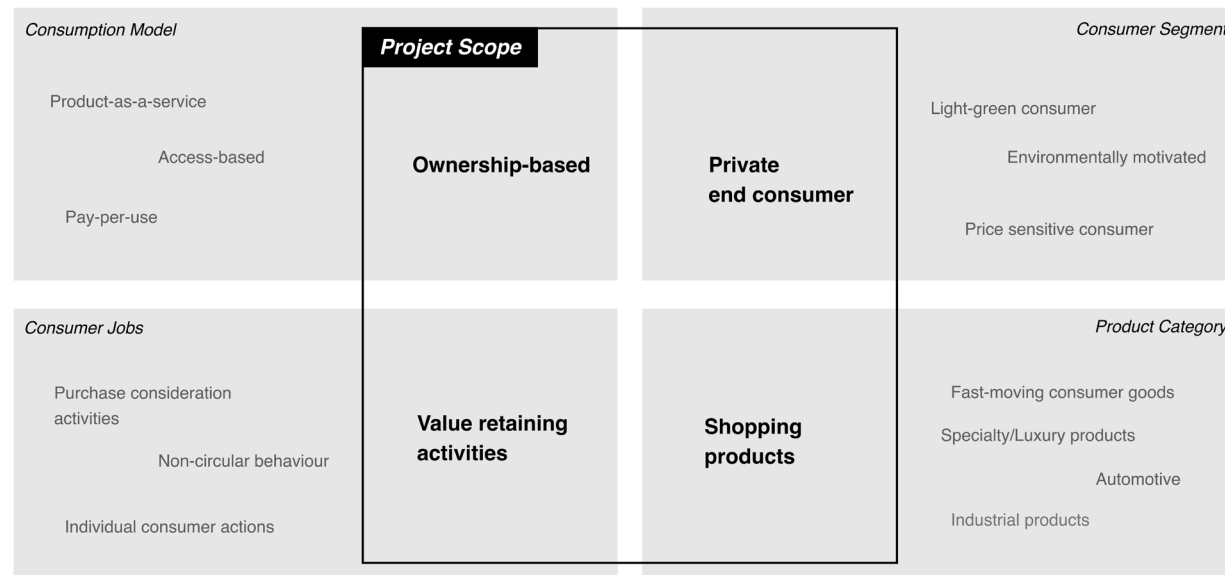


Figure 6: Project scope positioned in adjacent field

Consumption model

Focus lies on ownership-based consumption models. Within such models, consumers play an active role as purchasers, users, and post-use product holders. Therefore, their individual decisions shape whether a product is bought, repaired, or, for example, resold (Kirchherr et al., 2018). Product-service systems and access-based models are recognised as integral to the CE (Tunn, 2020). However, they are excluded from this thesis because the responsibility for circular action shifts from the consumer to the provider. The latter renders DPP-enabled services less critical. Furthermore, these consumption models remain marginal in the market, as psychological ownership of products remains a key factor to satisfy needs and status (Mykkänen & Repo, 2021; Singh & Giacosa, 2018). Considering that the DPP will first be mandated to products, such as consumer electronics and textile products, a focus on ownership-based consumption is relevant from a regulatory perspective for investigating DPP service propositions.

Consumer segment

Several factors influence consumer's decision to act circularly (Camacho-Otero et al., 2018). Some consumers like the idea of doing good for the planet, some favour quality products that last long, others simply want to earn money by

reselling their used products. Limiting the scope to a segment of consumers who are motivated by, for instance, their environmental motivation (e.g., Gilg et al., 2005), would miss consumers who act or want to act circularly out of self-interest. In line with the Dutch Behavioural Strategy for Citizens and the Circular Economy (Dutch Ministry of Infrastructure and Water Management, 2023), the DPP-enabled services aim to make circular actions obvious and effortless, and thus accessible to the general private consumer.

Product category

Further, this thesis focuses on products that fall under the “shopping products” category, adopted from Ali and Choe (2022). This includes, for instance, electronics, clothing, and furniture (Bucklin, 1963). Manufacturers of these product categories will be amongst the first to be mandated to have a DPP for their products by 2027 (European Commission, 2025). Therefore, DPP-enabled services that include electronics and textile products are likely to be the first realised and the earliest opportunity for real-world validation of DPP-enabled service propositions.

Consumer jobs

Following the main research question, the thesis focuses on consumer-product interactions that are desired from a CE perspective because they retain the product value on the highest possible level (e.g., choosing a circular product, repairing a product, reselling a product) (e.g., Shevchenko et al., 2023). Subsequently, this thesis aims to contribute to realising the transition to the CE.

2.3 Project outline

The thesis combines an established Double Diamond design process (Design Council, 2005) with a design-entrepreneurial mindset. Therefore, the project is structured in two phases: a research phase and a design phase that together answer the research and design sub-questions (see Figure 7).

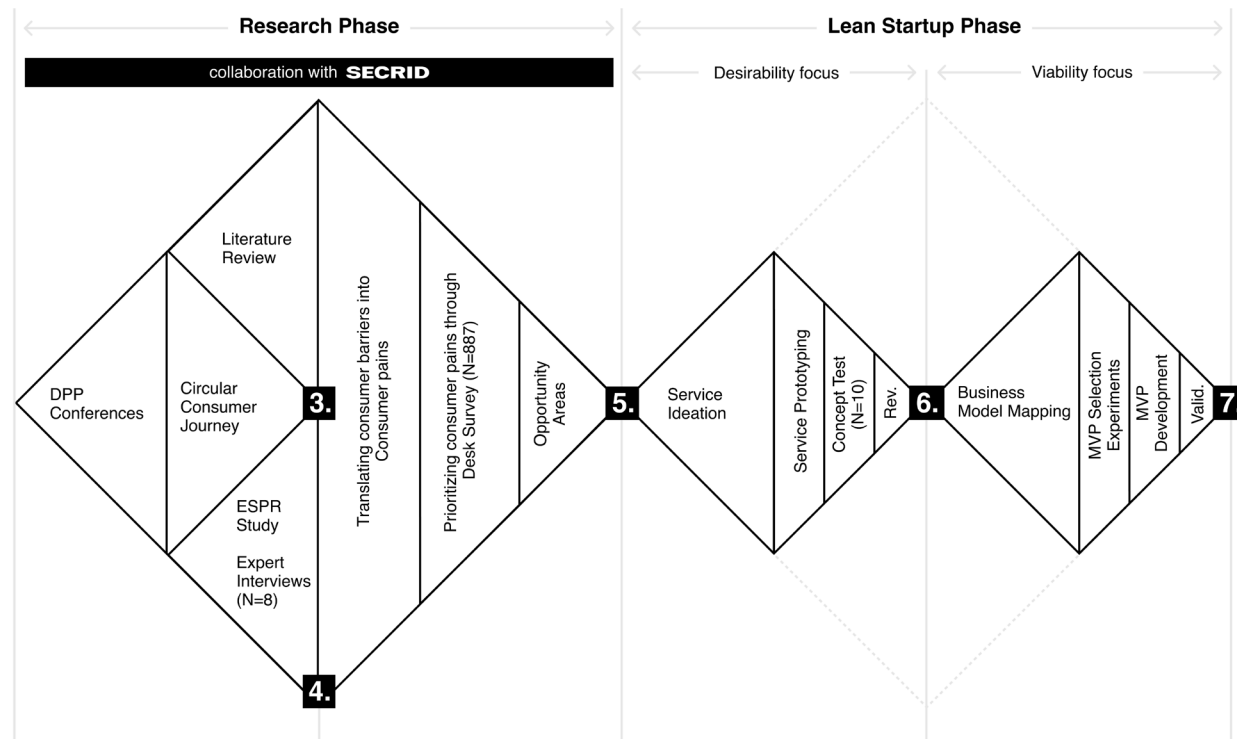


Figure 7: Research and design activities employed throughout the project timeline

Research Phase

The research phase employs diverging and converging. Two parallel research efforts open the project. The circular consumer journey is mapped through desk research, establishing the actions the CE asks of consumers across purchase, use, and post-use (Chapter 3). The capabilities of the EU Digital Product Passport ecosystem are uncovered through a systematic study of the ESPR, supplemented by insights from two DPP conferences and eight expert interviews (Chapter 4).

The phase then converges through a literature review of consumer barriers to circular consumption. These barriers are systematically translated into consumer pain statements and prioritised through a survey (N=887). The convergence point identifies three service opportunity areas along the circular consumer journey that offer the greatest potential for DPP-enabled services (Chapter 5). Together, these define where DPP-enabled services can add value and what is technically and legislatively possible.

Within this first phase, Secrid served as a collaborative research partner with a mutual interest in understanding how the DPPs or DPP-enabled services can create value for consumers. Their involvement supported the research in RQ1.1 through RQ1.3. Secrid funded attendance at two DPP-related conferences (the Circular Tech Forum in Cologne and the DPP Festival in The Hague) and provided access to their global customer database for distributing the consumer survey and recruiting interview participants for a consumer concept test. While the project was led by the author, two colleagues from Secrid's sustainability department contributed periodically to review findings or synthesise insights. Beyond this, the remainder of the project was conducted independently.

Lean Startup Phase

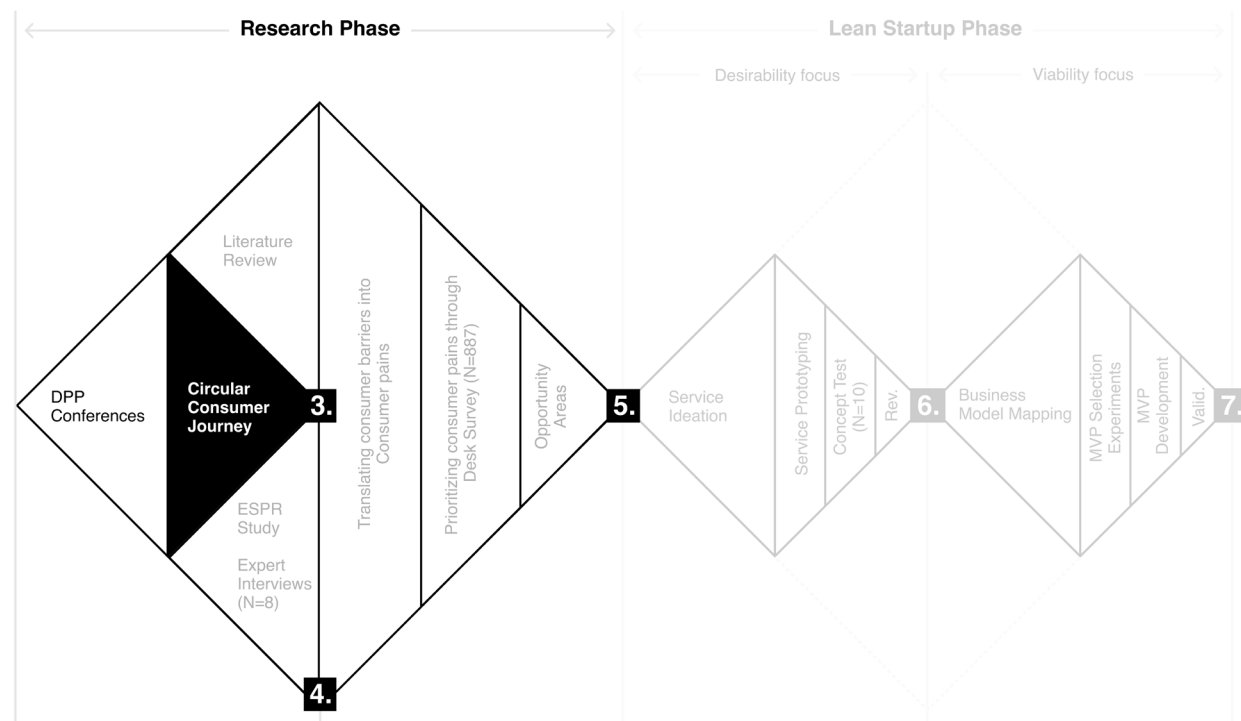
The second diamond attempts to deliver solutions to the problems uncovered in the first diamond. Following the design-entrepreneurial approach of this thesis, it employs the Lean Startup method (Ries, 2011). Lean Startup is centred around an iterative experimentation process of quick prototyping, testing and learning. Based on the learnings, a concept is either pivoted or persevered with for further experimentation. Established in the entrepreneurial field, the method promises to minimise upfront investment costs in solutions that are unwanted by their customers.

Two Lean Startup cycles were conducted in the second diamond to design and develop a minimum viable product (MVP) that serves as the final outcome.

The desirability focus (Chapter 6) diverges through iterative service ideation, translating the opportunity areas into DPP-enabled service concepts. A subset of the ideated service concepts is prototyped as experience scenarios and tested with consumers (N=10). The concept test aims to validate whether the value proposition addresses a real problem and whether it is addressed in the right way. Based on the consumer insights one revised service is persevered and carried forward.

The viability focus (Chapter 7) applies a viability lens to the prioritised concept. Through business model mapping, a variety of DPP repository versions with different value exchange mechanisms and partners are ideated. Subsequently, MVP selection experiments test key assumptions and provide the insights to pivot or persevere with the concept. One concept is persevered and developed into a clickable prototype for subsequent experiments. The second phase concludes with MVP validation interviews and a venture outlook that sketches the road forward.

3. The circular consumer journey



Introduction

This chapter addresses RQ1.1: What actions do consumers perform on the circular consumer journey? Before DPP-enabled services can be designed, it is necessary to understand what the CE means for consumers in their daily lives. Drawing on a desk study of existing consumer role frameworks in the CE literature, this chapter maps the circular consumer journey. For each phase, specific circular consumer actions are identified. The resulting circular consumer journey serves as a framework onto which consumer barriers and, eventually, service opportunities are mapped in subsequent chapters.

Method

Journey maps are a well-established tool in service design practices. They are used to draw the entire path of a consumer interacting with a product or service - from initial awareness to post-purchase actions. That way, opportunities for improvement can be uncovered, pain points addressed, or new experiences created (Stickdorn et al., 2018).

To identify established frameworks in the CE domain, the literature was searched on Google Scholar using the following query: “Circular Economy” AND “Consumer actions” OR “Circular Consumer Journey” OR “Circular Economy” AND “Consumer Role”. Relevant literature was selected if it directly proposed journey phases and consumer actions that are specific to the CE. This literature search did not attempt to be exhaustive; instead, it focused on adapting a general, pre-existing consumer journey.

Results

Building on Shevchenko et al. (2023), this thesis examines the consumer’s role in the CE as a private customer, user, and post-use product holder. This enables an exploration of DPP value creation across the phases of direct consumer-product interaction. In line with this thesis’s strict consumer perspective, the “end-of-life product holder” role is replaced with a “post-use product holder” role (Onel & Mukherjee, 2015). This acknowledges that stopping the use of a product is not necessarily a result of a dysfunctional product, but can also emerge from changing needs, perceived obsolescence, or the thrill of newness (e.g., Camacho-Otero et al., 2018).

In the transition to the CE, the consumer journey changes (e.g., Gomes et al., 2022; Vidal-Ayuso et al., 2023; Wastling et al., 2018). That includes the way consumers purchase, use, and dispose of their products (see Figure 8).

Instead of simply buying a product that fits their needs, the CE asks consumers to choose durable or repairable products consciously and to refuse products designed for one-time use. It encourages consumers to purchase less, or instead of buying a new product, to opt for a used one, either via the second-hand market or the refurbishment market.

During product use, circular consumer actions focus on being more economical. From a CE perspective, consumers are asked to maintain their products and repair them to prolong their lives. Intensifying the product’s use, for instance, through sharing, is another strategy to act circularly during product use.

Lastly, in the linear economy, consumers simply dispose of their products once they are no longer used. In contrast, the CE calls for products to be circulated at their highest value. This means that consumers must assess whether a product is, for instance, worth reselling on the second-hand market, sending to a refurbishment company, or recycling.

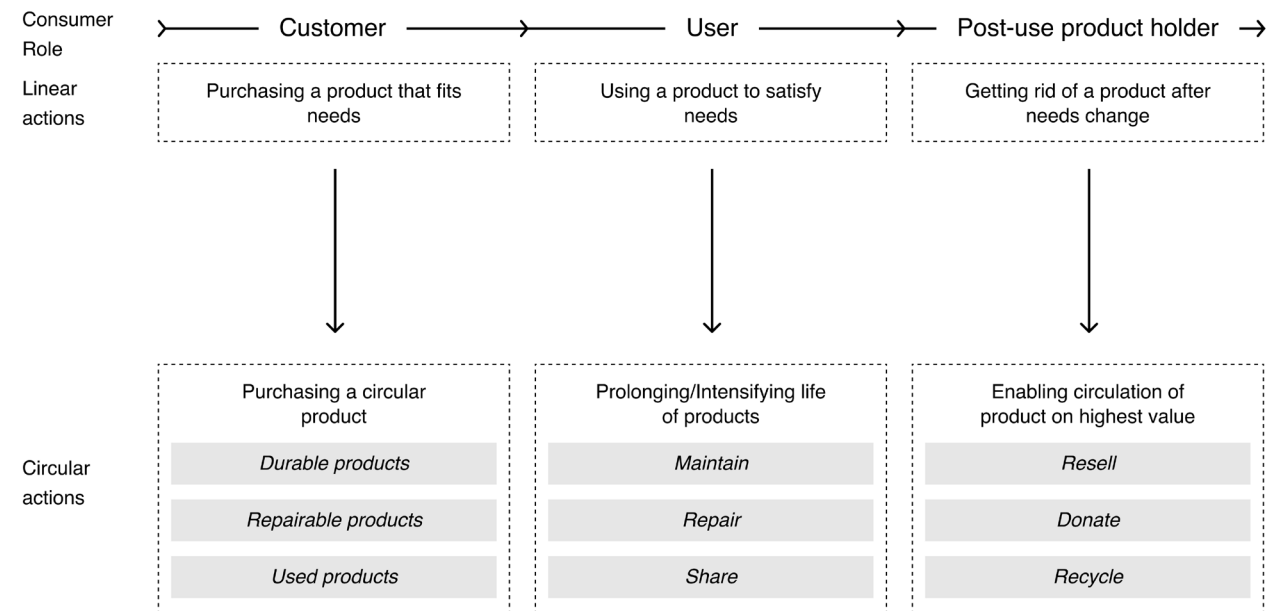


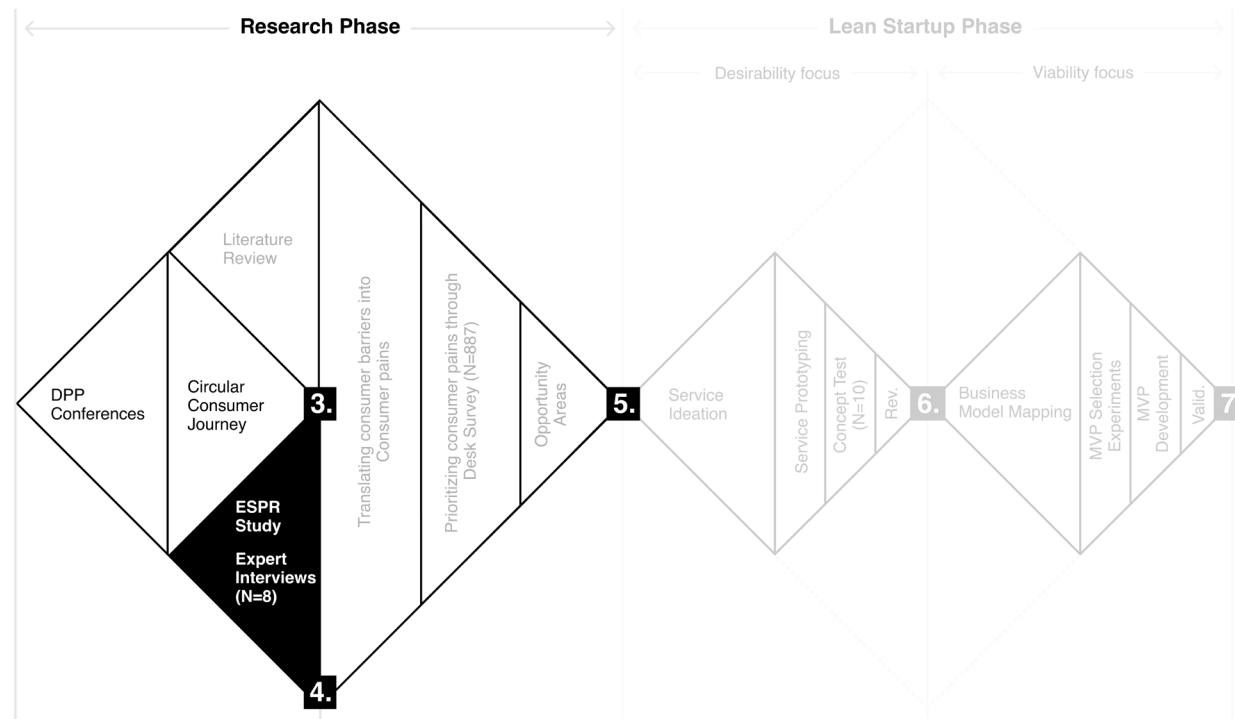
Figure 8: Circular consumer journey dissected by their role - Gap between linear to circular consumption

Conclusion

This chapter addresses RQ1.1 by mapping the circular consumer journey across three consumer roles: customer, user, and post-use product holder. Within each role, specific circular actions are identified that retain product value from a CE perspective. Together, these actions illustrate that the transition to the CE demands a fundamental shift in how consumers interact with their products, from conscious purchasing and active maintenance to value-retaining disposal. The resulting framework serves as the foundation for the following chapters, which first uncover the capabilities of the DPP ecosystem for service creation (Chapter 4) and then map consumer barriers and service opportunities onto this journey (Chapter 5).

While there is a variety of consumer journey formats and terminology used in design, they typically begin at the awareness phase and progress through the consideration phase to the purchase phase (Onel & Mukherjee, 2015). By focusing on the phases with direct product interaction, this thesis excludes the awareness and consideration stages, aiming to design services that facilitate value retaining circular actions.

4. The capabilities of the EU DPP ecosystem for service creation



This chapter addresses RQ1.2: What are the functional data capabilities of the DPP system available for service creation? First, a systematic study of the ESPR regulation extracts the functional data capabilities, technical architecture, access rights, and governance mechanisms that define the boundaries for service creation (4.1). Second, eight expert interviews with DPP researchers, providers, manufacturers, and EU policy actors supplement the legislative analysis with a practical, current-state perspective on the role of the consumer in the DPP ecosystem and the value of DPP-enabled services (4.2). Together, these define what is legislatively and practically possible, ensuring that the service ideation that follows is not purely speculative.

4.1 The DPP ecosystem defined by the ESPR

Introduction

Clarifying the concept of the DPP is essential to understanding which service propositions can be built upon it. What data will be provided? How reliable and trustworthy can the data be? Answers to those and more questions about the capabilities of the DPP ecosystem have a direct impact on how a consumer service offer looks. This chapter concludes with a general understanding of the DPP and a list of capabilities that consolidate what the ecosystem offers for service creation.

Method

Considering the ongoing DPP development from the EU side, uncertainty remains a prevailing challenge for all actors in the DPP system, hindering proactive, prepared approaches to its introduction (e.g., Adisorn et al., 2021; Jensen et al., 2023). This leads to multiple interpretations in literature and industry. To avoid this bias, the thesis draws exclusively on the European Commission's foundational legislative source, the Ecodesign for Sustainable Products Regulation (ESPR) (European Commission, 2024b), and its accompanying impact assessment (European Commission, 2022). Subsequently, the most authoritative and stable definition currently available is used to describe the DPP's capabilities.

The ESPR and its impact assessment were analysed systematically in three steps. (1) First, a general definition and purpose of the DPP were derived. (2) The second step focused on mapping the DPP System, its stakeholders, and their functions. (3) Third, the ESPR was searched for DPP characteristics that define its capabilities and can enable services. These characteristics were clustered in information requirements, technical architecture, access rights, and EU governance.

Results

Definition and purpose of the Digital Product Passport

The digital product passport is a digital record linked to a product's unique identifier. The record stores information specific to a product. Included may be information on the product composition, material origin, performance, reparability, or end-of-life management. The information must be accessible on the product or its packaging via a data carrier (e.g., a QR code or an RFID tag). The roll-out of the DPP will occur progressively through delegated acts per product category. These delegated acts will make it mandatory for any economic operator that places a product on the European market to register the DPP in an EU-provided registry. Further, in these delegated acts, it will be defined what specific information must be included, as this varies per product category. (Article 2(28) of the ESPR (2024))

The first delegated acts are expected to be released by the end of 2026 for products with batteries over 2 kWh (see Figure 9). Shortly after, textiles, tyres, and furniture are expected to follow in 2027, and products in the toy category in 2030 (European Commission, 2025). These categories are prioritised because

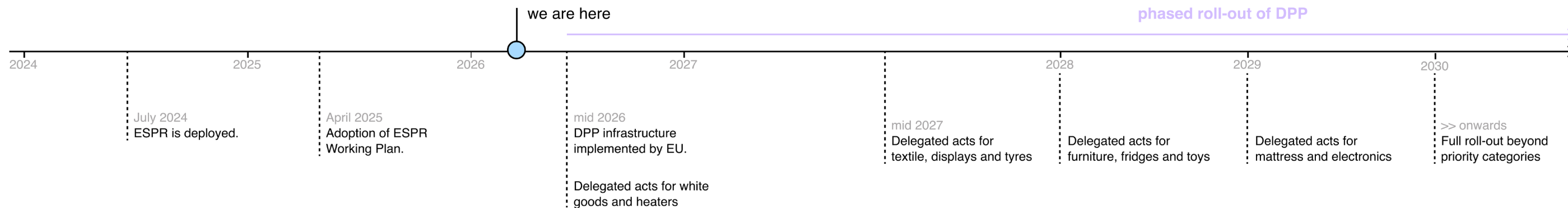


Figure 9: Roll-out timeline of the EU DPP (European Commission, 2025)

the DPP is expected to have the greatest impact (European Commission & Joint Research Center, 2024). Other product categories will follow, as almost all products on the European market are forecast to have a DPP in the future (European Commission, 2022).

The purpose of the DPP is to centralise and provide verified, complete, and up-to-date information to all value chain actors of a product. By linking this information and events (e.g., repairs) throughout a product’s lifecycle, the DPP data also enhances product traceability.

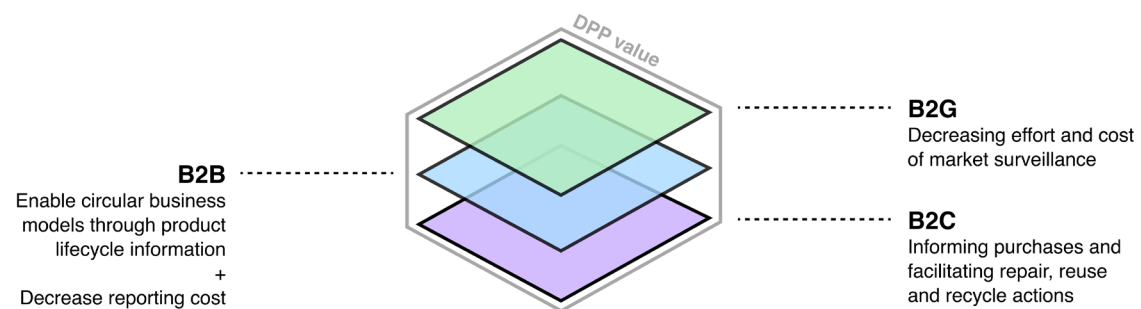


Figure 10: Actor-level values from the EU DPP ecosystem

The won transparency and traceability facilitate the transition on three levels (see Figure 10). (1) In a business-to-government (B2G) context, the DPP aims to decrease the reporting burden and cost through a Europe-wide, standardised, and automated approach. Additionally, it serves as an entry requirement to the European market, enhancing customs’ ability to assess and clear imports. (2) Secondly, in a business-to-business (B2B) context, its purpose is to consolidate and provide critical product information to actors like repairers and recyclers that facilitate value-retaining or resource-recovering circular business models. (3) Lastly, in a business-to-consumer context (B2C), transparency and traceability aim to unlock trusted, informed purchases and to facilitate reuse, repair, remanufacturing, and recycling practices (Recital 32). The DPP further aims to enable services that use the information to display aggregated data and simplify, for instance, product comparisons (European Commission, 2022).

The DPP ecosystem and its actors

It is not only the data that realises the purpose of the DPP, but also how the ecosystem is governed (see Figure 11). To design DPP-enabled consumer services, it is essential to understand the ecosystem, including the actors that must provide data and those that can utilise it.

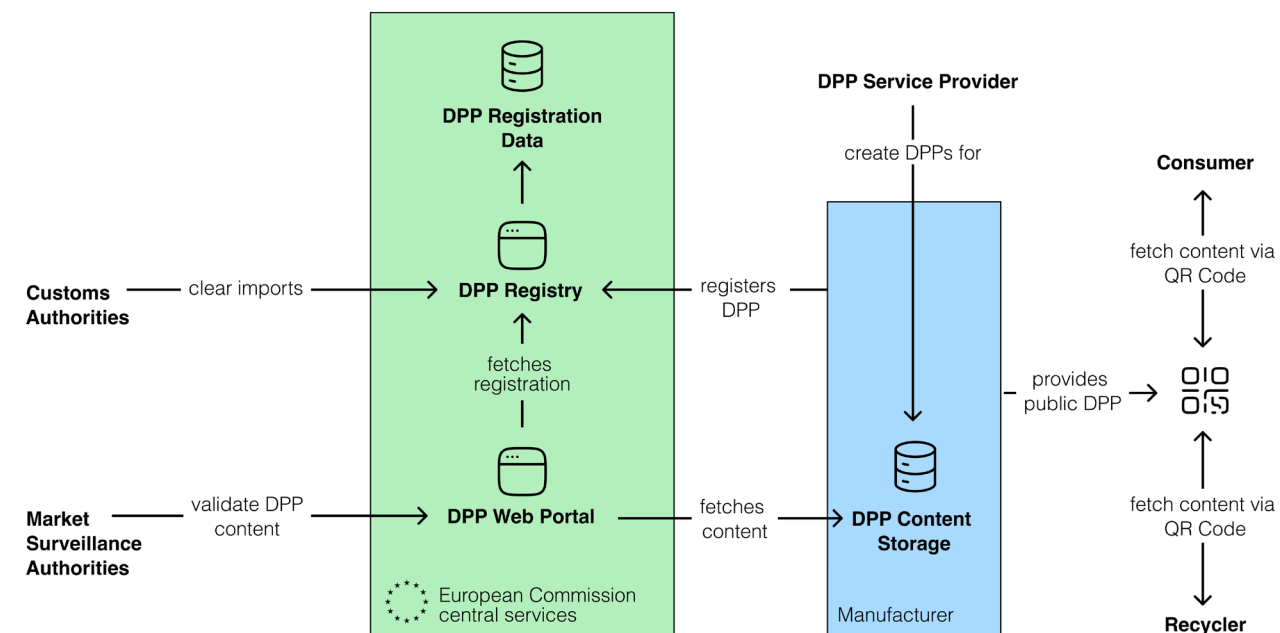


Figure 11: The DPP ecosystem building blocks with manufacturer as economic operator (adapted from GS1 (2025))

Economic operators place a product on the European market. That can be either a manufacturer or an importer. They are responsible for complying with the ESPR and for collecting the required information from upstream parts manufacturers or material suppliers. Before the product is sold, it must be marked with a data carrier that directly links to the DPP. Economic operators also bear the legal responsibility to maintain and update the data in the product passport, for example, in the event of a recall.

Market Surveillance Authorities (MSAs) are tasked with verifying compliance. They can request corrections in the DPP or halt the sale of a product if the information is inaccurate. (Article 21)

Customs Authorities verify the existence of the DPP. If products do not have a DPP, they are refused entry to the European market (Article 14).

DPP service providers are actors that support manufacturers in creating DPPs. They can host and update the DPP data for an economic operator. Furthermore, they must also ensure that the DPP information remains available even if an economic operator ceases its activity (Article 2, 32).

Consumers do not have a compliance role in the DPP system. Still, they are an integral part of it. The validated information in the DPP aims to inform their purchasing decisions and empower them to care for, repair, resell, or recycle their products. Consequently, they determine whether products reach any downstream actors.

Downstream actors such as professional repairers, refurbishers, and waste management companies are collectively referred to as independent operators (Article 2, 47). If specified in the delegated act, they are authorised to update data in the DPP with repair events, including their operator identification (Article 9, 2). Independent operators also contain SaaS companies that utilise data in the DPP to help other actors maximise their value in the CE. For instance, software could help waste management companies assess products based on DPP information and provide advice on the most efficient technology for recovering resources, depending on the material composition.

DPP Data capabilities

The help that DPP-enabled services can provide to consumers partly depends on the information included in the DPP. Article 7 of the ESPR clarifies the information requirements. A distinction is made between horizontal information requirements that apply to all DPPs and vertical information requirements that may be mandated via the product-specific delegated act.

The horizontal information requirements ensure that products can be easily compared, and information can be processed efficiently and safely. They define the information across every DPP to be:

1. Developed on open standards
2. Interoperable
3. Machine-readable, structured, searchable
4. Transferable through open data exchange
5. Accurate, complete, up-to-date, and available over the entire product lifetime
6. Anonymised (only with consent of the consumer personal data may be stored (Article 10, 1e))

The vertical information requirements differ per product category. The delegated act will specify the required information, the method for developing it, and whether it must be provided at the product, batch, or item level. Depending on the product category, the information may include:

1. Manufacturer ID, product name, SKU, and serial or batch code (ANNEX III)
2. Material composition and potentially the material origin (ANNEX I, d)
3. Environmental footprint, e.g., carbon footprint or water usage (Article 7, 2b (i))
4. Circularity information, e.g., reparability or durability score (Article 7, 2b (i))
5. Documentation such as user manuals, repair instructions, safety warnings, declarations of conformity, or spare parts (Article 7, 2b (ii-iii), ANNEX III)
6. Lifecycle events such as repairs, ownership transfers, or end-of-life treatment (including IDs of the independent operator) (Article 10, 3)

Technical Architecture capabilities

The technical architecture sets the boundary conditions for a DPP-enabled service. Every DPP is linked to a globally unique identifier that ties it to the product (Article 10, 1a). The unique identifier must be linked to a data carrier, which is either on the packaging, the product, or the product documentation (Article 10, 1b). The European Commission will establish a central DPP registry (Article 13), in which economic operators must register DPP metadata before it is sold on the European market. The content of the DPP is stored in a decentralised manner, either by the economic operator or the DPP service provider (Recital 41, p. 10/89). When the DPP content is viewed, the information is fetched from the data host. The DPP Web portal serves as a tool for searching, comparing, or downloading DPPs (Article 14).

EU Governance and Access capabilities

Without a body that enforces the completeness and correctness of the DPP, trustworthy information cannot be guaranteed. If information is incomplete, inaccurate, or proven to be wrong, MSAs can request changes, withdraw the product from the market, or hand it over to local authorities to pursue enforcement (e.g., fines). For a product mandated to have a DPP, the economic operator is prohibited from selling it on the market unless it is registered in the DPP registry (Article 13).

To protect businesses and consumers, not all information can be viewed publicly via the data carrier. Which actor has access to what data will be specified in the delegated act (Article 9, 2g-h). Access can be public, protected, or confidential. Public information is available for anyone, including consumers. Article 9 (2e) clarifies that the public DPP information must be free and easily accessible to consumers before purchase and via the searchable web portal. Protected information, such as build plans, may be relevant for repairers but should not be shared publicly to protect the manufacturer's business interest. Sensitive supply chain data may be confidential and only be viewed by customs or MSAs.

Conclusion

The table below links DPP characteristics to the potential opportunities they create for a consumer-facing service. The characteristics combine functional data capabilities, technical architecture, access rights, and DPP governance.

Table 1: DPP capabilities extracted from ESPR

DPP capability	Example consumer service opportunity	ESPR Reference
Structured, open, and machine-readable information	Enables services to aggregate data from multiple brands into a single comparison platform.	Article 10(1d)
Free and easy access before purchase	Enables services to access public data (e.g., repair scores) to inform at the point of sale. Helping consumers to assess and compare products holistically.	Article 9(2e)
Verified, complete, and up-to-date information	Enables “Trust-checking” services that validate marketing claims or product histories against the DPP registry.	Article 9(1)
Digital use, repair, and disposal guidance	Enables repair services that utilise the specific technical manuals to guide a self- or professional repair step-by-step.	ANNEX III, Article 7(2)
Lifecycle continuity (ownership and repair records)	Enables services that use resale value, warranty validation and transparent and trusted product history for second-hand consumers.	Article 10(3)
Role-based access rights	Ensures data reliability and trustworthiness. Keeps potential personal information confidential.	Article 9(2)
Data carrier on product or packaging (e.g., QR code)	Provides instant access to verified, comparable information at the point of sale or during use.	Article 10(1b)
Information interoperability	Unlocks fair and trustworthy comparisons across products (apples are compared with apples).	Article 11
Product performance and sustainability score	Simplifies the scattered landscape of claims and scores into comparable indicators that ease environmental choices (comparable with the energy label or the Nutri-Score).	Article 7(2b)
Market Surveillance Authorities and Customs controls	Ensure that consumers can trust the information and are not exposed to products without DPP.	Article 11, 13-14
Globally unique product identifier	Allows consumers to verify product authenticity and supports lifetime traceability.	Article 10(1a)

The DPP is intended not merely as a static label, but as a dynamic, interoperable information system. The functional capabilities that serve as the foundation for service ideation can be categorised into three pillars:

The “horizontal” requirement for machine-readable, structured data based on open standards (Article 10) is the most critical functional capability for service creation. This confirms that services can be built to aggregate, compare, and

visualise data across different brands and categories without friction.

Unlike eco-labels, the DPP system’s capabilities allow write access and updates (e.g., by independent operators or repairers). This capability transforms the product from a passive object into an active data carrier that accumulates history (repair events, ownership transfers).

The system architecture, specifically the combination of the EU DPP registry and MSAs, provides a functional layer of trust. Services do not need to verify the data’s origin themselves; they can rely on the governance structure mandated by the ESPR. The globally unique identifier serves as the digital anchor, enabling services to connect value propositions to a specific physical product rather than a generic model.

Contributing to RQ1.2, this chapter establishes that the DPP ecosystem provides a robust set of functional capabilities for service creation: structured, machine-readable data on open standards, dynamic lifecycle updates via write access for independent operators, and an embedded trust layer through the EU registry and market surveillance authorities. Together, these capabilities offer a rich ground for third-party services to aggregate, compare, and act on DPP data across brands and product categories. However, these findings are based solely on legislative sources and represent a best-case scenario. To ground them in the current practical reality of DPP implementation and fully answer RQ 1.2, the following section supplements this regulatory analysis with perspectives from eight experts across the DPP ecosystem.

Limitations

While the ESPR provides a stable structural definition of the DPP, this thesis acknowledges limitations in applying these findings to a tangible, specific service design.

The primary limitation is the reliance on the general ESPR framework before the release of product-specific delegated acts. While the functional capabilities (how data is stored and accessed) are defined, the specific data points (vertical requirements) remain vague. Consequently, service ideation must rely on assumed rather than guaranteed data availability in delegated acts.

Second, this chapter draws exclusively from legislative text rather than including desk research on current DPP initiatives. While choosing the most stable definition of the DPP available, there is often a gap between legislative intent and actual implementation. The latter is therefore not included in the study.

4.2 Expert perspectives on DPP-enabled consumer services

Introduction

The previous chapter analyses the DPP's capabilities to enable services from a regulatory perspective. To minimise the discrepancy between the DPP service opportunities extracted from the ESPR and the current, practical state of the DPP implementation, expert interviews were conducted. These expert interviews provided valuable insights into the role of the consumer in the DPP ecosystem and the value of DPP-enabled service propositions. This chapter concludes by enhancing the legislative DPP opportunities with a more recent expert perspective to inform the following creation of service propositions.

Method

Since the DPP is still under ongoing development, the literature around DPP-enabled services is limited. In contrast, industry discussions highlight the value of third-party services added to the DPP data (see Appendix 10.1). To capture the current discussions, expert interviews were selected as the method of inquiry.

Interview participants were purposively sampled from two conferences that were attended during the project duration (Circular Tech Forum in Cologne and the DPP Festival in The Hague). Multiple actors were included to minimise the risk of a one-sided perspective (see Table 2).

Eight online interviews were conducted, lasting 40 - 50 minutes each. First, the semi-structured interview guide (see Appendix 10.2) inquired about their views on the consumer in the DPP ecosystem and how relevant they believe the DPP is to the consumer. The second part of the interview focused on factors that hinder consumers from acting circularly and on how the DPP itself or enabled services can facilitate circular actions.

With the participants' consent, the interviews were audio-recorded. The recordings and researcher memos (see Appendix 10.3) were used to first note and then cluster insights and remarks in the following themes: (1) The role of the consumer in the DPP ecosystem and (2) the value of DPP-enabled services for consumers.

Table 2: Expert Interview Participants

Actor	Perspective	No. of participants
DPP researcher	DPP research project coordinator	1
	Researcher green information systems	1
DPP provider	CEO	2
	Independent DPP consultant	1
Manufacturer	Sustainability manager in textile industry	1
European legislative body	UNITAR Program officer	1
	European Commission policy analyst	1

Results

The consumer in the DPP ecosystem

Experts doubt the relevance of the DPP to consumers as a pure information provider. While sustainability information and supply chain transparency are relevant to a subset of environmentally motivated consumers, experts indicate they are less relevant to the general public. A DPP provider notes:

“People don't really care about those traceability maps. They think it's funny, but at the same time [...] what does it tell the consumer? I think not so much [...]. I don't think anybody's going to scan products in the store [...].” - DPP provider

Therefore, betting on additional information moving consumers towards purchasing circular products or performing circular actions at scale is premature. Instead of relying on consumers' altruistic environmentalism, the DPP must create tangible value for them.

Increasing consumer participation in the CE, for instance through repair or resale activities, is recognised as another goal of the DPP implementation. However, experts stress that while the DPP can supply information to inform purchases and circular actions, it cannot solve the barrier that circular alternatives are often still more expensive. Experts acknowledge that purchasing circular products is often more economical in the long term. However, the high initial cost of more durable or repairable products is an essential hurdle to widespread adoption.

“I saw firsthand how people on low budgets were always buying like the cheapest laptop that's out there and two years later you saw them again.” - DPP provider

“If they can get at the same price a more sustainable product, most of them say okay fine. But they will not pay extra for it.” - DPP provider

An interesting tension arises between the consumer role in a circular economy and a manufacturer's perspective. Experts from the DPP research field or legislative body emphasise the DPP's role in providing objective information to consumers as a basis for informed decisions during the product's purchase, use, and disposal. In contrast, manufacturers seek business value in the DPP. DPP service providers, who work closely with manufacturers, indicate that DPPs are currently seen as innovative technology that advertises sustainability brand values to their customers. Others try to return the investment in DPPs by using them as another monetizable touchpoint with the consumer, through which, for instance, other products are sold. However, both ways of generating business value of the DPP struggle. A sustainability manager of a manufacturer mentions:

“The DPP is still so unknown at the consumer end, that it is not scanned a lot yet. For the general consumer, the call to action is still very low. The majority may not be even interested.” - Manufacturer.

While most experts still emphasise the relevance of the consumer in the DPP ecosystem, one warns against focusing too much on them. Without manufacturers adopting the DPP, no consumer will ever have a chance to change their behaviour. Therefore, current discussions primarily revolve around the value for manufacturers and consumers are seen as a compliance endpoint rather than an actor that influences the system. Comparisons to the European energy label or the Nutri-score are used to exemplify how these regulations are imposed upon the consumer.

“If you rely on the consumer value [...] to drive the change, then we’re never going [...] to get mass adoption. [...] this (the DPP) will have a big impact on consumers. Consumers can be a big force in creating pull, [...] steering the direction we’re going in. But I don’t really want to rely on consumer demand to drive product passport adoption because I don’t think that will be enough.” - DPP researcher

The value of DPP-enabled services for consumers

Experts see multiple ways the DPP can enable consumer services. The sheer volume and complexity of the DPP’s data may be too much for consumers. Experts fear that information overload can be counterproductive, making clear choices even harder than before. Services can simplify and aggregate DPP information for a specific use case, making it more digestible and comparisons easier. Experts now formulate it as an intermediate data layer, with third-party tools serving as value creators for specific actors and use cases. For instance, one expert sketches a service that solves a specific problem the consumer has with a specific product category:

“If you are someone who wants to know about harmful ingredients, you may have an app that focuses on that. So, scan the passport and it tells you these three cancerous ingredients in this product.” - European legislative body

In addition to simplifying and aggregating data, experts highlight the potential to reduce consumer friction in product repair and maintenance processes. For example, services can surface repair points in proximity to the consumer that are capable of repairing that specific product, something the DPP itself does not provide. Another expert describes how self-repair can be facilitated through interactive manuals and lists of spare parts that are attached to the product. This way, DPP-enabled services can make repairs effortless:

“So, if someone is scanning the washing machine and they want to repair it, then [a service] could also offer them a spare part so they can change it.” - European legislative body

Another expert describes a generative AI chatbot trained on DPP data that solves consumer problems related to the product instantaneously.

“If your machine breaks, you get E5. What the hell is E5? What do you do? Talk to the AI, right? The AI knows your model, your product version, all your documentation.” - DPP provider

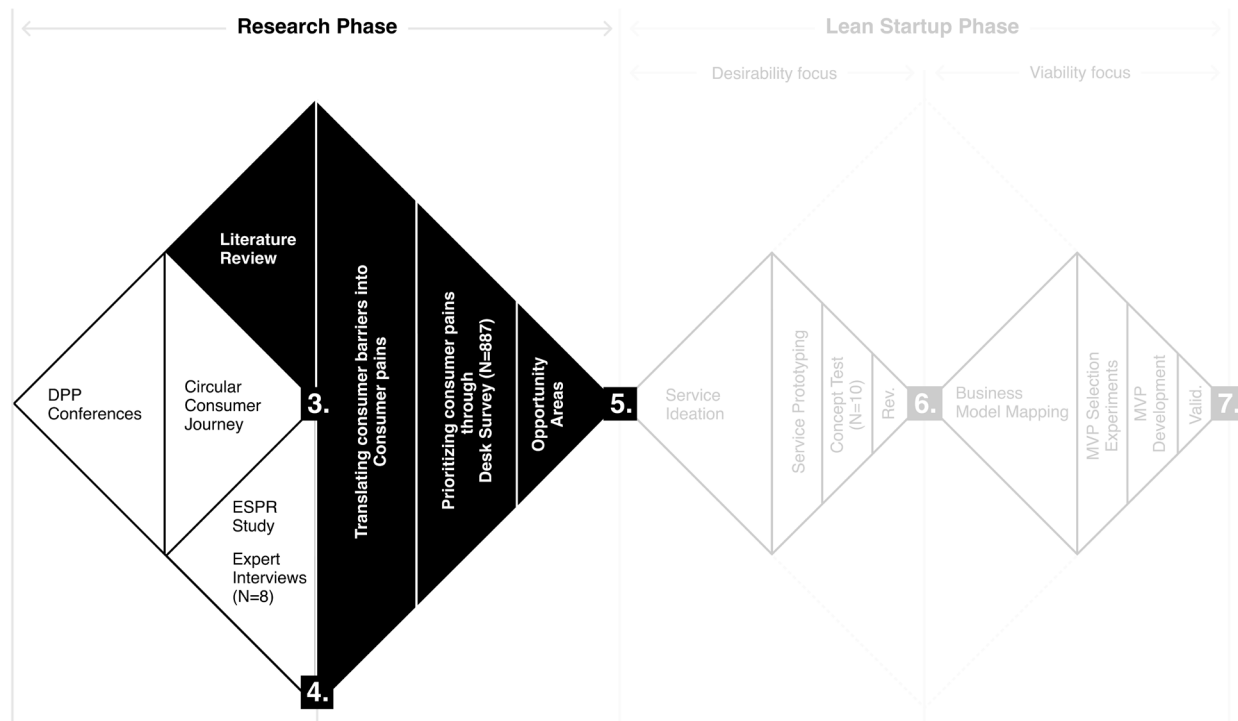
Lastly, experts note that DPP services can enhance the trustworthiness of resale activities. Trust services can de-risk second-hand purchases by verifying authenticity and product history. The data in the DPP can also be used in services that streamline listing a product on a second-hand platform, with content automatically filled in.

“The consumer would scan the product, go to a [service] and ask what should I do with this product? I want to get rid of it - what’s the most economic and what’s the most ecological way? and then a service could be like: you can choose to donate or resell it [...].” - European legislative body

Conclusion

Together with the ESPR analysis, these expert perspectives complete the answer to RQ1.2. The interviews strengthen the fact that the DPP may not serve only as a consumer-facing information provider but also as an infrastructural data layer upon which third-party services create tangible, personally relevant value. Adding to that, the study of the ESPR lists substantial capabilities for service creation. Experts elaborate that DPP-enabled services can simplify repair, streamline resale, or aggregate product information for a specific use case. These are more likely to drive consumer engagement than just information. This reframing effectively establishes the design direction for the service ideation in Chapter 6. However, before starting the ideation, the specific consumer pains that these services should address are identified and prioritised.

5. Service opportunity areas along the circular consumer journey



This chapter addresses RQ1.3: What pains do consumers experience on their circular consumer journey? This chapter investigates what friction consumers actually face when acting circularly. First, a semi-systematic literature review identifies 17 general consumer barriers to circular consumption (5.1). These barriers are then systematically translated into 11 consumer pain statements (5.2). To prioritise which pains matter most, a consumer survey (N=887) is conducted, complemented by segmentation analyses across gender, age, and purchase motivation (5.3). The chapter converges on three service opportunity areas mapped onto the circular consumer journey, guiding the service ideation in the next phase.

5.1 Consumer barriers to circular consumption

Introduction

In the Dutch Behavioural Strategy for Citizens and the Circular Economy, it is emphasised that providing more environmental information is relevant for consumers who are already engaged and driven by environmental beliefs. For the larger, less engaged group, the opposite works. Instead of providing information, reducing barriers can facilitate and direct consumer action towards more circular choices. (Dutch Ministry of Infrastructure and Water Management, 2023)

The barriers that hinder consumers in circular action offer the opportunity to design meaningful, DPP-enabled services for the consumer that support the broader transition to the CE.

This chapter reviews prevailing literature and identifies 17 general consumer barriers along the circular consumer journey.

Method

Since the rise of the CE, barriers have been an extensively studied subject in literature (Vidal-Ayuso et al., 2023). To gain a general understanding of what hinders consumers from adopting circular practices, a semi-systematic literature review was conducted (see Figure 12). A semi-systematic review approach, as described by Snyder (2019), enables the mapping and synthesis of diverse insights rather than exhaustive statistical aggregation.

For the review, Scopus was chosen as the primary database due to its comprehensive coverage of peer-reviewed journals in the social sciences, environmental studies, and engineering and design, as well as its established quality and reliability.

The search was performed using the following query: TITLE-ABS-KEY(("circular*") AND ("consumer*" OR "customer*" OR "user*") AND ("barrier*" OR "challenge*" OR "obstacle*")). Publications from 2015 onward were included, reflecting the period in which the CE concept became formally embedded in European policy discourse.

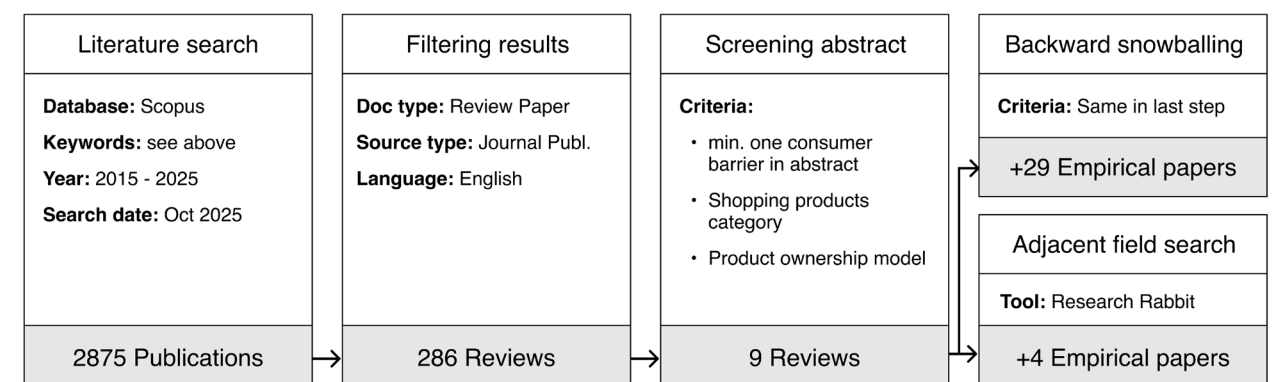


Figure 12: Semi-systematic literature review process

The search was restricted to journal articles to ensure academic quality and peer review and returned 2875 papers (October 2025). Due to the extensive number of results, review articles were prioritised to capture consolidated knowledge. 286 papers with the above-mentioned search results were review papers in relevant subject fields. Titles and abstracts were screened to identify reviews that addressed barriers related to consumers, circular actions, or a specific product category aligned with the scope of shopping products and ownership models. In total, nine reviews were selected as anchor papers.

An initial set of 128 barriers was extracted from these nine reviews using NotebookLM (see Appendix 10.4). After reviewing the findings, 21 barriers were removed as they did not reflect barriers related to the consumer actions. The resulting 106 barriers were inductively clustered and merged based on similarity (see Appendix 10.5). This resulted in 17 barriers, categorised into four groups (see Figure 13).

To add depth to how the 17 barriers manifest, backward snowballing was performed. A total of 29 empirical cases were selected to be included. Four papers were included using research rabbit to explore adjacent research fields.

Results

The framework below shows the barriers in their respective consumer phase. They are positioned between the linear and circular consumer role, as they inhibit the transition between them (see Figure 13).

Convenience

Establishing circular-economy actions in a linear economy system that has been optimised for decades, is perceived as high effort that spans across all consumer roles. Simple, ingrained habits of purchasing, using, and disposing of products, which were originally driven solely by consumer needs, suddenly become more complex and less convenient. Navigating sustainability claims and comparing products beyond a need fit runs counter to the habit consumers have long followed (Frahm et al., 2025). Therefore, it is perceived as more time-consuming and requires more physical and mental effort. Preparing, curating, and describing products for a second-hand sale or communicating with potential buyers requires more work than simply discarding them (Selvfors et al., 2019). Similarly, investing time and money to search for and purchase spare parts, with the risk that a repair will fail, discourages circular engagement (Da Silva & Ramos, 2024).

Trust and knowledge

Lacking consumer awareness and interest is cited as a cross-phase barrier to circular consumption (e.g., Khan & Haleem, 2021; Kirchherr et al., 2018). Consumers often lack knowledge of what a circular product is and why they should choose one over another. The lack of awareness and interest is further reflected in misunderstandings of circular concepts which can lead to the rejection of a more circular product (Uriarte-Ruiz, 2022; Van Weelden et al., 2016).



Figure 13: Consumer barriers to circular actions

The lack of perceived personal value is another barrier that appears repeatedly across all consumption phases and actions (Frahm et al., 2025; Schiaroli et al., 2024). While some consumers appreciate feedback on their positive environmental impact when acting circularly (Vidal-Ayuso et al., 2023), others don't see a clear financial benefit, for instance, in buying more durable products or repairing them (Mugge R. et al., 2017). Although some consumers see financial and self-expressive value in refurbished or second-hand products, others are confronted with the social perception of being "poor" or "frugal" (Cole et al., 2019).

Little or missing trustworthy information at the point of purchase leaves consumers unable to confidently evaluate a product's longevity, repairability, or environmental impact (Da Silva & Ramos, 2024; Frahm et al., 2025). The increased use of sustainable claims and labels in product marketing has been undermined by the phenomenon of greenwashing, which decreases the consumer's confidence in accurately assessing a product (Apaolaza et al., 2023; Choudhury et al., 2024). The lack of trustworthy information about a product's performance and condition also hinders confident purchases of second-hand or refurbished products (Selvfors et al., 2019).

Limited information about the product's repairability often leads consumers to assume that a broken product cannot be fixed (Ali & Choe, 2022; Kirchherr et al., 2018). That products are prematurely replaced rather than repaired is also a result of unclear and limited repair offers from manufacturers or repair providers (Wieser & Tröger, 2018). While some consumers are motivated to repair their product themselves, missing information on how to repair it and the availability of spare parts hinder attempts to repair it or limit self-repair success rates (Laitala et al., 2021).

A hindrance to effective recovery of materials is the lack of information on how to recycle a product (Islam et al., 2021). For instance, not knowing about the hazards of batteries in phones results in limited consumer willingness to recycle (Wibowo et al., 2022). Instructions for dismantling a product could also make the recycling process more effective (Gu et al., 2017).

Financial and infrastructure

The high initial cost of new circular products is often cited as a barrier that hinders the widespread adoption of the CE (Da Silva & Ramos, 2024; Schiaroli et al., 2024; Serra & Alfinito, 2025). Compared with linear alternatives, more durable or repairable products are often more expensive. Although the higher initial expenditure is ultimately recovered through longer product life, some consumers are discouraged by the high price or simply unable to afford a circular alternative (Van Weelden et al., 2016; Zimmermann et al., 2024). Similarly, the cost of product repair is frequently high (Da Silva & Ramos, 2024; Islam et al., 2021). Designing products to be repairable and increasing spare part availability can decrease labour costs and, consequently, lower prices for

consumers (Güsser-Fachbach et al., 2023). However, until then, the perception that a replacement has a higher cost-benefit ratio than fixing a broken product prevails (Jaeger-Erben et al., 2021; Laitala et al., 2021). The high cost of repair is partly attributed to the shortage of skilled workers and the lack of infrastructure (Ackermann et al., 2018; Blake et al., 2019).

The lack of visibility and accessibility of circular offers competes with the abundance of linear alternatives (Da Silva & Ramos, 2024; Schiaroli et al., 2024). For instance, although the second-hand market is growing, the limited product diversity is recognised as a barrier to consumers choosing used products (Cole et al., 2019; Van Weelden et al., 2016). The limited availability of new, circular products further impedes the search to find a better alternative.

A lack of established recycling infrastructure or appropriate formal disposal options hinders consumer participation in the material recovery process (Gu et al., 2017; Islam et al., 2021). The proximity to the current waste management system is inadequate to promote the return of products in an organised waste stream (Ylä-Mella et al., 2015).

Psychological and behavioural

The perception that used products have an inferior quality or performance keeps consumers from purchasing second-hand or refurbished products (Polyportis et al., 2022; Serra & Alfinito, 2025; Zimmermann et al., 2024). Similarly, uncertainty about whether a used product is authentic or concerns about cleanliness limit consumers' confidence in choosing a used product over a new one (Cole et al., 2019; Kuah & Wang, 2020; Ranta et al., 2018).

Another social barrier is the thrill of newness amongst consumers (Frahm et al., 2025; Jaeger-Erben et al., 2021). Strengthened by rapid technological advancements and trend-based phenomena such as fast fashion, products are quickly perceived as obsolete (Echegaray, 2016; Wibowo et al., 2022). This, combined with the feeling of social exclusion that comes from not having the latest product, further discourages prolonging a product's life and supports looking for novelty.

Consumers frequently store products they no longer use at home rather than properly dispose of them (Zimmermann et al., 2024). This phenomenon, known as hibernation, occurs due to perceived residual value, concerns about privacy leaks, or unclear information about product disposal (Kurusu et al., 2020; Wibowo et al., 2022).

Conclusion

This chapter contributes to RQ1.3 by mapping 17 consumer barriers across the circular consumer journey, providing the first building block for understanding where DPP-enabled services can create the most value. The barriers span trust and knowledge gaps, financial and infrastructure constraints, psychological patterns, and convenience friction. Not all these barriers are equally felt by consumers, nor are all of them addressable through an information technology like the DPP. To move from an academic understanding of barriers to an actionable design input, the next section translates these barriers into consumer pain statements that can be empirically tested.

Limitations

It is essential to note that the barriers mentioned are not mutually exclusive. They are appearing in a complex entanglement of cause-and-effect relations: the existence of one may reinforce the other (Kirchherr et al., 2018). For instance, the lack of information about how to repair a product causes a higher effort to search for spare parts, which in turn makes repairs expensive and time-consuming.

Some barriers from this chapter persist at the systemic level. The thesis acknowledges that more concrete barriers could have been revealed if the scope had focused on a specific product category or circular action.

Additionally, the effects of drivers, as phenomena that motivate or support circular consumer actions, have not been discussed. Although these are often named alongside barriers and recognised as input to design practices, this thesis focuses on the problems a DPP-enabled service could solve.

5.2 Translating consumer barriers into circular consumer pains

Introduction

Reflecting on the nature of the uncovered barriers, it is important to understand whether all barriers matter equally to the consumer. To uncover the relevance of each barrier, a survey was conducted amongst consumers. However, before doing so, the barriers had to be translated into felt pains that consumers can refer to.

By systematically analysing the 17 barriers, a subset of 11 statements are formulated, representing consumer pains rather than systemic-level barriers.

Method

The translation was performed collaboratively with a colleague from Secrid to reduce researcher bias (see Figure 14). To easily transfer the knowledge from the literature review, each of the extracted 17 barriers was described on a barrier card. The cards were used in a co-working session to cluster, include, exclude, or translate barriers systematically into statements that reflected potential consumer pains.



Figure 14: Translating barriers into pain statements with a Secrid colleague

The translation process was guided by three criteria.

(1) The first criterion filtered for barriers that are explicitly felt by the consumer rather than systemic barriers. Therefore, the systemic barriers were translated into statements to reflect the lived experience. For example, “Lack of repair infrastructure” was translated into “Repair services are hard to find”. This shifts the focus from the absence of shops (which a digital service cannot fix) to the visibility of existing shops (which a digital service can fix). In that line, “Thrill of newness” and “Lack of awareness” were excluded because they represent a lack of motivation or a cultural norm rather than a felt pain.

(2) Since the DPP is an information technology rather than a pricing or infrastructure policy tool, only barriers that are reducible through data are relevant. “High initial cost” and “high cost of repairs” were therefore excluded. The DPP data can highlight the total cost of ownership or surface the cost of repairs, but does not directly reduce purchasing or repair costs. The focus remained on barriers that are caused by information asymmetry, gaps in trust, or knowledge, where data aggregation offers a solution.

(3) Finally, a distinction was made between the outcome and the cause that prevents a specific circular action. Therefore, “Hibernation” was excluded as it is a symptom of other barriers. Instead, the cause of hibernation, which may be the effort required to resell or the unknown resale value, were included.

Results

The systematic translation yielded 11 consumer pain statements derived from the original 17 barriers (see Figure 15). Six barriers were excluded through the three criteria.

In the purchase phase, consumers may struggle to find sustainable products or alternatives and could lack trustworthy information to confidently assess a product’s longevity or environmental impact, a pain potentially amplified by greenwashing. Additionally, doubts about the quality, cleanliness, or authenticity of second-hand products surface as a potential trust-related pain. In the use phase, repair-related pains are most prominently represented: repair services may be hard to find, knowledge for self-repair could be lacking, and information about spare parts may be insufficient. In the post-use phase, consumers may be hindered by the effort required to resell products, the unknown remaining value of their belongings, and unclear information on how to properly recycle or dispose of a product.

Notably, the majority of the 11 pain statements cluster in the use and post-use phases. In the purchase phase more barriers have been excluded through the translation process.

Conclusion

By filtering the 17 barriers through three criteria, whether they are explicitly felt by the consumer, reducible through data, and represent a cause rather than a symptom, this chapter arrives at 11 statements that may represent a pain for

a consumer and are potentially addressable by DPP-enabled services. This translation is essential to answering RQ1.3, as it shifts the perspective from systemic barriers to felt pain. The resulting pain statements form the input for the consumer survey in the next section, which will prioritise them based on empirical relevance.

Limitations

Although the translation from barriers to consumer statements is systematically performed, a degree of subjectivity and researcher bias may remain that led to the exclusion of barriers. Since the high-level barriers cluster multiple product categories, translation into statements sometimes resulted in highlighting a specific aspect of the barrier.

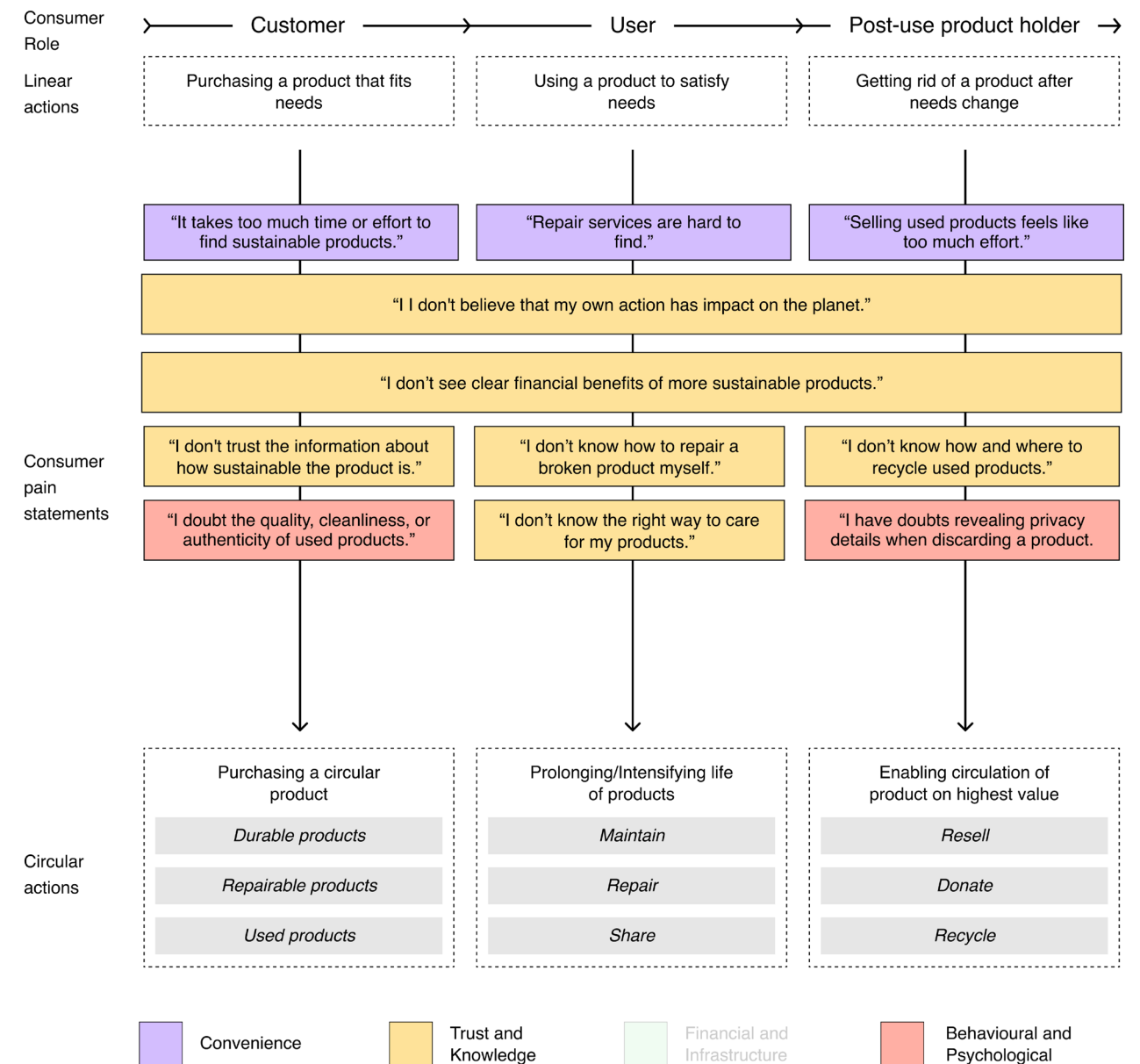


Figure 15: Translated consumer pain statements from barriers

5.3 Service opportunity areas based on the relevance of circular consumer pains

Introduction The statements translated from the barriers identified in the literature search provide starting points for DPP-enabled services to reduce friction for consumers. To identify which of these barriers matter most and subsequently offer the biggest potential to decrease consumer pain, a survey was conducted. Furthermore, the effects of gender, age, and purchase motivation were analysed to identify the basic segments for whom a specific consumer pain matters most.

Method The survey was conducted in collaboration with Secrid BV, a Dutch wallet manufacturer. Secrid BV provided a database of global customer contacts who have previously consented to participate in concept tests. These contacts were invited to participate in the survey via email.

The survey questions were divided into six sections (see Appendix 10.6). (1) First, the purchase motivation was assessed with the help of four statements on which participants could indicate their level of agreement using a five-point Likert scale. (2) Next, participants were asked to select the three most relevant pain statements out of a list. (3) Following that, participants were asked to select what makes it easier to repair, resell, or recycle. (4) In the fourth section, the participants could select information points that are most relevant when purchasing a new product. (5) In order to understand the effect of gender, age, and country of residence participants were asked to add demographics. (6) Lastly, contact data was collected voluntarily to recruit interviewees for the concept tests.

To ensure the survey was clear and understandable, a test was conducted with seven participants (two colleagues from Secrid, and five test participants from the personal network). This revealed that the previously translated statement “I have doubts about revealing privacy details when discarding my product” is misinterpreted in the Secrid survey context. This barrier predominantly occurs in the consumer electronics domain and was therefore excluded from the questionnaire to avoid bias resulting from the sample group and survey context.

The objective was to gain a basic understanding of the pain relevance, patterns, and relationships across different consumer groups. Subsequently, an exploratory, descriptive data analysis is adopted (Tukey, 1977), complemented by several statistical tests to evaluate specific segmentation effects. For the analysis, Tableau and Google Colab (with a custom Python script) were used.

The final survey was conducted in November 2025 and 887 submissions were analysed.

Results

Distribution

The respondents in the sample are predominantly male (84%). While the age distribution is broad, the age group from 45 and above (n=617) is substantially bigger than the younger group from under 25 to 44 (n=260). Most respondents reside in the USA, the United Kingdom, the Netherlands, Canada, or Germany.

Due to the strong skew in gender and age (see Figure 16), the influence of these factors was analysed with special care to generalise the findings as best as possible. In addition, respondents were divided into two groups: participants residing in the EU (n=569, including the United Kingdom and Switzerland) and those residing outside the EU (n=319).

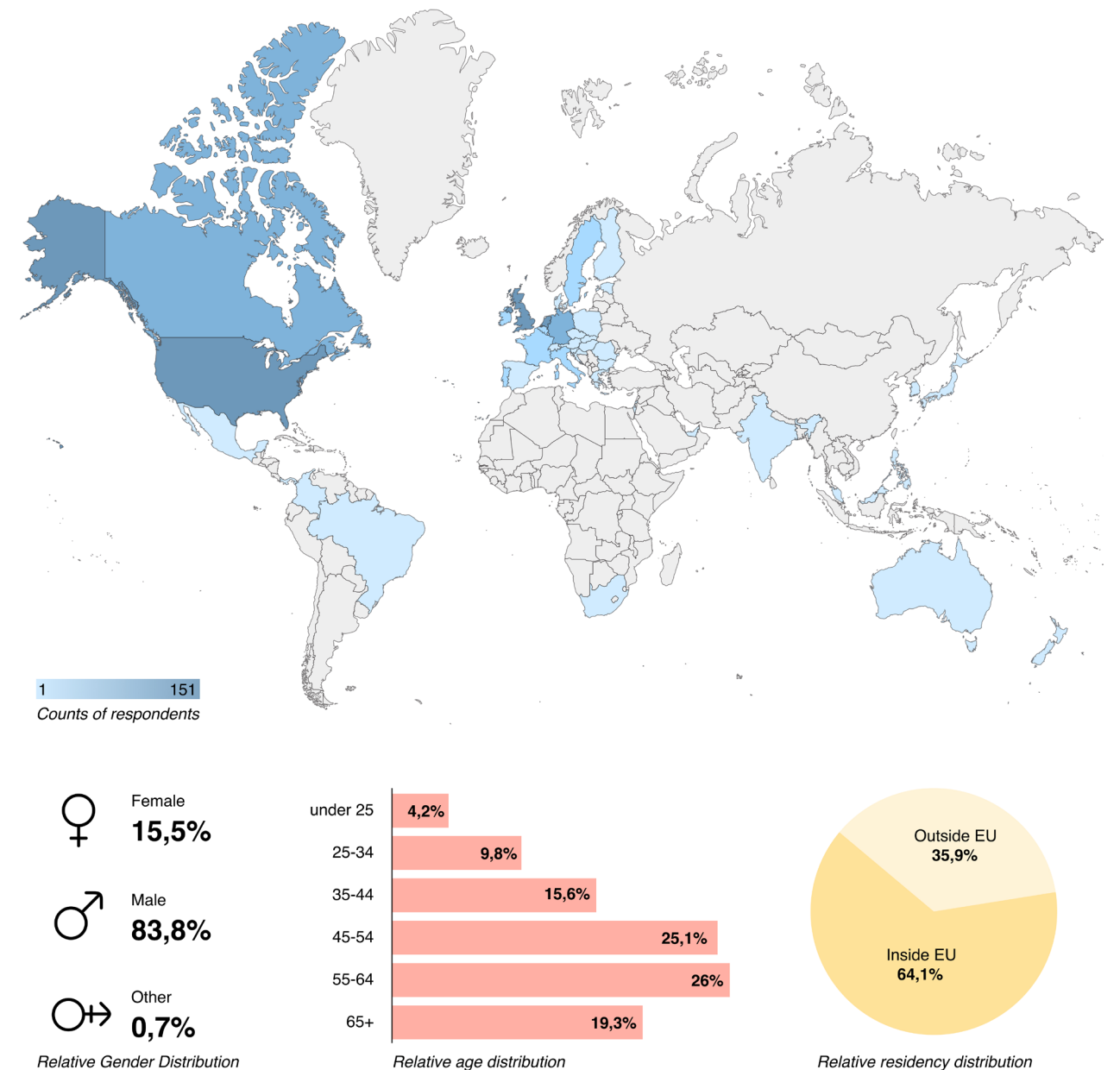


Figure 16: Demographics of the survey participants (N=887)

Purchase motivation

The sample shows high purchasing motivations across all reasons (see Figure 17). The top motivations are the product's functionality (M=4.77) and its aesthetic design (M=4.63). Durability (M=4.47) ranked third highest. Sustainability is the least strong motivator across respondents (M=3.72).

Secrid BV is known for its quality, long-lasting products. Since the sample consists of customers who already bought a product, their purchase motivation may already align with the brand values. Interestingly, sustainability is the lowest-ranked motivation across all ages and genders, despite being a core value of the brand. This emphasises that the purchase of a circular product is not driven by environmental motivation alone, but also by its functionality, design, and durability. Although durability is often considered a component of sustainability, the survey results suggest that respondents value them differently. Durability may appeal to consumers for reasons beyond environmental concern, such as getting more value from a product over time, which could explain its consistently higher rating across all groups.

Separating respondents who have indicated the same or higher sustainable purchase motivation from the other motivations reveals that approximately 30% of respondents can be segmented as "environmentally motivated shoppers". A one-way ANOVA indicates that there is no statistical significance between the environmental motivation and age group ($p = 0.64$). However, a significant effect of gender on sustainability motivation is revealed ($F(3, 884) = 5.37, p = 0.001$). Furthermore, analysis using an independent-samples t-test between male and female gender groups revealed that female respondents (M=4.01) scored significantly higher on sustainability as purchase motivation than male respondents (M=3.66), $t = -4.57, p < .001$.

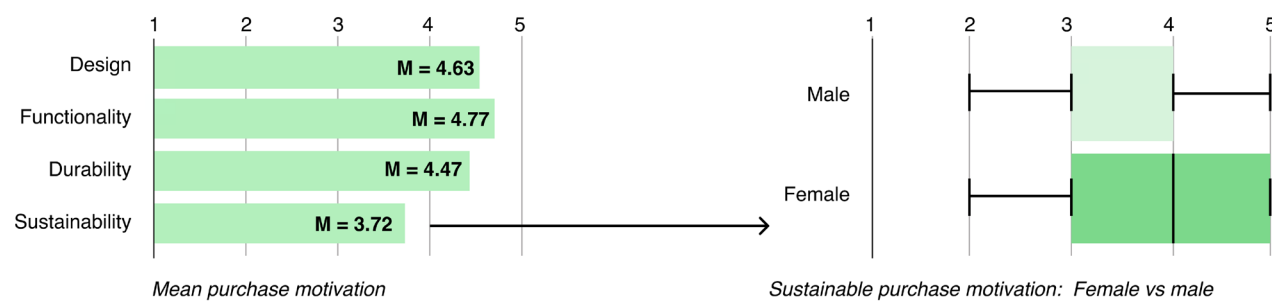


Figure 17: Purchase motivation in the sample

Most relevant pains and drivers

The data reveals a clear image where consumers struggle most (see Figure 18). The biggest barrier is connected to the repair of products. Respondents do not know where to get their product repaired (55%) or feel they lack the knowledge to repair it themselves (28%). This lack of knowledge for self-repair is especially

prevalent amongst women (49% of women vs 25% of men). A statistically significant relationship between gender and the knowledge to self-repair was demonstrated by a Chi-square test of independence ($p < 0.001$). Finding a location to repair is the biggest pain for everyone, except for respondents under 25 (32% vs. more than 54% for older groups). Respondents indicate that repair points and clear self-instructions may make it easier to repair. Factors that stimulate repair are knowledge of the remaining warranty and more convenient manufacturer repair support (e.g., shorter repair claim forms).

Pains related to the resale and second-hand purchase are also strongly represented. Respondents often doubt the quality, cleanliness, or authenticity of second-hand products. This barrier is especially prevalent amongst young respondents. A statistically significant relationship between doubts about second-hand products and age can be demonstrated by a Chi-square test of independence ($p = 0.007$). This means that services that overcome this specific barrier must be targeted at younger consumers. Additionally, respondents are hindered from reselling products because it takes too much effort, or the remaining value of their products is unknown. The survey indicated that, company take-back programs would decrease this friction the most. Furthermore, estimating the remaining value of the product can also make it easier to resell.

Lastly, the difficulty of finding a sustainable product or alternative is mentioned as a relevant purchase pain, next to the lack of trust caused by greenwashing. Surprisingly, the environmentally motivated segment does not paint a drastically different picture of pains and motivators. This may indicate that environmental motivation does not strongly influence the pain's relevance within the sample.

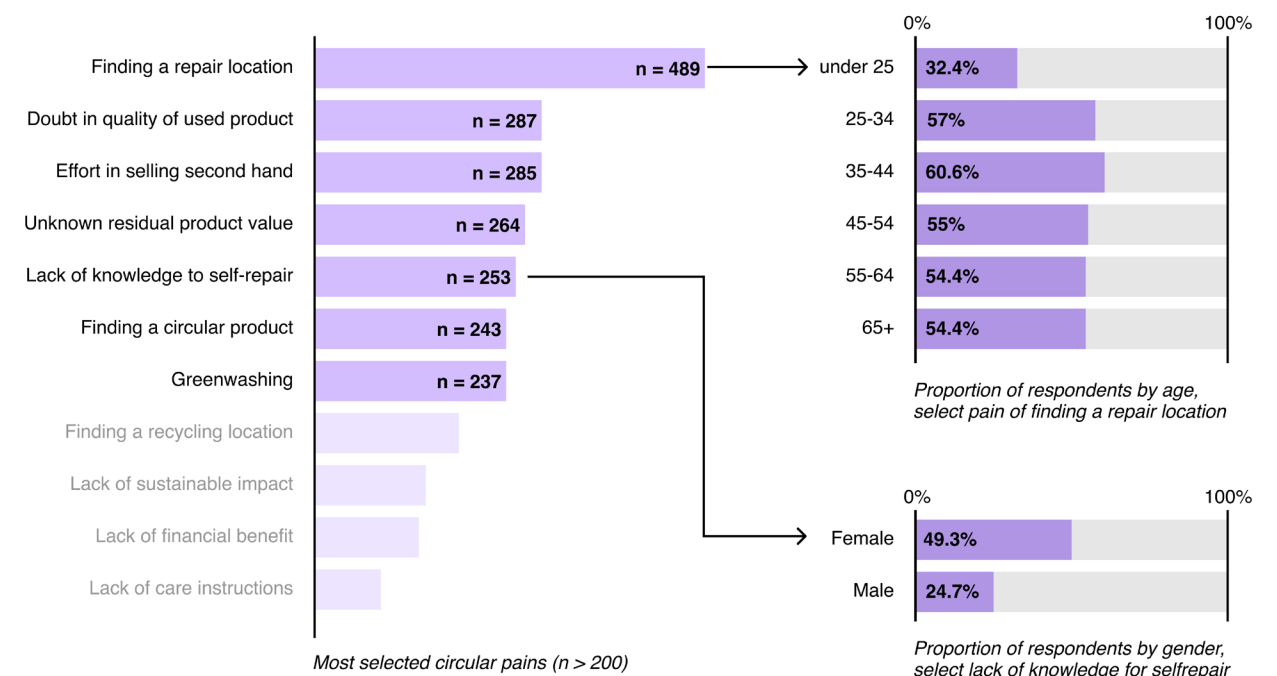


Figure 18: Circular pain relevance in the sample

Information requirements before purchase

The results show that the product’s materials, warranty, and basic descriptions of function and features are the most relevant information to respondents at the point of sale. Care advice and product repairability information rank second. How workers are treated, the specific origins of materials, and the product’s sustainable impact are the least relevant to respondents (See Figure 19). Women care more about the sustainability impact, how workers are treated, and how to care for a product. The effect of environmental motivation can be observed in the slightly higher need for information that is related to how the workers are treated, where materials are sourced, and how repairable a product is. The effect of age does not have a significant influence on the relevance of a specific type of information.

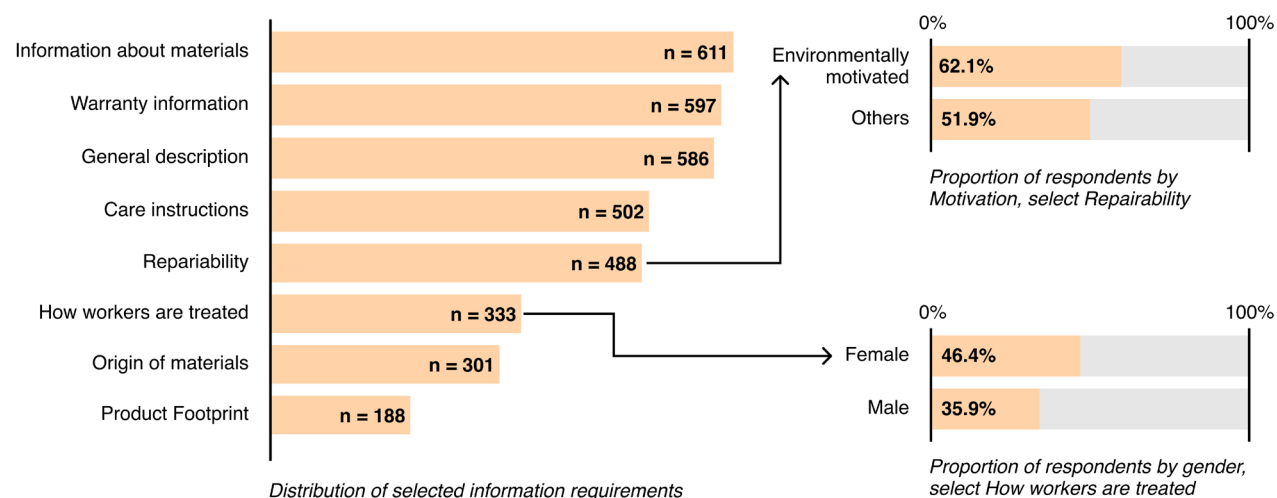


Figure 19: Information requirements in the sample

Conclusion

This chapter completes the answer to RQ1.3. Guided by the survey results, three distinct opportunity areas are formulated. These define the design space for the following service ideation (see Figure 20).

The first opportunity area lies in the purchase phase. The difficulty of finding a sustainable product or alternative is mentioned as a relevant purchase pain, increased by a lack of trust induced by greenwashing. Yet the information consumers actually prioritise at the point of sale is not a product’s sustainable impact, which ranks lowest, but its materials, warranty, and functional features, followed by care advice and repairability. This suggests that the opportunity lies in making it easier to find sustainable products, not in promoting sustainability claims.

The second opportunity area manifests in the use phase. Repair-related actions represent the single largest cluster of consumer pain. 55% of respondents do not know where to get their product repaired, a pain that is strongly represented across all age groups above 25. Meanwhile, 28% feel they lack the knowledge

to repair products themselves. Together, these findings point to a service opportunity that makes repair points discoverable.

The last opportunity area lies in the post-use phase. Consumers are hindered from reselling products because the process takes too much effort and the remaining value of their products is unknown. On the buyer side, doubts about the quality, cleanliness, or authenticity of second-hand products form a significant barrier, especially amongst younger consumers. The opportunity therefore sits in reducing the seller’s effort while providing verified product information that builds buyer confidence.

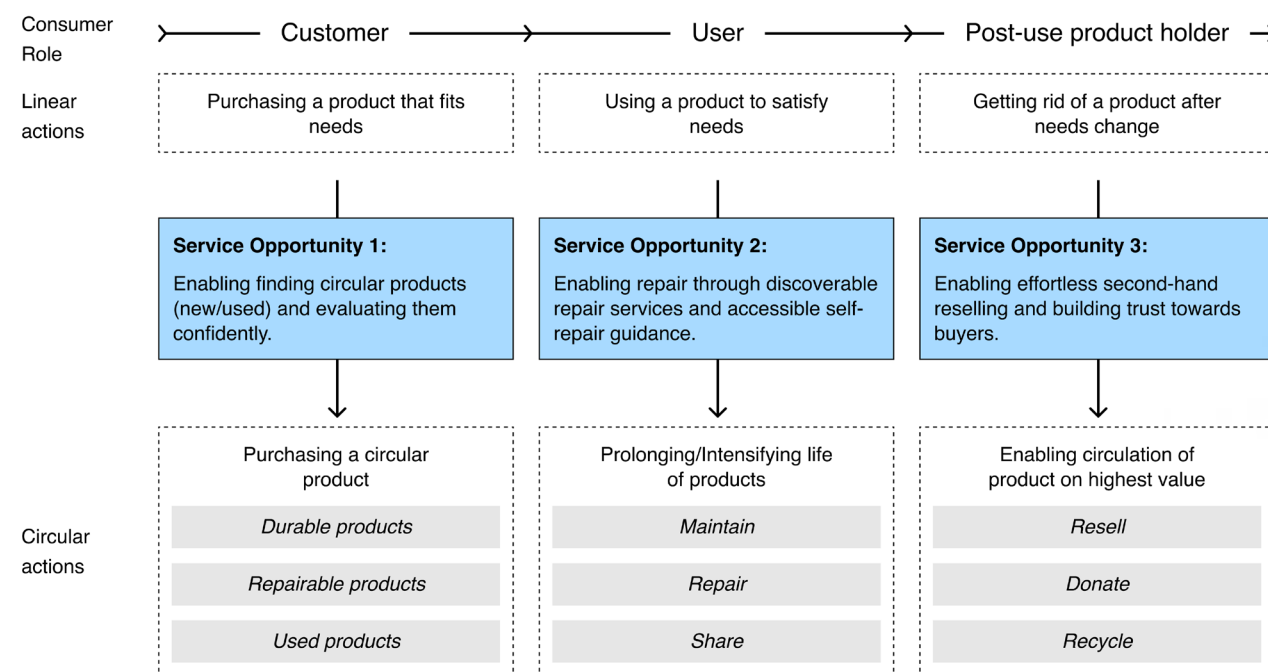


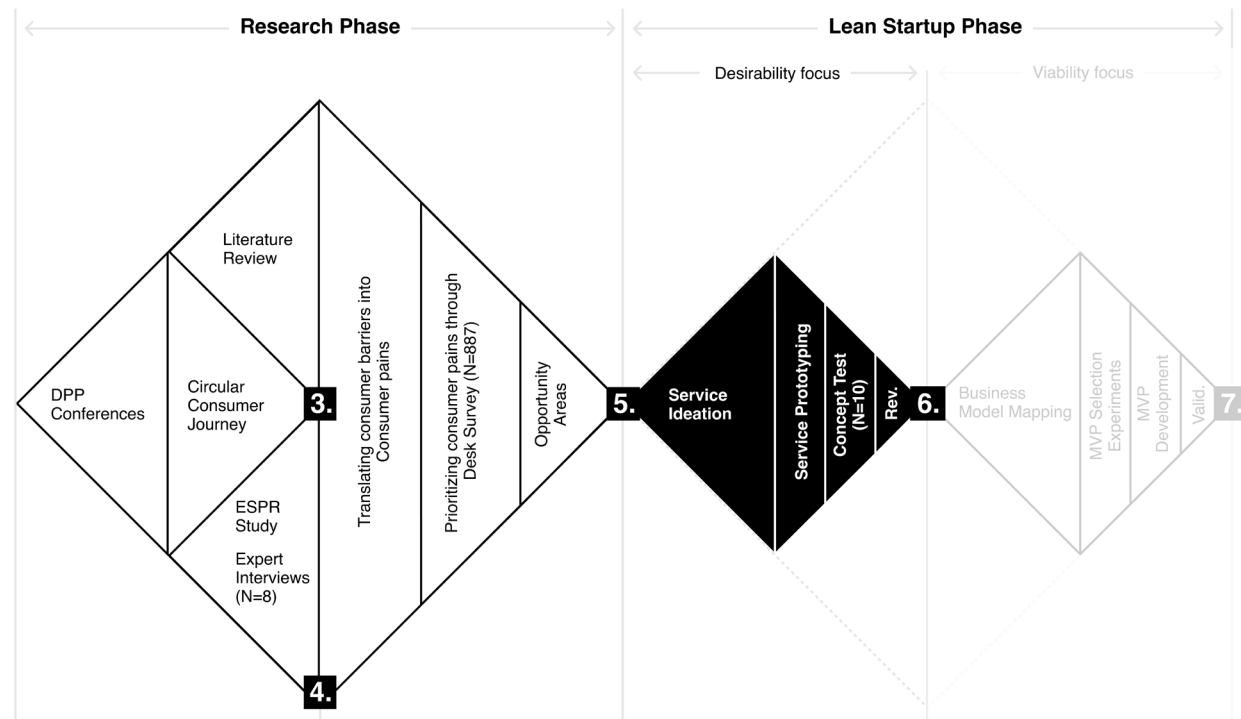
Figure 20: DPP-enabled service opportunities on the consumer journey

Limitations

The survey was conducted amongst Secrid BV customers. Therefore, the sample likely includes a selection bias of consumers who purchase a premium, durability-focused brand with strong sustainability values.

That, combined with a strongly skewed sample towards an older male group, may mean the survey does not fully represent the general public as intended in the research scope. Consequently, the sample skew can only partially be eliminated by analysing gender and age effects.

6. Consumer-centred DPP-enabled consumer services



This chapter addresses DQ1.4: How can DPP-enabled services resolve consumer barriers? Moving from analysis to synthesis, this chapter translates the consolidated knowledge of DPP capabilities and consumer pains into tangible service concepts. Through iterative ideation five service concepts are prototyped as experience scenarios (6.1) and tested with consumers in ten semi-structured interviews (6.2). Based on the interview insights, the chapter concludes by revising and integrating the concepts into a single service direction: the DPP repository, a product lifecycle platform that combines a central product repository with surrounding lifecycle services (6.3).

6.1 Designing DPP-enabled service concepts that reduce consumer pain

Introduction

The collected knowledge of DPP data characteristics and of pains consumers currently face in their circular consumer journey, guided the ideation of DPP-enabled service concepts. This chapter presents five service concepts that emerged from an iterative ideation process, address consumer pains, and leverage DPP capabilities.

Method

This thesis primarily aims to explore services enabled by DPP data and therefore naturally focuses on a subset of technologically enabled solutions. The general approach to ideating meaningful concepts is nested in established idea-generation techniques and follows three iterative phases.

(1) The phase of self-ideation occurred in two different modes. To make use of the often unexpected and unstructured nature in which ideas emerge, they were captured in a memo to come back to at a later stage. This approach allowed ideation to be used during the process of understanding consumer problems and the DPP capabilities. Secondly, the consolidated knowledge guided another self-ideation. This time, “How might we” questions (HMW) were developed turning each of the three service opportunity spaces (see chapter 5.3) into a solution space more specific to the uncovered consumer pains (IxDF-The Interaction Design Foundation, 2016).

“How might we design a DPP-enabled service which helps the consumer to find circular products (new/used) easily and evaluate them confidently?” - HMW question 1

“How might we design a DPP-enabled service which makes repair services discoverable and self-repair guidance more accessible?” - HMW question 2

“How might we design a DPP-enabled service which makes second-hand reselling effortless and ease building trust towards buyers?” - HMW question 3

(2) To enrich ideas, a co-creation workshop was performed. Together with two PhDs in the field of CE and two TU Delft alums whose master’s theses focused on DPPs, a 90-minute ideation workshop was facilitated. The participants were purposefully selected because they already had pre-existing knowledge of the general concept of CE and the ESPR.

To onboard and immerse them in the research findings, nine consumer pain cards and eleven DPP feature cards were developed prior to the workshop. The consumer pain cards are an evolution of the previously named barrier cards (see chapter 5.2). The core difference between barrier and pain card is the reformulation of the barrier into a (hypothetical) pain statement from a consumer perspective. That way, it is easier for workshop participants to empathise with

the struggling consumer (see Figure 21).

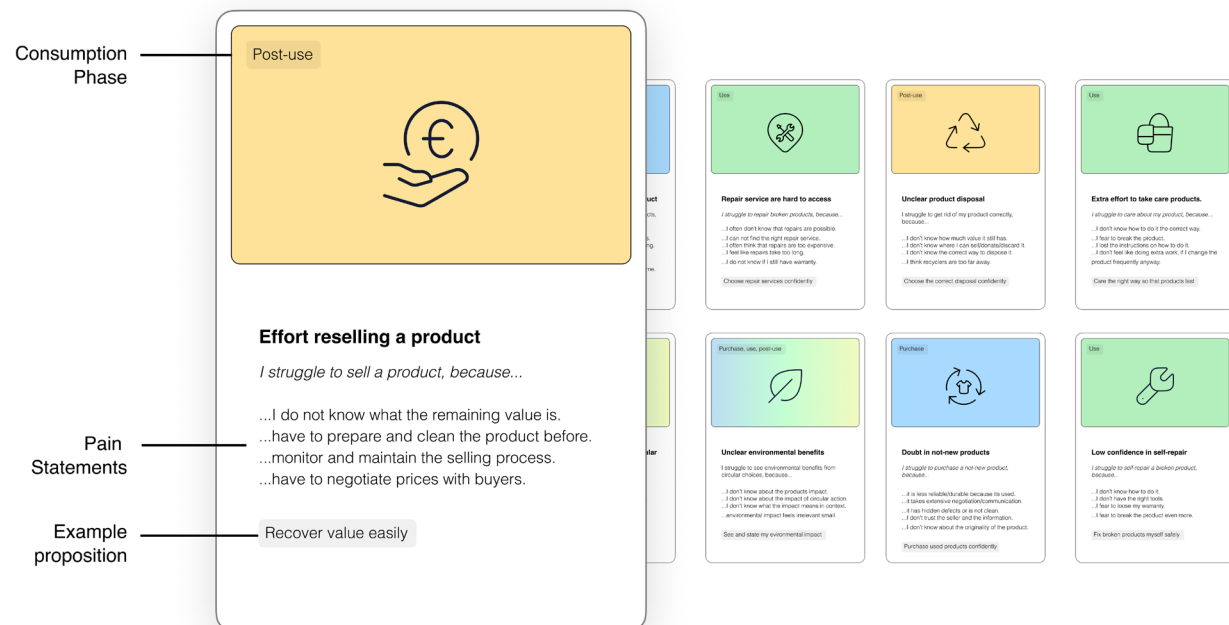


Figure 21: Consumer pain cards (see all in appendix 10.8)

The DPP feature cards were designed to consolidate the capabilities of the DPP for service creation extracted from the ESPR (see chapter 4.1). They are designed to trigger ideas about how a DPP feature create a service to cure a consumer pain (see Figure 22). The workshop flow and cards were tested and adapted with an industry expert in innovation and workshop techniques (see Appendix 10.7).

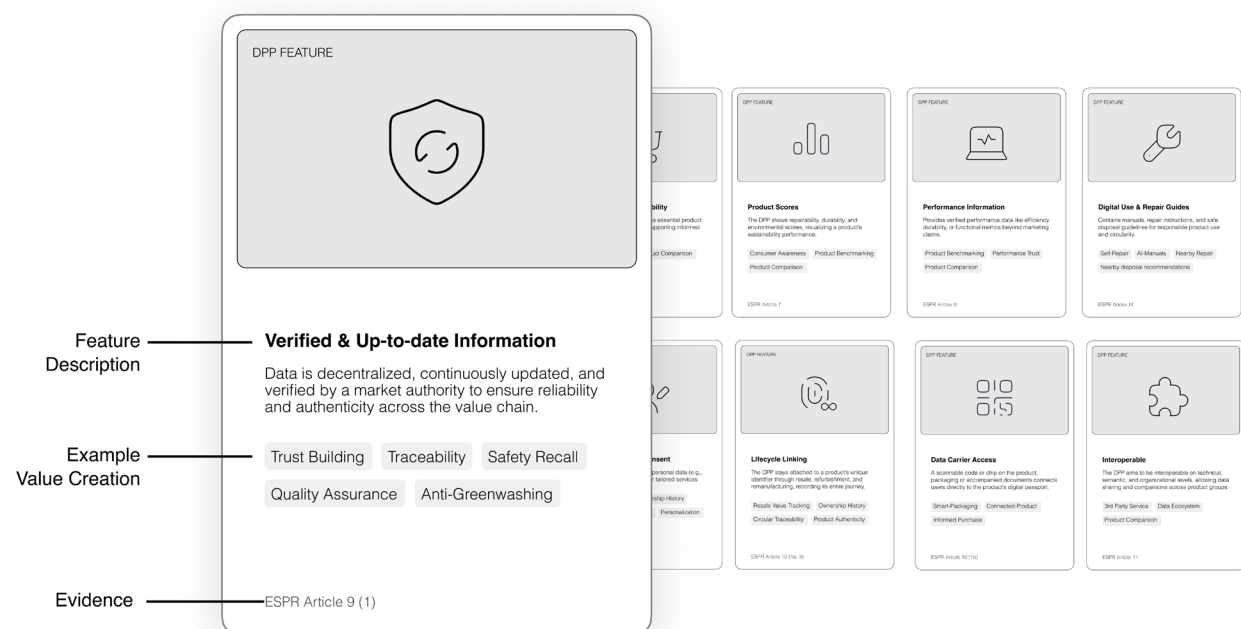


Figure 22: DPP feature cards (see all in appendix 10.8)

An initial immersion in the materials and cards started the workshop (see Figure 23). The first ideation round utilised the barrier cards and silent brainstorming to come up with ideas that decrease the consumer barriers (see Figure 24). After presenting and clustering (see Figure 26), a more focused second ideation round aimed at creating services that utilise DPP characteristics to address barriers. Lastly, the results were prioritised using dot voting (see Figure 25).



Figure 23: Service ideation workshop with pain and DPP feature cards



Figure 24: Silent brainstorming



Figure 25: Dot voting

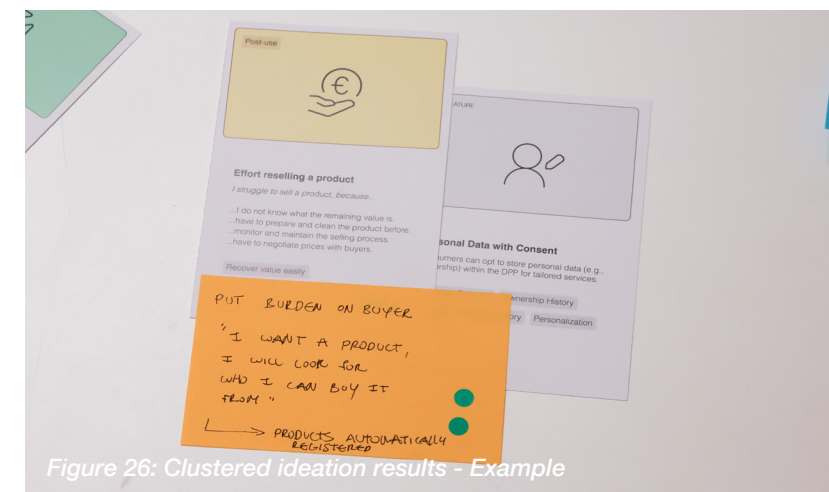


Figure 26: Clustered ideation results - Example

(3) The interviews conducted with DPP experts (see chapter 4.2) ideas were gathered about what services can emerge from the DPP data. During the analysis process of the interviews, these were clustered and later integrated into the ideation of DPP-enabled service concepts.

Results

The three separate ideations resulted in 14 concept clusters (see Appendix 10.9). One concept cluster comprises a set of related ideas or features that share similarities. To proceed, five concept clusters were prioritised based on the most prevalent pains identified in the survey results and a heat map vote within the workshop.

To identify the different concepts, each was given a descriptive name. The core value proposition was prototyped through a scenario which is meant to be tested with consumers in the next chapter (6.1). The five prioritised service concepts are distributed over all phases of the circular consumer journey (see Figure 27).

Pre-loved and Certify aim to reduce the pain points of the product purchase phase. The concept of ProductWallet and RepairMatch supports consumers acting circularly during the use phase. SimpleSell addresses consumer pain points in the post-use phase of the circular consumer journey.

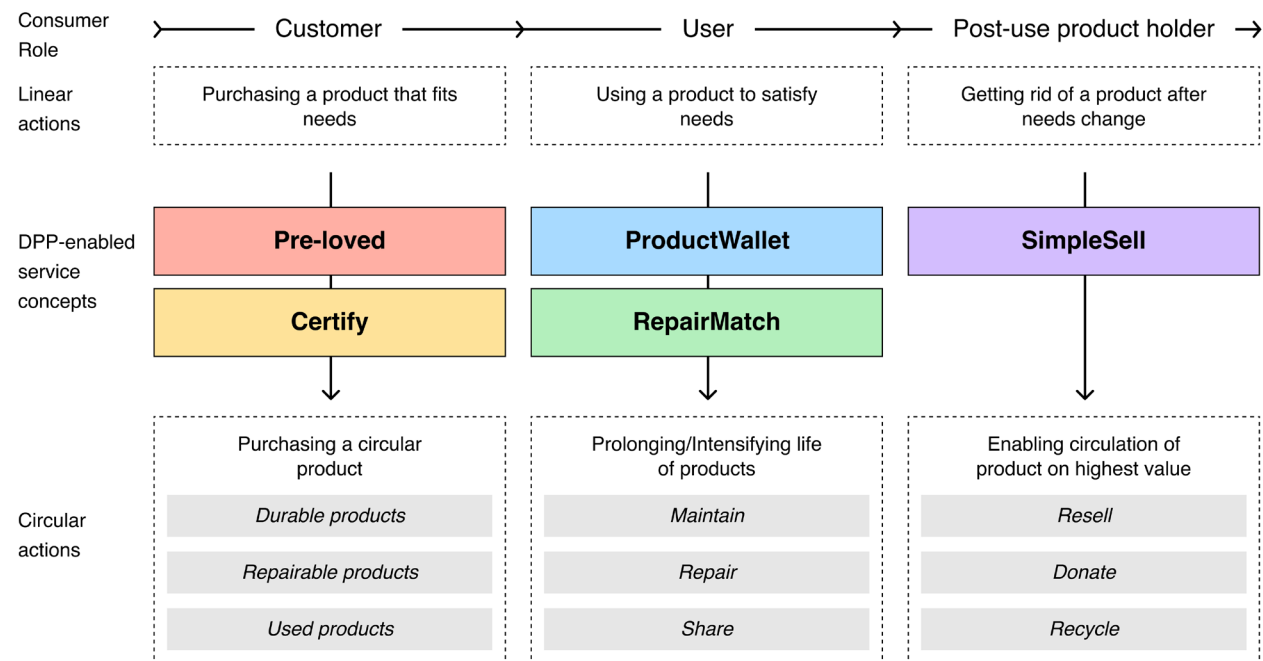


Figure 27: DPP-enabled services on the circular consumer journey

Pre-loved

Shop Premium Quality at a Lower Price.

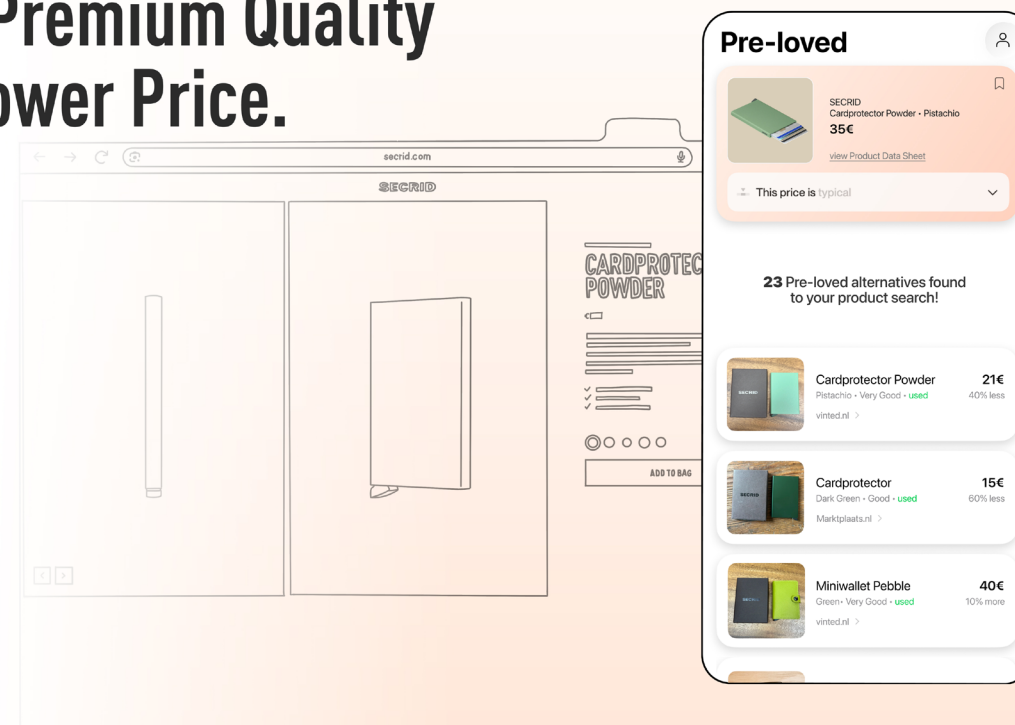


Figure 28: DPP-enabled service prototype - Pre-loved

Pre-loved intervenes during the online shopping experience by suggesting used alternatives when a consumer is viewing a new product. It shows available second-hand options that match the exact model and quality of the desired product, at a lower price, offering an immediate circular alternative.

This service addresses the pain of not finding a more circular product by instantly surfacing used alternatives that might otherwise be hard to find.

Showing a cheaper, pre-owned product option when considering a new purchase provides a clear financial benefit, reduces the search effort, and makes second-hand options visible.

This concept relies on information interoperability, which allows different products and databases to be compared accurately. It also leverages the globally unique product identifier to identify the exact product variant (e.g., size and colour) a consumer is looking at, enabling searches for available options and pulling the right offers from different second-hand platforms.

Certify

Shop Second-Hand Products confidently.



Figure 29: DPP-enabled service prototype - Certify

Certify allows consumers to use the DPP of a second-hand product to access a verified report of its history instantly. The report aggregates the product's age, authenticity, past repairs, and number of previous owners into a purchasing recommendation, giving the buyer confidence in the product's true condition before purchasing it.

This service directly addresses the lack of trust and knowledge that hinders the purchase of second-hand products. Specifically, it addresses the consumer pain in which individuals “doubt the quality, cleanliness, or authenticity of second-hand products”. It also mitigates the pain of “limited information about a product's performance and condition” which typically prevents confident second-hand purchases. By providing a verified report, the service builds trust and confidence, allowing consumers to make “informed purchasing decisions” about used products.

To function, this service relies on the unique product identifier, which tracks the specific history of an individual product. It uses lifecycle continuity data to display ownership history and repair records and relies on verified, complete, and up-to-date information to ensure the “Safe to buy” score is trustworthy.

ProductWallet

One place for all your warranties and manuals.

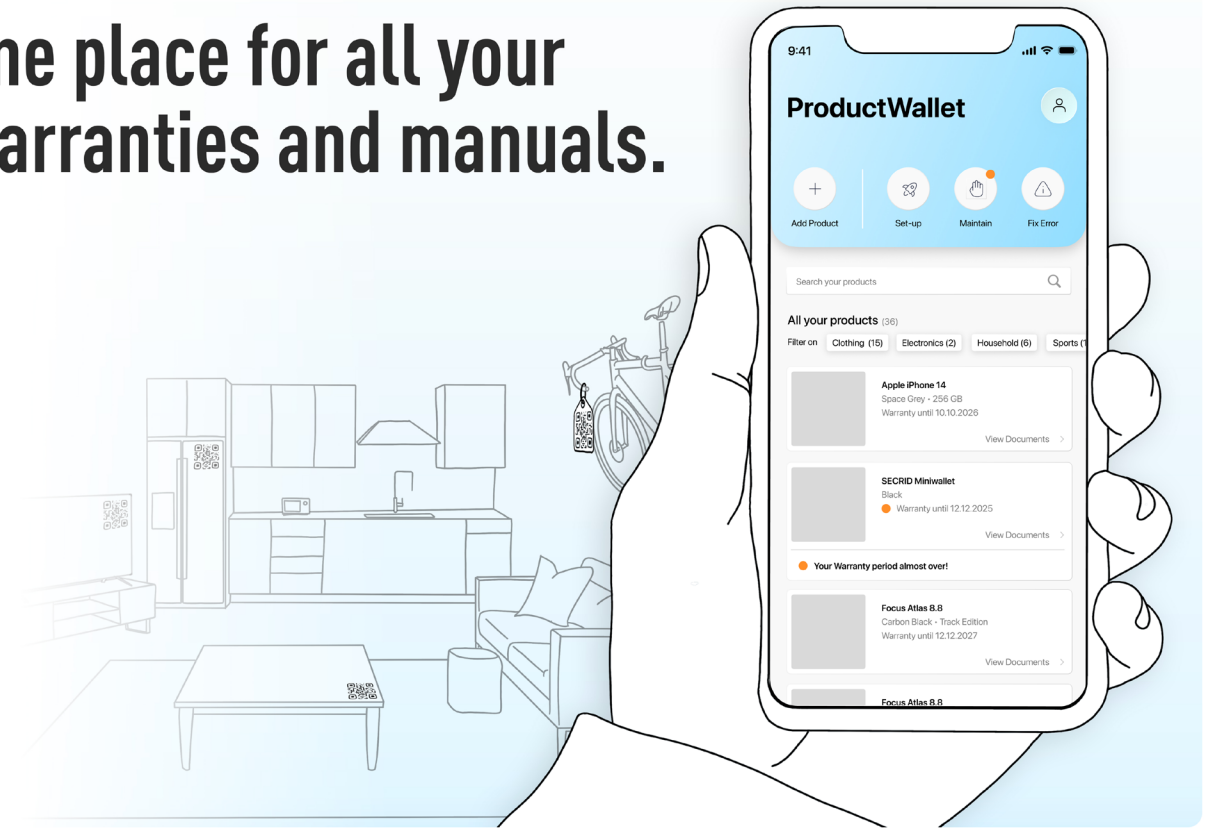


Figure 30: DPP-enabled service prototype - ProductWallet

ProductWallet serves as a digital hub that centralises all product documentation, eliminating the need to keep physical receipts and manuals. It provides an instant overview of active warranties, maintenance schedules, and product alerts, ensuring consumers stay organised without administrative effort.

In the ideation, this service did not directly emerge from a pain the consumer has. Instead, the concept was triggered by the need for warranty information that participants indicated in the survey. On a general level, this service tackles the “convenience” barrier where managing the product and accompanying warranties or manuals is perceived as messy. The gain is a peace of mind for the consumer, knowing all documentation is safely organised, keep track off.

The service is enabled by the data carrier (e.g. QR code), which provides instant access to the digital record and allows for an instance of the DPP to be saved in the ProductWallet. Furthermore, tracking warranties the ProductWallet offers an accessibility layer that supports the consumer through use, repair, and disposal guidance.

RepairMatch

Find specialized repairs based on your product.

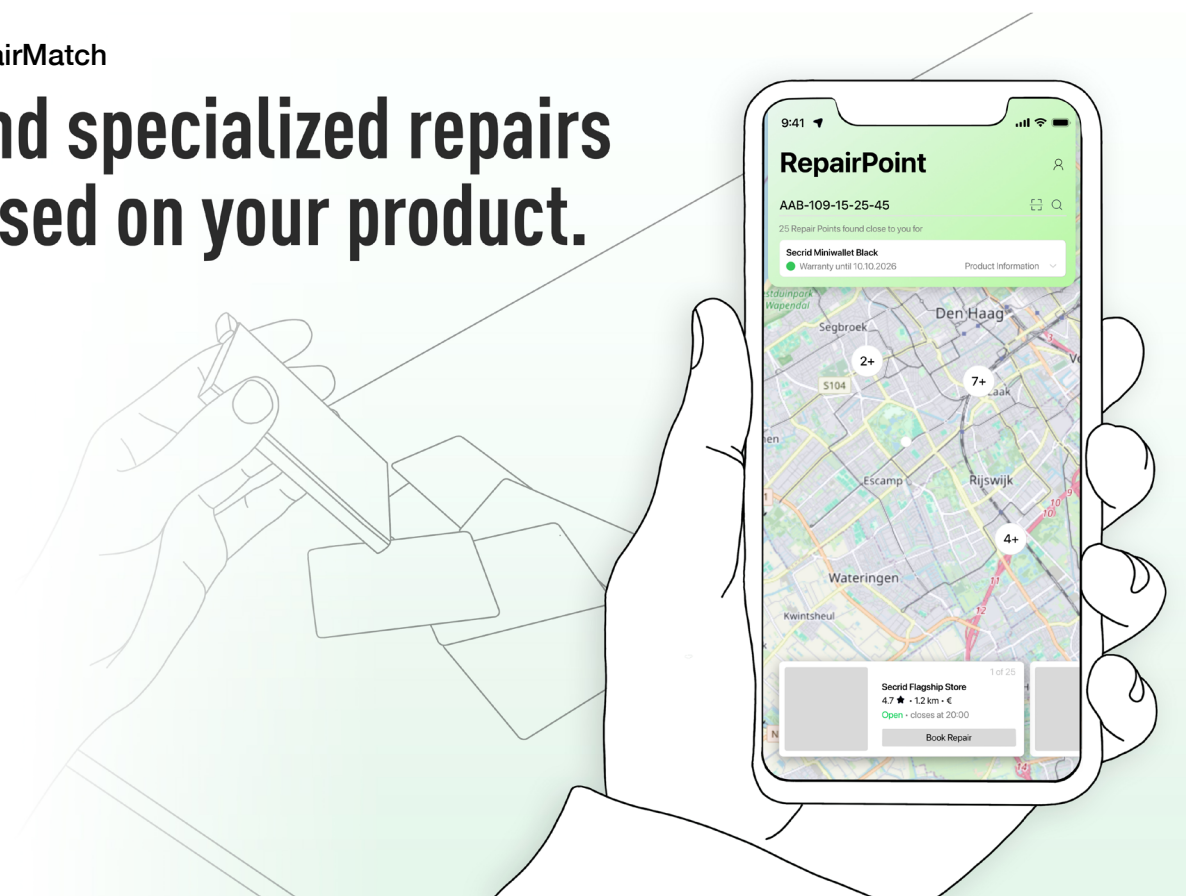


Figure 31: DPP-enabled service prototype - RepairMatch

RepairMatch simplifies product maintenance by allowing users to scan a broken product to locate specialised repair services nearby immediately. The service offers transparent cost estimates and repair times tailored to the specific issue of each product. This eliminates the hassle of searching for help via customer support channels or other means.

RepairMatch addresses the most significant barrier identified in the survey: that “repair services are hard to find”. It also reduces the barrier of consumers not knowing how to repair products themselves by effortlessly connecting them to professionals. The gain is immediate access to specialised care, providing certainty through cost and time estimations. This is crucial, since the effort required are major pains in consumer repair efforts.

The service utilises role-based access rights to connect the specific product with authorised repairers who have access to technical data. It leverages digital use, repair, and disposal guidance to provide necessary technical specifications to the repairer. The globally unique product identifier ensures that spare parts and repair centres match the specific product model and that the product history is updated.

SimpleSell

Turn your unused products to money in one-click.

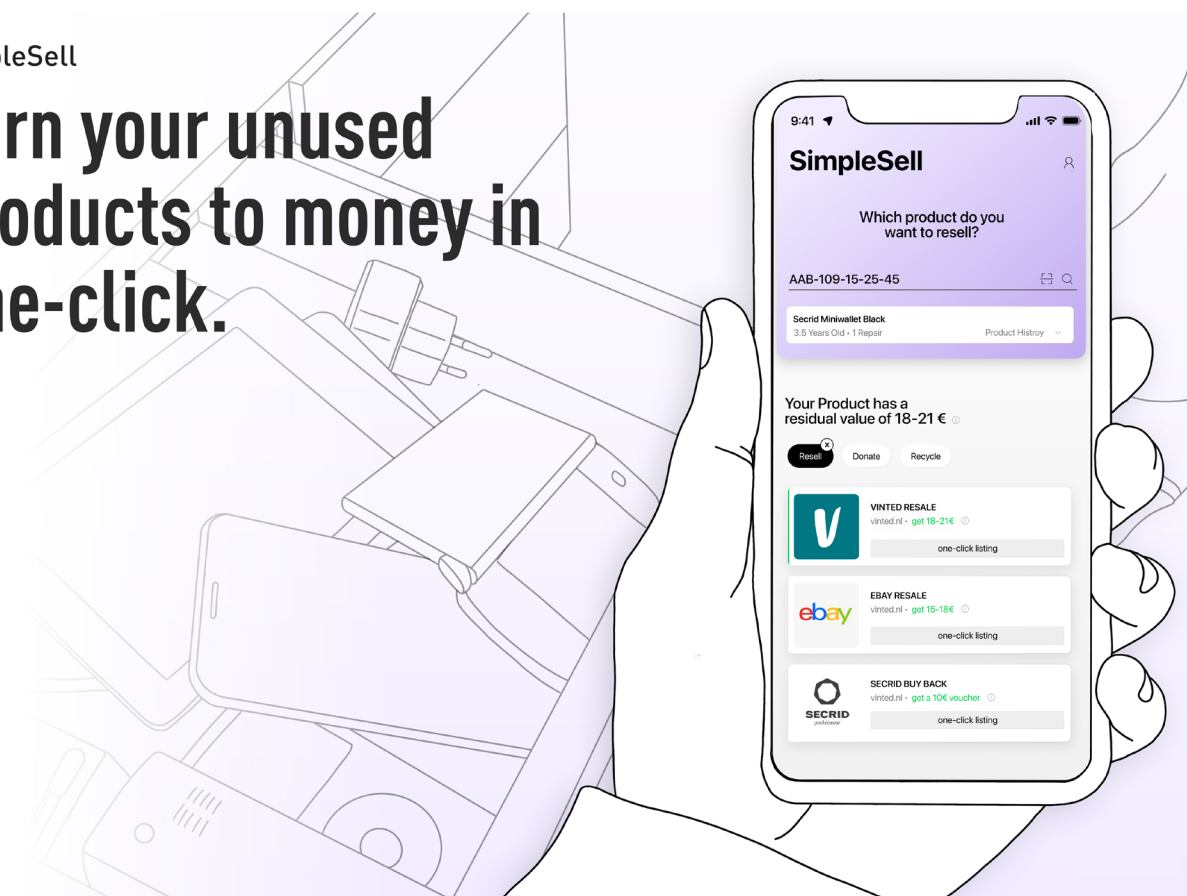


Figure 32: DPP-enabled service prototype - SimpleSell

SimpleSell streamlines the resale process by using the product’s digital data to estimate the remaining value of the unused product and to identify through which resale channel the best chances exist to capture that value. With one click and a few photos, SimpleSell allows users to post their product on multiple second-hand platforms, maximising convenience.

This service minimises the barrier where “selling used products feels like too much effort”, which often leads to product hibernation. It also addresses the barrier of “unknown resale value” by providing an immediate value estimate. The primary gain is the reduction of friction. By auto-generating descriptions, it turns a tedious task into a “one-click” action.

The concept relies heavily on structured, open, and machine-readable information to automatically populate listing fields (colour, material, model) without user input. It uses lifecycle continuity to verify the product’s age and history to calculate the residual value, and material composition data to offer recycling options if resale is not possible.

Conclusion This chapter opens the response to DQ1.4 by ideating within the three service opportunity areas. Through multiple idea-generation techniques and prioritisation rounds, five concrete DPP-enabled service concepts are created: Pre-Loved, Certify, ProductWallet, RepairMatch, and SimpleSell. Each concept is grounded in specific consumer pains or specific DPP capabilities. To validate whether they address the right problems in the right way, the next section tests their desirability with consumers.

Limitations The resulting concepts are based on literature reviews and legislative studies, which risks creating services that do not fully empathise with the consumer's everyday life. To successfully develop a meaningful service, the concepts need to become more grounded in consumer reality. Therefore, these prototyped scenarios are used as early, mid-fidelity artefacts to make the propositions more tangible and to inquire about the consumer's desires.

Additionally, the economic viability of the proposed service concepts has not been taken fully into account. An iteration of the service concepts based on the viability is performed in chapter 7.

6.2 Testing consumer desire for DPP-enabled service concepts

Introduction The five service concepts are created based on pains uncovered and the ESPR study of the DPP concept. Although partly represented through the empirical studies and the survey, the consumer has so far not been qualitatively included. That is, to sufficiently understand the reasons behind certain consumer behaviour and to build empathy towards it as a designer. To gather qualitative insights, this chapter reports on 10 qualitative consumer tests.

Method The concept tests served to validate the core value propositions. An established approach for concept testing is described by Buchenau & Suri (2000). They define "Experience Prototypes" as prototypes that mimic a user interaction with a future service or product, as a tool to explore and validate ideas.

By adopting the approach of Buchenau & Suri (2000), the service scenarios were developed with a focus on the value for the consumer and the ability to walk the interviewee through the main interactions. The prototypes are all composed of the same three elements to minimise the effect of aesthetic preferences between the concepts. (1) A tagline clarifies the core value to the consumer. (2) A sketched background conveys the context in which the service offers to help. (3) A phone shows a wireframe of a user interface mock-up that illustrates the interaction with the service. The service scenarios are presented in medium fidelity, although the rest of the concept remains raw. Medium-fidelity prototypes are well-balanced because they allow interviewees who are new to concept testing to relate to the concept easily. Therefore, interviewees are able to explain why the service would help them, rather than focusing too much on how the prototype looks (Lim et al., 2008). The participants were selected from the Secrid customer database. To bridge the mental gap, the scenarios were built around the wallet as an example product. In addition, a "future setting" was included, sensitising interviewees to the DPP context and a reason to believe that presented concepts are possible. Before the interviews, the service concepts were tested with the supervisor team and two students. Based on their feedback, the taglines were formulated more clearly and user-value focused.

The participants were selected from the previously conducted survey. Although the survey was conducted globally, only participants residing in Europe were selected due to the project context. Since the survey had an overrepresentation of older male participants, the sampling aimed to correct for that bias to the best of the researcher's ability. However, practical availability reasons restricted an entire correction. Via the Google booking tool, the participants were able to reserve a time slot that fit their own agenda. Once booked, a follow-up email requested them to sign an informed consent form before the interview took place.

Ten concept tests were conducted online in 30- 60-minute video conversations.

Online interviews were chosen over in-person interviews because participants were located throughout Europe. The test did not yet involve direct interaction with the service's interface. Instead, the participants were asked to react to a verbal walkthrough. This kept the prototyping effort lower.

Semi-structured interview guides were used to balance comparability and comprehensive analysis, allowing for spontaneous follow-up on questions (see Appendix 10.10). The order of the presented scenarios was changed to avoid an order effect. With the participant's consent, an interview was audio recorded. A structured analysis of the interviews was performed in five steps. (1) First, the interview recordings were re-listened to. (2) Per scenario, quotes and comments were noted down. These were either related experiences that exemplified the value of the presented service or factors to use/not use the service. Further, the interviews shed light on the product categories and services that are most valuable, as well as on ideas for using them in different ways. Letting the interviewee reflect across all services at the end of the interview revealed most/least preferred concepts, or viability/feasibility doubts. (3) The insights were inductively clustered. Themes emerged from reviewing the comments per scenario and merging similar ones. (4) The cluster of comments was summarised into multiple insights per service scenario. To reconstruct how themes emerged, colour codes were used (see Appendix 10.11).

Results

Interview sample demographics

The ten interviews included seven male participants and three female participants. The participants' age ranged from 35-65 years. A self-introduction provided the context and a picture of a mixed cohort consisting of more and less environmentally motivated consumers. Notably, three participants brought familiarity with the DPP concept due to contact with the topic in their professional work.

Pre-loved

Pre-loved promises to find any product via the DPP on a second-hand platform at a lower price. One interviewee mirrored this proposition and emphasises the value specifically for high-quality products.

"I'd rather buy a used qualitative drill, where I know that there are spare parts and service available, instead of a cheaper, new alternative without services." - P2

While price was highlighted as an important benefit in the scenario's tagline, interviewees emphasised the environmental motivation. Finding a used alternative for a new product is also driven by the idea of giving something a second life rather than needing to produce a new product.

Interviewees provided depth to what factors influence the second-hand purchasing decision. For instance, Second-hand products that are closer to the

buyer promise less time investment to take a look, test, or pick up the product. Interviewees remark that their usual shopping journey begins with the intention to purchase a product second-hand or new. However, Pre-loved intervenes in the process of shopping for a new product, a context in which interviewees say they rarely switch to a used alternative. An exception to this behaviour can be observed with higher-value products and collectibles. Interviewees mention that for expensive furniture, jewellery, watches, or cameras, the product model is known upfront in their search.

"No, it's coming from the idea of what I want to have and then I look around at the websites which have a selection of used watches." - P7

The general attitude towards purchasing second-hand products was limited amongst the interviewees. As a reason, some interviewees mention that they have the financial situation to afford new products and therefore do not shop so much second-hand.

Certify

Certify promises to solve trust issues hindering consumers from purchasing second-hand. Instead of trusting the seller's description of the product's condition, it provides the user with an aggregated DPP report on the product's authenticity and condition.

The sentiment about the concept was generally positive. However, since the cohort showed low second-hand shopping intention, this service remained less relevant to the interviewees, similar to Pre-loved.

Still, the interviews revealed an interesting tendency: Interviewees whose actions are motivated by their environmental beliefs seem to have pre-existing trust and confidence when second-hand shopping. In contrast, for the other interviewees, lack of trust is mentioned as main a reason for why they don't purchase second-hand. The fear of buying something broken or being scammed is too big. One interviewee reflects:

"I have tried Vinted a few times. I always got clothes with stains or holes that were not declared. Since then, I don't use it anymore." - P1

Interviewees mentioned that Certify helps them restore some trust, but it can only address the problem partially. While age, materials, or reported repairs can build trust, some defects can still be hidden or remain unknown to the seller, even with a DPP.

Similar to Pre-loved, the value of the concept increases with the value of the product and the investment risk. Interviewees mention that for cameras and watches, professional condition checks and verified product history are emerging in the market, while for clothes, the cost-benefit is too low.

ProductWallet

ProductWallet promises to centralise all the warranties and manuals in one place. The main value interviewees resonated with is the peace of mind that everything is stored safely and findable. One participant comments:

“It [ProductWallet] will really alleviate stress in your life [...]. We renovated the whole house and then you have to register your fridge, your oven - all on different websites. That alone was a job.” - P5

Further, it evoked positive resonance amongst the interviewees because losing receipts is also reflected in a financial loss. An interviewee explained:

“My toothbrush broke and I could not find the receipt. Therefore, I had to buy a new one.” - P8

Another participant valued the easy overview of remaining warranties by stating:

“My access point did not work correctly anymore for a while. I had no idea that my warranty was almost over. Two weeks after the warranty ended it broke entirely. I could have repaired it.” - P2

In addition to keeping track of warranties and where receipts are stored, some interviewees highlighted the repository of manuals. Interestingly, for both receipts and manuals administration, makeshift consumer solutions already exist (e.g., physical and digital folders). However, interviewees are still deterred by not quickly finding them when needed or losing them when moving. Others report storing receipts in their email accounts but note that they are not reminded when a warranty period is about to expire. One participant notes:

“Of course I didn’t print it out, but it [the receipt] was saved you know somewhere in my browser or one of my phone or whatever. Then I couldn’t get a hold of it when I would need it when the washing machine was having an issue.” - P1

The ProductWallet concept also inspired interviewees to imagine other ways in which a repository of products can be useful. One interviewee mentions the use case to share manuals within the family, so that everyone always has access in case any household appliances break or malfunction. Another participant mentioned that it can be used to easily claim insurance reimbursement in case of loss due to moving, fire, or flood.

“I think this is great for insurance purposes in my mind. If I have to say what is the value of the items in my home, the fixed assets, I have a whole list of my inventory.” - P5

Some interviewees recognise that similar services already exist from brands with a wider product portfolio (e.g., Samsung, Bosch). For these interviewees, the convenience of staying in that brand ecosystem outweighs the value the Product wallet can deliver through its ability to work across all brands and products. However, other interviewees also frame its cross-brand compatibility as a competitive advantage by saying:

“I understand if every company would do this for their product world, it’s not as valuable because then you would end up with a lot of wallets like the [one] you have for Apple and so on.” - P10

Another participant describes their value of a cross-brand platform differently, by saying:

“I think that will be a great success because you are also eliminating this pollution of applications that we are living in today.” - P8

RepairMatch

As the survey results suggested, the RepairMatch concept also resonates strongly with interview participants. The participants add that an important factor in proceeding with a repair is knowing how long it will take and how expensive it will be. One interviewee explained:

“If I know that I can hand it [the smartphone] in, go around the corner, drink a coffee and get it back - then I could easily fit it in my schedule.” - P5

In addition to more information and pre-diagnostics, the ability to schedule a repair confirms that a repairer is available, increasing the likelihood that the consumer will follow through with the repair. A participant notes:

“I would definitely like to book it. I would hate to go all the way there without them being able to take my case right away.” - P6

Furthermore, interviewees transferred the concept of RepairMatch to a service for searching for spare parts. The DPP either directly links spare parts or can help resolve the model specification so that spare parts can be bought without too much guesswork. An interviewee exemplified the need for a service that helps to find spare parts by reporting on a failed self-repair:

“I have a disassembled coffee machine standing in the corner, because I could not find out which exact spare part fits this machine. I would love to repair it myself, but I can’t.” - P1

SimpleSell

The last scenario, SimpleSell, promises to make it effortless for consumers to sell unused products. Consistent with the literature review, the effort required to sell products online undermines most interviewees’ intentions. This is exemplified by one participant saying:

“I have so many things that I could get rid of, but I just do not have enough time and energy. It almost feels like a second job.” - P8

The interviews revealed that important factors to resell a product online are the probability of sale and potential profit. Some interviewees share their strategies

of placing products on multiple platforms simultaneously, increasing their chances of a successful sale. Others invest a lot of time and effort in writing good descriptions and taking better pictures to gain buyers' trust, differentiate from other listings, or ask for a higher price.

"I put like a clear description of what the... condition [was]... and some close-up pictures, so the buyer knows exactly what he's buying." - P1

These findings suggest that the lack of buyer trust in second-hand markets affects sellers as well, as they invest considerable effort in building credibility to sell more quickly and at a higher price. Speed and convenience played such a big role that some interviewees even prefer a direct brand take-back option even if it means receiving less money.

"I would definitely go to the platform with the higher probability to sell even if the price tag is a bit lower. Potential money is not as good as real money." - P10

Importantly, interviewees note that automatically generated AI descriptions and images decrease the trust as buyer. Hence, that also decreases the probability of selling, and therefore do not add value for consumer.

Conclusion

The consumer interviews advance the answer to DQ1.4 by validating which service concepts resonate with real consumer problems and revealing how they should be combined.

Across all service concepts, the perceived value of the service increases with the value of products that it is used for. For products like electrical appliances, furniture, or collectables, interviewees indicated that the concept-specific financial and functional gain is a reason they use a service. Low-value, fast-cycling products, like apparel were considered less relevant for the services.

The problem that the ProductWallet concept tries to address, generated immediate recognition across seven of ten participants, with concrete examples of lost receipts leading to unnecessary purchases and missed warranty repairs. RepairMatch similarly validated the survey findings: locating repair services remains a significant friction point. The interviews added crucial depth, revealing that cost and time estimates, as well as spare parts identification, fundamentally increase the likelihood of a repair decision.

Furthermore, participants noted that the ProductWallet and RepairMatch can work well in one concept, since the action of searching for product documents often occurs when a repair is needed or resale is intended. An interviewee mentions:

"I really like that this [RepairMatch] ties in with your app beforehand [ProductWallet] because then if I put all my products in my app and I need to repair my tumble dryer or washing machine, I could also go onto this app and see where the repair point is." - P1

SimpleSell validated the real pain of the high effort required to resell products. However, the interviews exposed a critical tension: participants desire to reduce effort, yet distrust auto-generated content when purchasing second-hand themselves. This suggests the solution must balance convenience with authenticity. Interviewees added depth in the reselling decision-making process, indicating that the probability and speed of selling and the product influence the choice of a second-hand platform.

Certify and Pre-loved showed greater conditional value, as both concepts resonated mainly with high-value products (e.g., cameras, watches, furniture) and with interviewees who had pre-existing experience with second-hand selling. However, participants noted that Certify can reduce lack of information but cannot eliminate hidden defects or authenticate condition beyond what's recorded in the DPP.

The interviews exceeded their validation goal by not only validating a problem-solution fit but also exposing critical design tensions and revealing unexpected use cases. Therefore, they provide a foundation for revising the concepts in the next step.

Limitations

The interviewees were sampled from the survey conducted amongst Secrid customers. Since Secrid produces premium, durable, and repairable products, and emphasises their sustainable and social impact, the interviewees likely mirror these values. Therefore, the insights gained in the interviews likely do not entirely represent general consumer scope of this thesis.

In addition, the sample of ten interviewees is relatively small, which limits the generalisability of the findings. Moreover, the participants self-selected by first completing the survey and then voluntarily booking an interview slot, which may introduces an engagement bias. These individuals are likely more motivated and more engaged with topics related to product care, repair, and sustainability than the average consumer. As a result, the largely positive insights may overrepresent the perspectives of consumers who are already receptive to circular practices.

6.3 A revised consumer service: The consumer DPP repository

Introduction This chapter synthesises the learnings from the interviews into a revised service proposition. Rather than selecting a single standalone concept, the revised proposition takes the form of a product lifecycle platform. At its centre sits the consumer's DPP repository. It resembles a repository of owned products and their accompanying information. Surrounding the DPP repository are services that utilise the DPP data and integrations with other infrastructures to solve specific consumer problems at specific stages of the product lifecycle.

Method The revision process of the concept synthesises the consumer insights. In the lean startup tradition (Ries, 2011), the interviews served as a discovery cycle that prompted a pivot from five separate concepts towards an integrated platform architecture. Two steps guide this revision.

First, the five concepts were evaluated against problem resonance. ProductWallet, RepairMatch, and SimpleSell consistently evoked the strongest recognition of real, lived problems. Pre-Loved and Certify, while valued, addressed barriers that were less prevalent in the sample or dependent on purchasing habits that were limited within the interview cohort.

As already suggested by interviewees, the concepts ProductWallet, RepairMatch and SimpleSell services work well together as they require the same foundational layer: access to verified product information. In the process of revising the concept, this foundational layer was named DPP repository. While it shares similarities with the ProductWallet concept, its only function is to store DPPs. Tracking warranties and aggregating DPP content, the proposition of the ProductWallet, is one of several services the DPP repository can connect to.

Second, the DPP repository concept was member-checked with a DPP expert to receive feedback on the revised direction. A DPP provider from previous interviews indicated the potential of the idea through an informal conversation:

"[...] a GS1 DL, cross-platform, able to store all your DPPs. That is not a bad idea at all. [...] Once DPPs hit consumers at scale this will be a no brainer." - DPP provider (personal communication, 05.02.2026).

Results The revised service concept, centres a DPP repository, for consumers to store and access their DPPs. Orbiting that central repository are direct consumer and integrated lifecycle services (see Figure 33).

Direct consumer services

At the platform's centre sits the consumer's personal product repository, a digital home for all owned products, accessible by scanning a product's DPP. This repository directly addresses a recurring pain point in the interviews. Participants

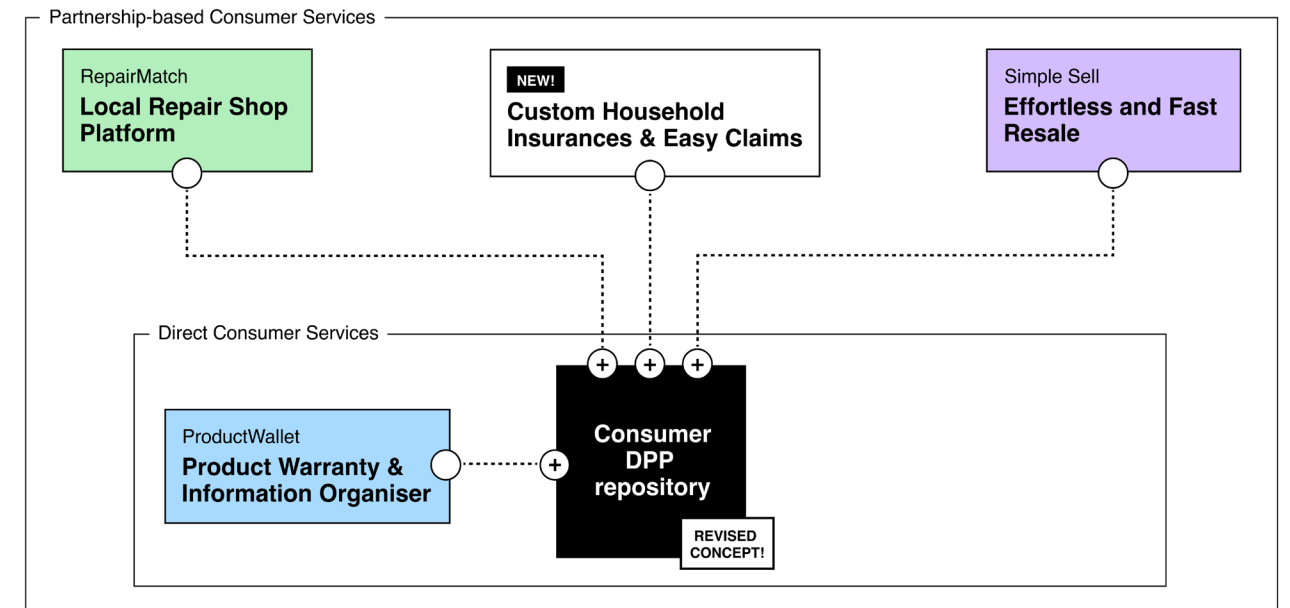


Figure 33: Revised concept: DPP repository service platform

described storing receipts in email inboxes, keeping physical folders that get lost during moves, or simply not knowing where product documentation ended up. The primary service value for interviewees was peace of mind, the assurance that everything is stored safely, accessible, and findable when needed.

Beyond convenience, the repository addresses the information asymmetry that underlies multiple barriers identified in the literature review. Consumers currently lack reliable information, which contributes to premature replacement, failed repair attempts, and product hibernation. While the DPP aims to solve part of this problem, the interviews uncover that some information demanded by consumers cannot be provided entirely by the DPP itself. For instance, the ESPR does not include warranty status, proof of purchase or residual value as part of the information of the DPP. The DPP repository attempts to add a consumer-specific, contextual layer on top of the DPP that can integrate that missing information. For example, the platform not only shows how repairable a product is, but also surfaces where the nearest repair shop is based on the consumer's location, how much it costs and how long it takes.

The DPP repository further simplifies access to verified product information. Instead of requiring consumers to remember and repeatedly scan the DPP to access manuals or repair information, the user scans it once to save it in the DPP repository. This way, the DPP repository effectively turns the DPP, which would otherwise remain hidden behind the QR code, into a live connection to the consumer.

Lastly, storing DPPs in a personal repository addresses a practical risk in the current DPP design. For products where the data carrier is placed on the packaging rather than the product itself, the link to the DPP may be lost once

the packaging is discarded or the tags are cut off. Without that link, downstream actors such as repairers, recyclers, or second-hand buyers cannot access the product's digital record, and lifecycle continuity is broken. A personal repository ensures that consumers can transfer DPP data to other actors when needed, preserving the chain of information that the DPP aims to establish and on which the CE depends.

Lifecycle services layer

Orbiting the consumer repository are services that can add consumer value based on product type and lifecycle phase. The interviews revealed that RepairMatch and SimpleSell could represent two of the services that leverage the centralised product data to resolve specific circular pains.

RepairMatch

When a product malfunctions, this service integration could provide pathways to action: product-specific self-repair guidance with spare part identification, diagnostic tools that translate error codes into understandable information using the DPP data, and connection to nearby repair services with transparent cost and time estimates. Interviews confirmed that consumers abandon repair attempts due to uncertainty about feasibility, cost, and spare part compatibility. By drawing on the DPP data already stored in the repository, this service integration offers potential to reduce the effort of initiating a repair.

SimpleSell

When consumers decide to part with a product, this service integration could estimate its current market value, suggest optimal channels, second-hand platforms, manufacturer take-back programs, or donation points, and can auto-generate listing content with verified product data. For higher-value products, the DPP history can be surfaced as a trust signal to potential buyers. This service integration aims to address the convenience barrier in the post-use phase by reducing the cognitive and physical effort of reselling and surfacing the financial benefit of doing so.

Custom household insurances

The interviews already surfaced another service idea that could integrate with the DPP repository. An interviewee suggested that the repository could double as an asset register. Consumers could generate inventory reports for insurance claims in the event of fire, theft, or flood, or use product data as ownership certificates.

Conclusion

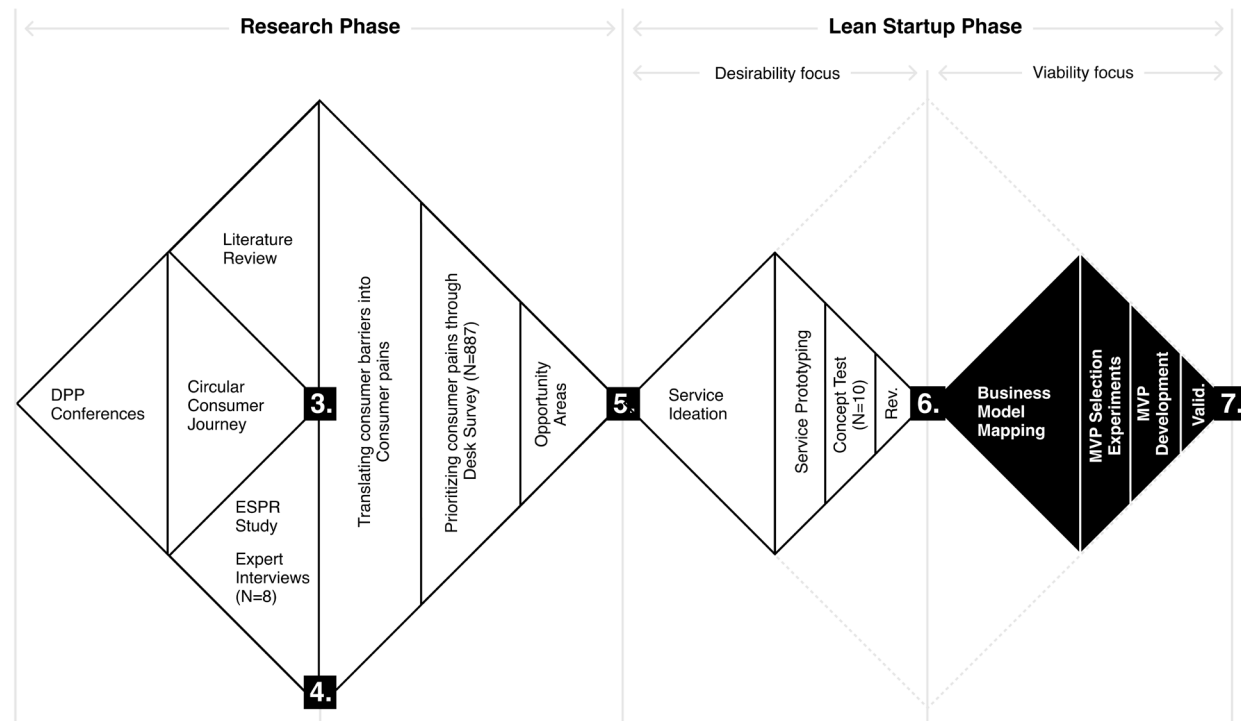
This chapter completes the answer to DQ1.4 by converging towards one revised DPP-enabled service concept: the consumer DPP repository.

This concept reframes the DPP not as something consumers scan once in a store, but as a persistent data layer that helps consumers to effortlessly care for, maintain, and discard products in a circular manner. From a CE perspective, the DPP repository solves a fundamental coordination problem: consistently getting

verified product information from the consumer to the actors who need it. With a platform that connects consumers and circular services digitally, the DPP can be transferred across actors and have circular events recorded, preserving the lifecycle continuity that the ESPR envisions.

A cross-validation with a DPP expert further confirmed that the concept can deliver consumer value once DPPs reach market saturation. This suggests that the DPP repository, as described above, is a concept that can only be fully realised once DPPs are widely deployed and adopted. Hence, actually building the DPP repository and all service layers now is neither feasible nor does it respect the legislative timeline of the DPP and its current low maturity. Naturally, the question that follows is which minimum viable product variant (MVP) of the concept demonstrates enough market signals to warrant further development right now. This question is addressed in the following chapter.

7. A viable DPP-enabled service MVP



This chapter addresses DQ1.5: How can the prioritised service concept be transformed into an MVP that balances market desirability, viability, and the current DPP deployment timeline?

Up to this point, the focus has been on solving a consumer pain through a DPP-enabled service offer, aiming to create a desirable solution. However, from a design-entrepreneurial perspective, this does not imply a successful startup. While an interview-validated problem is a good starting point, it says little about whether the problem is worth solving. For instance, the problem's urgency

and frequency have to be high enough for consumers to actually switch to the solution offered. Similarly, questions arise about monetisation. Who is going to pay? The consumer? And if not, are there other stakeholders or strategies that can sustain a venture? All these questions influence what is called “product clarity” in the entrepreneurial field. Gaining “product clarity” means that the articulation of one’s offer is iteratively adjusted towards a balance between the product’s desirability, its feasibility to produce at a given price and scale, and its viability to sustain a venture financially. Focusing solely on gaining “product clarity” by identifying the problem the product solves for the user can be detrimental. The solution’s feasibility and viability similarly shape the product’s form. A real-life example makes this more tangible:

Eric Gu, an experienced entrepreneur and serial founder, was developing a headset for blind people (Arx Vision) that helps them perceive their surroundings through AI image recognition converted into audio descriptions. Great idea, right? After receiving significant pre-seed funding, partnering with Microsoft and producing the first batch, they faced a harsh reality: Blind people usually don’t have much money. Direct consumer sales never took off, and efforts to sell the headset via insurance and logistic companies also did not generate enough revenue. The company ceased operations in 2024 and must now destroy its dead stock. In a conversation, Eric explains that the product would have looked completely different if they had not assumed the user would pay for it.¹

Complementing the focus on solving a consumer problem, this chapter further develops the concept through a viability lens. Subsequently, the central question for this chapter is to find the smallest, viable version (MVP) of the DPP repository, a starting point for a new venture. To do so, the first step is to explore business models that can make this concept viable (7.1). Second, rapid experiments are conducted to select the most promising business model to proceed with (7.2). Third, a clickable prototype is developed (7.3) to test a subset of assumptions and evaluate the MVP (7.4). The section concludes with recommended future experiments to be conducted after the thesis, as part of the journey towards product clarity. Lastly, it reflects on the opportunities and risks to launch a startup in this domain (7.5).

¹ Eric Gu gave his explicit consent for this account to be shared in this thesis (personal communication, 05.02.2026). Thanks for impersonating the obsessive learning culture in the entrepreneurial field, Eric!

7.1 Business model mapping

Introduction

Inspired by Eric Gu's tangible learning, this chapter of the thesis begins by exploring the business models surrounding the DPP repository. To do so, a business model mapping workshop was conducted to explore minimum viable product (MVP) versions of the DPP repository. The section finishes with five prioritised MVP variants for testing in experiments.

Method

Two participants, alums of TU Delft, were invited to the business model mapping workshop. The participants were selected purposively with a mixed backgrounds in design, CE, and computer science. This mix aimed at creating a more diverse set of ideas. The co-creation session was designed to last about two hours. The workshop's agenda centred on two ideation activities following an introduction to DPPs and the revised concept of the DPP repository. (1) First, potential diverse partnerships and actors were brainstormed guided by the question: Which actors along the circular consumer journey could create or capture value of a consumer's DPP repository?

(2) Building on who may receive or bring value to the DPP repository, ideas about the specific business model relationships with actors were generated, prompting the question: How do actors exchange, create, or capture value? The findings were collected and mapped onto the circular consumer journey (see Figure 34).

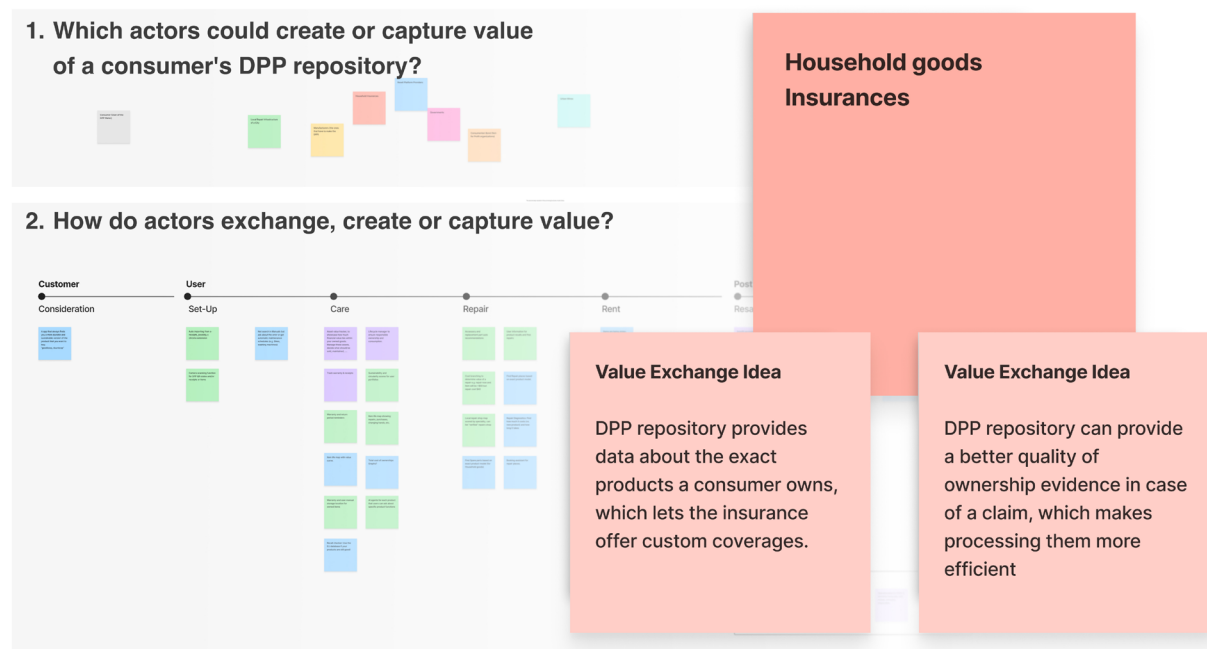


Figure 34: Business model mapping results with an example content

The five variants are described briefly in three sections: (1) the actor and the value proposition, (2) the value exchange mechanism, and (3) the riskiest assumption that the MVP relies on.

Results

The co-creation session produced five business model directions, each representing a variant of the consumer DPP repository. While carrying forth previous concepts like RepairMatch, new ideas surfaced to make the DPP repository viable. The mapping (see Figure 35) separates two model types: direct-to-consumer models (B2C) and platform models (e.g., B2B2C).

B2C models deliver value directly from the DPP repository, without requiring other actors to participate. Revenue is generated through subscription or a one-time payment. Platform models, in contrast, use the repository as a technological infrastructure that facilitates a value exchange between the consumer and a third-party actor. The platform acts as an intermediary that reduces transaction costs (Choudary et al., 2017). In domains that suffer from information asymmetry, such as the CE, this intermediary role is particularly relevant, as it enables information exchange (e.g., Blackburn et al., 2022; Boukhatmi & Van Opstal, 2025). A platform's revenue is typically generated through transaction fees or by monetising the value exchanged.

MVP variant 1: Product warranty and information organiser (B2C)

This MVP variant positions the repository as a personal documentation hub and stays the closest to the ProductWallet concept, which showed significant problem recognition during the consumer test. The service user scans product DPPs to centralise warranties, manuals, and receipts in one place and receives proactive reminders before warranty periods expire.

For this service, no external actor is required, the value is delivered directly to the consumer.

This MVP assumes that consumers not only recognise the missed warranty periods and lost product documentation as pain but also experience it as urgent and frequent enough to adopt and pay for a dedicated solution.

MVP variant 2: Product Value Tracker (B2C)

An alternative B2C MVP variant of the DPP repository uses product data to estimate the residual value of owned products over time. The consumer gains clarity on whether selling, repairing, or replacing a product is the most economical decision. This service aims to motivate value-retaining activities and help consumers optimise the resale moment.

Like the warranty organiser, monetisation relies on the consumer's willingness to pay directly, either through a subscription or a one-time payment.

The critical assumption of this MVP is that consumers perceive the unknown value of their general belongings as a problem they would actively seek to solve and be willing to pay for.

MVP variant 3: Local Repair Shop Platform (B2B2C)

In this MVP version, the repository connects consumers with local repair shops, previously referred to as RepairMatch. The value exchange is two-sided. The consumer benefits from reduced search effort, upfront pricing, and time estimates tailored to their specific product. Repair shops gain a new customer-acquisition channel and access to pre-diagnostic product data, model, age, and repair history, which enables them to prepare more efficiently.

The platform brokers the match between product need and repair capability. The platform could monetise through a commission on bookings made through the platform or a listing fee charged to repair shops for visibility.

This MVP assumes that both sides experience friction that a digital platform can resolve and monetise effectively.

MVP variant 4: Custom Household Insurances & Easy Claims (B2B2C)

This MVP version leverages the repository as a verified product inventory, connecting consumers to insurance providers. Consumers save their proofs of purchase in the repository, making it easier to file a claim without having to search for scattered receipts or photos. This eases the review process for insurers, resulting in faster settlements and cost savings. Beyond claims, insurers gain access to verified household data, enabling more accurate risk assessment and personalised coverage. The consumer, in turn, benefits from cheaper insurance without being underinsured.

Revenue would flow from insurers paying a referral or integration fee for access to verified household inventories, or through a revenue-share on policies sold via the platform.

An assumption of this MVP is that incomplete household insurance claims represent a pain for insurers and/or that personalised coverage translates into tangible savings that attract consumers.

MVP variant 5: Product Information Marketplace (B2B2C)

This MVP version creates an information marketplace between consumers and brands. The DPP repository stores all relevant product information centrally and makes it accessible to consumers. The consumer can then decide to use it as a key to the information marketplace and connect to brands. In exchange for sharing anonymised lifecycle data, the consumer receives brand rewards such as discounts, extended warranties, or post-purchase services. For brands, the platform provides structured insights into their consumer segment, product longevity, and failure patterns, as well as a direct, live channel to consumers.

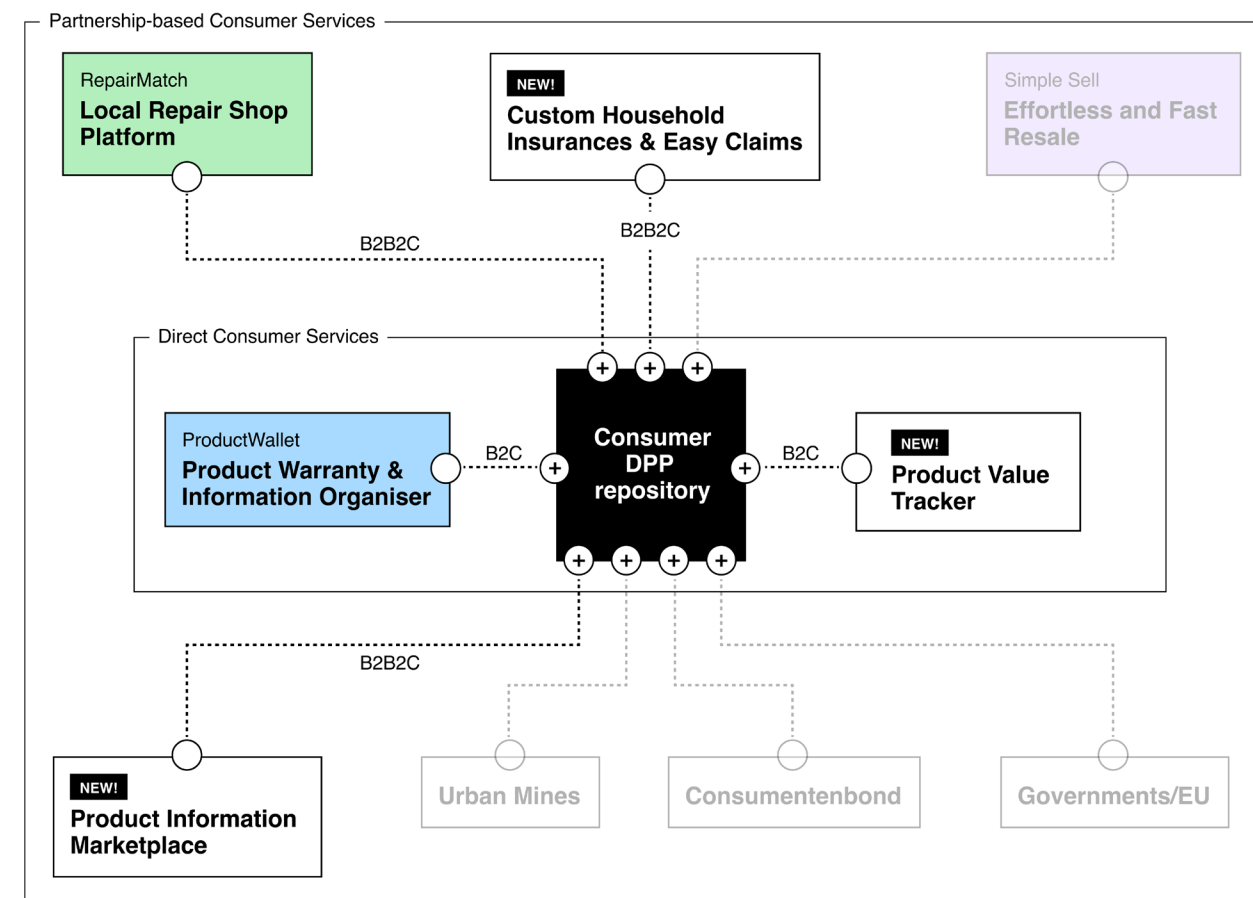


Figure 35: Results from the business model mapping workshop

Brands would pay for access to aggregated consumer insights and for the ability to reach their consumer base through the platform.

The critical assumption is that this data-sharing value exchange can generate sufficient revenue from brands to sustain the platform.

Deprioritised MVP variants

The workshop also discussed directions involving urban mining companies, public bodies, not-for-profit consumer organisations, and resale platforms. These were deprioritised for practical reasons. Urban mining is a nascent industry with few established actors to partner with or test against. Government and public body models involve long procurement cycles and institutional decision-making outside the thesis's scope and timeline. The not-for-profit direction implies a different organisational model with limited revenue potential, making it less suited for the entrepreneurial lens. Resale platform integration, while high-value, requires API access and partnership agreements that present significant entry barriers for early-stage ventures. It remains promising once the repository has an established user base.

Conclusion

This chapter opens the response to DQ1.5 by mapping the business model landscape around the DPP repository. The five prioritised variants, spanning direct-to-consumer models and platform models, each rely on different assumptions about who pays, who benefits, and what value exchange sustains the platform. By focusing on the riskiest assumption per variant, the mapping provides a structured basis for the rapid experiments that follow. Through testing these assumptions it is determined which MVP direction is pivoted or persevered.

7.2 MVP selection experiments**Introduction**

The objective of this chapter is to explore which of the mapped business models around the consumer DPP repository warrants further concept development. To identify early market signals, lightweight experiments are conducted. The experiments demonstrate that basing the solution solely on the consumer problem does not, by itself, create a viable business case that would allow the solution to exist at scale. This chapter concludes with one selected business model that offers the biggest potential for an MVP given the current DPP deployment timeline.

Method

Acknowledging the switch to a more entrepreneurial mindset in this part of the thesis, the experimentation process was deliberately exploratory rather than exhaustive. Each experiment informed the direction of the next probe, and learning from one often reframed the assumptions tested in the next. This non-linear, signal-guided process mirrors how early-stage ventures navigate uncertainty through the lean startup method: by learning from experiments, following emerging signals, and pivoting or preserving a direction (Ries, 2011).

Each business model experiment was designed to test the riskiest assumption. Depending on the business model and assumptions, different experimental techniques were deployed (e.g., Stakeholder conversations, search term trend analysis, market research, field studies). Within time constraints, experiments were designed to last no longer than two days. Each experiment was summarised in three main sections: Riskiest assumption, experiment description, and learnings.

Member checking regarding the experimentation process was done with an experienced entrepreneur and part-time lecturer from TU Delft. This led to the addition of a fourth section: the MVP potential. Within that section, the ESPR legislative timeline and previous research results were synthesised to provide a final rationale for whether to pivot or persevere the MVP variant.

Results**Experiment 1: Product warranty and information organiser****Riskiest assumption**

Consumers experience missing warranty periods and losing product documentation as urgent enough pain to switch to a paid solution over their current makeshift workarounds.

Experiment description

The experiment consisted of two steps. First, a market search was conducted to identify similar services that already address the consumer problem. Google was used with the terms “Warranty tracker app” and “Product information hub” to surface relevant similar services. Adjacent domains were explored using the term “Household inventory”. Eight similar solutions were reviewed regarding their core value proposition, market adoption signals and their business model (see

Appendix 10.12). Secondly, a search term volume analysis was performed. To do so, Google Trends was used to compare the relative search volumes for the terms “Home Inventory”, “Warranty Tracker”, and “Warranty Check”. The search term volume analysis was performed in January 2026.

Learnings

The competitive landscape of warranty-tracking and home-inventory apps reveals a fragmented market in which few consumer-facing services show signs of significant adoption. Apps like Everspruce (Apple app store: 4.7-star rating, 477 comments, +4 years old) and Warranty Keeper (Apple app store: 4.4-star rating, 15 comments, +4 years old) appear to have reached a niche group. Those users value the peace of mind of having product information centralised and tracked. Yet a barrier to greater market adoption appears to be manual data entry. This is exemplified by an Everspruce user reporting that they spend entire weekends cataloguing their belongings (see Figure 36).

Lost all my inventory and hours of work



@ by [@justuseapp](#)

When I first got Everspruce it was free. I went to town cataloging my inventory for a specific project—something that took a few weekends to do. (It's a thorough, very time-consuming process, but it was well worth it to me at the time, as I saw it as a long-term investment.) It's not something I accessed a lot after that, but when I needed it, it was super handy. *(Note: This is a blurred screenshot of a user comment.)*

Figure 36: Everspruce user comment (JustUseApp, 2025)

Interestingly, a Google Trends analysis showed that search interest for “home inventory” and “warranty tracker” has been steadily rising since late 2024 (see Figure 37). Despite fluctuations, the term “warranty check”, which refers to periodic verification of remaining warranties, has consistently ranked as the most searched term over the past five years. This suggests warranties are periodically checked rather than continuously tracked.

MVP potential

The experiment signals that while the pain of lost receipts and forgotten warranties is real, it may not be urgent enough for consumers to adopt and pay for a dedicated solution. This is evidenced by the consistently low traction of existing apps despite years on the market. A possible explanation is a timing mismatch: the moment a consumer must invest the effort of manually adding a product, likely after purchase, is when the reward, e.g., a repair claim, feels distant and abstract. An MVP of a DPP repository that tracks warranties and organises product documentation would face this same onboarding barrier given the current DPP deployment timeline.

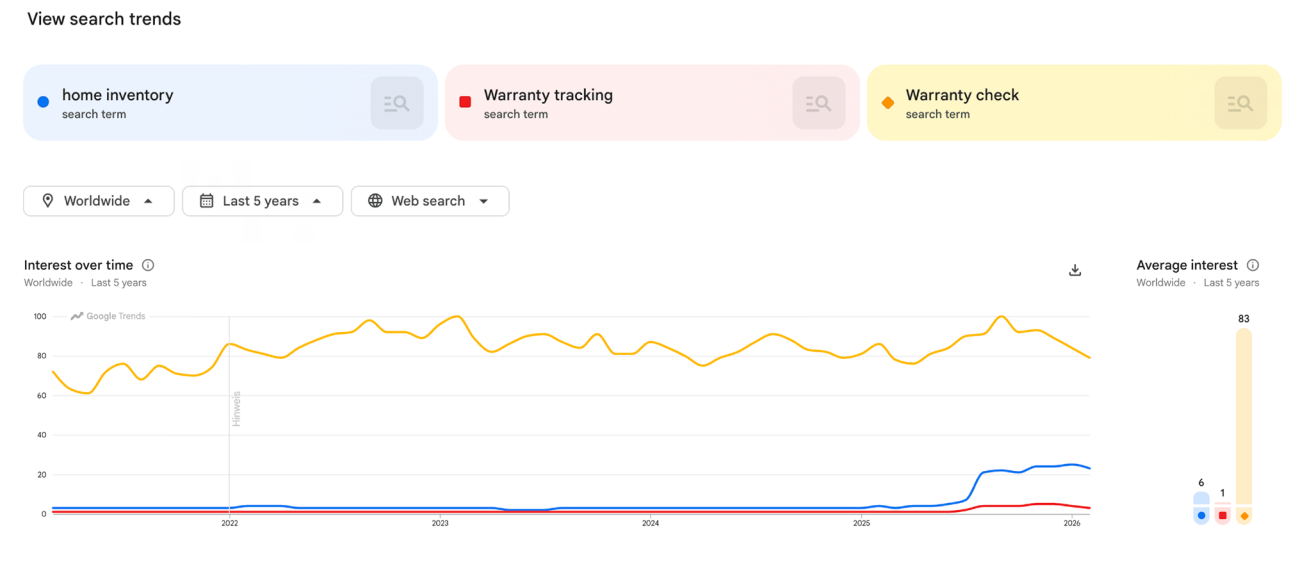


Figure 37: Search volume trend analysis performed in January 2026

Without automatic, effortless product registration through DPP scanning, a standalone warranty and information inventory MVP would simply replicate the adoption challenges already visible in the market.

Experiment 2: Product Value Tracker

Riskiest assumption

Knowing the residual value of owned products creates sufficient consumer value to sustain a standalone service.

Experiment description

The experiment was set up in two phases: first, market research was conducted to explore similar solutions. To do so, Google was chosen as the search engine using the terms “Product value tracking” and “Resale value calculator”. Similar services were selected for review if they fell into the durable product category and involved the private consumer. Four services were analysed regarding their value proposition, market adoption signals and business model (see Appendix 10.13). Secondly, together with two participants from the business model mapping workshop, a self-study of the participants’ own belongings was conducted. The task was to create a list of owned products, estimate the current market value of each, and research its resale value. After that, the participants were asked to reflect on the insights gained during the tasks.

Learnings

While showing greater market adoption than the warranty-tracking apps, the analysed services revealed a product-category pattern. Either the services target products of high monetary value (e.g., entrupey.com for luxury item authentication, StockX.com for sneakers) or for products that have a special collector value (e.g., discogs.com for vinyl collectors, brickeconomy.com for Lego). All services

have in common that the product value is embedded as the primary driver of engagement in selling a product or investing in a new one (see Figure 38).

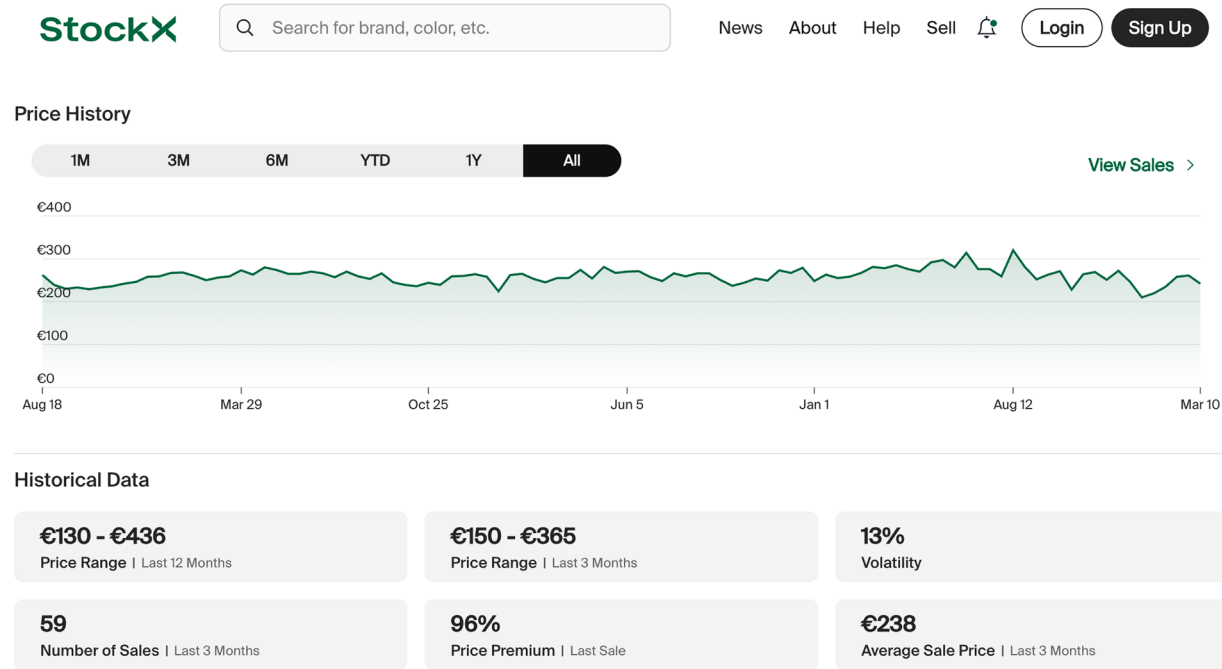


Figure 38: Example tracking of sneaker prices on StockX (2026)

The self-study of belongings (see example in Figure 39) revealed interesting insights into understanding the value of owned products. More than once, participants noted the uncertainty in estimating the current value. Remembering the original price and applying the depreciation over time and current condition felt more like guesswork than an informed estimate. In academia, the phenomenon of writing off the value of products is called mental book value (Westervarder, 2025). This effect repeatedly led to underestimating the value of items and to a positive surprise after researching their resale value (see the example of retro race bike in Figure 38). Nevertheless, participants reported that the time required and the uncertainty involved in the documentation process were discouraging. Especially for items with a lower resale value (5-20€), participants stopped listing them. In hindsight of the study, a positive feeling remained, driven by the resulting overview, the reassurance of prior investments, and the surprising overall value. In that line, one participant noted that knowing the value of a product makes them more motivated to resell it.

MVP potential

While the experiment indicates that knowing a product’s current value can nudge or motivate consumers towards reselling, the viability signals are weak for a B2C MVP for general products. The market research shows that value-tracking services mainly sustain themselves in high-value or collector niches. In these categories consumers are motivated enough to track value independently. For everyday durable products, the effort-to-reward ratio discourages engagement.

ID	Product	Category	Self- Estimated Value	Researched Value
35				
36				
37				
38				
39				
40				
41				
42	Retro Race bike 2	Sport Equipment	200	300
43				
44				
45				
46				
47				
		Sum		

Figure 39: Self-study of owned products (exact values anonymised for privacy reasons)

This means the core value proposition, tracking what you own and what it’s worth, appeals most to consumers who can afford high-value products. Additionally, as an MVP for the DPP repository it faces the same cold-start problem as the warranty tracker. Without a critical mass of DPP-equipped products in consumers’ homes, the effort to add products manually remains too high, making it premature as an MVP today.

Experiment 3: Local Repair Shop Platform

Riskiest assumption

Both consumers and local repair shops experience friction in the repair process that can be resolved through a digital intermediary platform.

Experiment description

The experiment conducted a one-day field study. To do so, the textile product category was chosen as focus as it remains earliest on the DPP legislative timeline and offers accessible repair shops. The field study was performed in two stages: (1) Consumers were asked whether they had clothes to repair. If yes, they were asked what hinders them from bringing them to a repair shop. (2) Second, it involved on-site visits to various local sewing and tailor shops, to inquire and observe daily operations, pricing structures, and communication styles. Findings were documented in field notes (see Appendix 10.14).

Learnings

A recurring theme across the shops was a complete reliance on analogue systems. Owners used physical lists, pegboards for organisation, or had no formal price list at all. Some shop owners struggle to provide quotes upfront. They sometimes need to inspect the garment in person before committing to a price, as the complexity of a repair is hard to judge without seeing it. However, the lack of standardised digital pricing makes it hard for consumers to judge

whether a repair is worth it. Although prices differ per case, most repairs cost around 8-40€.

The visited shops were usually run by one or two employees. While owners report that demand changes seasonally, most do not have difficulty organising their work or keeping track of their tasks. In addition, multiple shops reported that finding well-educated employees is a problem, making it harder to scale.

For consumers, convenience is a top priority. What kept most of the interviewed consumers from repairing was the simple act of finding time to go to a repair shop. Some consumers even collected broken pieces over time, planning to take them to a repair all together one day. Moreover, the unclear timing and price are discouraging repair efforts.

MVP potential

The experiment revealed little potential for a repair platform MVP in the textile category. The main consumer problem, having to physically visit a shop, is a logistics problem. Meanwhile, the supply side operates effectively with analogue systems and faces no urgent digitisation need. A platform connecting consumers to shops, therefore, solves neither the consumer's convenience pain nor a meaningful shop-side problem. Instead, to address the convenience pain it requires hands-on logistics infrastructure while operating at a low price point per repair. This leaves little margin for an intermediary platform to sustain itself. Without a clear value proposition for either side that can be delivered digitally and at scale, this direction shows few signs of a viable MVP.

Experiment 4: Custom Household Insurances & Easy Claims

Riskiest assumption

Incomplete household claims are costly and painful for both insurers and consumers, and product-level coverage can offer consumers lower monthly fees.

Experiment description

To receive signals from both sides, consumers and insurance, two actions were performed in the process of this experiment. (1) Consumers were consulted via a public forum about how they ensure they can provide evidence during an insurance claim of what has been damaged or lost. (2) Secondly, one household insurance expert was consulted in a direct conversation. The conversation was structured around a guide (see Appendix 10.15) that first inquired about the pain of incomplete claims and then about the potential for customised cheaper insurance coverages.

Learnings

The expert interview made clear that it is the consumer's duty to provide evidence to the insurance in case of a claim. This evidence can be in the form of a proof of purchase, product pictures, manuals, or certificates. When customers can't provide proof of purchase or product details during a claim, insurers often must judge on a case-by-case basis whether there is sufficient evidence for a

particular reimbursement. The forum responses illustrate that some consumers worry about incomplete claims enough to build their own workarounds - spreadsheets with purchase dates and prices, scanned receipts in the cloud, or even handwritten notebooks inherited (see reddit post answer below).

"[...] I have a list of all my 'expensive items' with the purchase date, price, where bought, etc. It's a Google Drive Excel file. I keep my receipts scanned in the cloud. The list mainly consists of electronics, white goods and furniture, but also things like a more expensive bag or suitcase.[...]"

My mum used to have a notebook where she wrote down everything expensive they bought, so that's why I started the Excel file in the first place.

I don't really take photos or anything, though I do have some photos inside my flat. In my previous job, I worked in travel insurance claims for a while, so I do take photos of my suitcase before I close [...], because once that thing's gone, you really can't remember what was in it." - tea_lover_8 (2026), translated from dutch

In contrast, the conversations with insurance experts explain that incomplete claims are not really a problem they face. For water or fire damages, consumers can still provide some evidence, only for theft this becomes a bigger problem. But even then, while it can cause the insurer more work to process a claim, missing evidence is not a problem of the insurance company as they can opt to simply reimburse less (see Appendix 10.16).

Further, most households are not insured on a product basis but employ a standard factor based on the location and the number of square metres of their residence. For a normal household in an 80 square metre flat, an insurance fee usually does not exceed 20€ per month. With that, normal households are often slightly overinsured. Therefore, an individual insurance policy, based on a product inventory, would probably only yield a marginal discount for the general consumer, not justifying the effort of creating an inventory of the entire household. Custom insurances are mainly relevant if the household contains high-value products (e.g., furniture or jewellery).

MVP Potential

The insurance experiment invalidates the B2B side of the riskiest assumption. Insurers do not experience incomplete claims as a significant operational pain. On the contrary, better-documented consumers might actually cost them more. Additionally, household insurance fees are already low leaving negligible room for personalised pricing to create a meaningful discount for consumers. The problem lies entirely on the consumer side: they bear the risk of under-reimbursement. While the forum responses indicate that this pain exists, a pivot to a pure B2C model means the product must generate consumer willingness to pay on its own. To do so, the value driver would be ease of use through DPP integration, something that cannot yet be realised. Without the DPP, the product competes directly with existing makeshift solutions and digital inventory tools without offering sufficient additional value to justify switching and paying.

Experiment 5: Product Information Marketplace

Riskiest assumption

Consumers sharing product lifecycle data in return for rewards and access to services represents a viable revenue model.

Experiment description

To iterate search terms that describe adjacent services, generative AI (Claude. ai) was used. To do so, Claude’s Opus 4.6 model was chosen for its capability of deep reasoning and context awareness. A project folder within Claude included previous conversations and provided context for the concept of the information marketplace and lifecycle platform.

As output, the search terms “Brand loyalty app”, “Consumer discount platforms”, “Brand post-purchase app” and “Consumer data sharing platforms” were suggested. To get more targeted results these search terms were combined with product category search terms like “bike”, “electronics”, “food”, or “fashion”. Also services previously known to the author were considered. Ultimately, five services were reviewed regarding their core value proposition, market adoption signals and their business model (see Appendix 10.17).

Learnings

The market research identified several services where consumers willingly share data or engage with brands in exchange for tangible value. For instance, UniDays demonstrates that students are willing verify their student status and share personal data when rewarded with exclusive discounts. Loyalty apps similarly incentivise post-purchase engagement through gamification and vouchers, aiming to increase customer lifetime value (e.g., DB Bahn Bonus). NeoTaste pairs

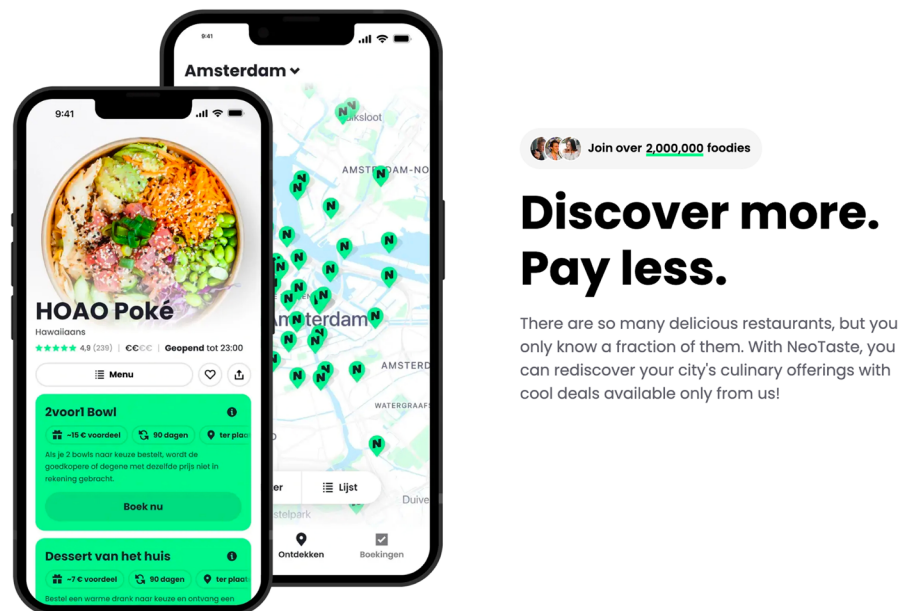


Figure 40: NeoTaste app and user value proposition (NeoTaste, 2026)

restaurant discounts with the discovery of new restaurants, adding an experience layer that justifies a consumer subscription (see Figure 40).

Another example is DB Rad+ (see Figure 41). The app engages cyclists to track their route through cities in exchange for rewards (e.g., a coffee or pastry). The data is used by another stakeholder to improve the city’s bike infrastructure.

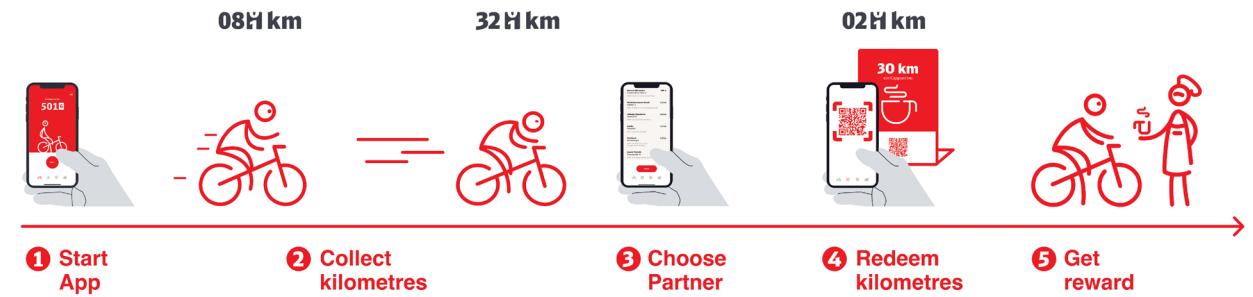


Figure 41: Example information sharing App - DB Rad+ (translated, accessed on Stadt Regensburg (2026))

MVP potential

The experiment validates a critical assumption for the information marketplace concept: consumers engage with a platform and share data if the value exchange is immediate and tangible. Unlike the warranty-tracking apps that struggle to incentivise their users’ efforts, these services succeed because they offer continuous discounts, discovery, guidance, or gamified rewards. A DPP repository that positions itself as the consumer’s link to brand-specific benefits, repair support, and resale opportunities could replicate this model. This reframes the concept from a passive storage tool into an active value-exchange platform, with a revenue model that mirrors the proven UniDays and loyalty-app economics.

Reflecting on the previous research, this concept has the potential to also address an emerging brand-side pain. Manufacturers are being mandated as responsible economic operator to invest in DPPs. For them, a tension actively debated at industry conferences, is the lacking return on investment (see Appendix 10.1). Low consumer scan rates of early DPPs (see expert interviews in 4.2) underline that the few promised returns, such as direct consumer engagement, new upselling channels, and insights into product failure patterns, none are realised if the consumer does not engage with the DPP. DPP experts reinforce this direction, explaining that the current challenge is to realise enough value for manufacturers to create DPPs in the first place (see expert interviews in 4.2). Since consumer data is not shared with the brand via the DPP itself (European Commission, 2024b), the DPP repository effectively establishes an information marketplace that promises to increase the DPP value for manufacturers through a clearer path for return on investment.

Conclusion

The experiments advance DQ1.5 by systematically narrowing the business model landscape from five directions to one. Four variants were pivoted: the warranty organiser and value tracker face onboarding barriers that cannot be overcome without widespread DPP deployment; the repair shop platform addresses a logistics problem rather than an information problem; and the insurance platform was invalidated on the B2B side. The consumer-brand information marketplace was selected to persevere: analogue services validate that consumers engage when the value exchange is immediate and tangible, and the direction addresses an emerging brand-side pain of low DPP return on investment (see Table 3).

The consumer willingness to exchange data for tangible rewards, combined with signs of a brand-side pain of low DPP engagement, supplies enough signals to advance this direction. However, simply looking at analogue services does not answer the question whether the above-mentioned problem is actually a pain for them nor if early DPP pioneering brands would partner with a platform to solve it. To tackle this question, the fifth experiment continues with the development of a clickable prototype, which is validated with three early DPP brands.

Limitations

The MVP selection process prioritised speed and signal detection. Not all business models received equally thorough experimentation, and the sequence in which experiments were conducted influenced which directions were pursued or abandoned. A more systematic approach, such as testing all models against identical criteria, could have surfaced opportunities that the intuitive process overlooked. However, given the thesis's time constraints and the entrepreneurial framing, this trade-off acknowledges the inherent uncertainty of the entrepreneurial process. The goal was not to produce a definitive ranking but to identify one direction with sufficient market signals to reason further MVP development.

Table 3: Summary of MVP selection experiments

DPP repository variant	Value proposition	Riskiest assumption	Experimentation method	MVP decision
Warranty & Product Information Organiser	One place for all your product warranties, manuals, and receipts - never miss a period or lose a document again.	Consumers perceive missed warranty periods and lost product information as urgent enough pain to adopt and pay for a dedicated solution.	Market research, Google Trends search term volume analysis	Pivot
Product Value Tracker	See what your products are worth today - know when it's worth to sell, repair, or replace.	The unknown value of a product or a household is a problem that consumers seek to solve.	Market research, self-study of belongings with workshop participants	Pivot
Local Repair Shop Platform	Instantly find a nearby repair shop that can fix your product - with upfront pricing and time.	Both consumers and repair shops experience a pain that a digital platform can solve.	Consumer interviews, on-site visits to local sewing/tailor shops	Pivot
Custom Household Insurances & Easy Claims	A verified inventory of your household that simplifies insurance claims and unlocks personalised coverage.	Incomplete household claims are a costly pain for insurers, and individual coverage maker cheaper fees.	Forum research, Call with insurance professional	Pivot
Product Information Marketplace	Register your products and share lifecycle data, for free brand rewards and effortless post-purchase services.	A data-sharing value exchange between consumers and brands can sustain a viable B2B revenue model.	Market research of analogous services (loyalty apps, discount platforms, brand post-purchase apps)	Persevere

7.3 MVP development

Introduction

The signals received from analogous services indicate that an information marketplace between consumers and brands could adopt scalable value-creation mechanisms. Still, several assumptions remain about this two-sided market concept. This chapter focuses on two of them:

A1: A DPP repository can be designed as an information marketplace between brand and consumer.

A2: The information marketplace and its data can solve a current pain for brands.

Below, the development process is laid out, and the MVP concept is described. The presented prototype is the revised version based on five user tests. Therefore, it embodies the first assumption. This chapter concludes with a walkthrough of the clickable prototype. The second assumption is answered in the chapter 7.5.

Method

In Lean Startup tradition (Ries, 2011) a solution is built, tested and insights gathered to pivot or persevere with the concept. While the focus lies on the consumer-side of the platform, a lightweight mock-up of the brand-side interface was sketched to complement the two-sided market concept.

The process for designing and building the consumer-side prototype of the app followed several steps (see Figure 42) adapted from the digital service design process (Stickdorn et al., 2018). (1) Using the circular consumer journey, the touchpoints of the concept with the consumer were identified. This aimed to iterate on features and UI elements that solve uncovered pains as part of the consumer-side of the DPP repository concept. (2) Benchmarking user flows and UI elements of adjacent app concepts uncovered interaction patterns that can be adopted and therefore feel familiar to the user. (3) Building on the user journey and benchmarking, key interfaces were sketched on paper and converted into a low-fidelity wireframes. This low-fidelity prototype was filled with mock-content of three products. (4) To validate the first assumption, whether an information marketplace can be designed that connects consumer and brand after purchase, the prototype was tested with five participants. All tests followed the same semi-structured interview guide (see Appendix 10.18). The insights were clustered into two themes. One theme included unclarities and doubts about the concept's proposition, and the other summarised usability improvements (see Appendix 10.19). (5) Based on the interviews the consumer app concept was refined and the user interface improved. The resulting mid-fidelity prototype is tested with brands to validate the second assumption.

For the brand dashboard, a similar, but shorter process was employed. One screen was created in the form of a low-fidelity prototype. To do so, first key interaction patterns were benchmarked from similar SaaS dashboards which informed the wireframe of a dashboard UI. The wireframe was filled with mock analytical data prompt a discussion about which metrics the dashboard should ideally include for a specific brand.

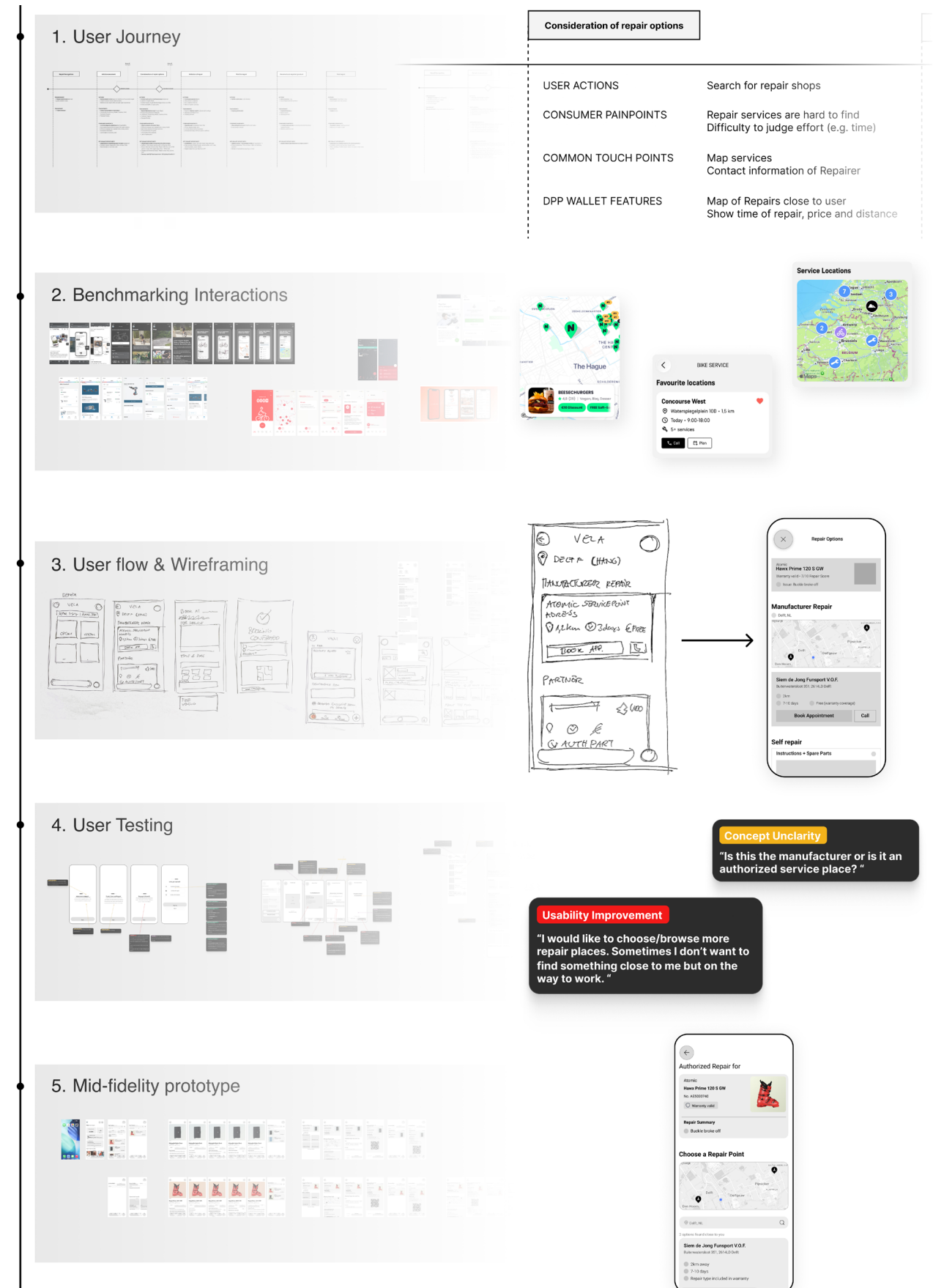


Figure 42: MVP development process of the consumer app exemplified with a brand repair service feature



Figure 43: Keep It app - Example advertisement campaign highlighting three different app features

Results

Meet Keep It.

Keep It helps you to get more out of what you own: one place for all your product info, warranty reminders, and instant access to brand services and rewards.

Concept Description

Keep It is a two-sided platform concept that uses DPPs to create a persistent connection between consumers and the brands whose products they own (see Figure 44). On the consumer side, it takes the form of a mobile app to administer owned products (see Figure 43). Users can store product information, look up and track warranties and receipts and access care, repair, and resale services from brands. To unlock all features of the app, consumers agree to share data with the respective brand. That makes Keep It free for them. On the brand side, it provides a dashboard that enables manufacturers to access aggregated product lifecycle data, reach their consumers directly after sales, and offer circular services such as repair, take-back, and recommerce. To use Keep It, brands pay a fee that sustains the platform.

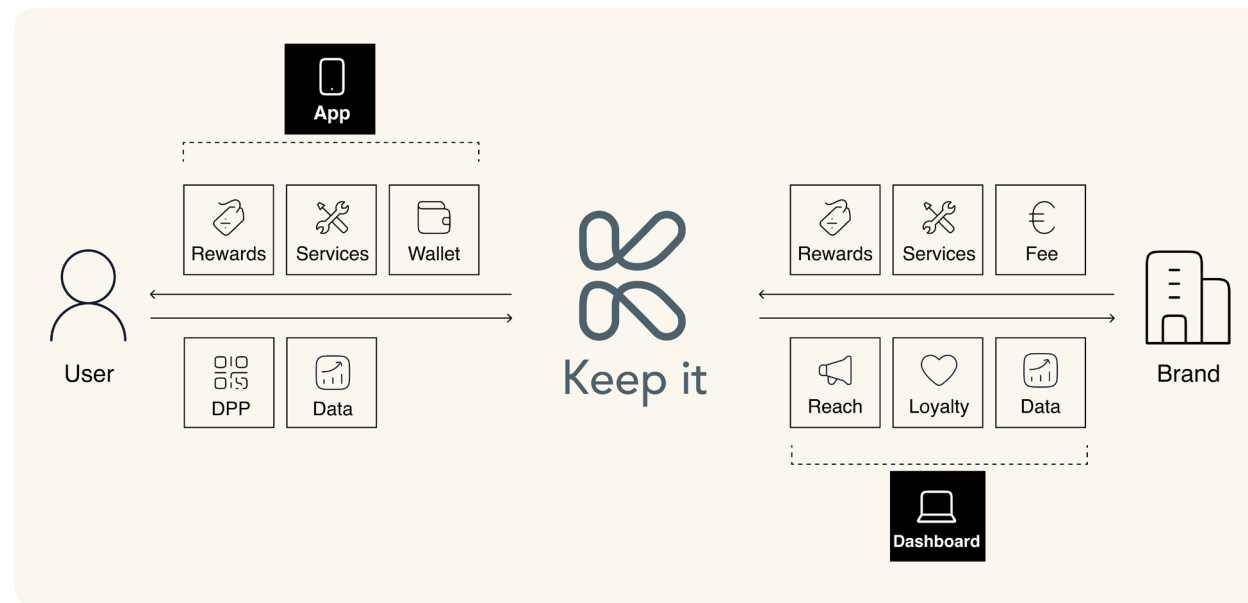


Figure 44: Keep It - Value exchange mechanisms

For users, Keep It centralises all product information in a single, cross-brand repository. Rather than scanning a DPP each time a user needs a manual, wants to check a warranty, or considers a repair, the DPP is scanned once and stored in their Keep It app. From that, the DPP data can be augmented to the specific user context. The platform can surface warranty expiration reminders, connect the consumer to nearby brand repair services with transparent cost and time estimates, and facilitate take-back or resale when the consumer is ready to part with a product. Product information is stored safely, accessible and actionable at the right moment. As a result, Keep It positions itself in the use and post-use phase of the circular consumer journey (see Figure 45).

On the brand side, Keep It responds to an emerging pain that early DPP adopters may already experience. Manufacturers are investing in creating DPPs to comply with the EU's ESPR legislation, yet without a clear return on that investment.

Keep It offers these brands a solution by turning the DPP from a compliance cost into a persistent post-purchase touchpoint. Through the brand dashboard, manufacturers gain access to aggregated and pseudonymised lifecycle data. More importantly, the platform gives brands a direct, low-effort channel to reach consumers with circular service offers without needing to build and maintain their own consumer-facing app.

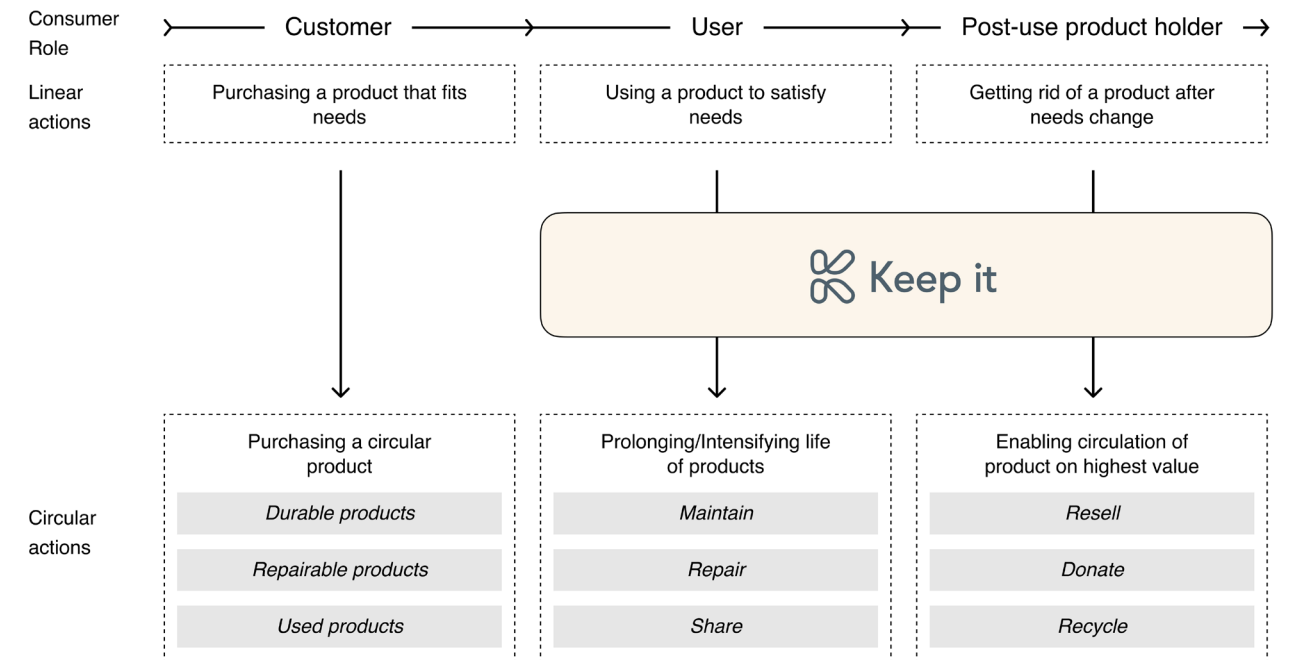


Figure 45: Keep It placed on the circular consumer journey

Three layers of value exchange

Analogue services such as loyalty apps, discount platforms, and data-sharing models (e.g., UniDays, DB Rad+) demonstrate that consumer engagement can work when they receive continuous rewards, services, or guidance in return. Keep It applies this logic to the DPP context. The platform establishes an information marketplace where the consumer's product data becomes the currency of the value exchange. Users retain sovereignty over their data and choose to share or not.

This information marketplace is structured across three layers of value exchange that build on each other (see Figure 46).

The first, most basic layer enables scanning and storing a product's DPP. The consumer gains easy access and findability of warranties, manuals, and product details without the risk of losing that information. This level requires no data sharing and ensures that every user can simply save DPPs in their Keep It wallet.

On the second layer, the consumer can choose to connect a product to its brand. That way they unlock brand-specific services and registration rewards. In return, the brand may provide setup guidance or care tips, authorised repair booking,

spare part ordering, and take-back programs. What specifically is offered to the consumer is in the brand's hands and varies by product and pre-existing service offer. At this level, the brand receives product lifecycle data and therefore gets valuable insights into how long a product has been in use, whether it has been repaired, and under what conditions.

On the third layer, consumers can opt in to share specific insights through surveys or take part in periodically launched campaigns. In exchange, the brand offers tangible rewards, for instance, discounts on future purchases, free service check-ups, or early access to new products. For the brand, this data feeds into product development, failure analysis, and circular strategy development. For the consumer, brand rewards provide a recurring reason to return to the app, as brands can push new offers, seasonal campaigns, or service reminders.

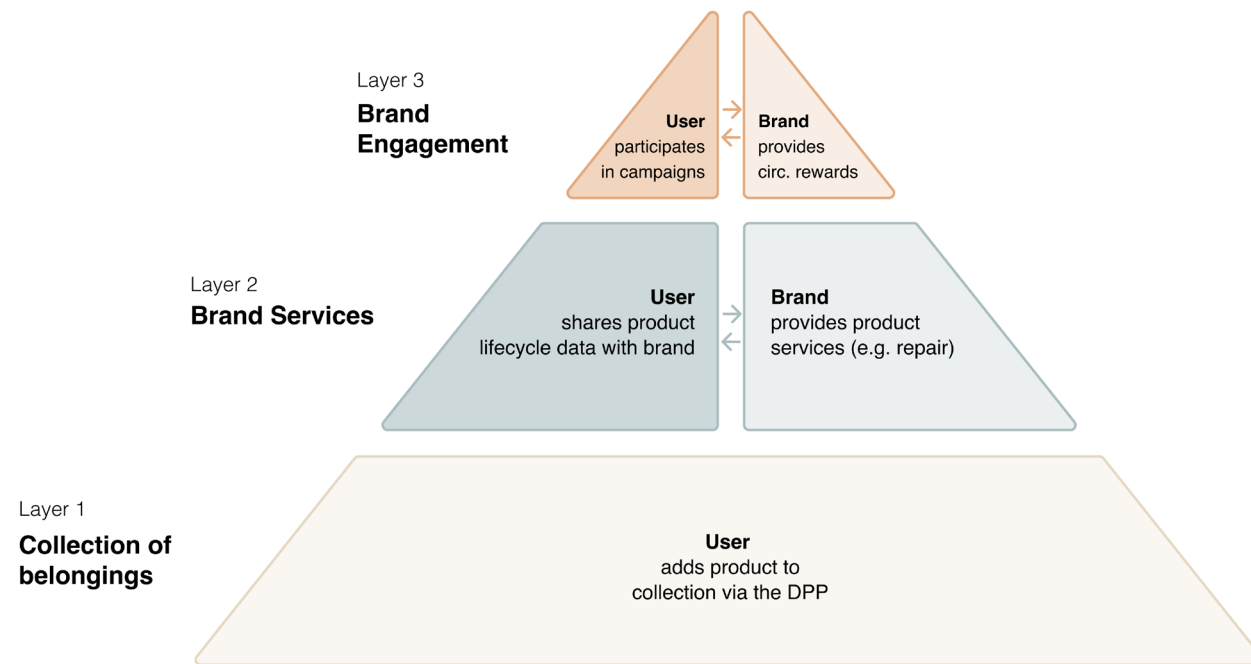


Figure 46: Three layers of value exchange

Consumer app walkthrough²

The following walkthrough demonstrates how the platform concept translates into a consumer-facing mobile application. The prototype uses public mock data from Atomic, Secrid and Studio Anneloes to illustrate the interactions. The brands were not involved in the development of the concept. However, all three brands were later reached out to, in order to validate the second assumption mentioned above.

²All brand content displayed in the prototype, including product names, imagery, and specifications, is sourced from publicly available marketing materials. This content remains the intellectual property of the respective brands (Atomic, Secrid, and Studio Anneloes) and is used solely for illustrative purposes within this research. Interface icons are sourced from Huge Icons under their free license.

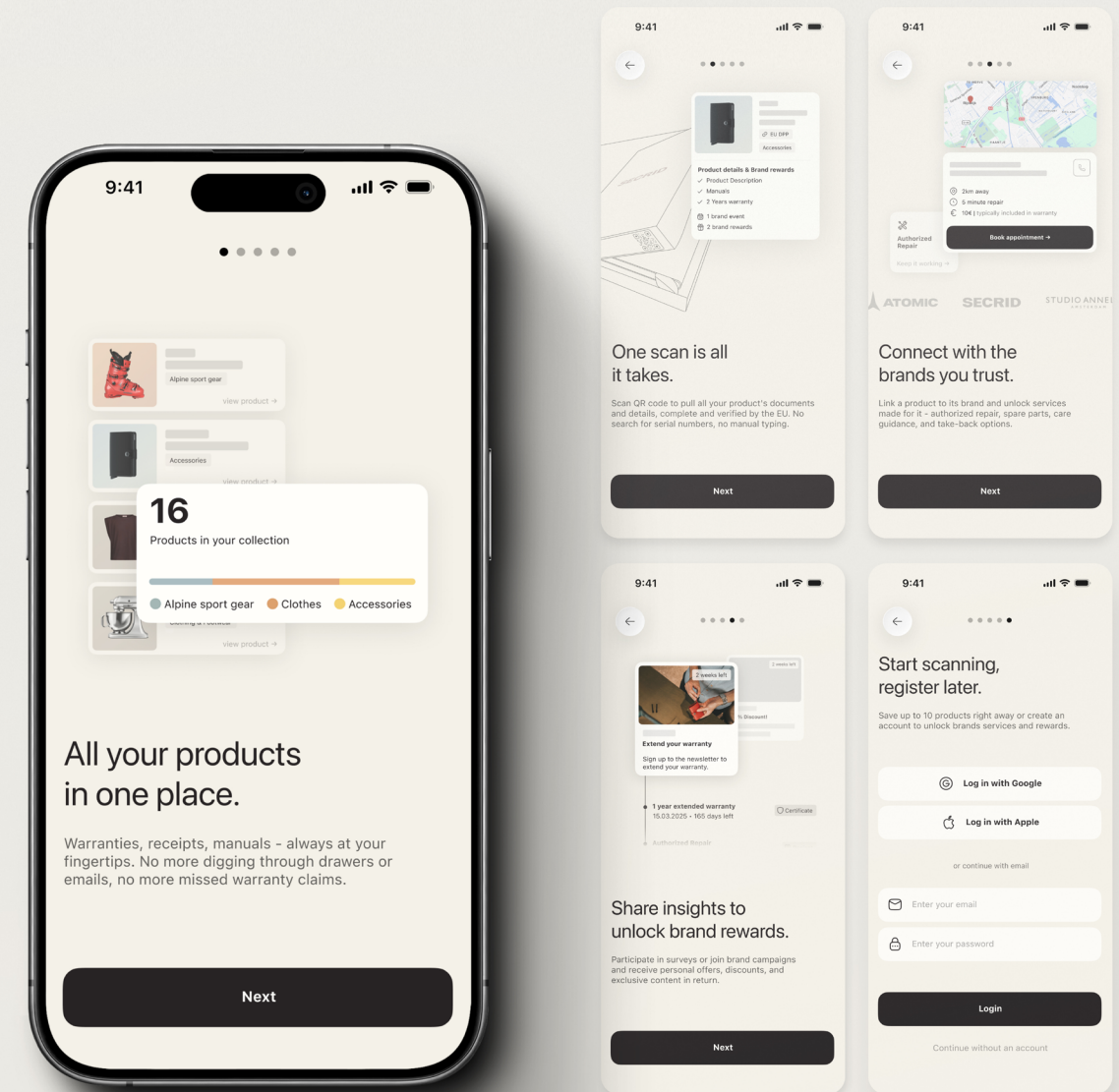


Figure 47: User onboarding flow

Onboarding the user

The onboarding flow introduces the user to core value proposition of Keep It and explains the main features (see Figure 47). It is designed to communicate three things: what the app does, how it works, and what the user can expect to gain.

After the onboarding, first-time users are asked to create a new or connect a to existing account for authentication. If a user only wants to store DPPs for personal administration, accessing manuals, checking warranties, or keeping product information organised, they can proceed without making an account for the first ten products. This reduces the activation cost and lets users first experience the repository's utility before fully committing. If a user wants to connect with brands to access services or rewards corresponding to layers 2 and 3 of the value exchange, an account must be created.

Home

The home screen serves as the consumer's ownership overview. Its primary function is to frame product ownership positively. Instead of treating it as a burden to manage, it aims to depict it as something users feel good about and are proud to take care of. At first glance, the UI surfaces three metrics: the total value of owned products, the number of completed circular actions (such as repairs or resale), and the total count of registered products organised by category (see Figure 48).

Each metric is designed with a specific intent. The total ownership value makes the financial dimension of belongings visible, which the value-tracking experiment showed to be a motivator for resale and care (see experiment 2 in chapter 7.2). The circular action streak reinforces positive behaviour by framing repairs, resales, or returns of products as accomplishments. The total product count with category breakdown provides an overview and a sense of control, contributing to the peace-of-mind value that resonated most strongly in the consumer interviews (see chapter 6.1)

A notification island on the dashboard can surface contextual information and personal insights: ownership milestones (such as a product anniversary), warranty expiration alerts, or status updates on ongoing repairs. These are designed as nudges to encourage users to return to the app.

Below these metrics, the dashboard provides access to open brand rewards and upcoming brand events in the user's area. This represents layer 3 of the value exchange and is designed to further drive returning engagement with the app.

The bottom navigation bar features buttons to "Home", "Products" and "Wallet". These are the core interfaces the user interacts with to use Keep It. Under "Products", the user finds a list of all added products. Under "Wallet", the user finds all saved service tickets or claimed and open reward vouchers. The "Add Product" button is visually separated from the other navigation items. In contrast to the other menu options, adding products is an essential action the entire platform depends on. Without products in the wallet, the user would not receive any services or rewards, and there would be no insights for brands. Therefore, giving this action a prominent place on the navigation bar ensures that this action is always quickly accessible.

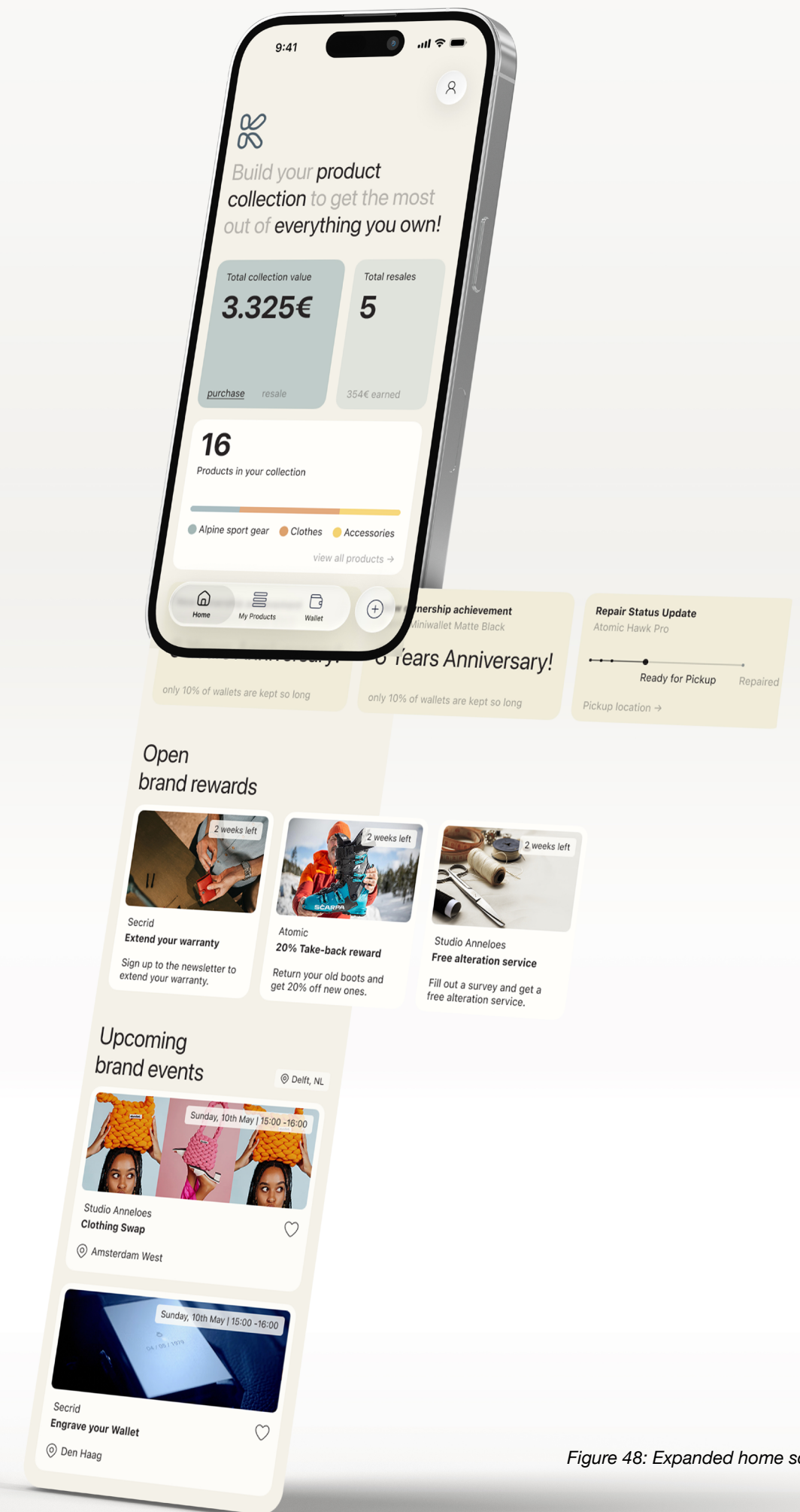


Figure 48: Expanded home screen



Figure 49: Scanning the QR code to add a product

Adding a product

The product registration flow is an essential interaction in Keep It. The flow is designed around showing rewards for user effort as early as possible (see Figure 49).

The process begins with scanning the product's QR code, which retrieves verified product information directly from the EU DPP registry (see EU DPP architecture in 4.1). For a product with missing or lost a QR code, a manual entry option is provided as a fallback. After scanning, the consumer is presented with a confirmation screen showing the retrieved product details. This screen also shows available brand rewards and events connected to the product, making the user feel they are getting something back in the moment of registering a product.

Optionally, the user can scan a purchase receipt to activate warranty tracking. This step is not required but enhances the app's utility by enabling expiration reminders and safely storing the proof of purchases, a pain point that the first concept test revealed (see chapter 6.1).

The final step of the registration flow asks the consumer whether they want to share product lifecycle data with the brand. This unlocks layer 2 of the value exchange. The interface transparently shows which brand-specific services become available, such as authorised repair, setup guidance, or take-back programs. However, Keep It remains its basic functions also without sharing data. This opt-in design respects data sovereignty while making the benefits of sharing immediately visible.

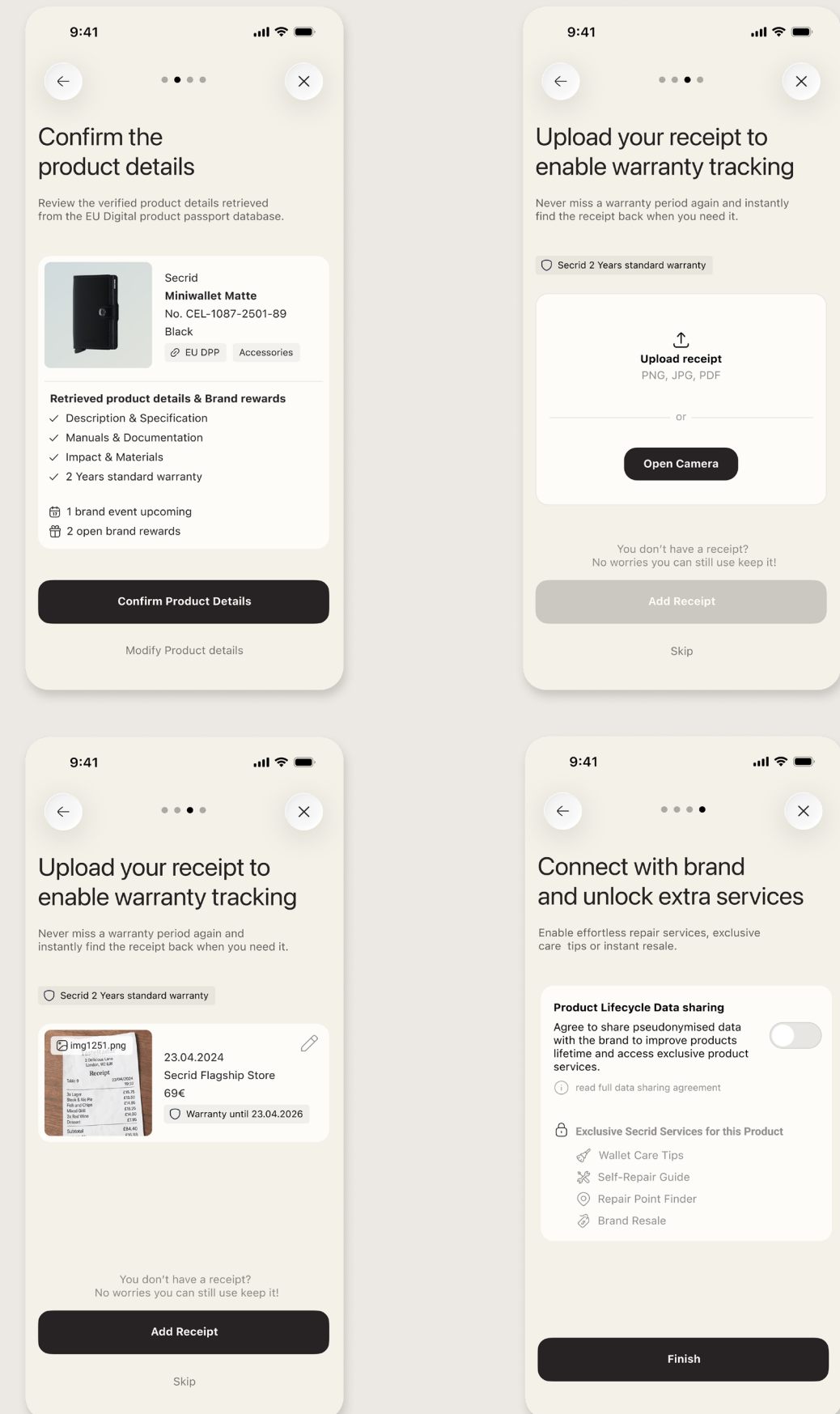


Figure 50: Adding a product to the collection - example of a Secrid wallet

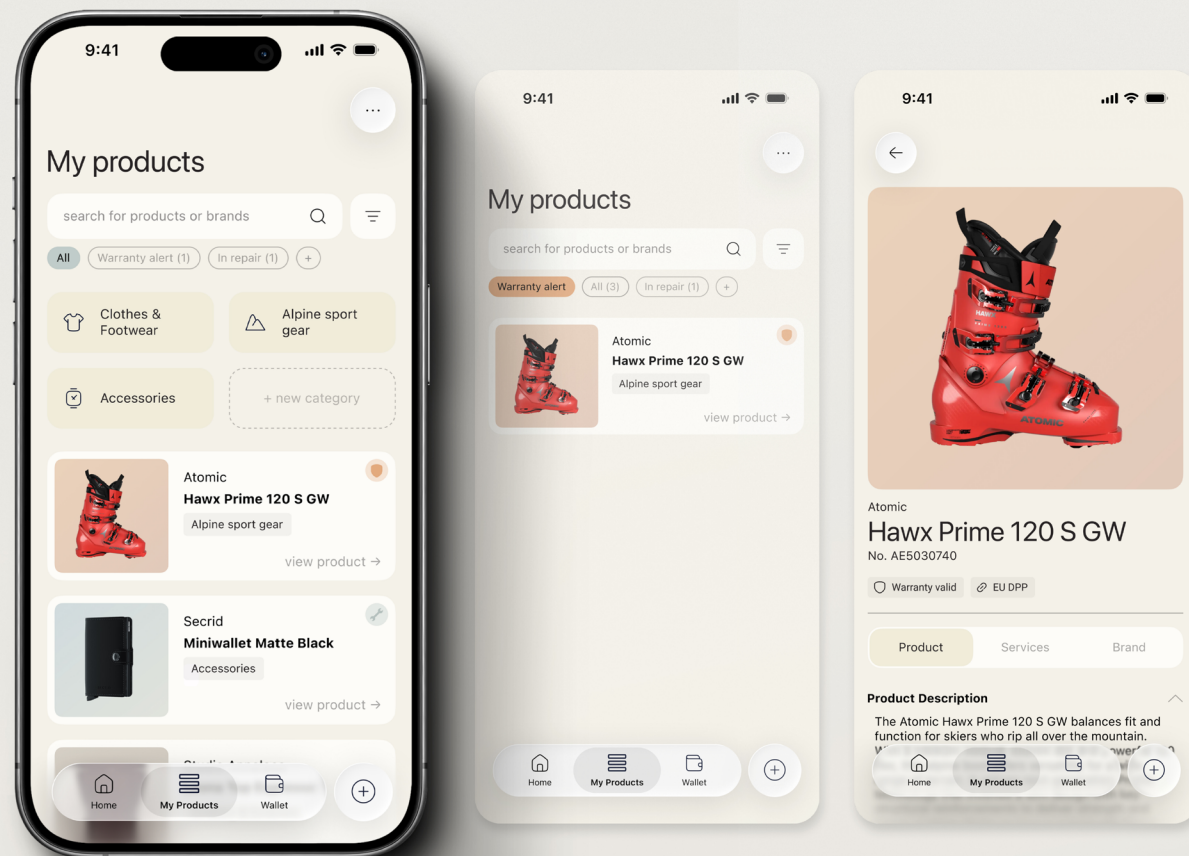


Figure 51: Product listing and detail page for an Atomic ski boot

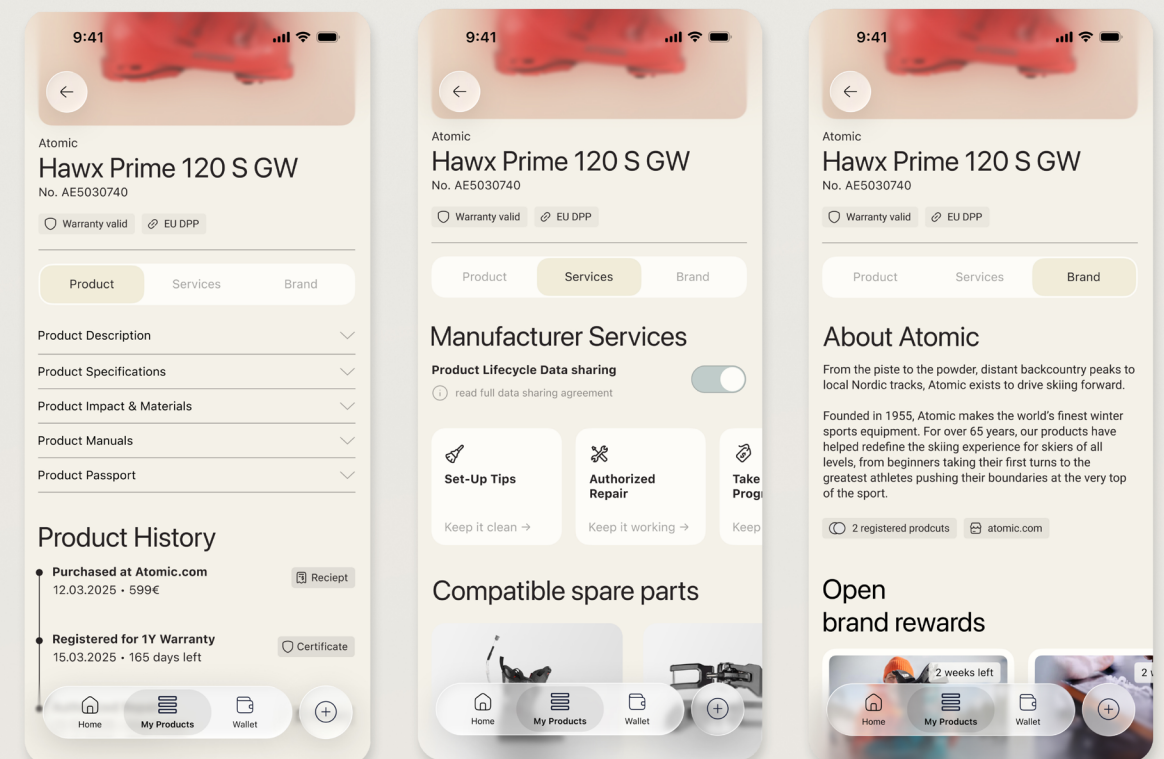
Product Pages

While the dashboard is oriented around overview and positive framing of ownership, the product listing page is designed more action-focused. It serves as the user's starting point for any action related to their products.

A search function allows finding products by name or brand. Quick filters under the search bar highlight products that require attention. Those may include products whose warranties have expired, items currently in repair, or products flagged with a brand notification.

Product cards display essential information such as product image, name, brand, and the product category they belong to. If a product needs attention, an icon at the top left corner of the product cards visually separates it from the rest of the list. That way it is quicker to find, which product needs attention.

The product detail page is where the user interacts with a specific product across its lifecycle. The top section presents globally relevant identification data such as product image, product name, model number, warranty status. Next to that, a tag indicates whether the product has a live connection to the EU DPP, as



the information can change with each lifecycle event or recall pushed from the manufacturer.

Below, three tabs organise the product's interactive surface along the main user actions. The first tab, Product, contains the DPP information: description, specifications, materials, and sustainability data. It also holds the product's history, including the receipts and warranty certificates.

The second tab, services, becomes active when the user has opted into brand data sharing. It surfaces brand-offered services such as authorised repair booking, spare parts ordering for self-repair, and take-back or recommerce programs. In the case that data sharing was not enabled when adding a product, this tab shows which services would potentially be unlocked and offers a slide button for the user to opt in.

The third tab, brand, offers the user a dedicated space to engage with the brand. This can include brand rewards, seasonal campaigns, product-related events, or a link to the brand's shop. This tab represents layer 3 of the value exchange. It functions as a space for ongoing brand-consumer interaction driven by content the brand actively curates through their own dashboard.

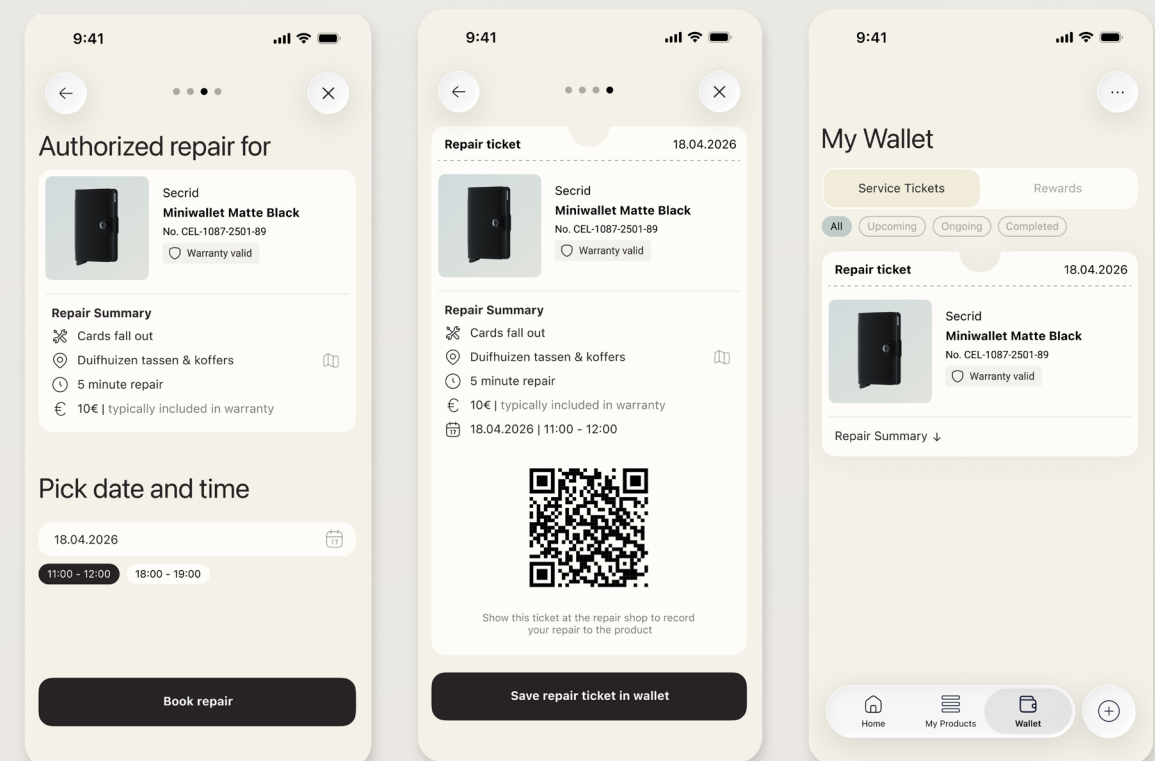
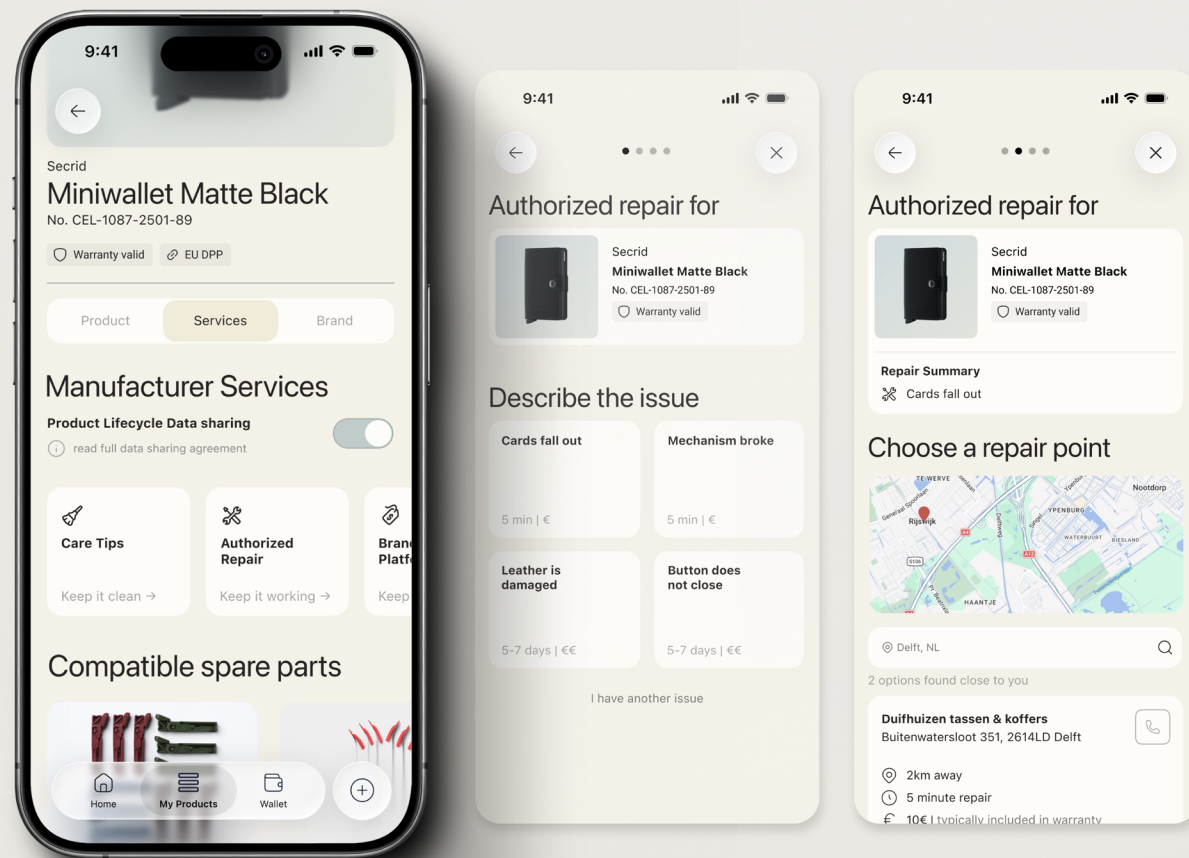


Figure 52: Example repair flow for a Secrid wallet

Example Repair Flow

The repair flow demonstrates how Keep It helps to reduce a key pain identified in the research: the difficulty of finding and initiating a product repair. Brands that partner with the platform can connect their authorised service network and pre-configure common repair scenarios specific to their product models.

When a user initiates a repair, the flow guides them through a structured diagnostic: selecting the type of damage from a pre-filled list tailored to the product. Keep It then surfaces nearby authorised repair points, showing the estimated repair duration, cost, and distance. This directly addresses the three uncertainties that interviews revealed consumers need resolving before committing to a repair: how long, how much, and how far.

Upon selecting a service point, the consumer receives a digital repair ticket saved in their wallet, which is the third button on the bottom navigation bar. There, the user can quickly locate the ticket and use it to route to the repair service. Additionally, the ticket is where the user receives status updates, including notification when the repair is completed and the product is ready for pickup.

For the repairer, the ticket facilitates the transfer of the product's DPP data. This ensures all information is available to perform the repair and the repair is documented on the product's digital record. The repair including the receipt will be added to the product history timeline.

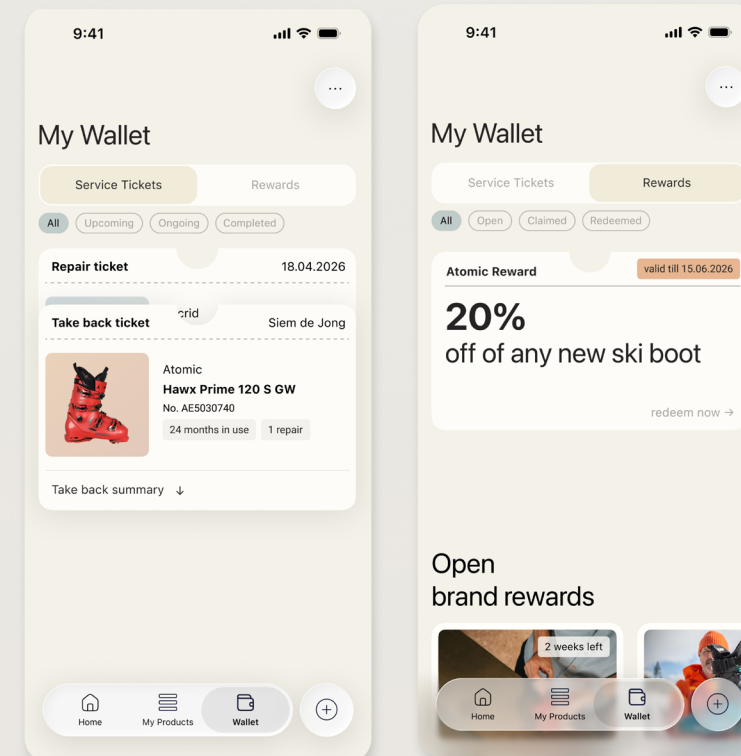
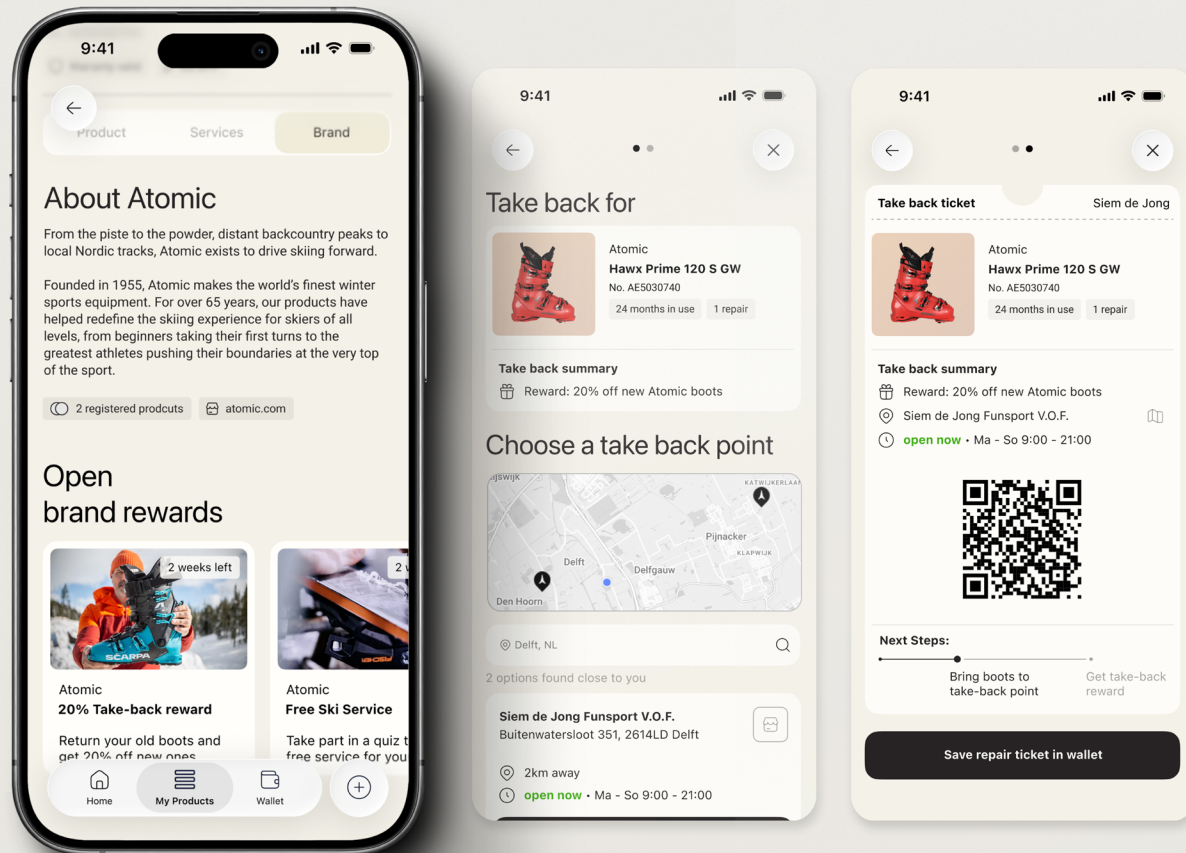


Figure 53: Example flow for participating in a take-back campaign

Participating in a take-back campaign

The take-back flow illustrates how brands can use Keep It to run circular campaigns that reach their customers after purchase. Unlike the repair service, which is triggered by a product malfunction, the take-back service may be initiated by the brand e.g., as a seasonal campaign tied to their recommerce or recycling ambitions.

The consumer encounters the take-back offer through the brand tab on a product's detail page or through the rewards section on the dashboard. The brand creates the take-back campaign based on its infrastructure and partners. For instance, they could offer returning old products to service points in exchange for a discount on new ones. The user then first selects a nearby drop-off point. After a take-back QR code is shown to the consumer, they can

save it under their wallet tab. Showing this QR code at the drop-off point links the returned product to the brand's reverse logistics system or recycling partner, ensuring the item is traced from the consumer back to the manufacturer. When the return is completed, the consumer receives a reward saved again in the wallet and the product is archived.

From a CE perspective, this flow closes the loop: the brand recovers materials or products for refurbishment, the consumer is rewarded for participation, and the DPP documents the product's transition from use to its next lifecycle phase.

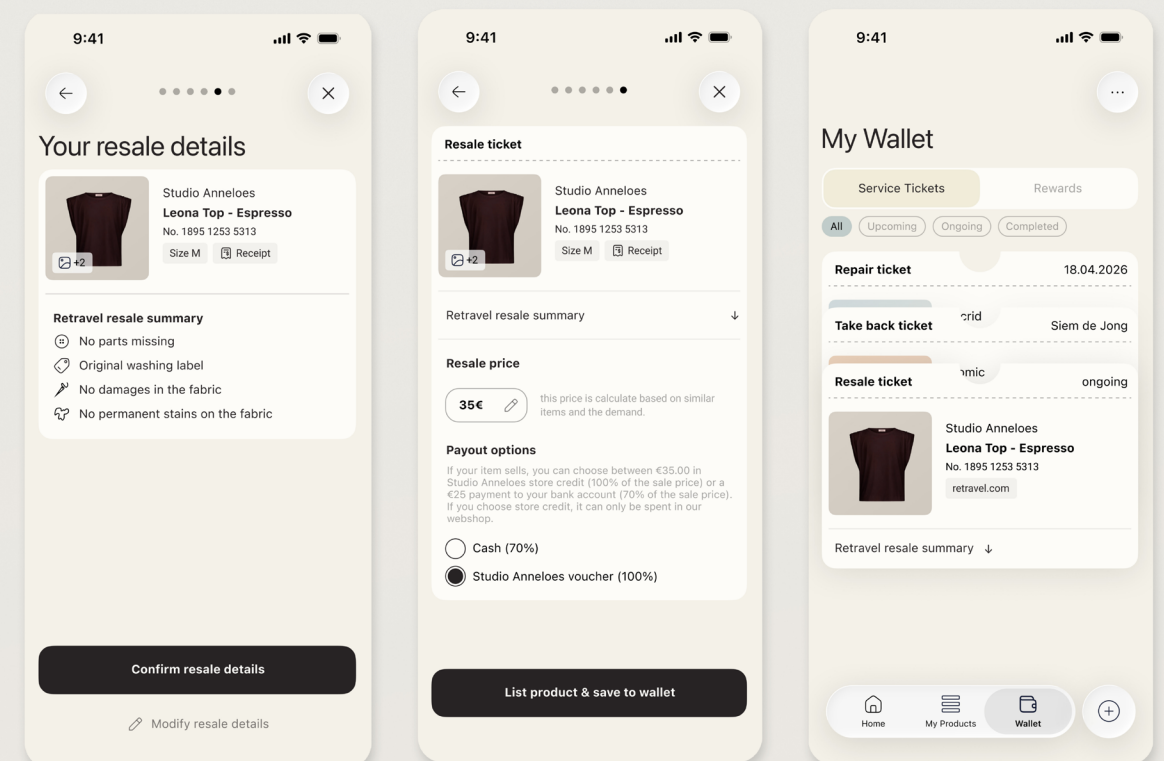
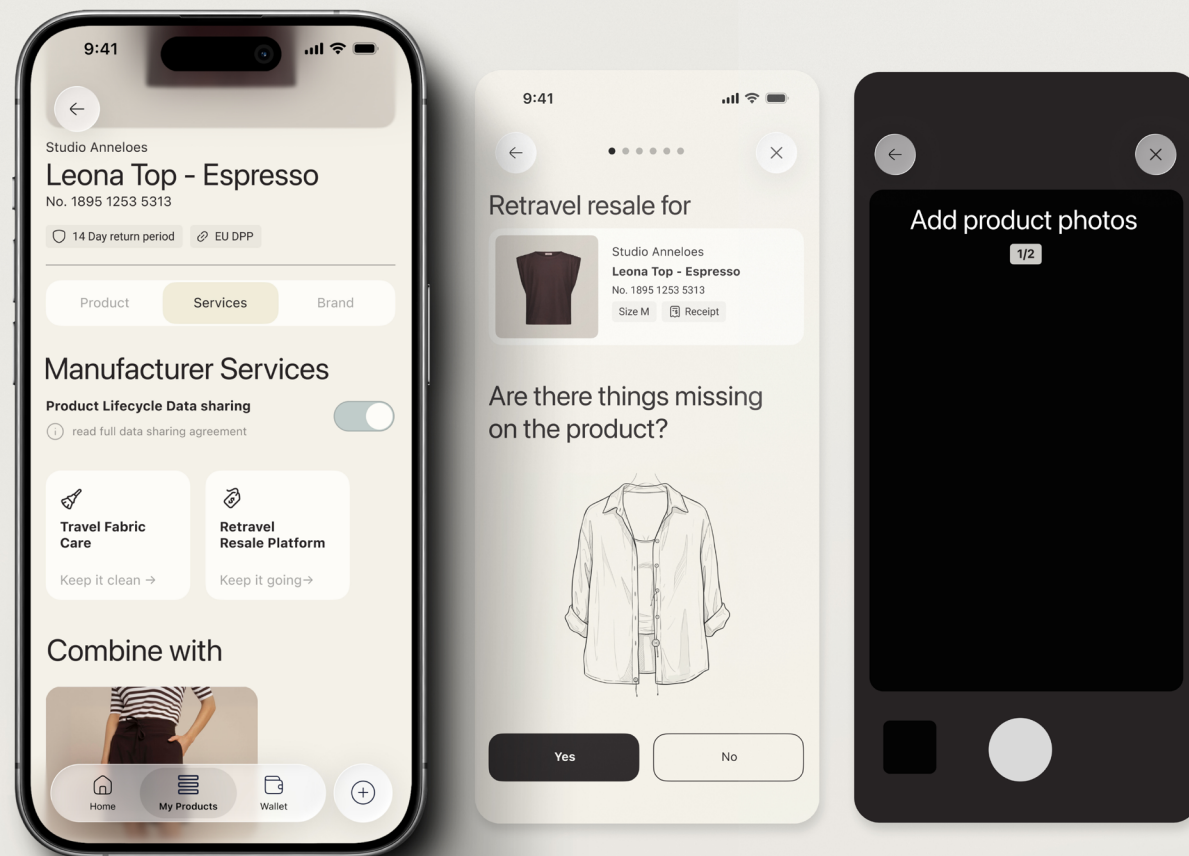


Figure 54: Example flow for reselling a Studio Anneloes piece

Example resale flow

The resale flow illustrates how Keep It connects consumers to a brand's existing recommerce infrastructure. The user decides to part with a product and uses Keep It to list it on the brand's own second-hand platform. In this example, the consumer resells a Studio Anneloes garment via Retravel, the brand's branded resale channel.

The flow begins with a guided condition assessment. The interface walks the user through a series of yes/no questions tailored to the product category. Each question is accompanied by an illustration that visually clarifies what is being asked.

After completing the assessment, the user is prompted to take product photos directly within the app.

The flow concludes with a resale summary screen, where the user reviews the

collected condition data before confirming. At this point, the consumer can either confirm the resale details or modify them.

Upon confirmation, the user is presented with a resale ticket. The price is calculated based on similar items and current demand but remains editable, giving the user a sense of control. Below, the payout options present a strategic choice: the user can either receive 70% of the sale price as a cash payment or 100% as Studio Anneloes store credit. This mechanism encourages them to stay within the brand ecosystem while still offering a no-strings-attached alternative. For the user, it makes the financial reward of resale immediately concrete.

By selecting "List product & save to wallet," the product is listed on Retravel and a resale ticket is generated in the user's wallet alongside any existing repair or take-back tickets. The ticket links to the Retravel listing and allows the consumer to track the resale status.

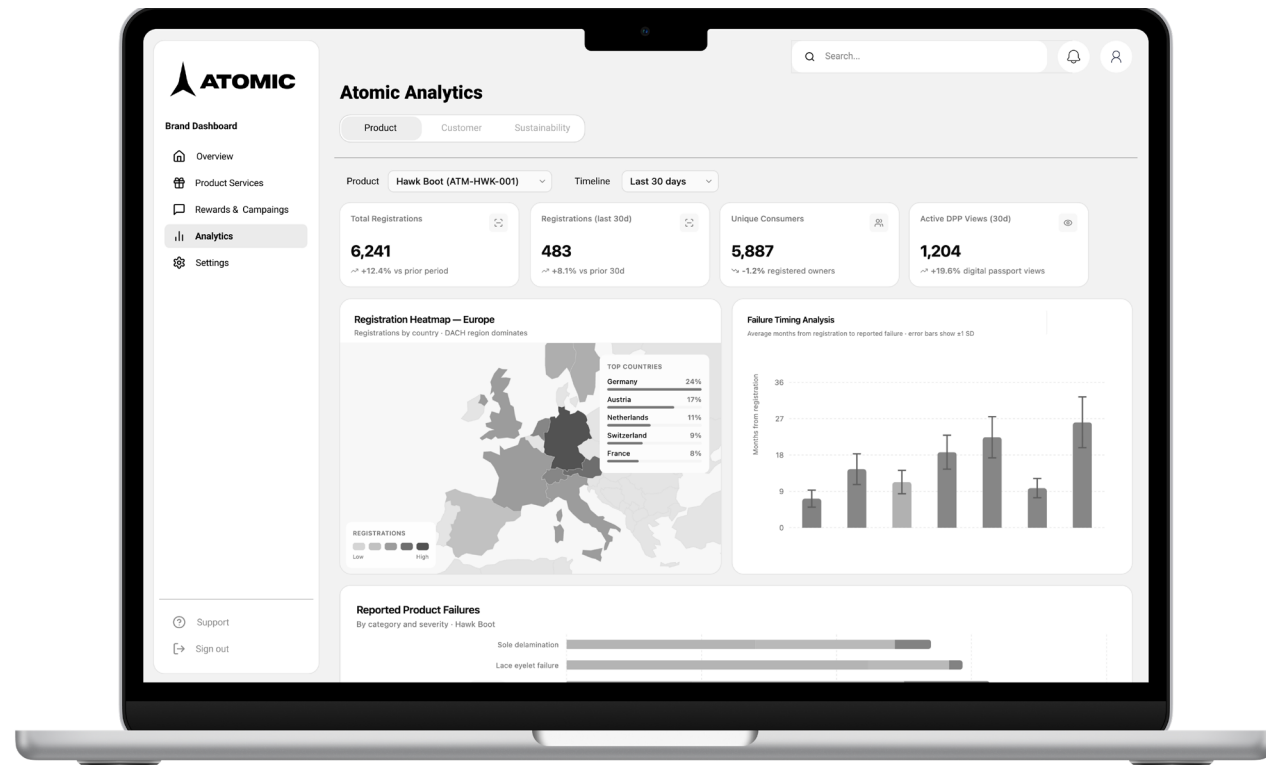


Figure 55: Analytics dashboard mock-up for Atomic

Brand Dashboard

The brand dashboard is the manufacturer-facing side of the Keep It platform (see Figure 55). The left-bound navigation bar structures the core interactions a brand has with Keep It: Under product services a brand can connect and manages repair, take-back, or resale services (level 2 of the value exchange). Under Rewards & Campaigns brands can create and distribute consumer incentives (level 3 of the value exchange). The analytics tab returns product and user data to the brand.

The analytics tab (see Figure 55) aggregates the customer and product data, in this case, of an Atomic Ski boot. Key performance indicators such as total registrations, unique consumers, and active DPP views give the brand analytics of post-purchase engagement. Below, a map reveals geographic registration patterns. A failure analysis and a reported product failures breakdown provide the brand with actionable insights into how and when their products fail in the field. This way, Keep It offers to that make DPP investments commercially viable through insights that feed into product development, circular service delivery and post-purchase consumer engagement.

Conclusion

The development of Keep It advances DQ1.5 by demonstrating that the DPP repository can take the form of a two-sided information marketplace. The consumer app prototype operationalises the three-layered value exchange, free storage, brand services for shared data, and rewards for deeper engagement, into concrete interactions. The five consumer tests confirm the assumption that the mechanisms of analogous service concepts uncovered in the last MVP selection experiment can be adapted to a product information marketplace. The brand dashboard complements the consumer side with a mock-up of a data analytics interface. Together, these prototypes provide the artefacts needed to test the second assumption: whether Keep It addresses a real brand pain. This is the focus of the following validation.

Limitations

It is acknowledged that the prioritised assumptions are only two of several that appear critical around this business model and can shape the journey towards product clarity. Yet, these have been selected in balance with the project timeline, their criticality to the MVP, and the researcher's ability to design a prototype that tests the assumptions.

7.4 MVP validation

Introduction

After the development of the consumer app and the draft of a brand dashboard, the prototypes were utilised in interviews with three selected brands to validate whether Keep It can solve a current brand pain. The section concludes with a synthesis of the signals received in the interviews that support or undermine the assumption.

Method

This chapter employs 30-minute semi-structured interviews with three DPP early-mover brands: Atomic, Studio Anneloes and Secrid. All participants are employed in sustainability-related functions within their companies. The prototype, the brand dashboard and the interview guides were adapted to the context and products of the company. Yet all interviews followed the same two sections (see Appendix 10.20). The first section revolved around the circular ambitions of the manufacturer. This offered the opportunity to inquire about actions (e.g., creating a DPP) taken towards and prevailing challenges that keep the manufacturer from reaching those ambitions. In the second phase of the interview, the research was briefly introduced, and a prototype walkthrough was performed. After inquiring about the general sentiment towards the concept, questions aimed at prompting the interviewee to reflect on the concept's ability to solve the challenges identified in section one. Lastly, a thought experiment was conducted with the interviewees. It asked to imagine a scenario in which a high number of the brand's products are registered on Keep It without them being a partner of the platform. Letting the interviewees formulate the value of partnering with Keep It in that scenario, was intended to reveal the most prominent gain the platform creates for them.

The interviews were analysed by capturing raw insights in memos (see Appendix 10.21). The insights were sorted in four main themes: (1) general sentiment about the concept, (2) signals related to the existence of brand pain, (3) signals related to the ability of Keep It to solve the brand pain, and (4) a brand's prerequisites to onboard Keep It.

Results

General sentiment

Generally speaking, brands responded positively to Keep It. The comprehensiveness of the proposition was exemplified by experts projecting the platform onto their own circular strategies and ambitions. Atomic's head of sustainability and compliance stated:

“Exactly something like Keep It I see [...] as the right way to move forward. It would simplify and converge everything finally together.” - Atomic

Secrid's sustainability manager and DPP project lead framed the platform's value in competitive terms:

“If you are not on there (Keep It) as a brand you almost get FOMO [Fear Of Missing Out]. It makes keeping the connection to consumers so low effort.” - Secrid

Beyond the positive sentiment, brands expressed light commitment to supporting the development of a Keep It pilot. Atomic offered access to early, pre-market DPPs by saying:

“We can definitely do a pilot to test the app with Atomic's early DPPs. [...] We do not have all data yet and still need to look at the delegated acts what to gather, but of existing products for sure.” - Atomic

Signals for Brand-Side Pain Existence

The interviews surfaced signals for three recurring pain points. As assumed, the first is the absence of a direct post-purchase consumer connection. Atomic operates as a B2B company, selling through retailers and sports shops. As their interviewee stated:

“We are a B2B company, meaning we have no direct connection to the customer.” - Atomic

Secrid faces a similar situation. Their main revenue flows through retailers. While Secrid works on reconnecting with consumers via newsletters, this mainly provides a sending touchpoint, not one that helps them regain information. Ultimately, this signals that the lacking connection to their customers, limits a brand's ability to offer post-purchase services, gather feedback, or facilitate product returns.

The second pain is the difficulty of making DPP investments pay off. Brands are investing in DPP infrastructure, but none has a clear mechanism to generate value from it. Atomic has been developing traceability systems since 2012 but consumer-facing activation remains absent. The Atomic interviewee summarised the problem by prompting:

“The key question is how do we motivate the consumer to scan the QR.” - Atomic

Studio Anneloes is struggling with a consumer engagement and therefore pivot to a different DPP-approach that promises more engagement:

“The consumer is not yet interested in where the product comes from, who made it, what material is it. Honestly I don't think they care [...]. So we now develop a ‘Shop the look’ DPP.” - Studio Anneloes

The Secrid interviewee explains that another problem occurs even before the DPP engagement. The DPP development involves multiple internal departments, each with its own priorities, success metrics, and timelines. This makes pushing for a DPP project internally a challenging, especially if there is not a direct ROI connected to it.

The third pain is the operational gap in circular service delivery. Atomic has initiated take-back and recommerce pilots but struggles because too few

products are returned. Returning more products would make recycling and refurbishing more cost-efficient. However, without a consumer-facing channel, reaching product owners at scale remains difficult.

A similar problem faces Studio Anneloes with their resale service, which remains unprofitable without greater scale adoption of their customers.

“Retravel is not a profitable business yet. We offer it from the sustainability perspective, as believe that our products can have 4-5 owners. [...]” - Studio Anneloes

Signals for the concept’s ability to address brand pains

All interviews produced signals that Keep It can address the identified pains. However, it must be acknowledged that the strength of these signals varies. For the consumer connection gap, the signal is relatively strong. Brands explicitly named the direct consumer channel as the primary value of the platform. Secrid’s interviewee noted that the platform does not necessarily enable something entirely new but reduce the effort to connect to consumers:

“We also have newsletters, or people can find a repair point online. But [with Keep It] it will be way easier to reach more consumers in a more direct way.” - Secrid.

Atomic went further, stating that the platform fits directly into their upcoming recommerce strategy:

“This could be one of the channels that we can use to let our customers connect with our recycle or refurbish partners and get back a reward.” - Atomic

The ability of Keep It to increase the DPP scan rates, is less discussed on amongst interviewees. However, Atomic for example recognises Keep It’s engagement technique to provide extra warranties, discounts or other rewards. Secrid reflects on Keep It’s functional value of overview and effortless care as a driver that increases engagement beyond information provision.

“Consumers will not always scan the QR code every time that you need information. It is very handy to have that all in place.” - Studio Anneloes

With regards to more targeted circular service delivery, brands could articulate specific use cases. Atomic needs a platform to trace returned products to specific collection points for their recycling partners. Secrid envisions notifying consumers about new circular services, selling product add-ons, and analysing failure patterns at the product model level to feed into product development. For Studio Anneloes, Keep It offers the opportunity to simplify adding product services to DPP.

“If something like Keep It exists the question is whether we have to develop all these service functions in our own DPP. That could make it easier for us.” - Studio Anneloes

Prerequisites

All interviews highlighted the practical prerequisites a brand must meet to partner with Keep It.

The most fundamental factor is the DPP readiness of the brand. Both brands need to have their DPP data consolidated and QR codes on products before they can meaningfully participate. Atomic is in the process of building this infrastructure but acknowledged gaps. Secrid still faces earlier technical challenges within the process of developing the DPP. This means that brand onboarding is not just about the value delivered by Keep It, but also about technical and organisational readiness.

A second essential prerequisite is the post-purchase service offered by the brand. If a brand has a limited service offer, the exchange of product lifecycle information for brand services may not be attractive enough for users to proceed with it. For brands like Secrid and Atomic with an existing retailer network and service offer, Keep It offers more value.

Conclusion

The brand interviews provide directional signals that support the second assumption: Keep It can address real brand pains. All three early-mover brands confirmed the absence of a direct post-purchase consumer connection, the difficulty of generating return on DPP investments, and operational gaps in circular service delivery. Keep It’s ability to bridge the consumer connection gap received the strongest signal. At the same time, it shows potential to increase DPP scan rates and enable circular service delivery showed promising but less concrete support. These signals, combined with the usability test from the previous section, indicate that the information marketplace model can balance desirability for consumers with viability for brands. The venture outlook in the next section lays out the steps needed to strengthen these signals and move Keep It towards a real startup.

Limitations

While maintaining a base level of scientific rigour, this validation is situated within the experimental nature of the entrepreneurial mindset and does not attempt to provide exhaustive validation of the second assumption. The author acknowledges that getting stronger signals would require a higher number of interviews and more testing. Further, it is worth noting that all interviewees were employed in sustainability departments of the respective company. Therefore, answers and reactions might not represent the strongest commitment signals to actually pilot the MVP.

7.5 Venture outlook

Based on the synthesis of the MVP validation interviews, the last chapter closes with formulating the next steps forward. It thereby reflects on the assumptions of Keep It that remain untested. Next to that, risks and opportunities of a startup in this domain are formulated in this chapter.

Next Steps

The MVP validation confirmed directional signals for brand-side interest but leaves several assumptions untested. The following steps outline the three immediate steps needed to advance Keep It to a real venture (see Figure 56).

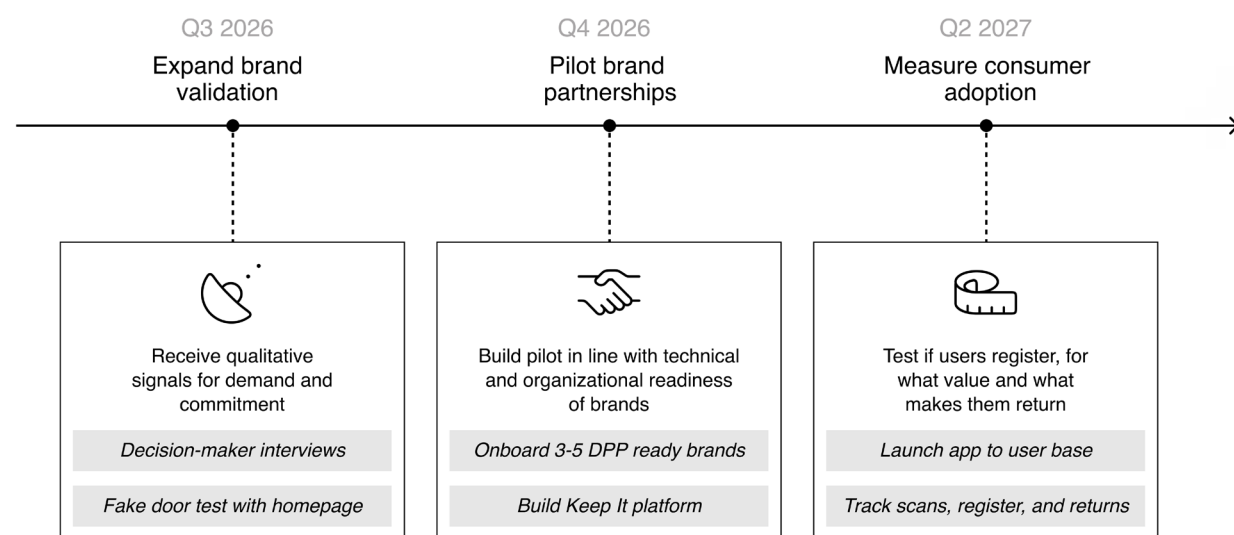


Figure 56: Timeline of next validation experiments

The priority is to continue and expand the brand-side validation. Three interviews are insufficient to draw confident conclusions. Conducting additional interviews with the current prototype would sharpen understanding of which brand types experience the severest pain and what the platform must deliver to convert interest into commitment.

Alongside qualitative interviews, a fake door test could yield a broader, less biased signal of demand than interviews alone. A fake door test involves creating a landing page that presents the brand value proposition, steering traffic to the website through advertisements, and tracking page analytics to reveal click-throughs. Based on the analytics, demand signals of the value proposition can be gathered.

The second step is to partner with three to five pilot brands. Therefore, interviews should target staff with greater internal decision-making power within the brand that can show real commitment to a pilot partnership. These can, for example, be senior management or business development departments. A functioning pilot

requires brands that have DPP data available, QR codes on at least a subset of products, and internal willingness to allocate time to the partnership. These (free) pilots would form the foundation to build a working version of both the consumer app and the brand dashboard with real data and real service integrations.

Third, once pilot partnerships are in place and a pilot is built, consumer adoption can be tested. This involves onboarding real consumers to the app with real products and measuring whether the app's value can sustain user engagement. Metrics such as registration completion rate, return frequency, and service activation would provide the first quantitative evidence of product-market fit on the consumer side.

An optional parallel track that was hinted at in a validation interview concerns partnerships with DPP service providers. Since Keep It depends on the existence of DPPs, collaborating with companies that help brands create and manage DPPs could be mutually beneficial. Keep It could offer these providers a consumer-facing engagement layer that makes their DPP infrastructure more valuable, while they offer Keep It access to brands that are actively building DPP readiness.

Entrepreneurial Risks

The most significant risk is the evolving legislative landscape. The ESPR and its delegated acts define when and how DPPs will be deployed. If timelines are delayed or the scope of DPPs is changed, Keep It must shift accordingly. A delay does not invalidate the concept but pushes profitability further out. A mitigation strategy could involve not coupling the platform's existence entirely to the DPP. Exploring other means to identify a product and fetching data about it could reduce legislative dependency. Simultaneously, building an external investment structure rather than relying on brand fees from day-one can provide financial stability when timelines shift or the MVP maturity is still low.

A related timing tension that remains is that textiles are a product category where DPP legislation arrives first, while they may not offer the strongest use case for the app. Durable products with higher price points and more established repair and resale paths (e.g., sporting equipment, electronics, furniture) showed higher value for the platform's actors. This means the legislative timeline and Keep It's immediate consumer value may not align entirely before full deployment of the ESPR in 2030. Until then, Keep It should focus on brands which are early movers on DPP adoption, especially B2B brands, that sell their products via retailers. Those brands experience the pain of a lacking post-purchase customer connection the most, as their business doesn't directly involve them. Targeted brands are those that sell durable, mid-to-high-value products, which justify customer engagement and where repair, maintenance, and resale are realistic lifecycle options (e.g., sporting equipment, electronics, kitchen appliances, and furniture).

The competitive landscape presents another risk. Other actors may develop DPP repository applications that aggregate freely accessible DPP information.

A mitigation strategy may lie in the early mover advantage combined with brand partnerships as a lock-in mechanism. While simply storing DPPs is something competitors can easily copy, the brand services and rewards delivered through partnerships offer a competitive advantage and a potential lock-in effect. This effect scales with users and onboarded brands as switching costs increase. To establish this competitive advantage early, a startup should focus a substantial part of its resources on key accounts and brand partnerships.

Entrepreneurial Opportunities

With the deployment of the ESPR, the DPP offers a new information source that previously did not exist. Keep It is positioned to be a logical addition to this infrastructure. It utilises the data of the DPP and increases its utility for consumers and commercial viability for brands. No individual brand can offer a cross-brand wallet, which gives a platform like Keep It a structural advantage. The brands interviewed confirmed this: neither Atomic nor Secrid sees itself building a comparable consumer-facing solution independently. As DPP deployment scales across product categories, the platform's value grows with every brand and product added.

In the beginning of the venture, the user audience Keep It targets are primarily customers of the brands that they partner with. Once more DPPs are deployed and Keep It has gained a base of users with saved products, the platform can expand naturally. For instance, if users save DPPs of brands that Keep It has not partnered with yet, offering these brands the opportunity to connect with their customers can expose Keep It to the rest of the brand's customers. This creates a positive feedback loop that scales the platform.

Conclusion

This chapter completes the answer to DQ1.5. The DPP repository can be transformed into a viable MVP by positioning it as a two-sided information marketplace. The entrepreneurial journey through this chapter demonstrates that the product's form is shaped not only by what consumers want but also by what can sustain a business. Keep It is positioned to grow with the DPP infrastructure as it scales across product categories towards 2030, with brand partnerships as both the revenue engine and the competitive advantage. The next steps, expanded brand validation, pilot partnerships, and consumer adoption testing, mark the transition from thesis to real-life startup.

8. Final remarks

8.1 Contributions

The following sections lay out this thesis's contributions to the scientific DPP discourse, the European CE, research at TU Delft, and industry.

To the scientific DPP domain

The DPP research domain has been characterised as predominantly technical and business-driven, with its scientific discourse centred around the DPP's regulatory design, technical architecture, and opportunities for economic actors (Van Capelleveen et al., 2023). This thesis adds a consumer perspective to that discourse. The expert interviews uncovered a fundamental engagement challenge: the DPP, in its current form as a static information sheet, may fail to evoke enough consumer interest to prompt a scan in the first place. The concept tests with consumers in Chapter 6 further demonstrate that circular action depends not only on the availability of general product information but also on its relevance within the consumer's specific context (e.g., location). These findings contribute to the DPP research domain by surfacing previously unstudied factors, such as, consumer adoption and contextual relevance.

Furthermore, this thesis shifts the analytical lens from the DPP itself as a medium to the services that aggregate and leverage DPP data for consumer interaction. By doing so, it positions itself as an early case study in the field of DPP-enabled service design. Through the analysis of the ESPR and the expert interviews, the project contributes a set of capabilities that the DPP ecosystem offers for service creation (Chapter 4). These capabilities, consolidated in the DPP feature cards, may serve future researchers or industry practitioners seeking to develop their own DPP-enabled services that deliver new and unique value.

Lastly, the project's practical outcome contributes to a predominantly theoretical research domain. Through the translation of research findings into a tangible concept, the Keep It platform, the value of DPP-enabled services for consumers and other stakeholders is explored. In doing so, it embodies an early version of a new generation of DPP-enabled circular business models.

To the European circular economy

The European Green Deal and the ESPR are frequently positioned as regulatory instruments that aim to enable new circular business models (European Commission, 2019). The design-entrepreneurial approach of this thesis contributes to the European CE transition in exactly that spirit: by proposing a new business model, enabled by the DPP, that promises to increase the consumer's participation in the CE.

Beyond the business model, the Keep It concept itself promises to generate systemic value. The CE domain currently lacks reliable data on the end-of-use and end-of-life of products (e.g., Adisorn et al., 2021; Ylä-Mella et al., 2022). Keep It may be part of a solution to acquiring such data through product lifecycle tracking that it enables. This data may, for instance, improve the circular design of future products, inform the design of access-based business models, or be used in the field of circular product design research. Additionally, Keep It offers

a mechanism to track material flows and closing-the-loop activities. Through its direct consumer access, it also has the potential to increase the intake of post-use materials, which in turn could make recycling processes more efficient and more competitive relative to low virgin material prices.

To research at the TU Delft

This project extends pre-existing DPP research (e.g., Turner, 2023; Trotereau, 2025) at TU Delft with a consumer perspective and a practical project outcome.

The intermediary research artefacts of this project have already found application beyond the faculty of Industrial Design Engineering. The DPP capability cards, developed to consolidate the ESPR analysis and expert insights (Chapter 4), have been adopted by a PhD researcher in the DPP domain at the faculty of Technology, Policy and Management (TPM).

Further, in a conversation with an associate professor from TPM, who represented TU Delft in the European CIRPASS consortium, the completeness of the work was acknowledged. The associate professor noted that master's theses typically conclude with recommendations that emerge from the research. This thesis goes beyond and translates the findings into a tangible concept.

To Secrid

The findings from the collaborative research phase of the project (Chapters 3-5) have significantly influenced the direction in which DPPs are being developed at Secrid. Rather than pursuing a transactional information-sheet approach to the DPP, the insights from this thesis led Secrid to adopt a consumer-action-focused DPP that reduces the effort required to repair a product. With their existing network of over 1300 care and repair points worldwide, Secrid wants to support their customers with a DPP, specifically in finding a repair place close to them. At the time of writing (April 2026), this concept is being piloted with 10.000 wallets on the market.

8.2 Limitations

Beyond the limitations discussed within individual chapters, several project-wide limitations deserve acknowledgement.

Consumer focus

This thesis assumes that reducing friction and solving tangible consumer pains through a service will increase the value of the DPP and, consequently, its adoption. While this approach is supported by the Dutch Behavioural Strategy for Citizens and the Circular Economy (Dutch Ministry of Infrastructure and Water Management, 2023), it means that the role of drivers, phenomena that actively motivate or pull consumers towards circular behaviour, received less attention. Drivers tend to be more specific to consumer segments and product categories and may reveal mechanisms beyond friction reduction, such as social identity, financial incentive, or emotional attachment, that can equally motivate circular action.

Relatedly, the project consciously maintained distance from the adjacent field of circular consumer behaviour. Established behavioural frameworks, such as the theory of planned behaviour, nudging theory, or habit formation models, were not formally engaged with. While the stance of reducing effort for a desired action aligns with theories such as the Fogg model (Fogg, 2009), the absence of a formal behavioural theory means it cannot fully shed light on consumer adoption or non-adoption of DPP-enabled services.

A further limitation lies in the breadth of the target consumer. By addressing consumers in general rather than a well-defined consumer segment, the research findings are broad but inevitably lack depth. Focusing on a segment, for instance, on committed environmentalists (Gilg et al., 2005), could have uncovered sharper pain profiles, clearer motivations, and more specific jobs-to-be-done. Consequently, Keep It's proposition is currently designed for a somewhat abstract average consumer rather than a well-characterised persona.

DPP maturity

A fundamental limitation of this thesis is that it designs for an infrastructure that does not yet exist. Mandatory DPPs have not been deployed at the time of writing (April 2026), and the ESPR's delegated acts, which will define the specific data points per product category, are still under development. While the research mitigated this by grounding capabilities in the ESPR and supplementing them with expert perspectives, all findings carry an inherent degree of speculation about how DPPs will materialise in practice.

This immaturity also limits the generalisability across product categories. Although the project scope defines "shopping products" broadly (see Chapter 2.2), the concepts were primarily developed and tested in the context of wallets, ski boots, and fashion. Whether the same service logic holds equally for other products remains untested. The DPP's value and the consumer's interaction with it may vary considerably across these categories once real deployment begins.

Methodology

The project combines a Double Diamond design process with a Lean Startup approach (Chapter 2.3). While this enabled the thesis to move from research to a tangible, validated outcome within 100 working days, it introduced several trade-offs.

First, the research phase (Chapters 3-5) operates with established academic methods: semi-systematic literature reviews, a structured survey, and thematic expert interviews. The design and entrepreneurial phase (Chapters 6-7) adopts a lean startup mindset that values speed, directional signals, and intuition-guided pivots over exhaustive validation. This is a legitimate methodological choice for early-stage venture development, but it means the later chapters operate at a lower scientific rigour.

Second, consumer desirability throughout the project was assessed through stated preferences, what consumers say they would do, rather than observed behaviour. Prototypes and experience scenarios captured reactions, interest, and intent, but not real-world adoption. Whether consumers would actually scan, register, and return to a DPP-enabled service like Keep It can only be determined through a live pilot, which sits beyond the thesis timeline.

Third, while the project involved co-creation participants, experts, and consumers at key moments, the synthesis, prioritisation, and pivoting decisions were ultimately made by a single researcher. This introduces a degree of subjectivity.

Lastly, Secrid's involvement as a collaborative research partner may have shaped the project in unintended ways. Their co-funding of conference attendance, access to their customer database, and periodic involvement may have subtly anchored the research towards durable, premium, and repairable product contexts. Combined with a consumer sample that is predominantly male, older, and Western European, the project's findings may not fully transfer to other product categories, consumer demographics, or cultural contexts across the EU.

8.3 Future work

The findings and limitations of this thesis point towards multiple opportunities for future work.

DPP adoption risk

As the DPP ecosystem matures towards mandatory deployment, future work should critically examine adoption-related factors across the ecosystem's stakeholders. This thesis has surfaced early signals that consumers may not engage with DPPs if the call-to-action communicates insufficient value (Chapter 4.2). However, adoption risks extend beyond the consumer. What happens, for instance, if recyclers do not integrate DPP data into their operations, or if retailers fail to communicate the DPP's presence to their customers? Future studies could model the effects of stakeholder non-adoption on the DPP's intended CE impact and explore mechanisms that mitigate these risks in practice.

Direct DPP consumer interaction

This thesis deliberately investigated the indirect interaction between consumers and DPP data, mediated through a service layer. The direct interaction with the DPP itself, however, remains understudied. What motivates a consumer to scan a DPP in the first place? What information do they seek, and what do they do after reviewing it? Answers to these questions promise to reveal essential insights about consumer engagement that directly affect manufacturer return on investment, and DPP-enabled services. As argued in the limitations, such studies would benefit from a narrower scope: focusing on a specific consumer segment and product category could uncover more concrete behavioural mechanisms than the broad approach taken in this thesis. For instance, investigating how young consumers interact with DPPs on textile products, one of the first categories to be mandated, could yield timely and actionable findings.

DPP-enabled services

The European Commission envisions that the DPP will give rise to new kinds of services that leverage its data to create value for specific stakeholders (European Commission, 2022, pp. 64-65).

Yet this emerging field has received little attention in literature. In industry, early examples are already visible: companies like Cylib (Cylib, 2026) use DPP-enabled SaaS solutions to increase the efficiency of their recycling processes and recover more resources. These cases suggest that DPP-enabled services may emerge as a new kind of intermediary actor in the DPP ecosystem, that increases the value of DPPs for a specific stakeholder by incorporating their custom context and needs. Future research could work towards a formal definition of DPP-enabled services and position them within the broader DPP ecosystem architecture. Beyond definition, researchers and practitioners may investigate the new business opportunities that emerge in this market and assess their potential to support the CE transition.

**Keep It
context factors**

Future work on Keep It specifically, would benefit from incorporating context factors. Once the ESPR's delegated acts specify the exact data points required per product category, work may investigate how category-specific DPP capabilities shape the value a service can deliver to consumers. Understanding these product category differences could inform more tailored service propositions.

Additionally, integrating with manufacturers' IT infrastructure and service networks introduces feasibility considerations that this thesis has not addressed in depth. The interoperability of data formats and systems across brands, repair networks, and resale platforms may present practical hurdles that warrant investigation.

These context factors are likely best discovered through continuous alignment with pilot manufacturers in a practical, iterative manner rather than through exhaustive research.

**Keep It
circular rebounds**

While this thesis frames Keep It as a service that facilitates circular consumer actions, it does not fully assess the potential negative effects the service itself could introduce. However, rebound effects may counteract the intended circular outcomes.

A first concern that may need future work regards the convenience that Keep It adds. By reducing the effort of resale to a near-frictionless experience, Keep It could inadvertently shorten ownership periods. Consumers might cycle through products faster increasing material throughput. The brand reward mechanism amplifies this tension. If consumers receive discounts on new products as a reward for registering or sharing lifecycle data, the platform provides a consumption driver. The latter could ultimately turn Keep It into a platform that intensifies consumption and resource use.

A further unintended effect concerns the risk of conspicuous consumption. By centralising product ownership in a single interface, Keep It inherently quantifies what a consumer owns. If users can view the total value of their registered products or browse detailed portfolios of premium items, the platform could shift motivation towards status signalling. This could reinforce positional consumption (Veblen, 1899), where products are bought and replaced based on the status they provide, a known barrier to CE (Wibowo et al., 2022). Therefore, future service design should investigate which ownership metrics are made visible to users.

A last concern relates to the product lifecycle data returned to brands. This thesis positions data as a tool for improving circular design and service delivery. However, the same data could be leveraged by brands to optimise the timing of replacement, enabling more sophisticated forms of planned obsolescence. Future research should investigate governance mechanisms that ensure brand access to lifecycle data supports circular outcomes rather than undermining them.

8.4 Personal reflection

I set out to use this thesis as an experiment to test whether a design-entrepreneurial way of working suits me and to explore the domain of consumption in the circular economy. Looking back, both the experiment and the deep dive into the domain have taught me a lot.

The most lasting takeaway is the aspect of experimentation itself. I have always believed that to actually know whether to pursue something, you have to try it out yourself. On a larger scale, you can use experimentation to find out how you like to live your life, your relationships or your job. But you can also zoom in and apply it within projects. Identifying a risky assumption, designing a quick test, and deciding to pivot or persevere turned out to mirror what felt already a bit natural to me when navigating decisions. In the thesis, it helped me to stay grounded in reality and honesty. And it forced me to ask: does this idea hold up when it meets real market conditions? I will carry this practice forward, because I believe it elevates how we as designers can deliver value. Rather than stopping at describing a solution, it pushes you to understand what it takes to make an idea come to life. It forces you to ask the critical questions: who pays, what is actually delivered, and whether the market cares. This is a designer skill I had not exercised much before, but I found it to be profound for our discipline.

I also learned about taking risks. In the entrepreneurial field, taking risk is seen as essential for success. During the thesis, I often asked myself whether I was taking enough. In hindsight, choosing this design-entrepreneurial approach was itself a risk, because it meant combining an entrepreneurial mindset with the academic conventions of a master thesis. I often found myself caught between the two. Both value different outcomes: entrepreneurial decisions are fast and intuition-driven; a thesis demands rigorous documentation and justification. A way to navigate that tension was the experimentation mindset itself. By defining experiments and documenting them well along the way, I tried to satisfy both ways of working. I am not naturally a risk-taker, but I have come to see that the willingness to be wrong, and to document that openly, is perhaps the most honest contribution a design-entrepreneurial thesis can make.

The bigger question, whether I am an entrepreneur or not, remains open. Since the primary focus lay on graduating, I feel that I have not fully experienced what it takes to be one. That experiment is yet to come. What I have learned, though, is that building a venture together with a co-founder would be essential for me. Quickly sparring on thoughts and making decisions together was what I missed during the project. At the same time, the moments when I did share ideas with others were what made me think entrepreneurship could still suit me. Reaching out to experts, attending DPP conferences, and conducting concept interviews pushed me forward. I was genuinely curious about what people saw in the concepts, what excited them, and what fell flat. Regardless of the path I choose, the facets this thesis has added to my design practice, such as, product clarity, viability awareness, and comfort with imperfection, will stay.

On the topic itself, the circular economy proved to be as complex as it is compelling. Rebound effects, global supply chain interdependencies, and the tension between European regulation that is not even there yet and hands-on implementation made it difficult to find a design space that felt both meaningful and had manageable degree of uncertainties. Regarding the Digital Product Passport, I still believe it holds potential to reshape how we consume. However, consumer engagement remains, in my view, the single biggest risk to realising the DPP's promise for consumer products. The DPP sits behind a QR code. Unlike, for instance, a Nutri-Score that is visible at a glance, the DPP requires scanning, before any value is unlocked. I see a major risk that that friction may cause the QR code to become an ignored mark on packaging. Keep It attempts to lower that threshold of scanning and increasing the gain for the consumer, but it cannot eliminate this friction entirely.

I will be closely observing the DPP developments on the market and regulation. I am curious how the first delegated acts will define DPPs and how that shapes the opportunities for ventures, like Keep It, to arise. Maybe you will see me out there with Keep It, doing just one more experiment to get closer to the product market fit.

This thesis marks the final output of my academic journey at the TU Delft. If I had asked myself after my bachelor's degree: how would your life look in four years? Nothing in me would have thought that I live close to the ocean, my grounding space that gives me calmness and clarity, that I find a place to call my second home with heart-warming friends, that I embark on a learning journey that brings me to Africa and closer to the designer I want to be. Nothing in me would have thought that. And still I ended up here. Feeling at the right place, at the right time. Trying to embrace the uncertain, taking opportunities, and experimenting my way through life.

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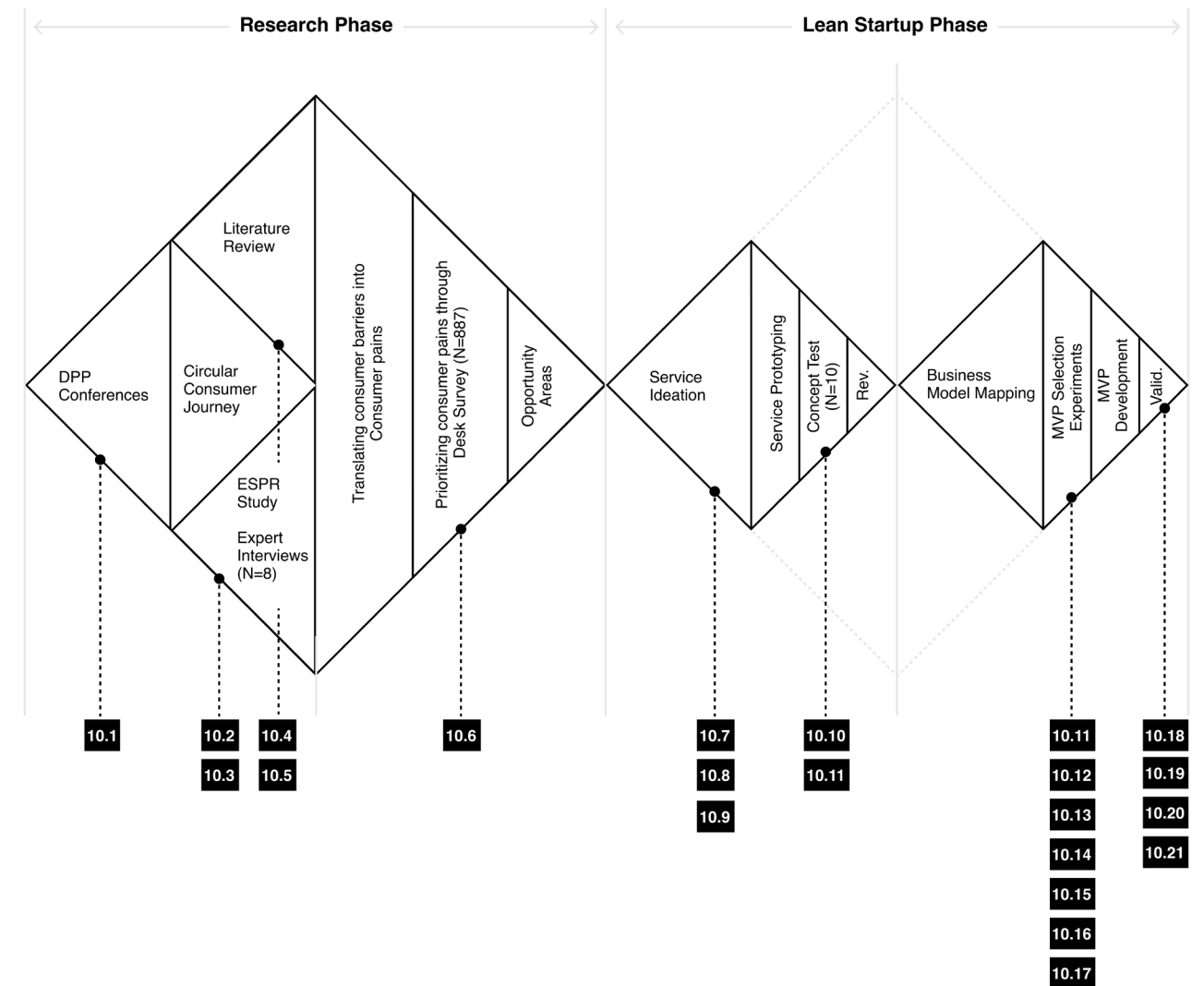
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10. Appendix overview

The appendices accompanying this thesis are provided in a separate document, which can be accessed with the link tim-eckert.com/thesisdocumentation

- 10.1 DPP conference memos
- 10.2 Interview guide - Expert interviews
- 10.3 Expert interview - Researcher memos
- 10.4 NotebookLM prompt for barrier extraction
- 10.5 Literature review - Barrier cluster table
- 10.6 Consumer survey questionnaire
- 10.7 Ideation workshop agenda and expert feedback
- 10.8 Consumer pain and DPP-feature cards
- 10.9 Concept clusters from service ideation
- 10.10 Interview guide - Concept test
- 10.11 Concept test - Insight clustering
- 10.12 Experiment 1: Market research
- 10.13 Experiment 2: Market research
- 10.14 Experiment 3: Repair field research
- 10.15 Experiment 4: Interview guide - Insurance expert
- 10.16 Experiment 4: Insurance expert insights
- 10.17 Experiment 5: Market research
- 10.18 Interview guide - Usability testing
- 10.19 Usability test findings
- 10.20 Interview guide - MVP validation
- 10.21 MVP validation - researcher memo
- 10.22 Thesis project brief



Conflict of interest

The author declares no conflict of interest. Parts of this thesis were performed with together with Secrid BV. However, the company did not influence the results of the work, nor did it steer the direction of the outcome.

Notion on Human Research Ethics

This research was approved from the TU Delft Human Resource Ethics Committee on the 25.10.2025 under the number 6087

Notion of AI usage

The thesis benefitted of generative AI to (re-)structure writing, improve wording or correct grammar and spelling mistakes. To do so, Anthopic's Claude.ai was chosen with their Opus 4.6 large language model for more complex task and deeper reasoning. To improve the context awareness of the topic of the thesis a project folder was created, that listed and could refer to previous conversations. To engage with research data Notebook LM from Google was used. Notebook LM only uses the data a user provides (e.g., literature, or anonymised researcher memos) and therefore minimises model hallucination. All content and conclusions are the author's own.