Visualization as a Tool to Enhance the Transparency of ICT Data Sharing in the Circular Economy

Mater Thesis
Integrated Prouct Design

Delft University of Technology
Faculty of Industrial Design Engineering

Auguest 2023

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Abstract

This thesis delves into the development of a project that aims to boost the awareness and willingness of TU Delft's research staff to share laptop data,needed to promote the further adoption of the Circular Economy (CE) in the Information and Communication Technology (ICT) domain. The project navigates the intricate landscape of data privacy challenges, particularly focusing on laptop hardware and organizational device management, with the ultimate goal of supporting AI processes such as predictive maintenance that requires laptop-specific data, which can be categorized as personal data.
The project employs the Agile methodology and the Double Diamond Model to iteratively design user interfaces that visually articulate informed consent for ICT (i.e. laptop) data sharing for CE processes, such as laptop's repair, reuse, and return. The main objective is to help cultivate a more sustainable ICT service in TU Delft by enhancing CE data sharing transparency and offering incentives for informed consent with the User Interface (UI) design. The design of the user interface aims to simplify the comprehension of consent for data sharing, bring more transparency, and raise awareness about data privacy. This approach is expected to motivate the research staff to actively participate in data sharing, thereby contributing to sustainability efforts within the organization. The thesis culminates with the presentation of key findings and potential avenues for future exploration and research, providing valuable insights into the interplay of data privacy, user experience, and sustainability within ICT services.

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1 Introduction

This part introduces the project's background and the main research problem, followed by the selected approach, the main objectives to be achieved, and the approach.

1 Introduction

1.1 Project Background

The concept of a circular economy (CE) has gained significant attention among governments and organizations as a viable solution to environmental challenges such as air, water and e-waste, leading to climate change. Within the field of Information and Communication Technology (ICT) hardware, the substantial volume of electronic waste (e-waste) laden with hazardous and toxic materials has underscored the urgency for more sustainable disposal methods (Pont et al., 2019). Pont suggests that prolonging the lifespan of ICT devices through strategies such as predictive maintenance, repair, and reuse can be a promising approach to solving this issue (Pont et al., 2019). Consequently, stakeholders, including ICT infrastructure purchasers, maintainers, and managers, require access to the device data for the implementation of efficient device management. This project focuses on the circular economy of laptops, as they are one of the most prevalent productivity tools at work today. As one of the segments of the ICT, the device status data, particularly for laptops, can include information about usage data such as battery health, CPU usage, memory usage, and other hardware-specific data that can indicate the overall health and performance of a device such as a laptop. With more precise knowledge of each laptop's hardware component, ICT staff can make more precise and intelligent pre-maintenance, refurbishment and recycling decisions, and even use AI's capabilities to perform predictive maintenance. The data for decision-making (automated or not) is collected from all phases of the product lifecycle and can be used to optimize design, production, use, and disposal, as each specific component in the device has a different design lifespan and actual usage scenario. However, the usage data generated by users will contain some personal data, raising concerns about potential user privacy issues.

The General Data Protection Regulation (GDPR) (Document 32016R0679, EUR-Lex, 2016), enforced since 2018, applies anywhere in the world as long as the data subject is an EU citizen. It mandates that technology companies adopt greater transparency in their data-sharing practices. GDPR is facing two challenges. First, the complexity of privacy agreements may deter the comprehension of users due to the intricate legal language and extensive terms, leading to uninformed consent. Therefore, many users give consent without truly understanding or do not consent because they do not understand the privacy policies Choi et al. (2018), which is also called blind consent. Second, many users seek clarity on how their personal information, once shared, can contribute to the development of the CE and require motivation to share data that can participate in this system. In order to solve these problems, several studies have contributed to using visualizations as a tool for improving the informed consent awareness and comprehension of individuals. Rossi and Palmirani (2017) highlighted the need for clear language to reduce confusion, including the terms in privacy policies and consent requests. Kitkowska et al. (2022) propose designing interactive visual elements that can increase users' engagement and comprehension, suggesting further optimization for better user experience. Holzer et al. (2020) introduced digital nudges such

as prompts and notifications to increase user awareness. Kurteva (2023) further explore informed consent request visualizations in combination with incentives to increase consent rates and raise awareness of sensor data sharing in smart cities. To summarise these studies offer insights on how to ease users' comprehension of consent and raise awareness of data sharing in various use cases.

Despite the diverse use cases the existing research addresses, there is a lack of research on visualising consent for data sharing for the CE. This project, motivated by the Circular Resource Planning for IT (RePlanIT) (RePlanIT, 2022) project, aims to bridge this gap by developing interfaces and enhancing the user experience iteratively for research staff at TU Delft in the context of ICT sustainable device management. The project focuses on improving users comprehension of data sharing through visual privacy explanations and raising awareness of privacy risks and sustainable benefits. It also aims to foster a willingness to review explanations and consent to data sharing for the circular economy. The project's main goal is to raise awareness among the research staff about the data needed for sustainability and to promote a sustainable ICT service by increasing transparency and providing incentives for data sharing for sustainability purposes. The expected outcome was the development of user interfaces that graphically represent consent requests and their relation to the circular economy processes within TU Delft, thereby promoting sustainability within the TU Delft community.

1.2 Project Problem Definition, Scope, and Main Objectives

Problem Definition

The challenge of ICT data sharing for sustainability lies in the complexity of consent requests and the lack of awareness of the contribution of data sharing for the users. The intricacy of legal language in privacy agreements often leads to blind consent, while the absence of clear communication about how data sharing contributes to sustainability hampers user participation. This project aims to address these challenges by focusing on the research staff at TU Delft, who are the users and are provided with laptops for working.

Scope

The scope of this project, as shown in Figure 1.1, is defined in response to these two challenges, the complexity of the consent request and the lack of awareness of the contribution for data sharing. The project's aim is to enhance both the awareness and willingness of research staff to share data, thereby contributing to the advancement of CE. To achieve this, the project will concentrate on improving the understandability of privacy explanations, raising awareness of privacy risks and sustainable benefits, and fostering a willingness to review explanations and consent to data sharing for CE. The exploration of user interface design and gamification as strategies to enhance these focus areas also falls within the project's scope. However, the design of a data collection system, backstage actions, and securing informed consent from external organizations such as manufacturers fall outside the project's scope.

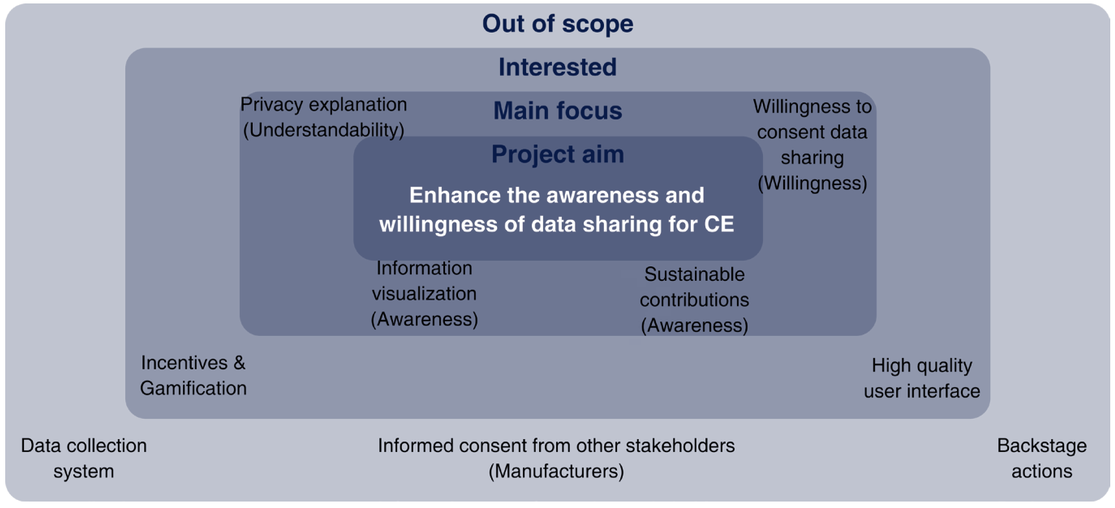

Figure 1.1 Project Scope

Main Objectives

As elaborate in the project scope, this project focuses on the creation of a visualization tool (in the form of a UI) as a medium of communication for informed consent request for data sharing, with the aim of promoting sustainability within the TU Delft community. The expected outcome is the development of UIs that graphically represent consent requests and their relation to the circular economy processes within TU Delft. The main goal is to raise awareness among the research staff about the data needed for sustainability and to promote a sustainable ICT service by increasing transparency and providing incentives for informed consent. An interactive demonstration of the interface is created for the final evaluation, providing valuable insights into the interplay of data privacy, user experience, and sustainability within ICT services.

1.3 Research Questions and Sub-Questions

For further contextual research and determination of design directions, the research questions (RQ) are defined as:

RQ1: How can we increase the research staff's awareness of personal data in data sharing within the context of CE in ICT service and personal data privacy at TU Delft?

To ensure a focused and effective approach, the sub-questions are identified:

RQ1.1 What is the current status and future development of ICT services' sustainability? (addressed in Chapter 4)

RQ1.2 How do researchers use and dispose of laptops from TU Delft? (addressed in Chapter 5)

RQ1.3 What are the consent behavior of research staff while using university-owned laptops? (addressed in Chapter 5)

RQ1.4 How can the consent request form be displayed in a more transparent and user-friendly manner for research staff so that it increases their awareness of data sharing? (addressed in Chapter 8)

RQ2: What incentives are most suitable for the research staff to willingly share data from their device for the advancement of sustainable practices within the organization?

To ensure a focused and effective approach, the sub-questions are identified:

RQ2.1 How can we highlight the sustainability benefits of consenting data sharing? (Chapter 7.2)

RQ2.2 To what extent are research staff willing to risk their privacy in terms of personal data sharing to support more sustainable ICT services? (Chapter 8)

To summarize, RQ1 focuses on exploring how to increase the research staff's awareness of personal informatiowwwn in data sharing, which was addressed firstly through a comprehensive exploration of the current state of ICT services' sustainability and device management practices (RQ1.1) by interviews with the ICT staff, the service provider in TU Delft. With the overview of the service blueprint, RQ1.2 and RQ1.3 aim to understand the current situation and the expectations of the research staff. In the evaluation and iteration phase, RQ1.4 focused on the UI design in the aspect of transparency and user-friendliness, finding a solution to enhance the awareness of the research staff.

RQ2 aims to explore strategies to motivate research staff to share their data willingly. This was addressed through the implementation of incentive elements in the user interface design and the evaluation of their effectiveness (RQ2.1). Additionally, the extent to which research staff are willing to risk their privacy for the sake of supporting more sustainable ICT services was investigated (RQ2.2).

These sub-questions allowed for a comprehensive exploration of the motivational factors influencing data sharing behavior and the development of strategies to enhance this willingness.

In conclusion, the research questions aim to address two main areas: increasing the awareness of research staff about personal information in data sharing for ICT sustainability and the circular economy (RQ1), and identifying suitable incentives to motivate research staff to willingly share data for sustainable practices (RQ2). The sub-questions provide a comprehensive exploration of the current state of ICT services' sustainability, device management practices, consent behavior, and the effectiveness of transparency and user-friendliness in consent request forms. They also explored the motivational factors influencing data sharing behavior and the willingness of research staff to risk their privacy for the sake of supporting more sustainable ICT services. By addressing these questions, the project aims to promote sustainability within the TU Delft community through informed and responsible data sharing practices.

1.4 Contributions of the Work

The outcome of this project is a ***prototype of a user interface that could increase the awareness and willingness of TU Delft's research staff to share laptop usage data for the advancement of sustainable practices within the organization***. This data includes information about battery health, CPU usage, memory usage, and other hardware-specific data that can indicate the overall health and performance of a laptop. These interfaces, developed through an iterative design process, incorporate strategies to enhance the transparency and user-friendliness of the consent request form, highlight the benefits of sustainability, and motivate data sharing through gamification elements and incentives. The UI is available at: https://cloud.protopie.io/p/67eddf43de455f8f230d3992.

In addition to the practical output, this project also ***contributes to the academic discourse on data privacy, user experience, and sustainability within ICT services***. It provides valuable insights into the current state of ICT sustainability, user behavior and consent practices, and the effectiveness of various design strategies in enhancing user awareness and willingness to share data. This work, therefore, has the potential to inform future research and practice in this area.

The rest of the thesis is structured as follows. Section 2 presents the theoretical foundation through a literature review. Section 3 introduces the approach and methods of this project. Sections 4 and 5 show the research results and key findings from ICT staff and research staff in TU Delft. Section 6 summarized all the key findings to define the problems within the design goal, design opportunities and design requirements. Sections 7 and 8 explain the design and iteration based on the evaluation results phase in this project. Finally, the last section 9 elaborates on the conclusion within recommendations and future works after finishing this project.

2 Literature Review

This chapter provides a literature review of the theoretical foundations upon which this thesis is based on. It is divided into three main sections. The first section introduces the concept of the CE and the role of Digital Product Passports in assisting reduction. It looks at the life cycle of laptops and the categories of data collection, highlighting the importance of these aspects in the context of sustainable device management. The second section focuses on the GDPR and the challenges of obtaining informed consent for data processing and sharing. It presents tools such as privacy explanations and the Privacy Segmented Index (Westin, 2002) as potential solutions to these challenges. The last section elaborates on the related works of UI design for informed consent and gamification design.

2 Literature Review

2.1 CE and Digital Product Passports

Electronic Waste

The escalating issue of e-waste has become a significant concern in the current era. According to Pont et al. (2019), global e-waste generation is rapidly increasing due to the short lifespan of electronic devices and rapid advances in technology. This surge in e-waste presents substantial environmental and health risks, necessitating the development of effective management strategies.

Circular Economy

The CE concept has been proposed as a viable solution to the e-waste problem. Unlike the traditional linear economy, CE is an economic system that aims to minimize waste and maximize resource utilization (Pont et al., 2019) by implementing strategies such as maintenance, reuse, refurbish, recycle, and molecular decomposition of products. It is about 'closing the loop' of the product lifecycle (Figure 2.1), benefiting both the environment and the economy.

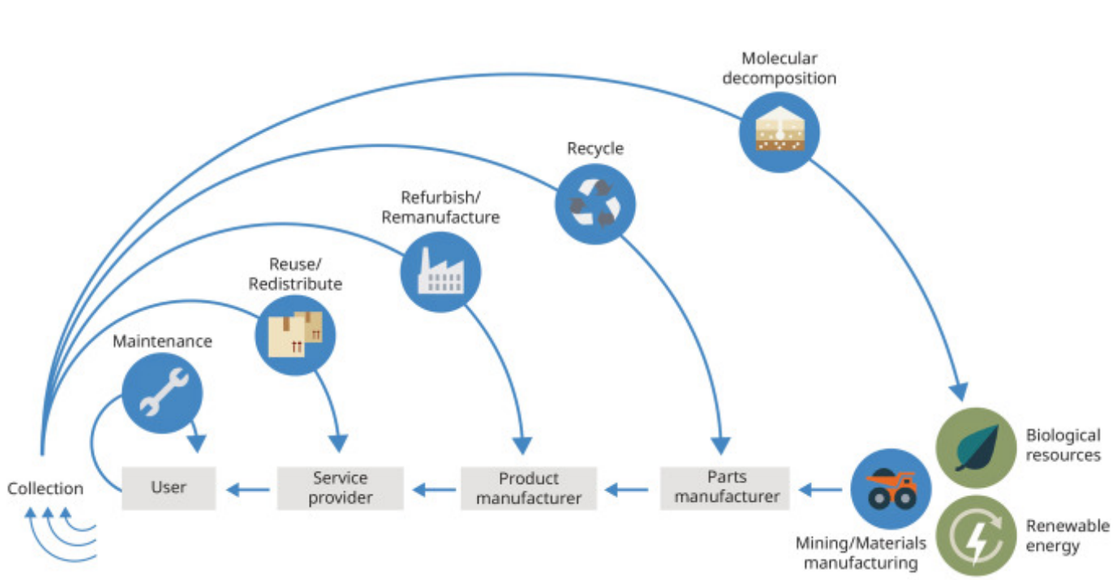

Figure 2.1 Circular Strategies for Products and Materials (Bakker & Balkenende, 2021)

Digital Product Passport

In the context of CE, the concept of a Digital Product Passport (DPP) has emerged as a promising tool for making more intelligent decisions about the product lifecycle. Walden et al. (2021) define the DPP as a dataset that summarizes the components, materials, and chemical substances in a product, along with information on reparability, spare parts, and proper disposal instructions. The data contained in the DPP is collected from all phases of the product lifecycle and can be used to optimize design, production, use, and disposal. The DPP is an important tool to achieve transparency and traceability of a product throughout its life cycle to incentivize sustainable decisions.

However, it is important to acknowledge that the successful implementation of DPPs necessitates multi-stakeholder collaboration and the resolution of several challenges. Therefore, to better achieve CE, the key among these is ensuring data accessibility for repairers, recyclers, and consumers. Other challenges include raising public awareness and addressing data privacy concerns.

2.2 Laptop Lifespan and Data Collections

This project focuses on CE in the field of laptops in the context of TU Delft. The ICT service in the university as the managers and service provider is also the focus of this project, where the most common equipment is the laptops being used by research staff, it is important to understand the lifespan of these devices and the data collected during their use.

Laptop lifespan

Research conducted by Sabbaghi and Behdad (2017) reveals that the design lifespan of most laptop components surpasses their average usage time. This suggests that many retired laptops remain functional. Consequently, a laptop's DPP should include performance data from each functional component (e.g., display screen, keyboard, processor, etc.). This information would enable stakeholders, such as maintenance staff, to make more informed decisions.

Data Collection

The DPP requires usage data from users for several reasons, as described in the research from Plociennik et al. (2022). The collected data can be utilized in several ways to promote sustainable practices and enhance the lifecycle of the product. Some of the possible applications for DPPs are:

- **Product Life Extension:**

The DPP documents all changes made to the product during its use phase, including any parts that have been replaced or repaired. This information can help users extend the product's life expectancy and enable optimal product use.

- **Health and Environmental Safety:**

Frequent product-specific damages and damage to components, especially those that are critical to health and environmental safety, should be recorded. This ensures proper handling of the product and can lead to product optimization.

- **Waste Management Planning:**

Ideally, users will indicate how they intend to dispose of the product when it reaches the end of its life. This information aids in better planning of the CE and better targeting of waste collection campaigns.

- **Product Improvement:**

The usage data, when combined with end-of-life data, can help improve waste management and can be fed back to the manufacturer to facilitate product (re-)design for improved circularity.

- **Understanding Consumer Behavior:**

The usage data can provide insights into the life expectancy of a product, user behavior, and recycling potential. This facilitates economic and CE planning.

However, the usage data generated by users will contain some personal data, which according to Article 4(1) of the GDPR, refers to any information relating to an identified or identifiable natural person. Research by Teltzrow and Kobsa (2004) defines "usage data" as data related to a user's interactive behavior. This can include usage patterns, frequently repeated interactions and other behavioral data. Under the GDPR this data is viewed as personal and needs to be legally processed. This type of data can be used for personalization purposes, but the collection and use of such data can raise privacy concerns. The potential risks associated with using personal data from a device include:

- **Invasion of Privacy:**

Users may feel that their privacy is being invaded if their personal information is shared with other sites or used without their explicit consent.

- **Security Concerns:**

Users are often concerned about the security of their personal information. If this information is not properly protected, it could potentially be accessed by malicious parties.

- **Misuse of Data:**

Personal data could be used in ways that the user did not intend or consent to. This could include targeted advertising, tracking of user sessions, or other forms of data exploitation.

- **Trust Issues:**

The extensive and repeated collection of detailed user data can lead to a decrease in trust in the company or service.

- **Legal Implications:**

Depending on the jurisdiction, there may be legal requirements for how personal data is handled. Non-compliance with GDPR can result in hefty fines. For instance, in 2022, Instagram, owned by Meta Platforms Inc., was fined €405 million by the Irish Data Protection Commission for violating children's privacy by publishing their email addresses and phone numbers. This fine is the second-highest under GDPR, following Amazon's €746 million penalty in 2021 (McCarthy, 2023).

2.3 GDPR and Privacy

As suggested by Jansen et al. (2023), regulations such as the GDPR must be adhered to in the context of the Digital Product Passport (DPP), particularly when personal data is being collected or processed.

GDPR

The GDPR is a regulation in EU law that governs data protection and privacy within the EU and the European Economic Area (EEA). Its primary aim is to enhance individuals' control over their personal data. An individual's informed consent is required to process individual's data under the GDPR lawfully (EUR-Lex - 32016R0679 - EN - EUR-Lex, 2016). The minimum content requirements for '**informed**' consent stipulate that the individual should be aware of the following:

i. The controller's identity

ii. The purpose of each of the processing operations for which consent is sought

iii. What (type of) data will be collected and used

iv. The existence of the right to withdraw consent

v. Information about the use of the data for automated decision-making

vi. The possible risks of data transfers due to absence of an adequacy decision and of appropriate safeguards

Personal Data

The regulation defined personal data as any information relating to a natural person ('data subject') that is directly or indirectly identified or identifiable, including identifiers such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity. (EUR-Lex - 32016R0679 - EN - EUR-Lex, 2016) For a lawful data collection, especially for those related to personal data, consent from the individual is necessary.

2.4 Challenges for Informed Consent

The GDPR has highlighted the presence of several challenges that both organizations and individuals face. A study by Choi et al. (2018) introduced the concept of 'privacy fatigue' or 'consent fatigue', which refers to the tendency of individuals to accept privacy policies without thoroughly reading them. This results in a sense of weariness and a decreased willingness to understand the implications of granting consent for the collection and use of personal information.

The barriers that prevent individuals from thoroughly reading privacy policies are varied and include:

- **Complexity:** Privacy policies can be lengthy, complex, and full of legal terminology that makes them difficult to understand.
- **High-frequency consent requests:** Individuals encounter privacy policies frequently for each online service.
- **Lack of control:** Some individuals may feel that they have little control over their online information regardless of whether they read privacy policies or not.

Visualization of Informed Consent

In the exploration of UI design for informed consent, several studies have made significant contributions. The study from Rossi and Palmirani (2017) identified underscored the importance of clear and concise language in the UI design, reducing user confusion and improving the consent process, despite the inherent complexity of legal language in consent forms. Following this, a study from Kitkowska et al. (2022), emphasized the use of interactive elements, such as buttons and sliders, to facilitate user engagement and comprehension during the consent process. In addition, its limitation suggested that further optimization could enhance user experience. The third study Holzer et al. (2020) introduced the concept of digital nudges, specifically the use of prompts and notifications, to increase user awareness and informed consent. This design significantly reduced the number of users who agreed to terms and privacy policies without viewing them. However, it did not inherently increase recall among users. Lastly, a study from Kurteva (2023) presented the successful implementation of the CampaNeo Consent Request UI. This design, which used a dark color scheme to minimize distractions and implemented a symmetric grid layout for structuring UI elements, was readily adopted by large online service providers. Moreover, this study also involved incentives with points and a leaderboard. Collectively, these studies provide valuable insights into the design and optimization of UI for informed consent.

2.5 Privacy Explanation and Privacy Segmented Index

Privacy Explanation

Privacy risk explanation is a significant challenge to data sharing. It does not mean a privacy policy, privacy statement, or privacy notice in the usual sense, but the information provided by a system to a user in a specific context clarifies why a privacy-related feature is being used and what its purpose is (Brunotte et al., 2023).

The research from Brunotte et al. (2023) also investigated the important aspects to be considered in privacy explanations from the end-user's sights, shown in Figure 2.2, which is referred in the context research in this project.

Privacy Segmented Index

The Privacy Segmented Index (PSI) is defined by Westin's research (2002) and has been found to be applicable in broader contexts beyond just customers (Woodruff et al., 2014). The individuals can be categorized into three groups, privacy fundamentalists, privacy unconcerned and privacy plagiarisms. The definitions of these groups are as follows:

1. Privacy Fundamentalists:

This group highly values privacy and believes that organizations should not be allowed to collect personal information without solid laws to protect privacy rights. They encourage individuals to refuse to give out personal information when possible.

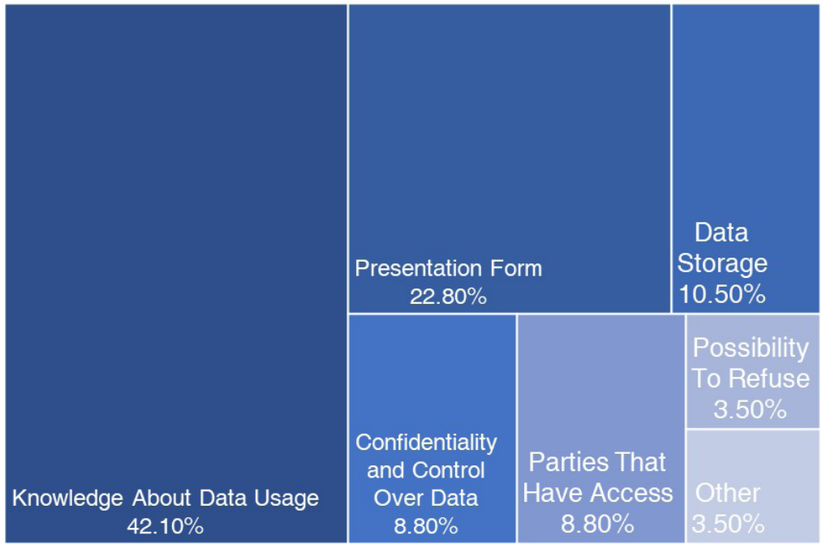

Figure 2.2 Ranking of Requirements of Privacy Explanation

2. Privacy Pragmatists:

This group considers the benefits and risks of sharing personal information with organizations and decides whether to share it based on the situation's specifics. They prefer voluntary standards and consumer choice over government regulations but may support laws if they believe voluntary measures are insufficient.

3. Privacy Unconcerned:

This group does not see the big deal about privacy and is willing to share personal information with organizations without much concern. They do not believe there is a need for government regulation to protect privacy.

2.6 Gamification and Incentives

Behavior change is a complex process, and various strategies have been employed to encourage it. Among these, the use of gamification and incentives has shown promise in promoting sustainable behavior change (Douglas & Brauer, 2021). Gamification, according to the definition from Douglas & Brauer (2021), the application of game design principles to a non gaming context, has been used to promote pro-environmental behaviors.

In the context of this study, these strategies can be used to encourage users to share their data, contributing to the effective implementation of DPPs. However, it is crucial to understand that the effectiveness of these strategies can vary based on the specific context and individual preferences. A literature review of incentives in digital participation from Hassan and Hamari (2019) focuses on the application of various incentive methods to enhance user engagement. It mentions the use of points, leaderboards, user rankings, missions, and achievements as popular gamification elements. However, it also notes that competition can lead to negative behavior between users, such as hyper-competitiveness, bullying, and behavior to break the system for one's benefit. In addition, the research from Tondello et al. (2016) analyzed different user categories from the user's perspective to have preferences for specific forms of incentives. The Hexad Tondello et al. (2016) model identifies six user types: *Philanthropist, Socialiser, Free Spirit, Achiever, Disruptor, and Player*, each associated with distinct motivations.

The research by Kurteva (2023) highlighted the effectiveness of gamification design with points and leaderboards in motivating users through extrinsic motivation to share data in the smart city use case. This aligns with the findings of Douglas and Brauer (2021), who emphasized the application of game design principles in non-gaming contexts, such as promoting pro-environmental behaviors. They noted that gamification principles, including clear progression paths with achievable goals, levels and rewards, player agency, strategy and novelty, feedback, social comparison or competition, and cooperation, can create an environment where individuals are intrinsically motivated to engage with the material related to the desired behavior change. They noted that apps using elements of gamification, such as providing feedback or earning points for behavior, are generally rated more positively by users than apps that attempt to change behavior by providing information alone. They also suggested that gamification can lead to longer-term psychological engagement than other behavior change methods such as nudging.

In the study by Cellina et al. (2019), the researchers utilized a persuasive mobile application called GoEco! to promote sustainable mobility behaviors. The app incorporated various gamification elements such as goal setting, challenges, and a reward system featuring trophies and badges. The app also included a leaderboard to foster a sense of competition among users to maintain user engagement and ensure data collection.

In the case of low-frequency and short-time usage, it is crucial to design gamification elements that can quickly engage and motivate users in this project. This could involve the use of immediate rewards, clear and achievable goals, and feedback mechanisms that provide users with a sense of progress and achievement, even within short usage periods. However, it is also important to note that the effectiveness of gamification can vary depending on the specific context and user characteristics. As such, further research is needed to explore the optimal design of gamification and incentive mechanisms for different usage scenarios and user groups.

2.7 Summary

In conclusion, the literature review has highlighted the growing issue of e-waste and the potential of the Circular Economy and Digital Product Passports to mitigate this problem. However, the successful implementation of these strategies requires careful management of personal data, which brings its own set of challenges. Despite the protections offered by regulations such as the GDPR, there are still significant obstacles to obtaining informed consent from users, such as the complexity and frequency of privacy policies and a general sense of lack of control.

While some tools, such as privacy explanations (Brunotte et al., 2023) and the Privacy Segmented Index (Woodruff et al., 2014), have been proposed to address these issues, there is still a knowledge gap in how these tools can be effectively implemented in specific use cases. This project aims to fill this gap by exploring how these tools can be used to enhance user awareness and willingness to share data in the context of ICT sustainable device management at TU Delft. The use of gamification and incentives, as discussed in Chapter 2.6 and Chapter 2.7, can be a promising approach to motivate users to share their data and engage with the system. However, the effectiveness of these strategies can vary based on the specific context and individual preferences, which calls for further research and exploration.

3 Approach and Methods

This section presents the approach and methods used in this project. The approach is based on the Double Diamond Model (Design Council, 2023), which guides the project through different phases, including context exploration, design and iteration, final evaluation, and reflection and summary. The methods used in this project include semi-structured interviews, questionnaires, the application of the Grounded Theory (Martin & Turner, 1986) for data analysis, and evaluations for design and iterations.

3 Approach and Methods

3.1 Approach

This project adopts the Double Diamond Model (Design Council, 2023) as a guiding framework, as illustrated in Figure 3.1. The Double Diamond Model model, widely used in design and innovation, comprises four distinct phases: Discover, Define, Develop, and Deliver.

In the Discover phase, also referred to as Context Exploration, we employ questionnaires and interviews with two different stakeholder groups: research staff (e.g., Professors, Associate Professors, Assistant Professors, Lecturers, Postdocs, Researchers and PhD candidates) and ICT staff. The goal is to gather insights, understand the context, and identify opportunities for design.

The Define phase involves interpreting and synthesizing the findings from the Discover phase to articulate the design problem clearly. This phase helps set design goals based on the insights gained from user research.

In the Develop phase, also known as Design and Iteration in this project, we use the Agile methodology, known for its emphasis on iterative development and evaluation. This approach allows for continuous refinement of initial concepts based on user feedback. Agile's focus on collaboration and adaptability ensures that the project remains responsive to new insights and requirements (Pakhtusova et al., 2021).

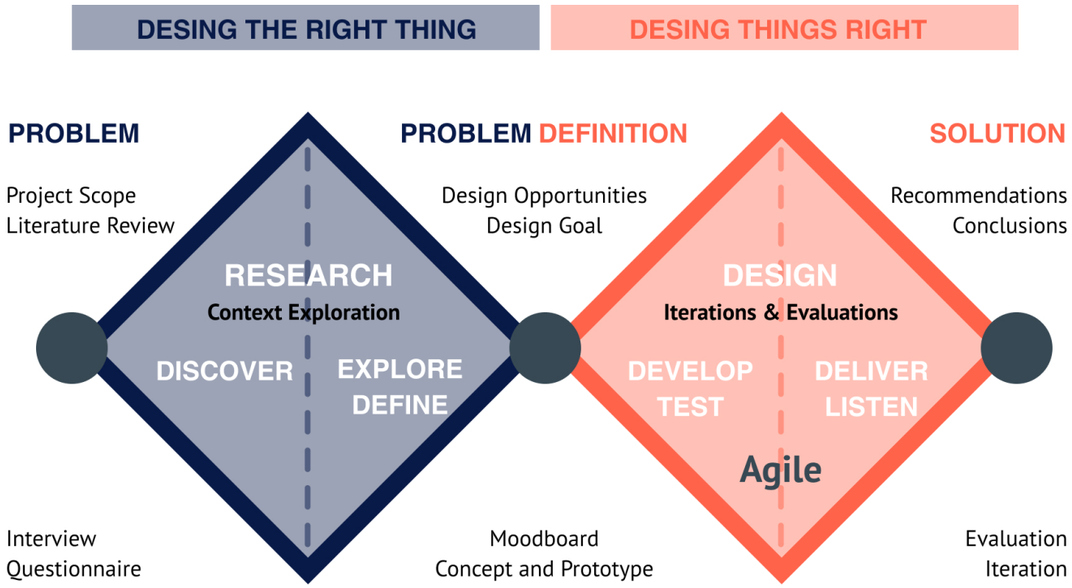

Figure 3.1 Double Diamond (Design Council, 2023)

The Deliver phase, referred to as the Final Evaluation phase in this project, involves the development of the final concept into a high-fidelity interface. This phase includes testing, feedback collection, and refinement of the solution.

The project concludes with the Reflection and Summary phase, where findings are summarized, and potential future work is reflected upon. This structured approach ensures comprehensive exploration of the problem space and iterative refinement of solutions.

3.2 Methods

By following the Double Diamond Model and Agile methodology, this project employs a variety of methods to gather and analyze data. These methods include semi-structured interviews with ICT staff, questionnaires for research staff, and semi-structured interviews with research staff. Each method is designed to address specific research questions and contribute to the overall understanding of the problem space and potential solutions.

3.2.1 Semi-Structured Interviews with ICT Staff

Set up

The ICT staff, who provide the ICT service and manage university-owned ICT devices, represent a significant stakeholder group. Interviews with the ICT staff can provide additional information on the laptops from the administrator's perspective and can address RQ1.1, which seeks to understand the current status of ICT sustainable service and future development.

The interviews began by asking participants about the process of using laptops for the research staff, from requesting the laptops to returning them, and all the related regulations. The participants then discussed the decision-making approach for the lifecycle of the used laptops, the sustainability vision, and related implements or plans.

Given the challenges associated with securing interviews with ICT staff, an alternative method of data collection was devised. This took the form of a questionnaire using open-ended questions that mirrored the structure and content of the semi-interview questions. Posters were strategically placed in the ICT office environment to increase response, which successfully encouraged a subset of ICT staff to engage with and complete the questionnaire.

Participants and Data Analysis

The participants of this stage were members of the ICT staff, who were recruited using crowd-sourcing on a small scale in TU Delft across departments. The data collected from these interviews and questionnaires were analyzed qualitatively, organized, and visualized by using the Service Blueprint tool.

Service Blueprint is a mapping tool used in service design to visualize the relationships between different service components in a specific customer journey, highlighting key touchpoints and potential improvements (Service Blueprints: Definition, 2017). The key findings from this analysis can provide a rich and holistic understanding of the current ICT service delivery and potential areas for improvement.

3.2.2 Questionnaire for Research Staff

Set up

The questionnaire method is used in the context exploration with the target user group, the research staff in TU Delft. The questionnaire aims to address the sub-questions RQ1.2 and RQ1.3, which explore the interaction of research staff with TU Delft laptops and their consent practices. The questionnaire is set in the online platform Qualtrics (Qualtrics XM - Experience Management Software, 2023).

RQ1.2 How do researchers use and dispose of laptops from TU Delft?

RQ1.3 What are the consent behavior of research staff while using university-owned laptops?

The structure of the questionnaire for research staff is shown in Figure 3.2. The questionnaire begins with background information from participants. Then the participants' PSI, a measure of attitudes toward privacy, is investigated. The statements of questions are modified from Westin's research. Participants will rate their level of agreement with the following three statements using a Likert scale of 1 to 7 (strongly disagree to strongly agree):

- S1: Individuals have lost all control over how personal information is collected and used by companies.
- S2: Most businesses handle the personal information they collect about individuals in a lawful and confidential way.
- S3: Existing laws and organizational practices provide a reasonable enough level of protection for individual privacy today.

Participants' responses classify them into three categories: Privacy Fundamentalists (agree with statement 1, disagree with statements 2 and 3), Privacy Unconcerned (disagree with statement 1, agree with statements 2 and 3), and Privacy Pragmatists (other responses).

For RQ1.2, the questionnaire explored the usage and privacy issues associated with university-owned laptops on campus. For RQ1.3, the questions focused on perceptions of future data collection for sustainability purposes and informed consent.

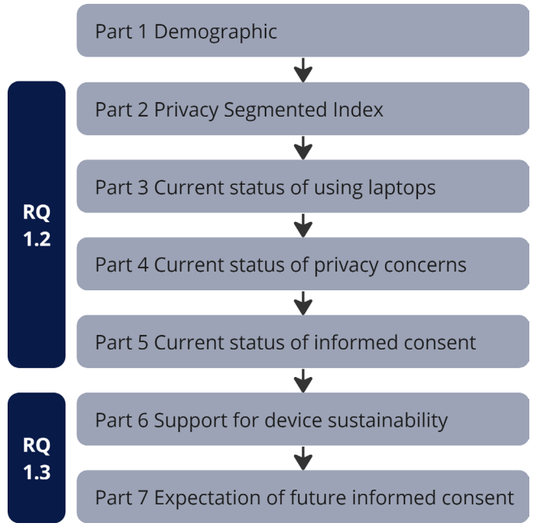

Figure 3.2 Structure of the Questionnaire for Research Staff

Participants and data analysis

The questionnaire was distributed through recruiting emails to the research staff at TU Delft and through posters in the office area of the research staff with the QR code of the questionnaire. The participants were randomly sampled, mainly from the Industrial Design Engineering (IDE) faculty. The results of the questionnaire were analyzed using descriptive statistics, specifically focusing on measures of central tendency and dispersion.

3.2.3 Semi-Structured Interviews with Research Staff

Set up

The semi-structured interviews with research staff aim to further investigate RQ1.2 and RQ1.3. The structure of interviews was organized around three main points: scenarios for using the laptops, consent practices in daily work, and visions for the future of sharing data for sustainability. The scenarios of laptops from the university are presented in the order shown in Figure 3.3: requesting the laptop, repairing the laptop, replacing it with a new laptop, and disposal the laptop.

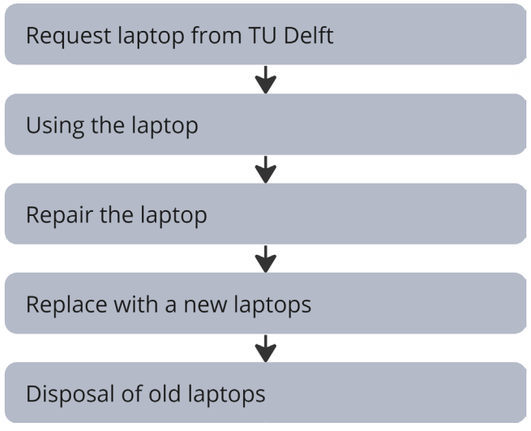

Figure 3.3 Process of Using a Laptop

When discussing consent practices, the interface of cookies settings on the website and software consent requests are shown to the participants (Figure 3.4). The “why” question was used to understand the values and pain points behind the participants’ agreement to the practice.

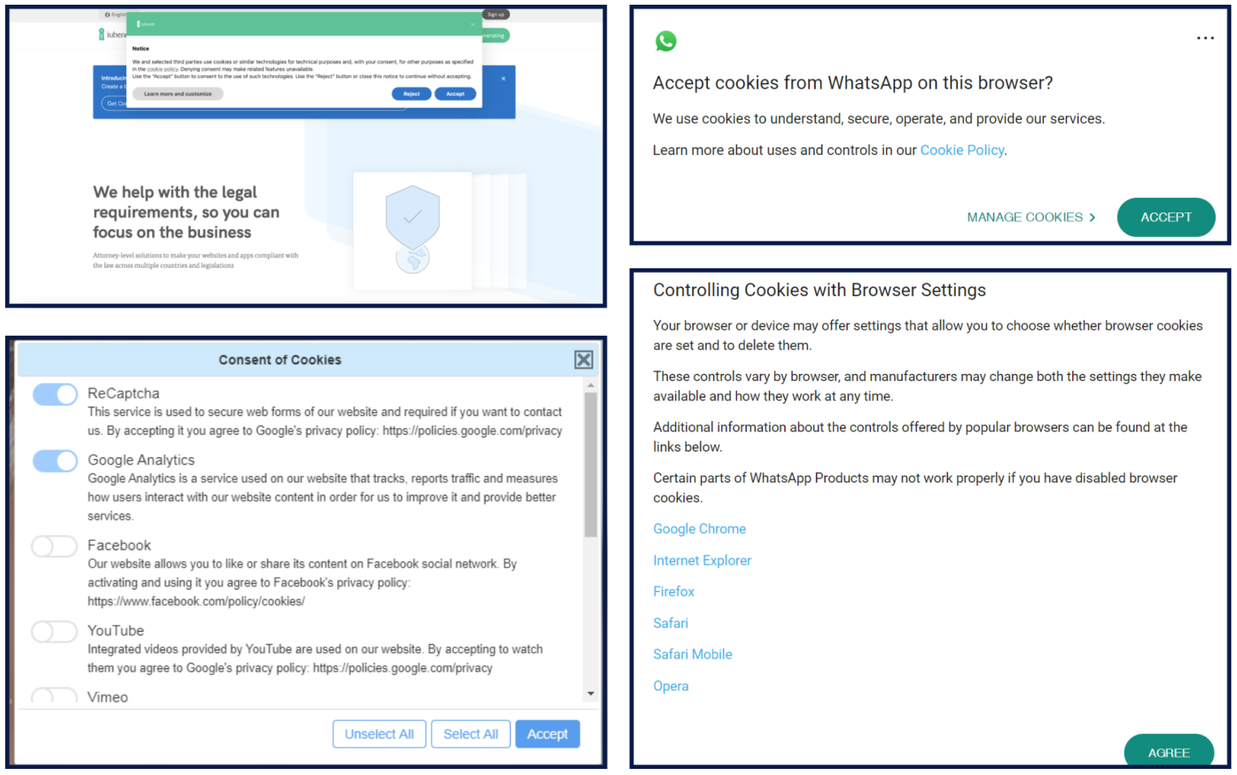

Figure 3.4 Interview Material for Research Staff

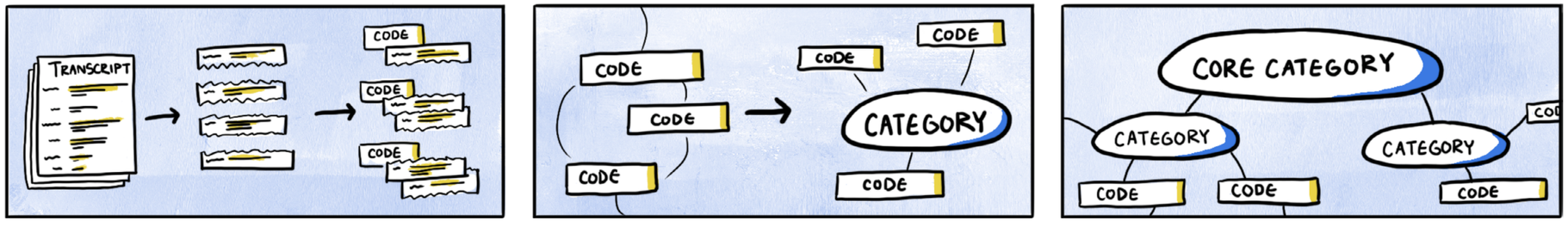

Figure 3.3 Process of Using a Laptop

Participants and Data Analysis

The participants were recruited through the previous questionnaire, and a snowball sampling approach was taken to be able to recruit more participants. The recordings of the interviews were transcript to text by the tool in Microsoft Word. Then the Grounded Theory (Martin & Turner, 1986) was chosen for the qualitative analysis.

Grounded theory is a method for generating theory from data in qualitative research through the collection and analysis of data. It involves three steps of coding: **open coding** (deconstructing and labeling data), **axial coding** (connecting and grouping codes), and **selective coding** (forming a central theme or idea), as shown in Figure 3.5.

Grounded Theory can help user research by finding out what users need, do, feel, and think. It can also help user research by making frameworks or models that can guide design or action. (Moghaddam, 2006)

3.2.5 Evaluations

This project employed a series of evaluations to iteratively refine the design concepts. The Double Diamond Model and Agile methodology were used to guide the project's approach, with the emphasis on iterative development and evaluation. The detailed setup for the three times evaluations can be seen in Chapter 8.

The first evaluation phase involved the creation of three preliminary prototypes, which were evaluated based on usability and alignment with RQ1.4. The prototypes were iteratively updated in response to participant feedback.

In the second evaluation phase, three conceptual prototypes were developed, incorporating different incentive strategies. The Hexad model was used to understand user motivations and design personalized user experiences. The evaluation aimed to assess the validity of the first design iteration and the motivational impact of the second round of design concepts.

The final evaluation was structured around four key objectives: usability, understandability, awareness, and willingness. A high-fidelity solution was developed, amalgamating the strengths of the options derived from the previous design iteration. The final solution was evaluated using the System Usability Scale (SUS) and a Likert scale to assess understandability, awareness, and willingness.

Throughout the evaluations, various methods were used to gather data, including questionnaires, semi-structured interviews, observation, and thinking aloud. The data were analyzed using qualitative and quantitative methods, providing valuable insights for iterative design improvements.

4 Context Exploration (ICT Staff)

This chapter provides an examination of the current status of ICT service in TU Delft, with a particular focus on the role of the ICT staff. The semi-structured interviews conducted allowed for the construction of a service blueprint that illustrates the processes related to sustainability on campus.

4 Context Exploration (ICT staff)

4.1 Results of Semi-structured Interviews

4.1.1 Demographics

A total of four participants were involved in the interviews, each with more than five years of professional experience in their respective fields. The participants included two members of the ICT Innovation Department, one from Central ICT, and one from the Workplace Service (WPS). Their respective roles reflect the wide range of responsibilities and areas of focus within the ICT sector at TU Delft. For questionnaires, there were 15 ICT staff who filled in some of the answers to questions, from different sections of the ICT department.

4.1.2 Current Status of Laptop Sustainability

Figure 4.1 provides a comprehensive overview of the laptop management process at TU Delft from the perspective of the ICT department. The most prominent sustainability aspects in this process are repair, reuse and recycling. The researcher's touchpoints are mainly online, by submitting the request on a self-service platform provided by the ICT service.

Request process

The process begins with research staff selecting laptops based on their individual needs from a range of models offered by ICT. Once the laptops have been set up by Workplace Service staff, they are picked up either from the ICT office or through the department secretary.

It is worth mentioning that The purchase of laptops is dependent on departmental funding, resulting in the reuse of the used laptop from previous staff where appropriate.

Repair

All laptops provided to the research staff have a four-year warranty. Throughout this period, the laptops can be repaired either in-house by the ICT staff or by an external party. However, the decision between repair and replacement is determined by a cost-benefit analysis. In many cases, ICT service opts for a new laptop instead of replacing costly parts such as screens or motherboards.

Replacing the laptop

After the lifespan of a laptop, the ICT service sends a notification to the research staff to replace their old laptops. The research staff can request a new laptop from the updated list of models on the online service platform. An overlap period is allowed for the return of the old laptop, but there are no binding regulations in place that mandate the return of old laptops.

Service Blueprint

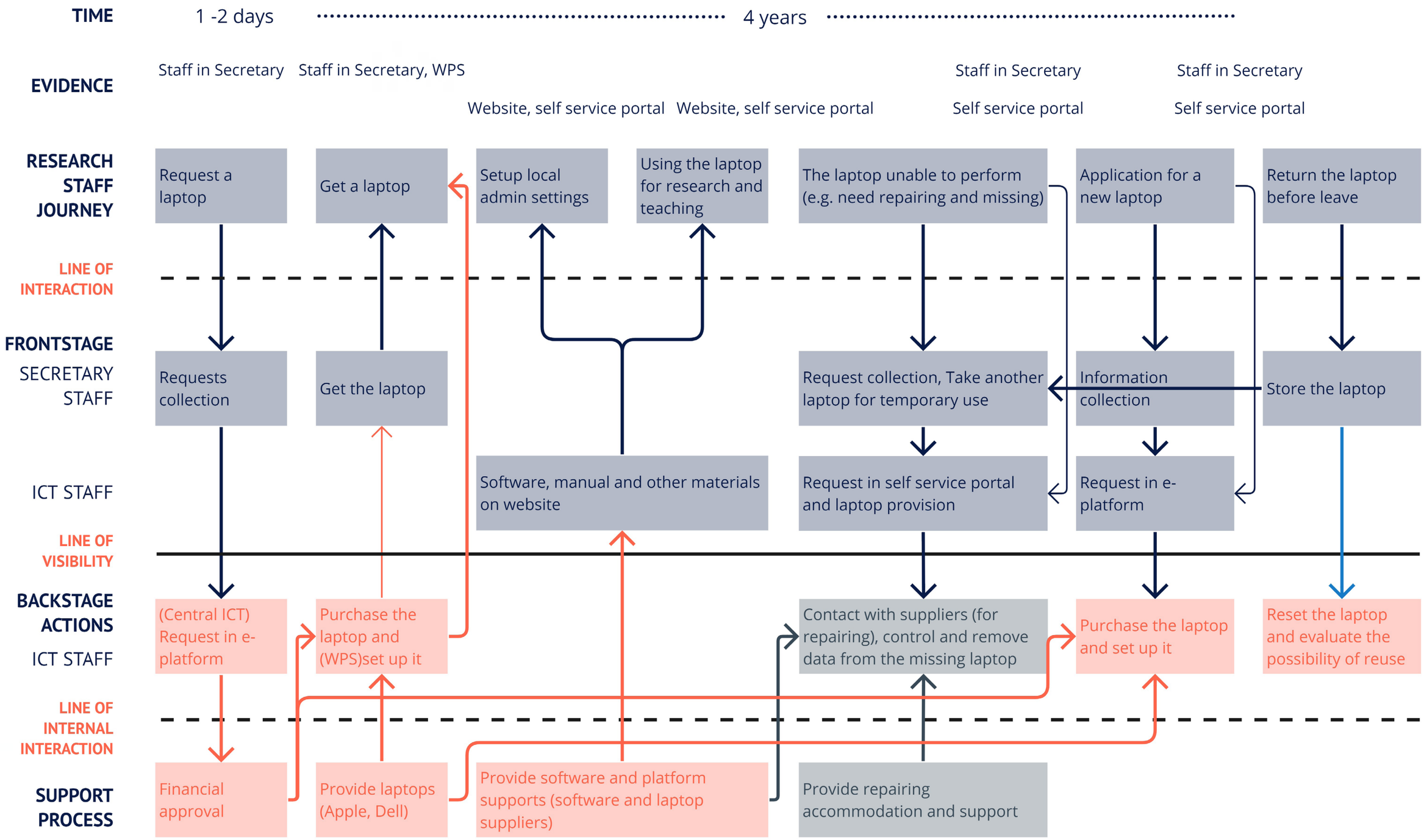

Figure 4.1 Service Blueprint for Laptops in TU Delft

Data collection

Currently, there are no specific initiatives or plans for data collection related to laptops within the ICT sector, and comprehensive device lifecycle management has not been put in place. In addition, when it comes to informed consent, many administrative data collection activities are not individually described, and explicit consent is not specifically sought in the relevant processes, effectively implying a default consent. For the research staff, there is a dedicated website with a general privacy statement (Privacy Statement, 2022).

4.1.3 Future Expectations

According to the ICT staff, all ICT equipment will be replaced periodically and the replacement equipment will be sold to recycling companies and the funds will be used to contribute to the construction of ICT equipment in Africa. The ICT Department also plans to organize activities to encourage research staff and students to donate used electronic equipment to participate in this project.

Although there are no plans to collect hardware data for sustainability, the ICT department plans to build a robust external defense system for organizational information security. This will require the identification of specific privacy statements and informed consent request forms designed to be understood and actively participated in this new system by research staff.

4.2 Key Findings

- **Online functional UI:**

Currently, there are no initiatives or plans for laptop-related data collection thus complete device lifecycle management has not been established. Given that most of the touchpoints for ICT services are online, it is crucial that the online interface is user-friendly and intuitive, enabling efficient service requests and interaction for the research staff.

- **Informed Consent:**

In order to prevent blindly giving consent for a more transparent and trustworthy data-sharing implementation, users need to be made to understand the context information related to data sharing, such as the purpose of using the data, the category of using the data, and the sustainable benefits of data sharing. In addition, the privacy explanation section needs to be easy to understand and assuage the research staff's concerns about the newly implemented data collection.

- **Efficient request processes:**

Although sustainability is one of the development goals of the ICT department, the ICT service is more focused on the efficiency of the research staff. Therefore, the design needs to keep the process concise.

- **User scenario definition:**

According to the service blueprint, the user scenario can be defined as three main scenarios, repair by the external companies (repair), use of refurbished laptops (reuse), and return to the ICT department (return), for the following design. Other related processes are not visible to the research staff. These three scenarios can phrase the questionnaire and semi-structured interview with the research staff.

5 Context Exploration (Research Staff)

In this chapter, we delve into the heart of our research - understanding the behavior and consent practices of the research staff at TU Delft. We aim to gain insights into how researchers use and dispose of their laptops, and their attitudes towards data sharing and privacy. This understanding is crucial as it forms the basis for our user interface design and strategies to enhance data sharing for sustainability.

5 Context Exploration (Research Staff)

5.1 Results of the Questionnaire

5.1.1 Demographics

A total of 23 researchers participated in the survey, ranging in age from 25 to 64. The majority of participants (16 of 23) were in the 25-44 age range. The participants' job titles were diverse, with 12 individuals being PhD candidates and 8 being senior research staff, including professors and assistant professors. Regarding their educational background, it was noted that 6 participants had a background in ICT or IT-related fields.

5.1.2 Privacy Segmented Index

In the second part of the survey, participants were asked to rate their level of agreement with three statements related to privacy concerns. Using factor analysis and K-means clustering, participants were classified into three groups. The largest group (56.52%) was classified as privacy pragmatists, while 17.39% were privacy unconcerned.(Figure 5.1)

In the additional questions, only three participants indicated that they were aware of the existence of privacy regulations and mentioned the GDPR.

5.1.3 Usage of Laptops in TU Delft

Most participants reported using their university-provided laptops for more than a year, with ten people using them for more than three years. Apple was the most popular brand, with 56.52% of participants using laptops with the iOS system, while the remaining participants used laptops with Windows systems from Dell and HP. Participants reported choosing their laptops based on their usage habits.

All participants were aware that their laptops contained some of their personal and sensitive information, with the categorization of data shown in Figure 5.2. The top three categories are browser history, browser cookies, and local files, with percentages of 25.93%, 23.46%, and 23.46%, respectively. It is interesting to note that only 9.88% of the responses mentioned that the performance monitor data contains their personal data.

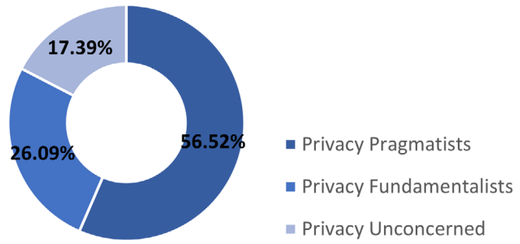

Figure 5.1 PSI of Participants

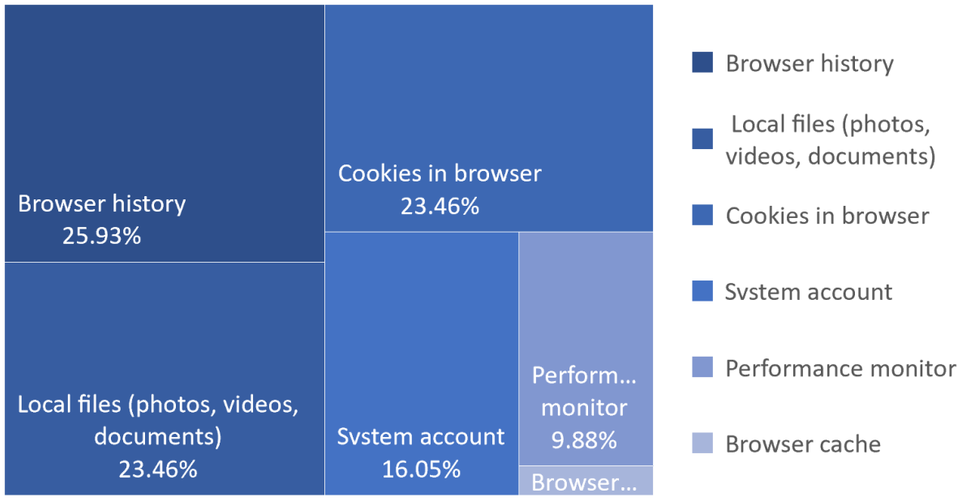

Figure 5.2 Ranking of Privacy Concerns for Data Categories

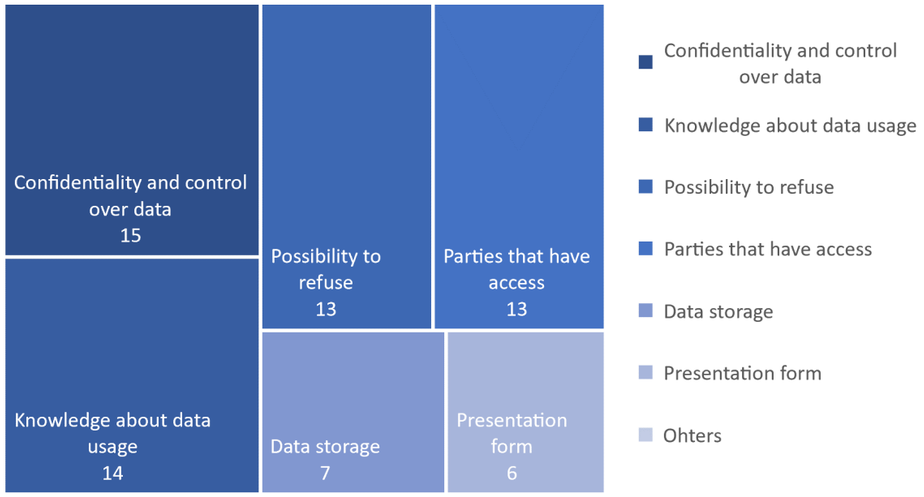

Figure 5.4 Ranking of Privacy Explanation

5.1.4 Privacy Concerns During Repair, Reuse and Return

During the survey, participants were asked to rate their privacy concerns on a Likert scale from 1 to 7 (from strongly disagree to strongly agree) regarding three sustainable scenarios: reuse the laptop by other research staff, repair the laptop by outside companies, and return the laptop to ICT staff in the campus. Participants expressed moderate levels of privacy concerns during these processes. The highest level of concern was reported during the repair process (with ratings ranging from 3 to 6), while the lowest level of concern was reported during the reuse and return processes (with ratings ranging from 2 to 5). The mean scores for these three processes were 3.83, 4.48, and 3.48, respectively. The data indicated that participants were more concerned about privacy risks during the repair process than during the reuse and return processes. (Figure 5.3)

5.1.5 Informed Consent Status on Campus

Only one participant reported having read the privacy policy, terms and conditions, and informed consent regarding data risks from the ICT service of TU Delft for the laptops. The participant's understanding of the agreement was represented by a score of 5 out of 7, suggesting that the contract form reached only a very small portion of the research staff.

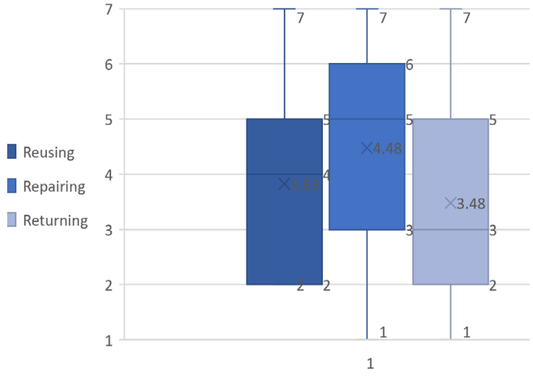

Figure 5.3 Privacy Concern for Three Scenarios (Repair, Reuse, Return)

5.1.6 Future Expectations

Regarding data sharing for sustainable ICT device management, 12 participants were open to the idea, while 6 participants were pessimistic about data sharing.

In addition, more than half of the participants (16 out of 23) agreed that visualization would be beneficial for informed consent. The ranking of privacy explanation elements for visualization is shown in Figure 5.4. The elements that most participants considered critical to include in the visualization were confidentiality and control over data, knowledge of data use, the possibility to refuse, and parties with access.

5.2 Key Findings from the Questionnaire

- **Values from research staff**

Drawing from the literature review, it was found that the majority (approximately 60%) of research staff are privacy pragmatists. In other words, they weigh the risks of sharing personal information against the benefits they may receive. However, further research is needed to understand how these benefits are weighed against the risks and identify their interests.

In addition, for the other two groups of participants, strategies to increase their awareness and willingness in this design case need to be explored in the subsequent design evaluation.\

- **Privacy concerns in three scenarios**

Participants expressed moderate levels of privacy concerns during the sustainable processes of reusing, repairing, and returning laptops, despite being aware that their laptops contain personal information and that data leaks can occur during the product lifecycle. Interestingly, they have more privacy concerns during the repair of the laptop.

- **Privacy awareness**

Only 5 of the participants were aware that the data from the performance monitors included their personal data. The explanation design should strengthen the links between hardware performance data and personal patterns data.

- **Privacy explanation**

Only one participant had read the privacy policy, terms and conditions, indicating the need for a more effective privacy explanation medium.

In addition, 19 of the participants had a positive attitude toward data sharing for sustainability in CE. The design should also strengthen the link between data sharing and sustainability.

Finally, the majority of participants agreed that visualizations such as graphics and icons would be beneficial for informed consent, and the ranking of privacy explanation elements can be referenced during the design phase.

5.3.1 Demographics

Seven people participated in semi-structured interviews, including two postdocs and five PhD candidates. Two of these participants had been using the university laptop for over three years and had fully experienced all three scenarios. These participants came from three faculties: Industrial Design Engineering (IDE), Civil Engineering and Geoscience (CEG), and Mechanical, Maritime and Materials Engineering (3mE). In addition, two had IT-related educational backgrounds and one had work experience in data analysis.

5.3.2 Interview coding tree

The coding results followed the three steps of grounded theory coding. The final coding tree was shaped by the structure of the interviews, which included habits of use, consent practices, and future expectations. Based on the frequency of keywords related to the framework mentioned by these participants, word frequencies were counted and rankings were created to visualize the order of importance type, as shown in Figure 5.5.

Using Laptops in TU Delft

Using scenrio

- Unclear regulations and long-term learning stage (5)
- No informed consent for laptops from TU Delft (5)
- Use laptops for personal things after work (5)
- ICT may be able to monitor/access to this laptop (4)
- Writings, literature reviews and coding works (4)
- Third-party chat software has been installed (3)
- Still trust with this laptop (3)
- Demand for laptops of efficiency and reliable (3)
- The laptop need to physical connected with the network cable connector for update the system (1)

Data management

- Back up data to the cloud regularly (4)
- Local storage with personal information (4)
- Back up data to hard drive (3)
- Delete browser history regularly (3)
- More worried about data loss than privacy breach (3)
- ICT service will remove all the data when provide an old laptop to a staff (1)

Consent Behavior

Habits of consent

- Always choose all accept (5)
- Sometimes choose 'Reject all' (2)
- Sometimes choose 'customize'/'just necessary' (2)
- Never have a look at the cookies (2)
- A quick browse when choosing 'customize' (2)
- Only read several times before (1)

Reasons of 'agree'

- Continue to use the service (4)
- Trust (never heard scandal) (3)
- Saving time and reducing workload (2)
- Loss of trust and control (2)
- Group effect (2)
- No privacy behaviors/data (1)
- No stakes for tech companies (1)
- Hidden options (1)

Reasons of 'disagree'

- Lack of trust (scandals) (2)

Reasons of 'customize'

- Concern of privacy risks (2)
- Rejection leading to unavailability (1)

Reasons of not reading explanation

- Information overload (5)
- Incomprehensible legal terms (4)
- Information is not structured (2)
- Lack of awareness (2)
- Consent fatigue (1)
- Loss of trust and control (scandal)(1)
- Too boring (1)
- Hidden entrance (1)

Future Expectations

Requirements for privacy explanation

- Confidentiality and Control Over Data (4)
- Possibility of rufuse (3)
- Knowledge about data usage (3)
- Parties that have access (2)
- Concise process (2)

Trade-off between 'sustainable' and 'privacy safety'

- Ensure privacy data safety at first (4)
- Willingness to share data for CE (3)
- May refuse, when informed of personal data risks (1)

Figure 5.5 Coding of the Interview with Research Staff

5.4 Key Findings from Interviews

- **Concise request process**

All participants expressed confusion about the request when encountering issues with their laptops. They preferred to seek assistance from their colleagues and the department's secretary to obtain a concise answer and tutorial. Moreover, each participant experienced the three scenarios about once a year on average. Therefore, the design should consider this factor in the design requirements.

- **Consent practices**

Consent fatigue was prevalent among most participants who ultimately chose to give their consent. The main reasons for this were fear of not being able to use the service and complete trust in academic applications. This phenomenon has two effects: First, it leads to the development of behavioral inertia to consent, resulting in default consent when faced with consent requests in other contexts. Second, they skip the step of reviewing specific privacy statements and lack an understanding of data sharing and control over personal data.

- **Privacy explanation**

It is common for research staff to use laptops for personal purposes and to store personal information and documents in local storage. Therefore, when it comes to collecting data for future sustainability device management, they will be very concerned about data security, despite their high level of trust in the university. Therefore, in response to the privacy explanation, participants were more concerned about confidentiality and control over data, the ability to refuse, and some relevant information about data usage. Participants' main problems are information overload and complex legal terms, so they will not read the privacy explanation, which the design should avoid.

Summary and Implications

In this chapter, we have explored the current status of ICT services' sustainability, the usage and disposal practices of laptops by the research staff at TU Delft, and their consent behavior while using university-owned laptops. Our findings have revealed several key insights:

- **Usage and Disposal Practices:**

We have identified common patterns in how researchers use and dispose of their laptops, highlighting areas where sustainability can be enhanced.

- **Consent Behavior:**

Our investigation into consent practices has uncovered challenges in transparency and user-friendliness, indicating a need for improved communication and design.

- **Data Sharing Attitudes:**

We have gained an understanding of the willingness and concerns of research staff regarding data sharing, which will inform our approach to incentivizing participation.

These insights lay the groundwork for the next phase of our project. They have identified specific areas that need to be developed, including the design of user-friendly consent request forms, strategies to increase awareness of data sharing, and methods to motivate participation in sustainable practices.

As we move forward, we will use these findings to inform our design process, ensuring that our solutions are tailored to the unique needs and preferences of the TU Delft research staff. The next section will delve into the design and development phase, where we will translate these insights into practical solutions for enhancing sustainability within the organization.

6 Problem Definitions

This section reviews all the key findings to summarize the scenarios, design goal, design opportunities and design requirements, pointing the way to the following design and iterative phase.

6 Problem Definitions

6.1 Scenario Definition and Data Collections

Three scenarios and detailed data collection for laptops are defined in this part according to the previous research.

Repair

The repair scenario (Figure 6.1) is defined as the research staff wanting to repair their laptops which are still under warranty. The research staff will send the request first and consent to the device data sharing with the ICT service. The ICT staff will check the laptop and make decisions on repair according to the device data. After repair by external companies, the research staff will take the laptop back from the ICT department.

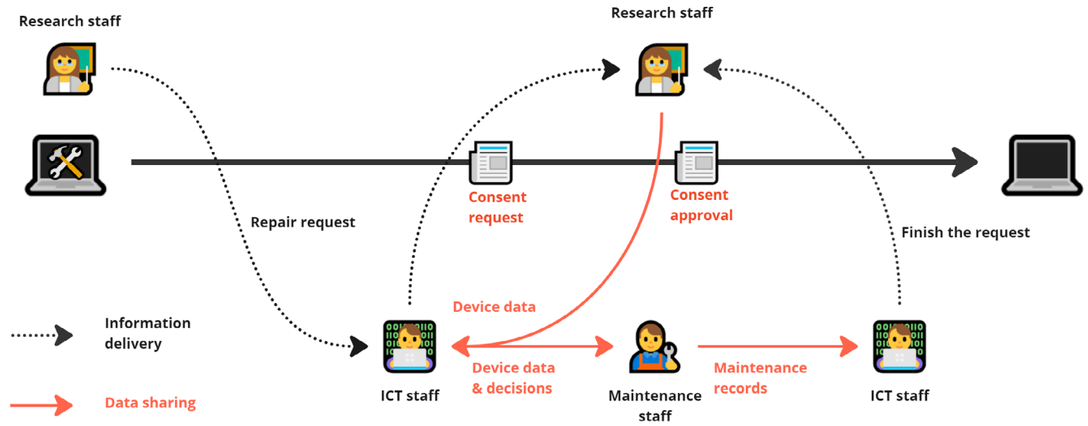

Figure 6.1 Repair the Laptop

Reuse for replacement / Reuse for temporary use

Some research staff have a lower requirement for working laptops, they can require a reused laptop for replacement from the ICT department. The reused laptop means the laptop was already used by other staff before, but it has been returned to the ICT department because of the higher performance replacement or separation. This laptop will be detected and its factory settings will be restored.

In this scenario (Figure 6.2), the research staff will send the request to the ICT service. The ICT service will request their consent for remotely collecting their laptop's hardware performance data.

Compared with the request for a new laptop, this request will be finished much faster. The ICT staff will pull the reused laptops out of storage and set them up accordingly.

In addition, there is another situation. After the request for repair, the research staff needs a laptop for temporary use to avoid stagnating their research. The request processes are the same as in the previous situation.

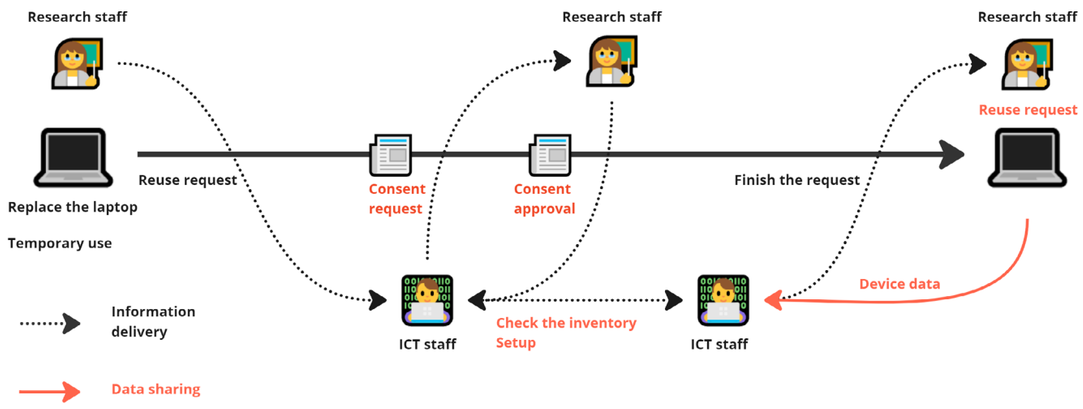

Figure 6.2 Reuse for Replacement / Reuse for Temporary Use

Return

In this scenario (Figure 6.3), the research staff have replaced their laptop with a new one. After some overlapping time for backup and dumping of their data, the research staff will return their laptops to the ICT department. The ICT service will send a consent request for collecting the device performance data from the old laptop. According to the data, the ICT staff can make the decision on refurbishing or recycling it. Refurbishing means the laptop will recover the factory settings and then be reused by other staff. Recycling means the laptop will be sold to a recycling company.

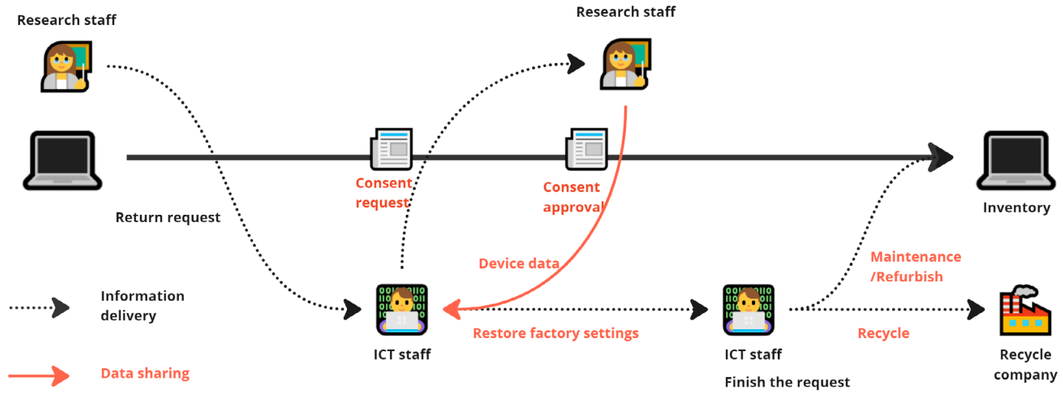

Figure 6.3 Return

Data collection

In the context of this research, certain assumptions are made regarding the categories of data collected from laptops. These assumptions aim to provide a comprehensive and realistic context for the design. With user consent, it is hypothesized that the ICT service will collect the following data to track the components of the laptop. This data will aid in making appropriate product lifecycle decisions:

- Usage time data
- Energy consumption
- CPU performance data
- GPU performance data
- Network traffic
- Software configuration
- Storage Performance Data
- Memory Performance Data

It is important to note that this data could indirectly infer user behavior patterns and even their occupation type, thereby involving personal data. This data will be anonymized to protect user privacy and will be securely stored and accessed only by authorized personnel for the purpose of making informed decisions about the product lifecycle.

6.2 Design Goal

The main goal is to enhance the awareness of research staff regarding data sharing and foster their willingness to consent to data sharing for the advancement of the circular economy when using TU Delft laptops.

The design will be easily **understandable** (will use clear language and visual aids to explain complex concepts) and **trustworthy** (it will clearly articulate how personal data is used, stored, and protected).

6.3 Design Opportunities

User-friendly Online Interface:

Given that most of the touchpoints for ICT services are online, there is an opportunity to design an online interface that is user-friendly and intuitive, enabling efficient service requests and interaction for the research staff.

Informed Consent Process:

There is an opportunity to design an informed consent process that is easy to understand and addresses the research staff's concerns about the newly implemented data collection. This could potentially increase the rate of informed consent and reduce instances of no consent or default consent.

Privacy Explanation:

There is an opportunity to design a more effective privacy explanation medium. This could involve using visualizations such as graphics and icons, which most participants agreed would be beneficial for informed consent.

6.4 Design Requirements

Understandability:

- Transparent data usage

The design should clearly articulate how personal data is used, stored, and protected. This transparency can help research staff understand the implications of their consent and the safeguards in place to protect their privacy.

- Accessible privacy explanations

The design should ensure that privacy policies, terms and conditions are easily accessible and comprehensible. This could involve using plain language, visual aids, or interactive elements to help research staff understand these documents.

Awareness:

- Highlighting the connection between device data and personal data privacy

The design should aim to make research staff aware of the connection between hardware performance data and personal patterns data. This could involve providing examples or scenarios that illustrate this link.

- Addressing Consent Fatigue

The information of the privacy explanation should keep concise and not include some legal terminologies, avoiding no consent or default consent.

Willingness:

- Promoting benefits of laptop data sharing for sustainability purposes

The design should highlight the benefits of data sharing for sustainability in the circular economy. By making these benefits clear, research staff may be more willing to share their data. This part may involve gamifying the process or providing incentives for giving consent.

- Empowering users with control over data

The design should empower research staff with control over their data. This could involve enabling them to select what data they share, with whom, and for what purpose. By providing research staff with more control, they may be more willing to participate in data collection.

7 Design Development

Chapter 7 delves into the design and development phase of the user interface for sustainable ICT services at TU Delft, addressing RQ 2.1: 'How can a user interface be designed to facilitate data sharing and consent requests for sustainable ICT services at TU Delft?' This chapter outlines the design principles, process, and the final interface prototype. It provides a comprehensive overview of the design decisions and their rationale, offering insights into the creation of an interface that promotes data sharing, consent requests, and sustainability.

7 Design Development

7.1 UI Design Version 1

7.1.1 Consent Request Process for Research Staff

The request process follows the scenario definition, as shown in Figure 7.1. To prevent users from blindly consenting to data collection, the data sharing page will appear after the request submission is complete and the progress of the request is displayed.

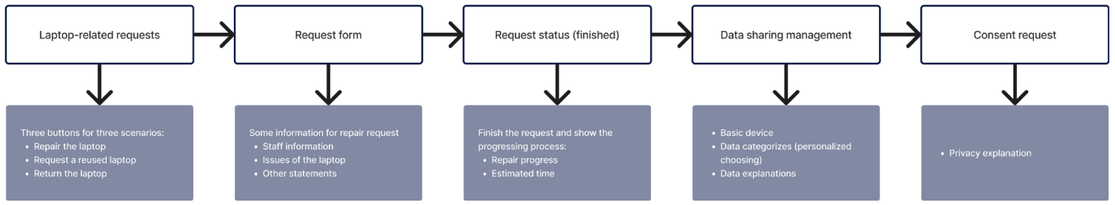

Figure 7.1 Request Process for Sustainable ICT Service

7.1.2 Information Visualization

The information that needs to be displayed on the interface (Figure 7.2) is categorized into laptop details, repair progress, consent request, data categories with explanations, and potential requirements. Based on previous research, the potential requirements from the user include the benefits of data sharing, structured information layout, concise information, and understandable terms.

An article (Flat Vs. Deep Website Hierarchies, 2013) contrasts flat hierarchies, which have more categories and fewer levels, in comparison to deep hierarchies, which have fewer categories and more levels. Flat hierarchies can make content more discoverable but risk overwhelming users with too many options. Deep hierarchies can make content easier to scan but may hide specific content under multiple layers. The article suggests that the optimal hierarchy depends on the specific needs of the audience and recommends usability testing, analytics, and search logs to understand these needs.

In terms of interface elements, there are many different ways to implement these two structures. Through the case in the mood board (Figure 7.3), I summarize the interface elements into flat information, floating window information, and external link information. They have different advantages and disadvantages and need to be tested in practice.

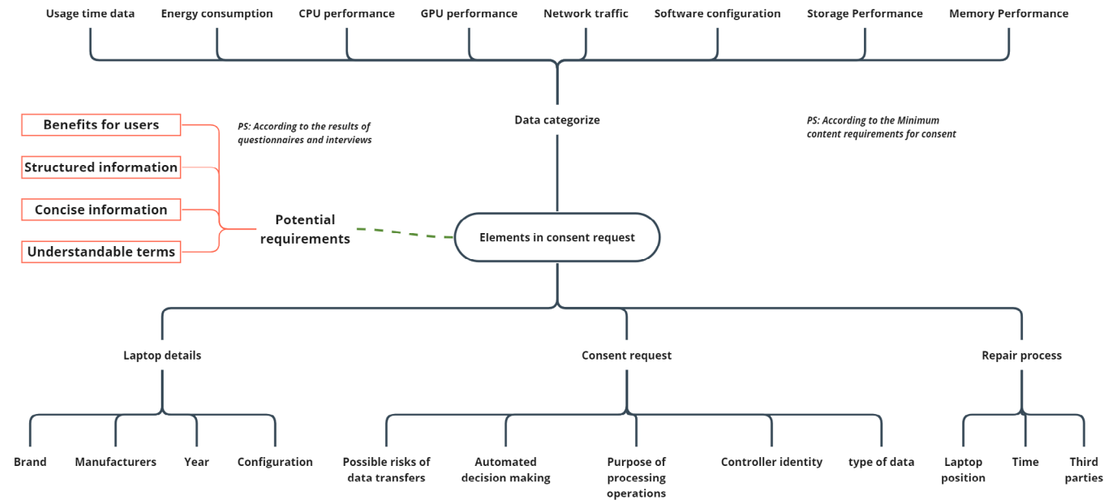

Figure 7.2 Information in the User Interface

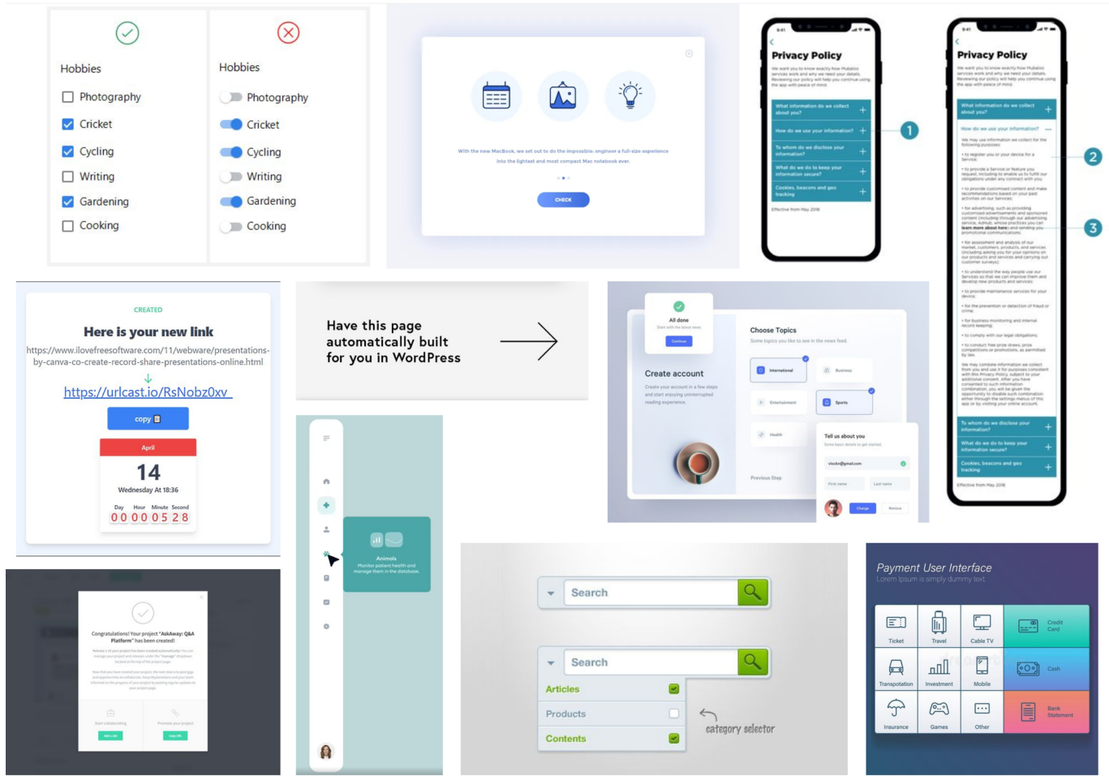

Figure 7.3 Moodboard for Information Visualization

7.1.3 Concepts for Design Version 1[1]

Three concepts were generated in the first design phase in low fidelity, each with different information prompt methods for observing the user's behavior during the evaluation test. The overview of the first concept is shown in the interface wireframe (Figure 7.4).

After submitting the repair request, Concept 1-1 (Figure 7.5) provides the user with an introduction to data sharing for sustainability at first glance. It then uses an external link to direct the user to the details page to control the shared data after the user completes the repair request. In addition, the data detail page uses a checkbox to allow users to personalize the data they want to share, with a very concise explanation. After confirming the data collection, the user is redirected to a dedicated consent request page to complete the process.

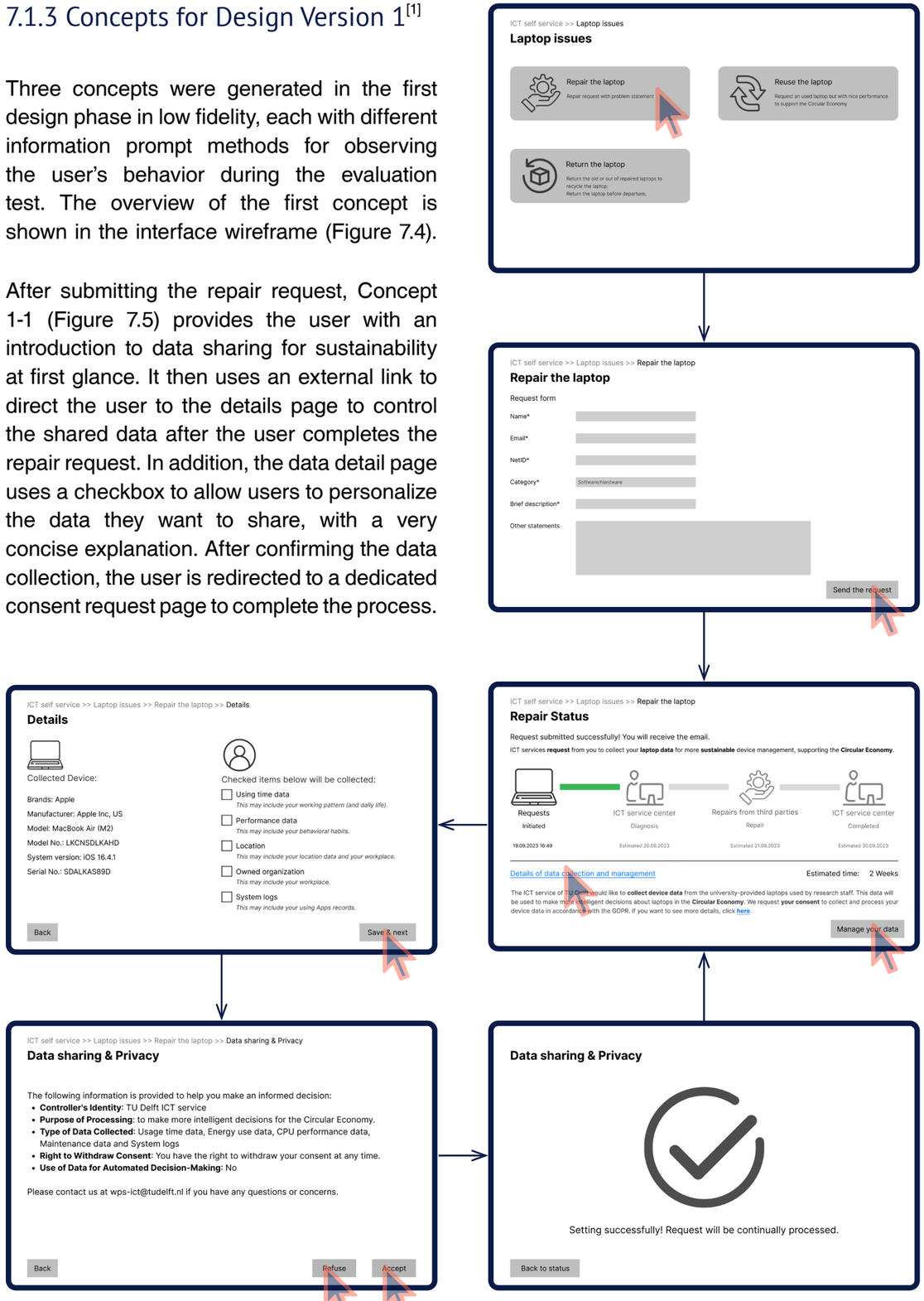

Figure 7.4 Interface Wireframe of Concept 1-1 (Prototype Overview)

The main difference between the solutions lies in two key pages, the data-sharing management page and the consent request page. Concept 1-2 (Figure 7.5) does not provide an introduction to data sharing on the submitted page, but a button named “manage your data” to raise the users’ attention. The page of data management provides a more detailed explanation of each data explanation, using an expanded bar that the user can click to expand and make their decisions. The consent request is placed on the right side, with a button to accept or decline at the bottom.

The unique feature of Concept 1-3 (Figure 7.6) is the use of mouse hover triggers for each data explanation with icons. In addition, the consent request is triggered by hovering over the information icon next to the title for understandability.

These concepts aim to provide a user-friendly and intuitive interface for users to understand and manage their data-sharing preferences. The different methods of information presentation and interaction are designed to cater to different user preferences and behaviors and will be evaluated through user testing to determine the most effective approach.

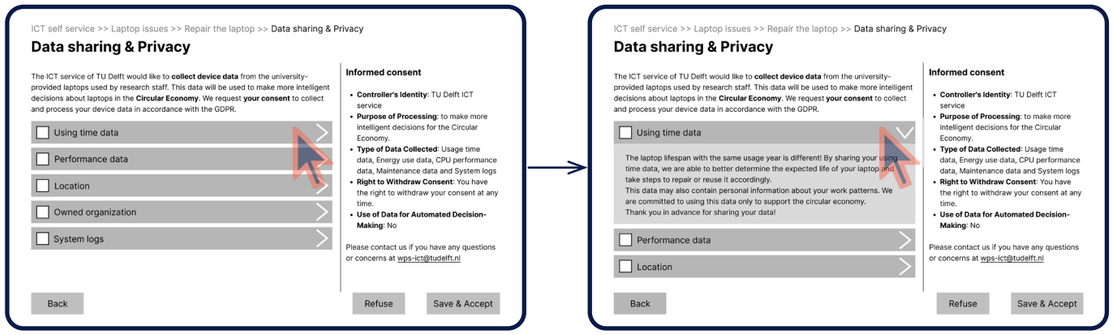

Figure 7.5 Concept 1-2

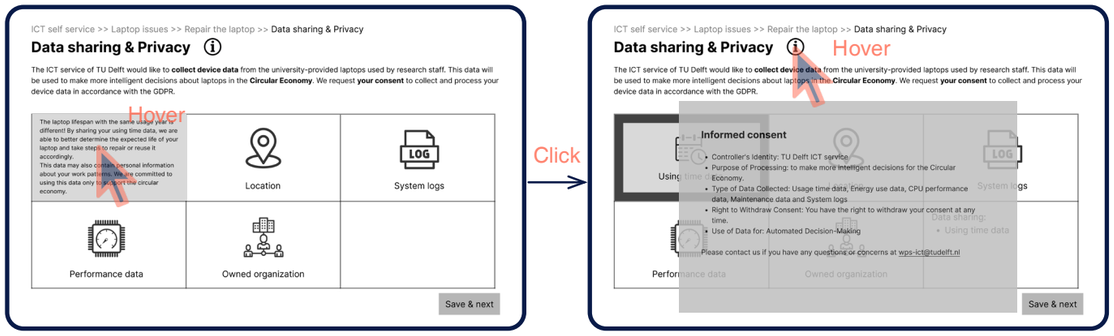

Figure 7.6 Concept 1-3

[1] The link of version 1 (Three concepts): https://www.figma.com/proto/F6ch86Dh3aG2TJOhmnsY7g/Version-1.0?page-id=0%3A1&type=design&node-id=1-172&viewport=612%2C613%2C0.13&t=LxCJvxj6hhNDkHPs-1&scaling=min-zoom&starting-point-node-id=1%3A17-2&show-proto-sidebar=1&mode=design

7.2 UI Design version 2

Based on the results of the first round of evaluations, users need to understand how data sharing relates to sustainability and the benefits to them personally. So in this conceptual design round, an incentive design was introduced. This section attempts a possible solution, exploring RQ2.1 and evaluates the effectiveness in the subsequent section 8.3.

RQ2.1 How can we highlight the sustainability benefits of consenting data sharing?

7.2.1 Incentives Design

By collecting examples of user interfaces with motivation, moodboard was built as a reference for this round of concept design (Figure 7.7). Several incentives design elements were selected, such as virtual farming, feedback progress bar, storyboard, badges, tasks and leaderboards.

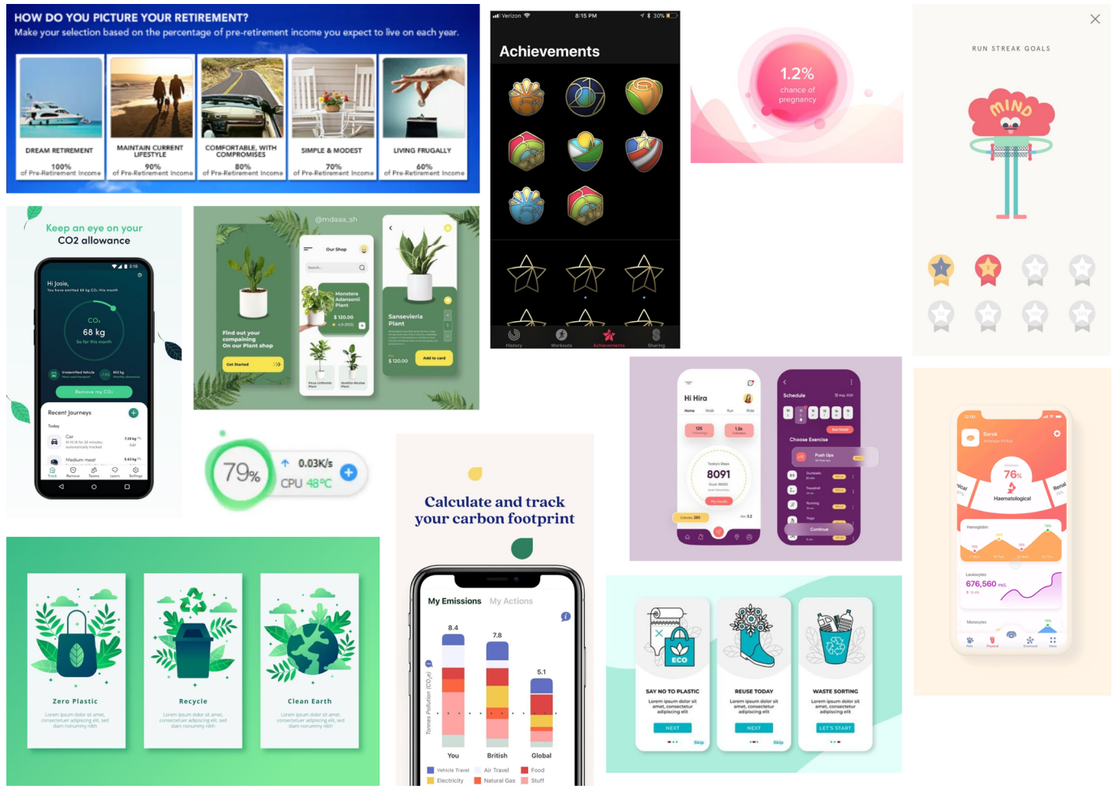

Figure 7.7 Moodboard for Incentives

7.2.2 Concepts for design version 2[2]

All concepts are based on the iterated process from iteration designs 1 (chapter 8.2). However, the layout was adjusted on the data management page, the incentive design element was added. The complete interaction flow chart is shown in Figure 7.8.

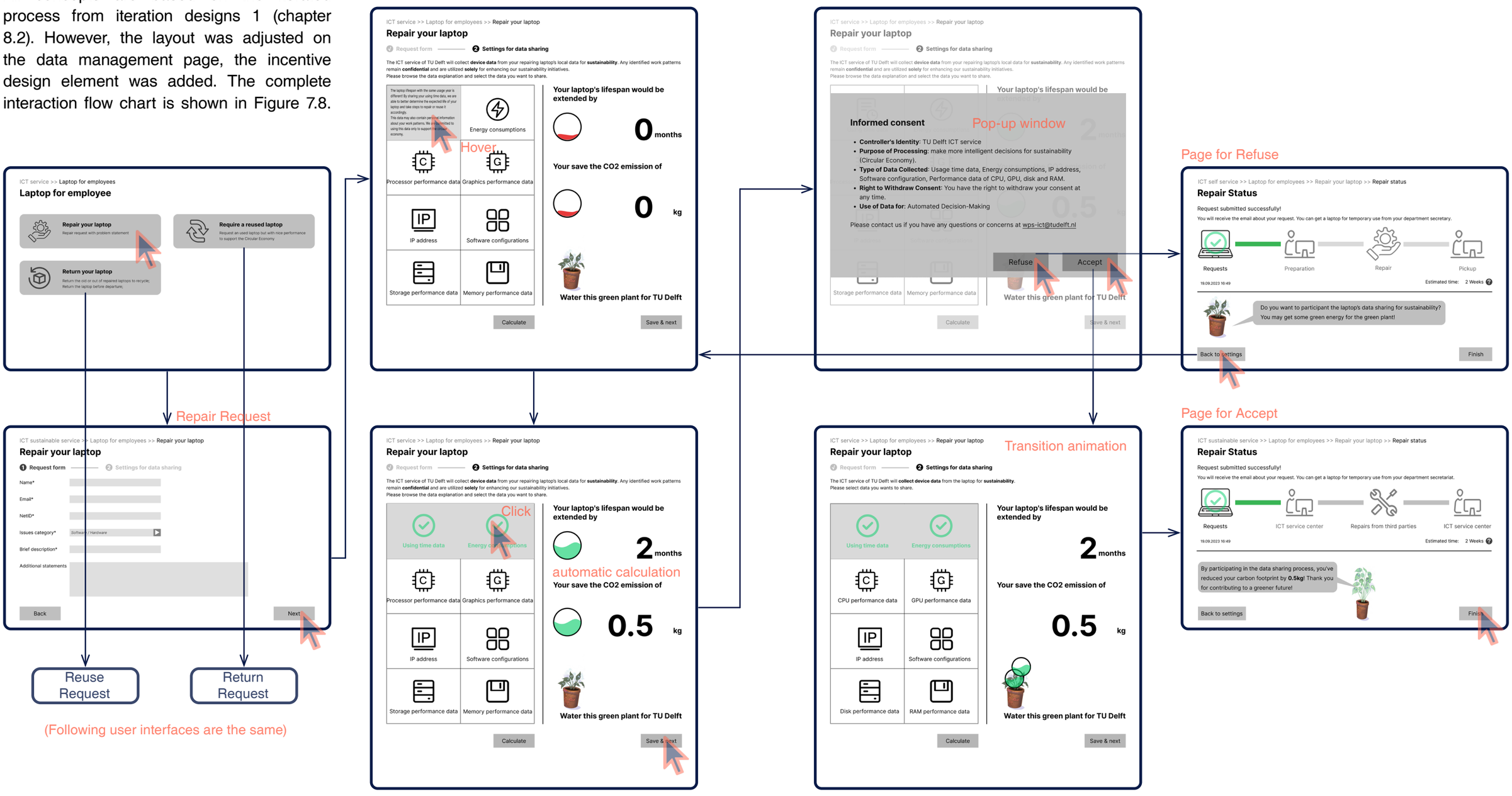

Figure 7.8 Interface Wireframe of Concept 2-1 (Prototype Overview)

[2] The link of version 2 (Three concepts): https://www.figma.com/proto/4b8FprKIgqXfoKSM38SfTn/Version-2?page-id=0%3A1&type=design&node-id=1-1721&viewport=437%2C1006%2C0.05&t=xqgXVZbWZ7uWYtaw-1&scaling=min-zoom&starting-point-node-id=1%3A1721&show-proto-sidebar=1&mode=design

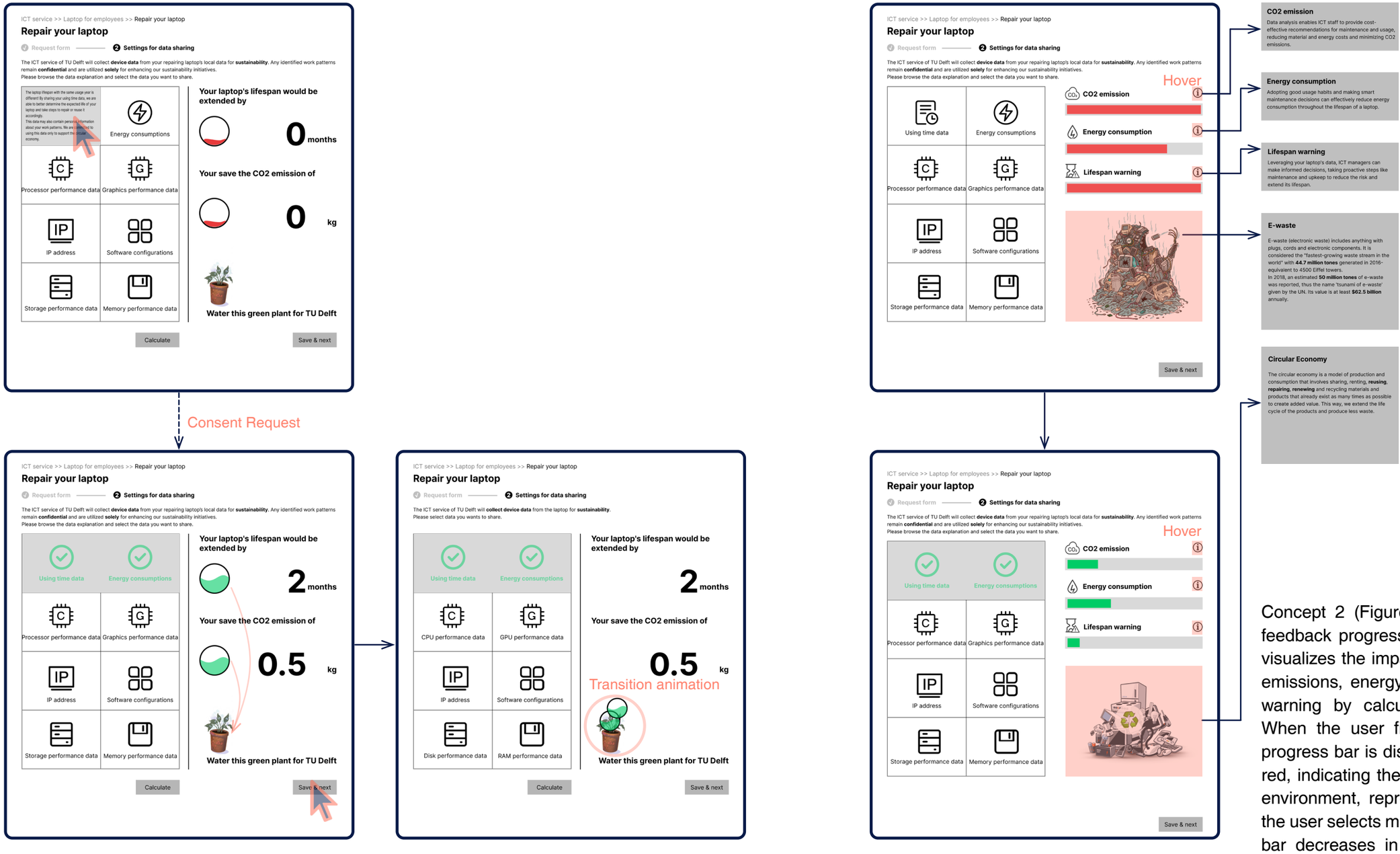

Figure 7.9 Concept 2-1

The first concept uses the incentive of the virtual tree, as from the design of Ali Pay (Zhang et al., 2020). Users select the data they want to share and can learn about the expected impact, including reduced carbon emissions and increased laptop life expectancy, through a “status sphere” next to them. As the user selects more data items to share, the “status sphere” accumulates green energy, which is then used to water the green plants below with informed consent.

Figure 7.10 Concept 2-2

Concept 2 (Figure 7.10) is designed with a feedback progress bar on the right side that visualizes the impact of data sharing on CO2 emissions, energy consumption, and lifetime warning by calculating the user’s options. When the user first jumps to this page, a progress bar is displayed with full progress in red, indicating the current state of the hostile environment, representing an alert state. As the user selects more data items, the progress bar decreases in progress and changes to green, representing a state where the alert has been cancelled. Below the progress bar is also a storyboard with the first illustration depicting the current status and hazards of the e-waste. After the user has selected more than half of the data points, the storyboard appears with a second illustration describing the circular economy. The explanation of the storyboard uses the same trigger as the explanation of the data, i.e., a mouse hover.

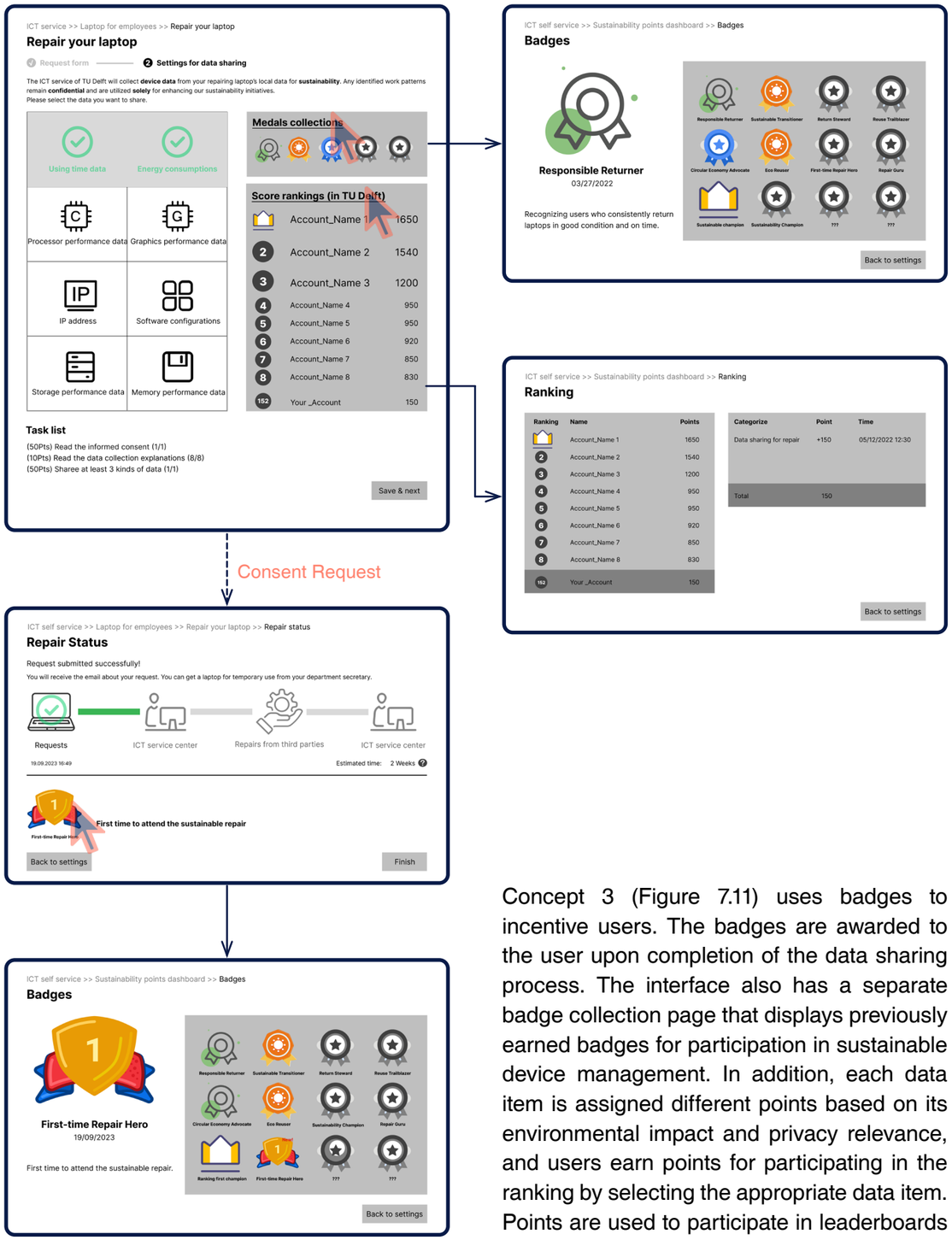

Figure 7.11 Concept 2-3

Concept 3 (Figure 7.11) uses badges to incentive users. The badges are awarded to the user upon completion of the data sharing process. The interface also has a separate badge collection page that displays previously earned badges for participation in sustainable device management. In addition, each data item is assigned different points based on its environmental impact and privacy relevance, and users earn points for participating in the ranking by selecting the appropriate data item. Points are used to participate in leaderboards and special medals are awarded for special rankings. Finally, a task list below each data item guides users as they explore the site. Points are awarded for completing tasks.

7.3 Design version 3 (Final design)[3]

After a second round of evaluation, the final solution used badges, feedback progress bars, and storyboard interactions to incentivize users to share data. In addition, the interface uses TU Delft's official color scheme and layout requirements. The final solution is shown in Figure 7.12.

There are a few more improvements to the concept based on design iteration two. The medals page was added with the option to display the medals on the university's profile page, taking into account the low frequency of use of this interface. In addition, the state change of the feedback progress bar changes color as the user selects more data items, from red to yellow to green. The feedback progress bar also pre-simulates the expected impact of selecting a data item when the user hovers over it.

[3] The link of final design (Protopie): https://cloud.protopie.io/p/67eddf43de455f8f230d3992

Figure 7.12 Final design

8 Evaluation and Iteration

This chapter presents the results of the user testing phase of the research project, addressing RQ 2.2: 'How do users perceive the designed user interface for sustainable ICT services at TU Delft?'. The chapter provides a detailed analysis of the user feedback, focusing on the understandability, awareness, willingness, incentives, and usability of the interface. The findings from this phase are instrumental in evaluating the effectiveness of the interface design and its potential to promote sustainable practices in ICT services. As shown in Chapter 7.1, the evaluation was conducted after the first round of the design phase. After completing the evaluation, the concept will be iterated based on the results and feedback from the participants, in a circle until the final design and evaluation.

8 Evaluation and Iteration

8.1 Evaluation 1

8.1.1 Evaluation 1 Setup

The three concepts in the first design phase (chapter 7.1) were designed to establish a preliminary request process for research staff based on a repair scenario. These concepts were developed using Figma (FigMa: The Collaborative Interface Design Tool, 2023), an interface design software application, and transformed into preliminary prototypes. The primary objective of the first evaluation was to investigate the methods of data collection request and the forms of information display, in alignment with Research Question 1.4 (RQ1.4):

RQ1.4: How can the consent request form be displayed in a more transparent and user-friendly manner for research staff so that it increases their awareness of data sharing?

As part of the evaluation process, participants were assigned tasks to evaluate the usability of each step in the request process, as shown in Table 8.1. Participants were encouraged to use the thinking aloud (Thinking Aloud: The #1 Usability Tool, 2012) method as they explored the interface. Upon completion of the tasks, they were asked to provide an overall rating of their experience and comments on each concept.

All participants were research staff of the IDE faculty by crowd-sourcing on a small scale. The test took 30 minutes in person. Their comments, along with the reasons for not completing each step, were grouped into key points based on frequency. Throughout the first evaluation phase, the concepts were iteratively updated in response to participant feedback, following the Agile methodology.

Table 8.1 Tasks for Evaluation 1

Scenario: Your laptop needs to be repaired. You need to submit a request to the ICT service.			
Tasks	Reasons for not completing		
	Concept 1	Concept 2	Concept 3
Choose one of the requests (repair)			
Fill in the request form			
Browse the request status			
Manage the data you want to share			
Find the informed consent and give consent or not			

8.1.2 Evaluation 1 Results

A total of 5 participants took part in the first round of evaluation. All three concepts presented some challenges for users, preventing them from completing all the tasks. By grouping the participants' comments, the issues for each concept were summarized (Figure 8.1).

For Concept 1-1, most participants overlooked the text related to data sharing for sustainability when there were no additional reminders. Therefore, most of the participants cannot be redirected to the data management page. Moreover, the explanations on the data-sharing management page, while concise and structured, were not detailed enough for all participants, leading to a reluctance to share data.

The expandable bars in Concept 1-2 encouraged participants to view more detailed information about data sharing. However, the two sections on the same page, the privacy explanation of data sharing and the consent request, overwhelmed participants with information. Additionally, users lacked guidance to understand the implications of data sharing.

The hover interaction method of privacy explanation in Concept 1-3, which is triggered automatically when the mouse hovers over the icons, received higher remarks. However, the icon for navigating to the consent request page was consistently overlooked.

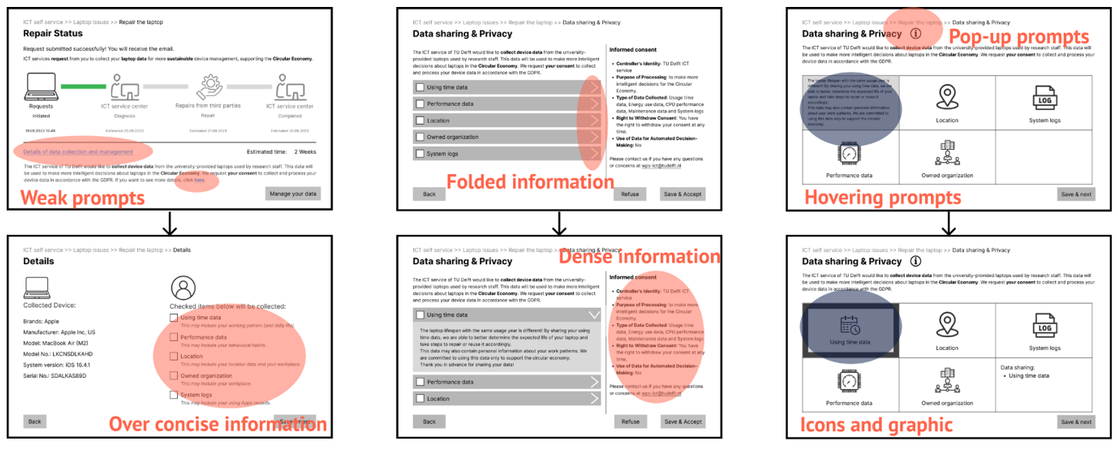

Figure 8.1 Issues for Each Concept

8.1.3 Key Findings

The first round of evaluations provided valuable insights into the design of the user interface and the presentation of information. he key findings can be summarised as:

- **Avoid specialized terminology:**

Participants struggled with specialized terms like "circular economy" and "digital product passport". These terms, while accurate, are not widely understood outside of specific fields. The design should use plain language that is easily understood by all users.

- **Balance Information:**

There is a delicate balance between providing enough information for users to make informed decisions and overwhelming them with too much information. The design needs to strike this balance to ensure users can understand the implications of their choices without feeling overwhelmed.

- **Clear Navigation:**

The design should make it easy for users to navigate the consent process. In Concept 3, for example, the icon for navigating to the consent request page was consistently overlooked. The design should make these important navigation elements more prominent. In addition, the process for management of data-sharing needs to be changed to before the submitted page, as the comments from all participants.

- **Interactive Explanations:**

Interactive elements, like the expandable bars in Concept 2 and the hover interactions in Concept 3, can encourage users to engage with the information. However, these interactions need to be intuitive and not rely on users discovering them by chance.

- **Incentives:**

The design should incorporate elements that highlight the benefits and positive impacts of data sharing. This could involve showing users how their data contributes to sustainability efforts or how data sharing can improve the services they receive. By making the benefits of data sharing tangible and personal, users may be more willing to share their data. This incentive-based approach could be a powerful tool for encouraging data sharing and enhancing user understanding of its importance.

These findings will guide the first round of iteration and the next round of concept design, with a focus on clear language, balanced information presentation, intuitive navigation, interactive explanations, and detailed data-sharing information.

8.2 Design Iterations 1[4]

The iterated process design, as shown in Figure 8.2, involves managing the data-sharing from the users after completing the application form. After clicking Next, a pop-up window appears requesting the user's consent. Once the process is complete, the progress of the request is displayed along with an estimated time frame. For the purpose of data interpretation, Concept 3 was selected and the data interpretation was subsequently updated, as shown in Figure 8.3. The overview of design iteration 1 is shown in Figure 8.4.

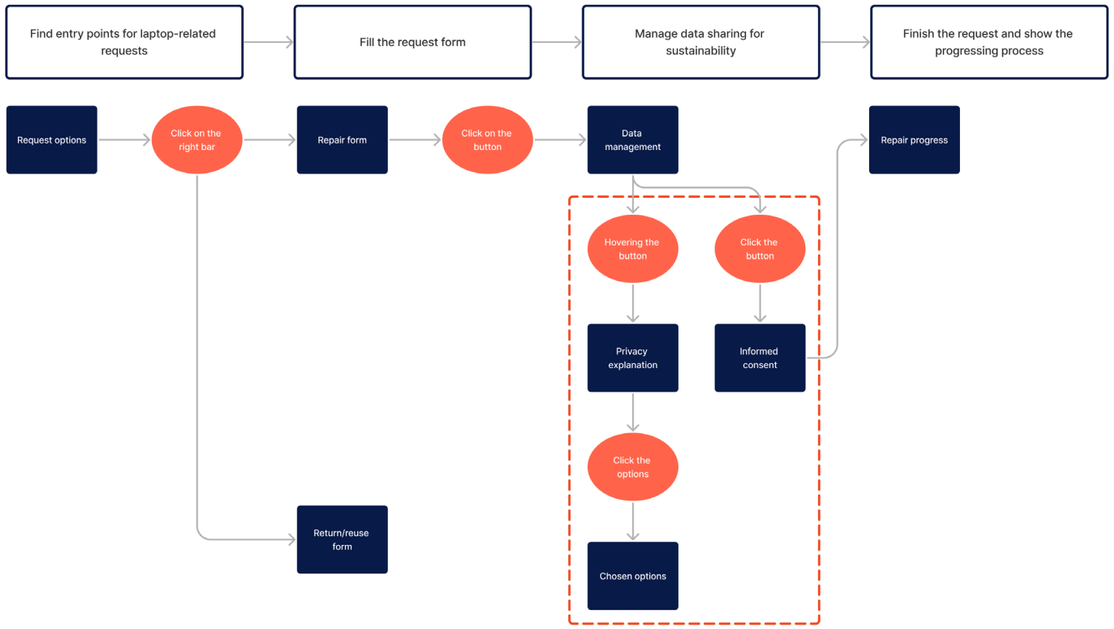

Figure 8.2 Interaction Logic Frame

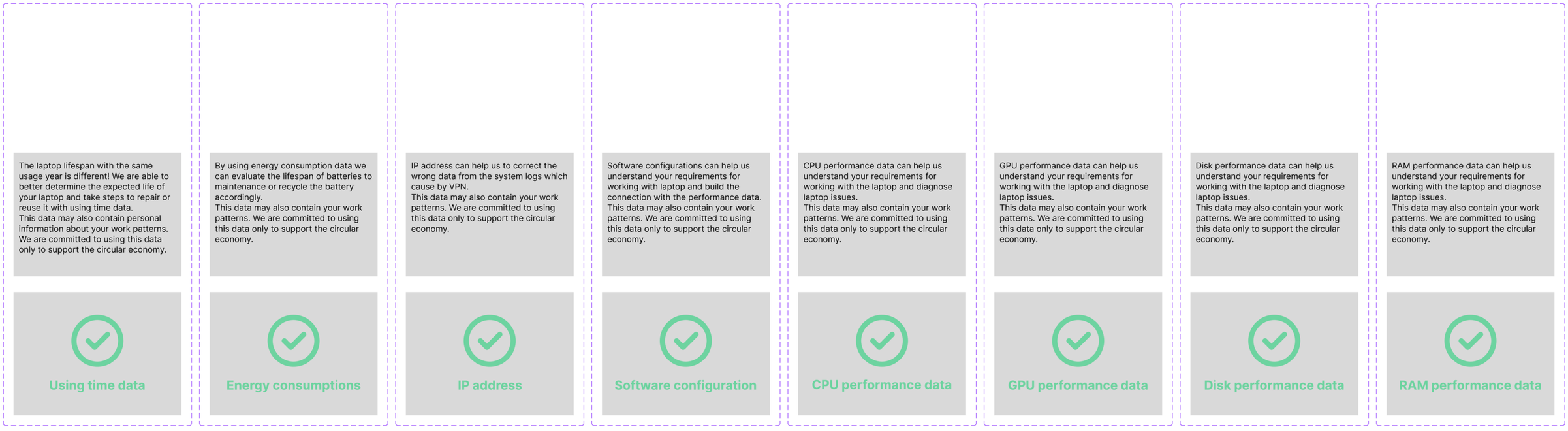

Figure 8.3 Privacy explanation for data sharing

Figure 8.4 Design Iteration 1

[4] The link of design iteration 1 (prototype): https://www.figma.com/proto/rt88pcevJc0uSuRccaJkJ8/Iteration-1?page-id=0%3A1&type=design&node-id=1-247&viewport=635%2C444%2C0.12&t=L3aCRuj39cHWufEy-1&scaling=min-zoom&starting-point-node-id=1%3A24-7&mode=design

8.3 Evaluation 2

8.3.1 Evaluation 2 setup

Consistent with the first evaluation phase, three conceptual prototypes were developed in Figma for this subsequent evaluation phase. The second design phase included different incentive strategies aimed at highlighting the sustainable benefits of data sharing for users. This approach was intended to increase users' awareness of the benefits of data sharing and thereby increase their willingness to participate in such activities. The aim of this evaluation was to assess the validity of the first design iteration and the motivational impact of the second round of design concepts.

User types for incentives

From the user's point of view, Tondello et al. (2016) provide a comprehensive framework for understanding user motivations and designing personalized user experiences. The Hexad model identifies six user types: Philanthropist, Socialiser, Free Spirit, Achiever, Disruptor, and Player, each associated with distinct motivations. These types are derived from various motivational theories, including Self-Determination Theory, the Big Five personality traits, and Maslow's hierarchy of needs. By employing the Hexad model, designers can effectively cater to a diverse user base, enhancing engagement and promoting desired behaviors. Furthermore, the model serves as a valuable tool for evaluating the effectiveness of a design, enabling iterative improvements based on user feedback and engagement levels.

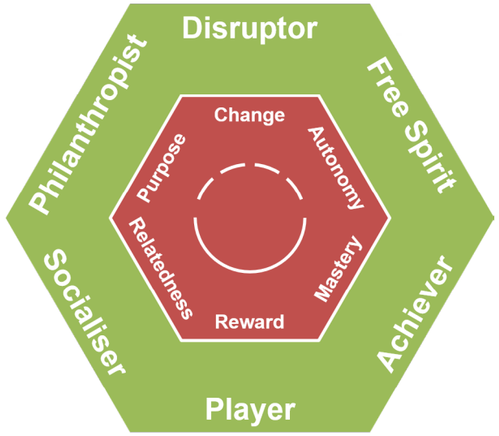

Figure 8.5 Gamification User Types Hexad (Tondello et al., 2016)

Set up

Participants were required to complete a test to determine their user type in relation to incentives (Gamified UK Gamification User Type HEXAD Test, 2023). They were then instructed to navigate the interface and complete all three processes according to the tasks outlined in Table 3.2, using thinking aloud (Thinking Aloud: The #1 Usability Tool, 2012) during the exploration process. Upon completion of the exploration, participants were asked to complete a rating scale, scoring the given statements on a scale of 1 to 6, ranging from 'strongly disagree' to 'strongly agree', removing the natural answer to push participants to give positive or negative feedback. The evaluation scale was divided into two parts, where the first part of the statement sentence was a question that tested the effect of the previous iteration, and the second part was used to assess the motivational effect of the different incentive schemes. Finally, the testers were asked to add some concept-specific comments and comments. The results of the scales evaluated used descriptive statistics to calculate and compare the scores of each mean. User comments during and after the test were analyzed qualitatively.

Table 8.2 Tasks for Evaluation 2

Tasks	Reasons for not completing		
	Concept 1	Concept 2	Concept 3
Choose one of the requests			
Fill in the request form			
Browse the introduction of data sharing for sustainability			
Manage the data you want to share (select and deselect)			
Save the settings and give consent or not			
Browse the request status and other information about incentives			

8.3.2 Evaluation results

Participants

A total of 8 participants took part in the second round of evaluation. Most of the participants (N=7) were the same in the first eval of evaluation. Each participant was categorized according to their user incentive type, with the most dominant type being chosen for the final categorization. Half of the participants were categorized as Free Spirits (Tondello et al., 2016), which means they could be motivated by autonomy and personalized elements. However, it is important to note that each participant's categorization was not strictly confined to one type, which proved for broad coverage of user types in the evaluation. (Figure 8.6 and 8.7)

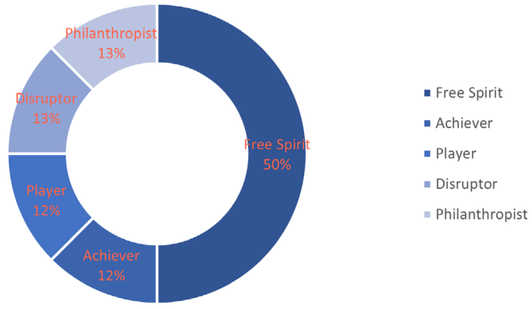

Figure 8.6 Participants' User Types

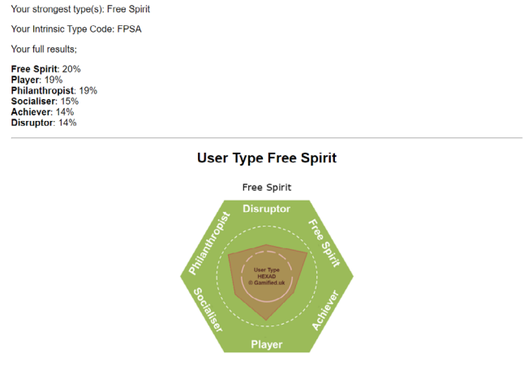

Figure 8.7 An Example for User Types

The previous iteration

The first half of the evaluation scale focused on the previous iteration (Chapter 8.2). Participants were asked to rate their agreement with six positive descriptions. The average agreement scores for these statements are illustrated in Figure 8.8. Statements three and six, which relate to the consent request page, received feedback suggesting that the information visualization on this page needs to be more structured and should incorporate some icons. Furthermore, the Privacy Explanation section was identified as an area needing further iterative design to make it more concise and comprehensible. Participants suggested adding more examples of data use or analysis for clarity.

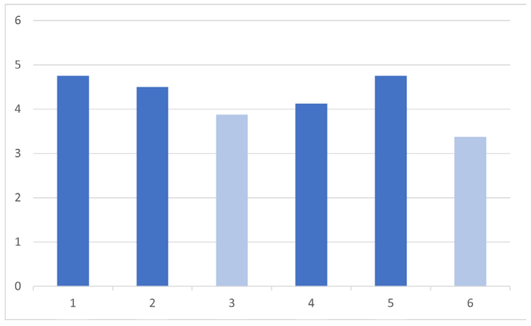

Figure 8.8 An Example for User Types

Incentives design

The second part of the evaluation focused on the incentives' design. The sum of the agreement scores for five declarative sentences was calculated. A side-by-side comparison showed that the second and third options of the three concepts scored the same and higher than the first concept. Feedback from participants indicated that the virtual farming metaphor in the first concept effectively communicated the contribution of data sharing to sustainability. However, this metaphor was deemed more suitable for high-frequency use scenarios, and participants generally agreed that this inappropriate design metaphor would cause them to lose interest over time.

In the second concept, the feedback progress bar was a good representation of the sustainability contribution of selecting different numbers of data-sharing items. However, some participants felt that the dramatic feedback was unprofessional and would reduce user confidence in the interface. The storyboard approach sparked interest in exploring the selection of more data to trigger changes in the storyboard, but participants suggested that some introduction or explanation should be added.

The taskbar of the third concept was largely ignored by most participants. Its location did not attract user attention, and it was ignored because it added to the difficulty and complexity of using the interface. The badges received the most positive comments, but some participants were confused about the collecting meaning of the badges in the context of the low frequency of use of ICT services. Therefore, the social or sharing meaning of badges should be enhanced. Lastly, the points and rankings received the most questions from the participants, as they raised ethical issues of ranking pressure and forced participation.

8.3.3 Key findings

Based on the evaluation results, several key findings were identified:

- **Need for Structured and Specific Privacy Explanation:**

The privacy explanation section needs to be more structured and incorporate some icons. It should be more concise and comprehensible, possibly by adding a few more examples of the use or analysis of these data.

- **Design Metaphor and Usage Frequency:**

The design metaphor of virtual farming in the first scenario, while understandable, is not suitable for low-frequency use scenarios like this one. Participants indicated that this inappropriate design metaphor would make them lose interest.

- **Appropriate level of Feedback Intensity:**

In the second scenario, the feedback progress bar was a good representation of the sustainability contribution of selecting different numbers of data. However, some participants felt that exaggerated feedback was unprofessional and would reduce the user's confidence in the interface.

- **Badges and Usage Frequency:**

Some participants were confused with the badges in the context of the low frequency of use of ICT services. Therefore, the social or shared meaning of badges should be enhanced and linked to other campus systems.

- **Ethical Concerns with Points and Rankings:**

The group of research staff within the campus as an organization is much smaller than the group of consumers in the society, so the design of points and rankings will bring a different effect than in the scenarios of mobile apps in the market. In the circle of acquaintances among research staff, users are socially pressured to passively share data, resulting in mandatory consent.

8.4 Design Iterations 2

Privacy Explanation

During the second round of evaluation, there were some design iterations for each concept. In general, an iterative design was developed for the interpretation of privacy and consent requests in all the concepts. Privacy explanations (Figure 8.9)are given in detail in the first two items with examples, such as the number of hours of use corresponding to different decisions about ICT services. And repetitive phrases such as confidentiality were organized on top of the choice box. The information on the consent request page was visualized by icons and grouped for layout to enhance understandability.

Figure 8.9 Iteration of Privacy Explanation

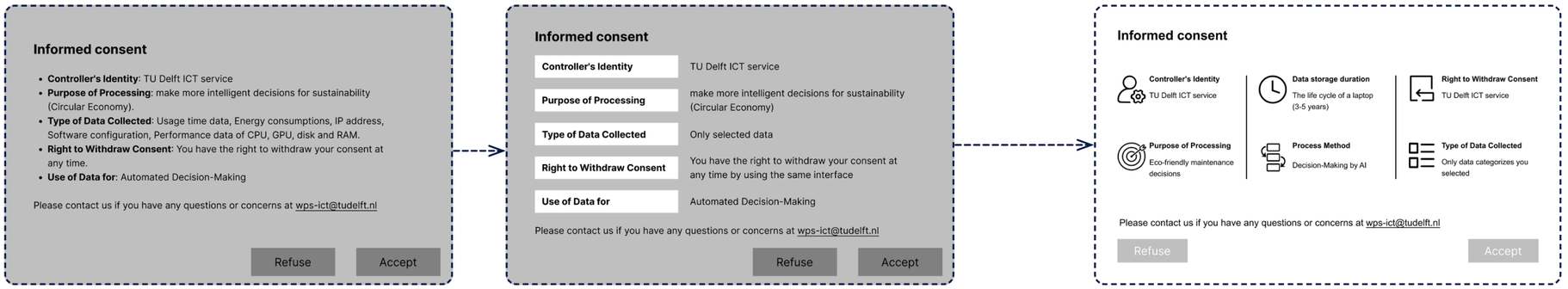

Figure 8.10 Iteration of Consent Request Page

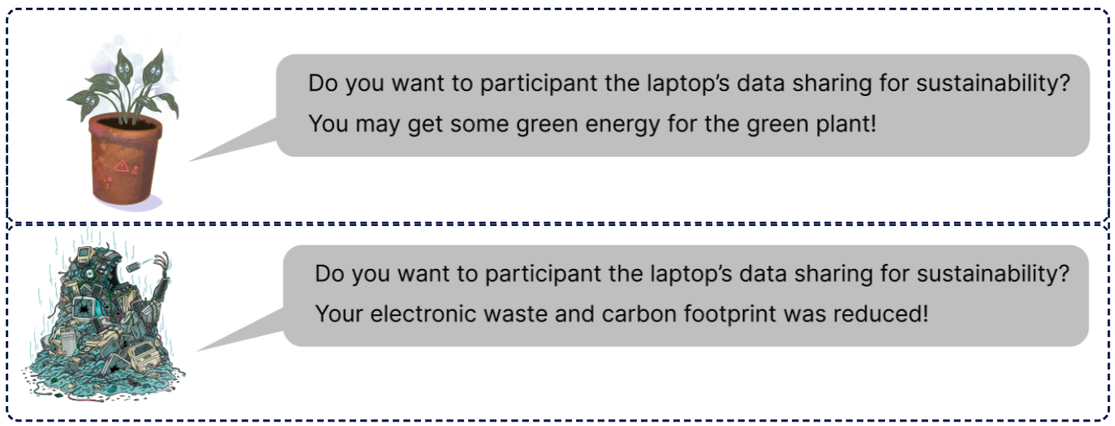

Figure 8.11 Persuasive Page

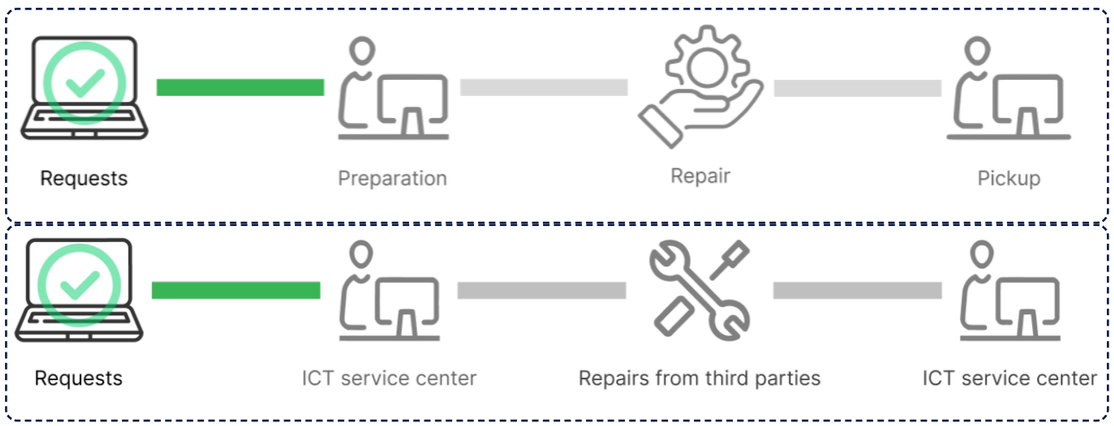

Figure 8.12 Iterations on Repair Status

Consent Request and Final Page

Based on observations from the second round of evaluations, participants sometimes tentatively chose not to agree on the consent request page. Therefore, in the second iteration, two subsequence pages, disagree and agree, were added after the consent request page. The final page with disagree uses elements of the incentive design to suggest that the user returns to the data sharing management interface to participate in this campaign, while also allowing the user to perceive that the data could not be shared without consent and to develop a sense of trust for that reason. (Figure 8.11)

For the final process display, the detailed process and corresponding icons have been adjusted to change from the laptop's perspective to the user's perspective to enhance comprehension, such as the repair status shown in Figure 8.12.

8.5 Evaluation 3 (Final Evaluation)

8.5.1 Final evaluation setup

The final solution amalgamated the strengths of the options derived from the previous design iteration, culminating in a high-fidelity solution. The test model was developed using Protopie (ProtoPie, 2023) to ensure the efficacy of the animations. The final evaluation was structured around four key objectives: usability, understandability, awareness, and willingness.

Participants were recruited through posters, and potential participants identified in the questionnaire section of the previous study were invited via email. Data derived from the scale were used to evaluate the final solution using descriptive statistics qualitatively.

Participants were randomly assigned to test one of the three processes (repair, reuse, and return). After acquainting participants with the background information and scenarios, they were instructed to navigate the user interface based on the tasks outlined in the task list (Table 3.4). Participants were encouraged to use the think aloud method during the exploration process. Any issues that arose during the process, obstructing completion, were observed and the reasons were documented. Upon completion of the exploration, participants were asked to fill out an online questionnaire. The first section of the questionnaire utilized a 7-point Likert scale, where participants rated statements related to understandability, awareness, willingness, and user experience on a scale of 1 to 7, while the second section use the System Usability Scale (SUS) (Brooke, 1996) to assess usability (Laubheimer, 2018) within a 7 point Likert scale.

After completing all tasks, participants were asked to respond to a series of short questions, providing their opinions and suggestions regarding the three design elements (feedback bar, storyboard, and badge system), as well as any additional expectations they had of the user interface.

Table 8.3 Tasks for the Final Evaluation

Tasks	Completion (Y/N)	If not, what went wrong	Comments
1. Choose a process and fill in the request form (type some random text, not your real information)			
2. Read the introduction of the data-sharing settings (above the choosing boxes)			
3. Hovering your mouse on the icons in the choosing boxes to see the explanation of data collections			
4. Select and de-select data you want to share with the ICT service in TU Delft			
5. Check the explanation of each meaning of the prog-ress bar			
6. See the explanation of the 'E-monster'			
7. Check the detailed information of "Badges Collection"			
8. Show the badges in your profile and find where the badge appears			
9. Back to the data setting page			
10. Click next and give your consent or not			
11. Read the process and the estimated time			
12. There is a new badge, find it and show it in your profile			

8.5.2 Evaluation Results

Participants

There are in total 18 participants involved in this final evaluation process, among which 2 are Assistant Professors at TU, 2 are PostDoc and the rest are all PhD candidates. The age range is from 27 to 51 with a gender ratio of 7 females to 11 males. They are recruited via emails and personal connections. To reduce the possible bias caused by employees from limited departments or faculties, the participants recruited for this evaluation obtained different educational backgrounds and worked in different faculties.

Understandability

The average score for understandability was 5.26 on the 7-point Likert scale in general. The request process was concise and less time-consuming. All the participants can finish the request autonomously. The data explanation with fragmented and structural visualization got positive comments from participants, but there were still some places to improve. There was some feedback from the participants (N=6) that the detailed explanation of the laptop hardware data lacked concrete examples to reinforce the connection between the working pattern and the device data. However, participants also expressed a reluctance to read too much information (N=4), so they expected more visualization of more detailed information based on the information layout of the final design.

Table 8.4 Mean score of the evaluation scale (1-7 Likert scale)

Scenarios	Understandability	Awareness	Willingness (without incentive elements evaluation)	Willingness (with incentives)	User Experience
Repair	5.39	5.33	5.17	4.57	5.21
Reuse	4.83	5.92	5.58	5.13	5.83
Return	5.56	5.92	5.17	5.00	5.79
Overall average	5.26	5.72	5.31	4.90	5.61

In addition, the average score was relatively low for the reuse scenario. Feedback from participants suggested that the application process for using a reused laptop was a new concept for research staff, requiring more introduction before submitting the application. Additionally, the remote data collection aspect of this scenario caused some confusion and concern among participants, indicating a need for more detailed explanations about data processing and a visualization of how the ICT service tracks data.

Awareness

For the assessment of the awareness aspect, the scale questions focused on two main areas. One is the awareness of the connection between hardware data and personal data, such as how data are collected and processed with potential risks. The other is the awareness of sustainable contribution when sharing data. The average score of awareness was 5.72, higher than other sections of the scale. Therefore, the final program was effective in giving participants more focus on personal privacy. All participants highly valued the session on self-selection of data sharing categories, which was able to evoke their attention and reflection on personal data.

In addition, the final design also motivated the curiosity of some participants about sustainability and data sharing. They would have liked to have additional external links (N=5) and relevant campus campaigns (N=3) that would introduce more of the working principles of device data sharing's contribution to the sustainability field, allaying concerns about personal data further.

The average score of the repair scenario was relatively lower than other scenarios because most of the participants were not aware that the results from device data analysis might be accessed by third parties (N=3), such as repair companies. The process description contained on the final page only is insufficient for the user to understand the possible flow of the results after analyzing the data. Moreover, this scenario has more stakeholders than the other two scenarios, and the user needs to visualize not only the process of hardware maintenance but also the process of device data processing.

Willingness

The willingness was evaluated from two aspects, the willingness to browse the explanation about data usage and the willingness to share data when submitting the request. The average score in the willingness section was 5.31, without considering incentive design. From the answers to the interviews after exploring the final design UI, the hovering interaction can obviously enhance the users' curiosity to read the explanation of the data collection and consent request. The pop-ups ensure the patience of users navigating through the process and enhance the relevance of data and consent requests. Additionally, participants also noted that explanations with icons can give an overview at the beginning (N=8) and increase their autonomy in reading explanations during the data sharing step (N=6). However, there were still two participants chose to agree directly and skipped the explanation on the consent request page because of their daily behavioral inertia.

Incentives

By comparing the mean scores on the willingness aspect with motivational design elements to the mean scores on the willingness aspect without motivational design elements, it is clear that the incentive design needs to be further improved.

The average score for different incentive elements is shown in Table 8.5. The Feedback progress bars are significantly more motivating than other incentive methods. Combined with participants' comments (N=10), this element is able to visualize the sustainable impact of data sharing in a more intuitive way. The mechanism of changing the color of the progress bar also persuades three of the participants to share more data. However, seven of the participants would like to see a specific measurement of the contribution to sustainability, such as adding quantifiable indicators for the mass reduction of carbon emissions, the amount of energy saved, and so on.

For the badges, participants rated them slightly lower than the feedback progress bar, mainly because there were not enough instructions on choosing a badge to indicate what badge the user would receive at the end of this data sharing, as well as a lack of explanation of the function and meaning of the badge. In other words, users did not have sufficient expectations of this incentive at the beginning. There should be a preview of what badges could be earned after participating in this sustainable application process.

Table 8.5 Average score for different incentive elements

Scenarios/Incentive elements	Badges	Feedback progress bar	Storyboard
Repair	4.00	5.00	3.50
Reuse	4.67	5.50	4.33
Return	5.33	5.00	4.33

The incentive effect of the storyboards was close to neutral, mainly due to the location on the page where they were located, which was easier to ignore and had fewer states that could be changed. The participants were also confused about the principle of changing illustrators because the threshold of incentives was too high and different from the feedback progress bar. The explanations of the storyboards did not motivate the participants to read them so a more concise and pictorial approach is needed.

User experience

From a user experience standpoint, data explanations with icons create a sense of trust in the user's sense, as it is easier to understand and more engaging. The way in which options to share data could be freely selected also gave participants a general sense of control over the data. At this point, it was also noted by participants (N=4) that they would like to have access to their shared data to have a better understanding and risk assessment of this device data. In addition, in response to the spreadability and contribution to the university, the participants' ratings showed positive ratings.

It is worth noting that two of the participants raised concerns about the risk of data sharing conflicting with the informed consent they had previously requested from the test subjects, as they had processed test data on their laptops in relation to other people. They would have liked to have been able to make a more detailed risk assessment in this case.

Usability (SUS)

The calculation of the SUS was based on the work of Sauro (2011), which was ultimately converted to a percentile rank. The final SUS score for the design was 74.73 of the hundred score. The study also states that a raw SUS score of 74 converts to a percentile rank of 70%. A SUS score of 74 has higher perceived usability than 70% of all products tested. It can be interpreted as a grade of a B-. The first question on the SUS relates to the frequency of use, so many users chose a lower score for this item in relation to the actual frequency of use. This affects the final SUS score to a certain extent.

8.5.3 Key findings

User Awareness:

The deployment of the user interface has been instrumental in enhancing user awareness regarding the importance of data sharing for sustainability. The user interface, with its visual cues and detailed explanations, has educated the research staff about the data sharing process and its implications for sustainability.

Transparency and Trust:

Many research staff expressed that the redesigned consent request form felt more transparent than its predecessors. This underscores the pivotal role that clarity in data usage, purpose, and the benefits of sharing has played in fostering trust among the research staff.

User Engagement:

The introduction of gamification elements into the interface led to increased active user participation in data sharing. This finding highlights the effectiveness of gamification and incentives in engaging and motivating users to share data.

Answering the RQs:

Post-deployment feedback revealed that a significant portion of the research staff felt more informed about personal data sharing implications, addressing RQ1. This indicates that the project has successfully tackled the issues of blind consent and lack of awareness through its user-friendly design and clear communication. Furthermore, in addressing RQ2, many of the research staff expressed a willingness to share data when presented with the sustainability benefits, suggesting that clear incentives and sustainability benefits can indeed motivate research staff to willingly share data.

Usability Assessment:

The final SUS score was 74.73, which indicates a good level of perceived usability, as it is higher than 70% of all products tested. However, the score was somewhat affected by the question related to the frequency of use, as many users chose a lower score for this item due to the actual frequency of use being lower.

8.5.4 Future Works

Enhancing Understandability:

The Reuse scenario was found to be less understandable due to its novel process and the method of remote data collection. To improve this, more detailed explanations and visualizations are needed, particularly about data processing and tracking. For instance, the explanation of laptop hardware data could include concrete examples to illustrate better the connection between work patterns and different hardware data.

In addition, users have different educational backgrounds so they have different levels of ability to understand the specialized terms and principles such as the name of laptop hardware and data collection methods. In the interface design, it is necessary to explain to the users in a more comprehensible way by giving examples and in a diverse way by classifying different versions of explanations for different backgrounds of users. At the same time, the user's ability to receive information is limited in a fast and efficient context. Therefore, the interface design also requires external links to other official TU Delft websites to promote the new implementation, making it easier for research staff to understand the context and more detailed information about the program before using this UI.

Improving Awareness:

There was a lack of awareness among users that the results of device data analysis might be accessed by third parties in the repair scenario. To address this, the process of data processing needs to be visualized in the repair process UI. Additionally, users expressed a desire for more information about how and why data sharing can contribute to sustainability. This information needs to be presented in the interface using larger hover windows and external links. Users need clearer quantitative metrics to measure the sustainable contribution of each item of data sharing.

Unskippable reading prompts:

To change the behavioral inertia of some users who skip browsing consent requests and privacy explanations, the information prompts and consent request screens should hide the next action buttons for a certain period of time, using a semi-compulsory approach to guide the user towards informed consent practices.

Optimizing Incentives:

The current incentive design requires further optimization. While feedback progress bars were the most effective incentive, users expressed a desire for quantifiable indicators of their sustainability contribution, such as the specific number of hours of energy saved to power all the lights in a given campus building. The badges need to add some clear instructions and hints of badges expected to be earned. The storyboard element received a neutral response for incentives, suggesting a need for a more concise and visually appealing approach. A potential solution would be to pair this with the feedback progress bar to visualize the impact on sustainability when this data is shared.

Improving User Experience:

The visualization of data explanation and the personalized choosing box for each data enhance the user's sense of control over their data. However, they also expressed a desire to access their shared data for better understanding and risk assessment. Some users raised concerns about potential conflicts between data sharing and previous informed consent agreements with test subjects from their previous research projects. This problem can be well solved by externalizing a function module in the interface that can compare the protocols of different consent requests. In future interfaces, the user could be alerted to this risk by highlighting it.

9 Summary of the Work

This concluding chapter encapsulates the outcomes of the research project focused on the design of a user interface for sustainable ICT services at TU Delft. It starts with a summary of key findings, followed by a discussion on potential future work and recommendations on future work. The chapter also acknowledges the limitations of the current research and concludes with reflections on the project.

9 Summary of the Work

9.1 Conclusion

The research project embarked on a journey to design and evaluate a user interface for a sustainable ICT service at TU Delft, focusing on the process of data sharing and informed consent requests. The goal was to create an interface that was not only functional and user-friendly, but also an UI that promots sustainability and privacy. The research was conducted in four phases, including a literature review, context exploration, interface design and development, and user evaluation.

The literature review provided valuable insights into the current state of sustainable ICT services, the importance of privacy, and the role of user interfaces in facilitating data sharing and consent requests. It highlighted the need for visualization interfaces that are easy to understand, promote awareness of privacy and sustainability, and motivate users to share data. The user interviews provided a deeper understanding of users' needs, preferences, and concerns regarding data sharing and consent requests. Users expressed a desire for clear and concise information, control over their data, and transparency about how their data is used. They also expressed concerns about privacy and the potential misuse of their data.

Based on the insights gained from the literature review and user interviews, a user interface was designed and developed. The interface featured several innovative design elements that were positively received by the users. One of these was the options for personalised data selection for each data item. This feature gave users a sense of control over their data and allowed them to select exactly what they wanted to share. It also made the process of data sharing more transparent and understandable. Another positive design point was the use of hovering interaction for displaying information about data sharing and consent requests. This method was effective in capturing the users' attention and encouraging them to read the information. It also made the interface more interactive and engaging, which enhanced the user experience. The interface also incorporated fragmented information accompanied by icon interpretation. This design element was highly appreciated by the users as it made the information more digestible and easier to understand. The use of icons also added a visual dimension to the information, making it more appealing and engaging.

In terms of incentives, the interface included visual indicators of the sustainability impact of data sharing, such as a feedback progress bar. This feature was highly appreciated by the users as it made the abstract concept of sustainability more tangible and understandable. It also served as a powerful incentive for users to share their data, as they could see the direct impact of their actions on sustainability.

The user testing phase involved a group of users interacting with the interface and providing feedback on its usability, understandability, awareness, willingness, and incentives. The results were generally positive, with good scores for understandability, awareness, willingness, and usability. The users found the interface easy to understand and use, appreciated the information and control over data sharing, and were motivated by the visual

indicators of sustainability impact. However, the user testing also revealed areas for improvement. Some users found the reuse scenario less understandable due to its novel process and the method of remote data collection. There was also a lack of awareness among users that the results of device data analysis might be accessed by third parties in the repair scenario. The incentive design, particularly the badges and storyboards, was not as effective as expected in motivating users to share their data. Some users also expressed a desire to access their shared data for better understanding and risk assessment.

In conclusion, the research project successfully achieved its goal of designing and evaluating a user interface for a sustainable ICT service at TU Delft. The interface was well-received by users and promoted data sharing, consent requests, sustainability, and data privacy. It addressed the research questions by increasing the research staff's awareness of personal information in data sharing (RQ1) and identifying suitable incentives to motivate research staff to willingly share data for sustainable practices (RQ2). However, there are areas that need to be improved, particularly in enhancing understandability (RQ1.4), improving awareness (RQ1), optimizing incentives (RQ2.1), and improving the user experience. These findings provide valuable insights for the future development of sustainable ICT services and user interfaces.

9.2 Limitations

The research and design process of the user interface for sustainable ICT services has been a comprehensive and insightful journey. However, it is essential to acknowledge the limitations that may have influenced the findings and conclusions.

Sample Size and Diversity:

The user testing phase involved a limited number of participants. While the feedback was valuable, a larger and more diverse sample could have provided a broader perspective and more generalizable results. The participants' backgrounds, expertise, and familiarity with sustainable practices and ICT services might have varied, influencing their perceptions and responses.

To address this limitation, future research could involve a larger sample size that includes participants from diverse backgrounds and varying levels of familiarity with sustainable practices and ICT services. This would ensure a more comprehensive understanding of user responses and allow for more robust conclusions. Additionally, conducting multiple rounds of user testing could help refine the user interface design based on iterative feedback, further enhancing its effectiveness and user-friendliness.

Novelty of the Concept:

The concept of sustainable ICT services and the specific reuse and repair scenarios were novel to many participants. This novelty might have affected their understanding and awareness, leading to potential biases or misconceptions. The lack of prior exposure to similar interfaces or concepts might have influenced their preferences and expectations.

Incentive Mechanism Evaluation:

The evaluation of the incentive mechanisms, such as badges and feedback progress bars, was based on user feedback and perceptions. There was no empirical measurement of the actual impact of these incentives on user behavior or sustainability contributions. The effectiveness of these incentives might vary across different user groups and contexts.

However, with time and continuous use, users will become more accustomed to the concept of sustainable ICT services. Additionally, providing training or educational materials about the importance and benefits of sustainable practices in ICT could help users better understand and appreciate the interface and its underlying principles.

Time Constraints:

Due to time constraints, the research was conducted over a relatively short period. This limited the amount of time available for user testing and feedback, as well as the refinement and optimization of the interface. Future research could involve a longer timeframe, allowing for more iterative cycles of design, testing, and refinement.

Despite these limitations, the research has made a significant contribution to the field of sustainable ICT services and user interface design. It has provided a foundation for future research and practice and has highlighted important areas for further exploration and development.

9.3 Recommendations and future works

Based on the findings and conclusions of this research, several recommendations and future works are proposed to further enhance the user interface for sustainable ICT services at TU Delft.

Enhance Understandability:

The reuse scenario was found to be less understandable due to its novel process and the method of remote data collection. To improve this, more detailed explanations and visualizations are needed, particularly about data processing and tracking. For instance, the explanation of laptop hardware data could include concrete examples to illustrate better the connection between work patterns and different hardware data.

Improve Awareness:

There was a lack of awareness among users that the results of device data analysis might be accessed by third parties in the repair scenario. To address this, the process of data processing needs to be visualized in the repair process UI. Additionally, users expressed a desire for more information about how and why data sharing can contribute to sustainability. This information needs to be presented in the interface using larger hover windows and external links.

Optimize Incentives:

The current incentive design requires further optimization. While feedback progress bars were the most effective incentive, users expressed a desire for quantifiable indicators of their sustainability contribution, such as the specific number of hours of energy saved to power all the lights in a given campus building. The badges need to add some clear instructions and hints of badges expected to be earned. The storyboard element received a neutral response for incentives, suggesting a need for a more concise and visually appealing approach.

Improve User Experience:

The visualization of data explanation and the personalized choosing box for each data enhance the user's sense of control over their data. However, they also expressed a desire to access their shared data for better understanding and risk assessment. Some users raised concerns about potential conflicts between data sharing and previous informed consent agreements with test subjects from their previous research projects. This problem can be well solved by externalizing a function module in the interface that can compare the protocols of different consent requests. The interface can highlight the conflicts to the users.

Further Research:

Future research could focus on exploring other methods of incentivizing data sharing, such as gamification or social recognition. It could also investigate the impact of different design elements on user engagement and data sharing behavior. Additionally, future research could explore the use of machine learning or artificial intelligence to analyze the data and provide personalized recommendations or insights to the users. The ICT industry should establish a platform or standard to quantify the sustainable impact of each link. In the future, designs can be designed to show users more concretely the direct and indirect impacts of sustainable behaviors in order to bring about behavioral change.

User Education:

The information carrying capacity of this interface is limited considering the length of time the user will be using it in a short period of time. Therefore, additional user education is necessary, such as the promotion of campus events and official university social media accounts. This could help to foster the behavior change of data sharing and sustainability among employees in TU Delft.

9.4 Reflections

Reflecting on this journey of designing a user interface for sustainable ICT services, I realize that it has been a transformative learning experience for me. As an Integrated Product Design (IPD) student, I initially had limited experience in interface design. However, this project has not only broadened my knowledge but also developed my skills in this area, including prototyping, user evaluations, survey preparation, legal knowledge, and data sharing knowledge.

Experience in Interface Design:

The process of designing the interface was a steep learning curve. I had to familiarize myself with the principles of user interface design, understand the importance of user experience, and learn how to create an interface that is both functional and aesthetically pleasing. I learned how to use design elements effectively, how to present information in a clear and concise manner, and how to create an engaging and interactive interface. This project has significantly enhanced my understanding and skills in interface design.

Being Consist in Design Scope and Goal:

One of the challenges I faced during this project was maintaining consistency with the design scope and goal. During the context exploration and iteration phase, I received various suggestions and feedback from the participants. While some of these were valuable and helped improve the interface, others were outside the scope of the project or did not align with the design goal. As a designer, I learned the importance of staying focused on the design scope and goal, and not being swayed by extraneous suggestions or feedback. This was a valuable lesson in project management and decision-making.

Balancing between Functionality and User Experience:

Users want an interface with extremely concise information, but overly omitted information can be confusing. Also for user behavior change, incentive design is needed, but too much incentive design makes the interface more complex. I learned how to strike a balance between these opposing demands, which is a valuable skill in any design project.

In conclusion, this project has been a rewarding and enlightening experience. It has provided me with a deeper understanding of the challenges and opportunities in designing sustainable ICT services and user interfaces. It has also improved my skills in interface design, project management, user-centered design, privacy protection, and interdisciplinary collaboration. These lessons will be invaluable in my future research and practice in integrated product design.

Acknowlegment

I would like to express my profound gratitude to my supervisors, Prof.dr.ir. Alessandro Bozzon and Dr. Anelia Kurteva, whose invaluable guidance, patience, and expertise have been instrumental in the successful completion of this research project. Their unwavering support and insightful critiques throughout this journey have significantly contributed to my professional and personal growth. Their dedication to academic excellence and commitment to nurturing my intellectual curiosity have been truly inspiring.

Furthermore, I wish to extend my heartfelt thanks to all the participants who generously contributed their time and shared their unique perspectives during the interviews and evaluations. Their willingness to engage in this research and their candid responses have provided a rich foundation for this study. Their contributions have not only enriched the quality of this work but have also provided invaluable insights that have shaped the direction and outcomes of this research.

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Appendix

1. Project Brief

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: Shang
initials: J.S. given name: Jinze
student number: 5529107
street & no.:
zipcode & city:
country:
phone:
email:

Your master programme (only select the options that apply to you):
IDE master(s): IPD ☆ | Dfl | SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: Honours Programme Master
specialisation / annotation: Medisign | Tech. in Sustainable Design | Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: Alessandro Bozzon dept. / section: SDE, HCAI
** mentor: Anelia Kurteva dept. / section: SDE, DfS
2nd mentor:
organisation:
city: country:
comments (optional):

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF
To be filled in by the chair of the supervisory team.

chair Alessandro Bozzon date 14 - 03 - 2023 signature

CHECK STUDY PROGRESS
To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _____ EC

Of which, taking the conditional requirements into account, can be part of the exam programme _____ EC

List of electives obtained before the third semester without approval of the BoE

YES all 1st year master courses passed

NO missing 1st year master courses are:

name _____ date - - signature _____

FORMAL APPROVAL GRADUATION PROJECT
To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: APPROVED NOT APPROVED

Procedure: APPROVED NOT APPROVED

comments

name _____ date - - signature _____

Personal Project Brief - IDE Master Graduation

Visualizations as a tool to enhance the transparency of ICT data sharing project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 03 - 03 - 2023 28 - 07 - 2023 end date

INTRODUCTION **
Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

ICT is widely used in organizations such as companies and universities to provide service and inner support to employees. A study shows that organizations can achieve higher levels of efficiency, flexibility, information security, and collaboration through ICT service to meet the requirements of employees and other stakeholders (Taruté & Gatautis, 2014).

However, to assure sustainable organizational development, ICT service also involves collecting and processing data from devices such as laptops used by employees during maintenance and reuse, which may include personal data. According to the GDPR in the EU (EUR-Lex - 32016R0679 - EN - EUR-Lex, 2016), personal data is any information about an identified or identifiable natural person. This can include identifiers such as name, identification number, location data, online identifier, or other factors specific to the individual. Therefore, there may be a value conflict between employees and employers for the organization's sustainability and personal privacy.

This project will focus on the use case of employees in TU Delft using university-owned laptops from ICT service. The privacy statement on the website does not specify the risks of the laptops and lacks the understanding of some legal terminology with a substantial reading volume (Privacy Statement, 2022). The main users are TU Delft employees, who request laptops according to their work scenario and lack understanding of data sharing in ICT services. The main stakeholders are the department of ICT service, which determined the lifecycle of the laptops. This project aims to improve the transparency of informed consent in ICT service for TU Delft employees to solve the value conflict when using university-owned laptops. Informed consent is the process of obtaining permission from data subjects before processing their personal data. Transparency means that users can understand and track their privacy data during the whole service process. I will use visualization to approach the aim, which is proven effective (Kurteva, 2023). It also needs to be explored that to what extent employees are ready to allow their privacy data-sharing to support more sustainable ICT services.

space available for images / figures on next page

introduction (continued): space for images

Iteration 1

Iteration 2

Details of Gamification

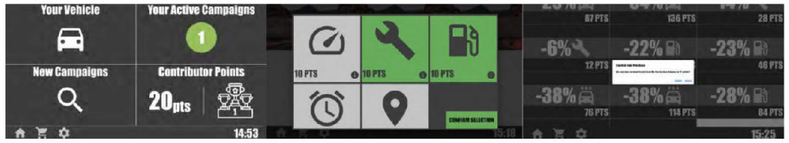


image / figure 1: Visualization examples from Anelia Kurteva

image / figure 2:

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

The ICT department in TU Delft involves collecting and processing data from devices such as laptops used by employees during maintenance, reuse, and recycling, which may include personal data. To comply with the GDPR, the university has a website with a privacy statement (Privacy Statement, 2022). However, substantial reading volumes and complex legal terminologies create barriers for employees to understand. The current challenges are information overload, consent fatigue and the need for more understanding about the lifecycle of ICT devices such as laptops. In addition, the employees have different values and preferences from ICT managers regarding the trade-off between sustainability and privacy.
The project primarily targets employees of TU Delft. The research question is
RQ1: How to improve the transparency of informed consent for ICT services on employee laptops?
The aim of improving transparency is to enhance the employees' awareness of privacy data-sharing and understanding of their data value in the sustainable ICT service system. Moreover, the sub-questions are:
RQ1.1: What are the sustainability goals of ICT services for employee laptops?
RQ1.2: What kind of data is collected and processed from employee laptops during maintenance, reuse, and recycling, and how does this data support sustainability goals?
RQ1.3: How can informed consent be displayed in a more transparent and user-friendly way for employees to increase their awareness of data sharing?
RQ1.4: To what extent are employees willing to risk their privacy in terms of personal data sharing to support more sustainable ICT services?
A study has shown that visualization can better enable users to understand the details of data sharing and make it traceable (Kurteva, 2023). Therefore, the expected output is interfaces (UIs) that visualize informed consent through optimized information categorization and appropriate icons.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

This graduation project will focus on designing a visualization of data sharing informed consent in the TU Delft ICT service to solve the problem mentioned in the above part. My expected outcome is interfaces (UIs) that visualize informed consent. The final output is the knowledge of how to achieve sustainable ICT service by making informed consent more transparent and an interactive demonstration of the interface.

The more detailed assignment to approach this is within the scope:

Questionnaires, literature reviews, and semi-structured interviews to understand the context and build a stakeholder map according to the research results.

Conducting co-design workshops or interviews to identify each stakeholder's requirements and pain points.

Visualization concept design according to previous research results and examples in different fields.

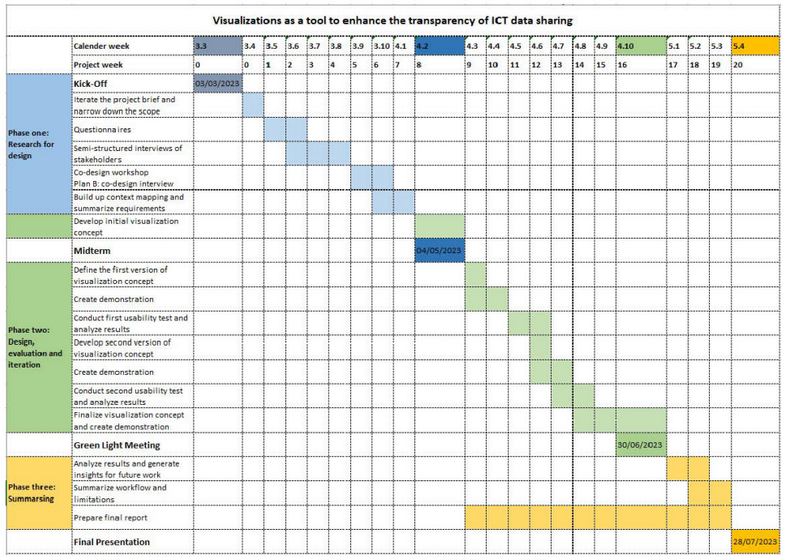
Conducting usability tests, using evaluation tools and interviews to iterate the concept.

A working flow or tool can be used for informed consent visualization in an organization's ICT service. Discuss how the visualization with data sharing informed consent fits into the broader landscape.

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 3 - 3 - 2023 28 - 7 - 2023 end date



In the first research phase, I will begin with the user research by questionnaire and semi-structured interviews to define all the stakeholders and acquire some initial information and requirements. After that, the data flow and the associated risks at each stage will be identified and visualized. Besides, I will also conduct a co-design workshop with initial ideas and simple design tools to deeply understand all the significant stakeholders' requirements. In case I am unable to engage with the ICT people to attend this workshop, another plan is to conduct co-design online one by one. The co-design interview will be short, with fewer operation steps for them. To summarize all the research results above, I will build a context mapping and generate my design goal and design criteria.

The second phase will entail the design, evaluation, and iteration of the visualization concept. I will generate some initial concepts and evaluate them with design criteria. The first visualization concept will be generated before the midterm meeting to check the effectiveness of previous research. Then the project will move into a circle of design, demonstration creation, evaluation, analysis, and iterations.

For the third phase, the results of previous research will be summarized to generate insights for visualization design in the context of informed consent in the organization's ICT service. The report will also provide an overview of the design process workflow and its limitations.

It is essential to note that the entire research process will be conducted with due attention to ethical considerations. Data privacy and security will be prioritized at all stages of the research, and ethical clearance will be obtained before data collection. Additionally, participant anonymity will be ensured, and the data collected will be used solely for research purposes.

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

I chose this project as my graduation project due to my interest in data visualization and multi-stakeholder analysis. In the ACD course, I designed an intelligent speaker for older adults with dementia. The information and data flow in it still need to be further refined. There are also many data visualization opportunities that I would like to explore further. Besides, the AED course also attracted me with its stakeholder analysis approach to determine the requirements of a product or system. I am eager to demonstrate my skills in this area through this project.

In addition to the above courses, my internship last year allowed me to develop skills related to interfaces. Through this project, I aspire to improve my expertise related to data visualization and advance my career plans accordingly. I also want to explore more areas of user research to make my designs more interactive, which could provide me with a solid foundation for my future career.

Finally, making user privacy data more transparent through visualization resonates with me, and I am eager to explore the user needs and challenges associated with this approach. I experienced firsthand concerns about the security of personal privacy in ICT services in companies during my internship. I believed that as a designer, I was responsible for contributing to sustainable solutions in this area. This project was a unique opportunity to gain valuable insights into data visualization and sustainability and hone my skills as a designer.

Reference
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Privacy Statement. (2022). TU Delft. https://www.tudelft.nl/en/privacy-statement
Kurteva, A. (2023). Making Sense of Consent with Knowledge Graphs [PhD Dissertation]. University of Innsbruck. http://doi.org/10.13140/RG.2.2.10392.67846

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

2. Informed Consent for Interview

Informed consent for the interview

You are invited to participate in a research study titled "Visualizations as a tool to enhance the transparency of ICT data sharing" for a master graduation project. This study is being conducted by Jinze Shang from IDE in TU Delft. This research study aims to improve the transparency of informed consent for ICT services on employee laptops in TU Delft. The aim of improving transparency is to enhance the employees' awareness of privacy data-sharing and understanding of their data value in the sustainable ICT service system.

I will ask you some opening questions according to your using experience with the laptops from the university. This semi-structured interview will take you approximately 45 minutes to complete. The data will be used to analyze the awareness of privacy risks during data-sharing and the goal of ICT device sustainability.

We assure you that your answers in this study will remain confidential. We will collect your job title, job sector or education background, and user behavior to analyze different user journeys. To minimize any risks, we will ensure that the analysis result of this survey is entirely anonymous, and no IP addresses or other Personal Data will appear. All the data collected will be stored safely, and confidentiality will be secured by anonymizing the data. Your participation in this study is entirely voluntary, and you can withdraw at any time. You are free to omit any questions. If you have any questions or concerns regarding this study, please feel free to contact the corresponding and Responsible Researcher, Jinze Shang at j.shang@student.tudelft.nl. Thank you for your participation in this study.

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated __/__/____, or it has been read to me. I have been able to ask questions about the study, and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves participating in the semi-structured audio-recorded interview. I also understand that the video will be transcript into text. The audio will be stored securely and anonymously for a maximum of 6 months, after which it will be destroyed.	☐	☐
4. I understand that there will be no financial compensation for my participation in this study.	☐	☐
5. I understand that the study will end in approximately 45 minutes	☐	☐
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. I understand that taking part in the study also involves collecting specific personally identifiable information (PII), including my first name, email address, and associated personally identifiable research data (PIRD), including job title, sector, and user behaviors.	☐	☐
7. I understand that some of this PIRD is considered as sensitive data within GDPR legislation, specifically [*see points below*]	☐	☐
List the relevant issues: e.g.: • *religion, political views* • *Data concerning criminal activities will/may be collected and processed* • *Research has a Data Processing Impact Assessment (DPIA) in place*		
8. I understand that the following steps will be taken to minimize the threat of a data breach, and protect my identity in the event of such a breach: - All the audio will be transcript into text - All the audio will be stored securely and anonymously in TU Delft Project Data Storage	☐	☐
- All the audio will be destroyed after 6 months		
9. I understand that personal information collected about me that can identify me, such as my name, sector, job title, and user behavior will not be shared beyond the study team.	☐	☐
10. I understand that the (identifiable) personal data I provide will be destroyed after the research is finished.	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
11. I understand that after the research study the de-identified information I provide will be used for the reference of design outputs and master thesis.	☐	☐
12. I agree that my responses, views or other input can be quoted anonymously in research outputs	☐	☐
D: (LONGTERM) DATA STORAGE, ACCESS AND REUSE		
13. I consent to the de-identified information I provide during this study being stored in the 4TU Research Data Repository for a minimum of 10 years after the study has concluded.	☐	☐

Signatures

Name of participant [printed]	Signature	Date

I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Researcher name [printed]	Signature	Date
Jinze Shang	Jinze Shang	17.03.2023

Study contact details for further information: Jinze Shang, j.shang@student.tudelft.nl

3. Questionnaire for ICT Staff

Informed consent

Informed Consent. **Informed Consent**

You are invited to participate in a research study titled **"Visualizations as a Tool to Enhance the Transparency of ICT Data Sharing"** for the graduation project. This study is being conducted by Jinze Shang from IDE. This research study aims to improve the transparency of informed consent for sustainable **ICT services on research staff laptops** in TU Delft.

I will be asking you to finish multiple choices and linear scales according to your using experience with the laptops from the university. This takes you approximately **15 minutes** to complete.

Collecting data

Data categories	Purpose
Email address	Selecting interview participants for my future work and communication
Age group	Analyzing the awareness of privacy risks during data-sharing and the goal of ICT device sustainability
Job sector	
Education background	
The result will be **entirely anonymous** and no IP addresses or other Personal Data will appear. All the data collected will be stored safely, and **confidentiality** will be secured by anonymizing the data.	

We assure you that your answers in this study will remain confidential. Participation in this study is entirely voluntary, and you can withdraw anytime. You are free to omit any questions.

If you have any questions or concerns regarding this study, please contact the corresponding and responsible Researcher, **Jinze Shang** at **j.shang@student.tudelft.nl**. Thank you for your participation in this study.

Background

Q1.1. **What is your department (or group) in ICT?**

- ○ Central ICT
- ○ ICT WPS
- ○ ICT Innovation
- ○ [ ] Others

Q1.2. **Your age**

- ○ 18-24
- ○ 25-34
- ○ 35-44
- ○ 45-54
- ○ 55-64
- ○ 65-74

Q1.3. **Your education background**

- ○ ICT
- ○ IT
- ○ [ ] Ohters

Privacy Segmentation Index

Intro.

This part is for understanding your privacy awareness tendency in daily life when you using the service from tech companies. To what extent do you agree or disagree with the following 3 statements:

PS: According to GDPR Art. 4 (1), personal data is any information that can be used to identify a person. This includes their name, identification number, location data, online identity, or any other unique traits that relate to their physical, physiological, genetic, mental, economic, cultural, or social identity. An identifiable person is someone who can be recognized, directly or indirectly, by this type of information.

Q2.1. **Individuals have lost all control over how personal information is collected and used by companies.**

Extremely disagree						Extremely agree
○	○	○	○	○	○	○

Q2.2. **Most businesses handle the personal information they collect about individuals in a lawful and confidential way.**

Extremely disagree						Extremely agree
○	○	○	○	○	○	○

Q2.3. **Existing laws and organizational practices provide a reasonable enough level of protection for individual privacy today.**

Extremely disagree						Extremely agree
○	○	○	○	○	○	○

Q2.4. **Are you aware of any laws that focus on protecting your personal data as an individual? (please enter the name of the laws)**

[ ]

Main questions

Q3.1. **Could you use short words to describe the sustainable goal for ICT service in TU Delft?**

Q3.2. **To what extent do you think the process of laptops (i.e. repairing, reusing) from the university is sustainable?**

Extremely not understand ○ ○ ○ ○ ○ ○ ○ Extremely understand

Q3.3. **What sustainable interventions (i.e. reuse, repair) do you think can be made?**

Q3.4. **How does the ICT service handle laptops that need to be repaired? (if "buy instead repair", how do you handle the old one) (short answers)**

Q3.5. **What happens when a laptop is broken beyound repair?**

Q3.6. **Is there somewhere the ICT service collects data for device management?**

- ○ Yes
- ○ No
- ○ Maybe

Q3.7. **If yes, what types of data does ICT collect about laptops?**

Q3.8. **Can some of the data collected by ICT be defined as personal/sensitive data?**

- ○ Yes
- ○ No
- ○ Maybe

Q3.9. **For what specific purposes is such data collected?**

Q3.10. **Who is responsible for requesting informed consent from the research staff in cases such as repair or reuse?**

Q3.11. **Who creates the consent request forms?**

Sustainable future

Intro. The ICT service needs to collect some **device data** to achieve more **sustainable laptop management** in the future. However, the data collected from the laptop would also include data related to the research staff's **personal data** unavoidably.
To comply with regulations such as GDPR, there will be a **visualization for informed consent** to enhance the transparency of data collecting. The visualization plans to clarify the **privacy risks, data usage, data storage** and **other detailed information** during data sharing.

Q4.1. **To what extent do you agree with or support this plan?**

Extremely disagree ○ ○ ○ ○ ○ ○ ○ Extremely agree

Q4.2. **What is the biggest obstacle to implementation (collecting data) in your opinion? (Max.2 choices)**

- ☐ Complex informed consent for research staff
- ☐ More working steps for research staff
- ☐ More working steps for ICT staff
- ☐ Others (short answers)

Q4.3. **To what extent do you think the visualization would be useful for informed consent?**

Extremely unuseful ○ ○ ○ ○ ○ ○ ○ Extremely useful

Q4.5. **What do you think are the important requirements for you in the visualization? (Max. 2 choices)**

- ○ Knowledge about data usage
- ○ Presentation form
- ○ Data storage
- ○ Possibility to refuse
- ○ Parties that have access
- ○ Confidentiality and control over data
- ○ Others

Q4.6. **If you can attend the future interviews about this, please leave you email address below, thank you!**

4. Questionnaire for Research Staff

Informed Consent

Informed Consent. **Informed Consent**

You are invited to participate in a research study titled **"Visualizations as a Tool to Enhance the Transparency of ICT Data Sharing"** for the graduation project. This study is being conducted by Jinze Shang from IDE. This research study aims to improve the transparency of informed consent for sustainable ICT services on **research staff laptops** in TU Delft.
I will be asking you to finish multiple choices and linear scales according to your using experience with the laptops from the university. This takes you approximately **10 minutes** to complete.

Collecting data

Data categories	**Purpose**
Email addresses	Selecting suitable interview participants for my future work and communication
Age group	Analyzing the awareness of privacy risks during data-sharing and the goal of ICT device sustainability
Job title	
Job sector	
Educational background	
The result will be **entirely anonymous** and no IP addresses or other Personal Data will appear. All the data collected will be stored safely, and **confidentiality** will be secured by anonymizing the data.	

We assure you that your answers in this study will remain confidential. Participation in this study is entirely voluntary, and you can withdraw anytime. You are free to omit any questions.

If you have any questions or concerns regarding this study, please contact the corresponding and responsible Researcher, **Jinze Shang** at **j.shang@student.tudelft.nl**. Thank you for your participation in this study.

Background

Q1.1. **Your age**

- ○ 18 - 24
- ○ 25 - 34
- ○ 35 - 44
- ○ 45 - 54
- ○ 55 - 64
- ○ 65 - 74
- ○ 75 - 84

Q1.2. **Your job title**

- ○ Professor
- ○ Associate professor
- ○ Assistant professor
- ○ Lecturer

- ○ PostDoc
- ○ PhD candidate
- ○ [ ] Others

Q1.3. **Your education background**

- ☐ ICT
- ☐ IT
- ☐ [ ] Others

Q1.4. **Have you experienced reusing, repairing, or returning the laptop before? I want to conduct interviews in the future, please leave your email address so that I can contact with you in the future.**

- ○ [ ] Yes
- ○ No

Privacy Segmentation Index

Intro.

This part is for understanding your privacy awareness tendency in daily life when you using the service from tech companies. To what extent do you agree or disagree with the following 3 statements:

PS: According to GDPR Art. 4 (1), personal data is any information that can be used to identify a person. This includes their name, identification number, location data, online identity, or any other unique traits that relate to their physical, physiological, genetic, mental, economic, cultural, or social identity. An identifiable person is someone who can be recognized, directly or indirectly, by this type of information.

Q2.1. **Individuals have lost all control over how personal information is collected and used by companies.**

Extremely disagree						Extremely agree
○	○	○	○	○	○	○

Q2.2. **Most businesses handle the personal information they collect about individuals in a lawful and confidential way.**

Extremely disagree						Extremely agree
○	○	○	○	○	○	○

Q2.3. **Existing laws and organizational practices provide a reasonable enough level of protection for individual privacy today.**

Extremely disagree						Extremely agree

O O O O O O O

Q2.4. **Are you aware of any laws that focus on protecting your personal data as an individual? (please enter the name of the laws)**

Main Questions

Q3.1. **How long have you used your laptop from TU Delft?**

- O Less than 6 months
- O 6 months to 1 year
- O 1 years to 3 years
- O More than 3 years

Q3.2. **What brand is the laptop you using from TU Delft?**

- O Apple
- O Dell
- O HP
- O [ ] Others

Q3.3. **Why do you choose this brand?**

Q3.4. **Do you think your laptop from TU Delft contains some of your personal and sensitive information (i.e. name, address, photo, video, IP address) in it?**

- O Yes
- O No

Q3.5. **What data do you think would contain your personal and sensitive information in your laptop from TU Delft?**

- ☐ Cookies in browser
- ☐ Browser history
- ☐ Performance monitor
- ☐ Local files (photos, videos, documents)
- ☐ System account
- ☐ No personal data in it
- ☐ [ ] Other data

Q3.6. **How concerned are you about the privacy risks (i.e. data leak and misuse) of the laptop during reusing by other staff?**

Extremely unconcern — Extremely concern

O O O O O O O

Q3.7. **How concerned are you about the privacy risks (i.e. data leak and misuse) of the laptop during repair by suppliers?**

Extremely unconcern — Extremely concern

O O O O O O O

Q3.8. **How concerned are you about the privacy risks (i.e. data leak and misuse) of the laptop during returning to the ICT office?**

Extremely unconcern — Extremely concern

O O O O O O O

Q3.9. **Have you read the privacy policy, terms and conditions and the informed consent regarding data risks from the ICT service of TU Delft for the laptops?**

- O Yes
- O No

Q3.10. **If yes, in what form did you receive the instructions? (Oral intro/agreements/manual/website...)**

Q3.11. **Can you understand the privacy policy, terms and conditions and the informed consent regarding data risks from the ICT service of TU Delft?**

- O Yes
- O No

Q3.12. **If yes, to what extent can you understand the privacy data risks during the process of reusing, repairing and returning the laptops.**

Extremely not understand — Extremely understand

O O O O O O O

Q3.13. **If no, please explain why you cannot understand it.**

Sustainable future

Intro. The ICT service needs to collect some **device data** to achieve more **sustainable laptop management** in the future. However, the data collected from the laptop would also include data related to your **personal data** unavoidably. To comply with regulations such as GDPR, there will be a **visualization for informed consent** to enhance the transparency of data collecting. The visualization plans to clarify the **privacy risks, data usage, data storage** and **other detailed information** during data sharing.

Q4.1. **To what extent do you accept the data sharing for sustainable ICT device management?**

Strongly unaccept ○ ○ ○ ○ ○ ○ ○ Strongly accept

Q4.2. **To what extent do you think the visualization would be useful for informed consent?**

Extremely unuseful ○ ○ ○ ○ ○ ○ ○ Extremely useful

Q4.3. **What do you think are the important requirements for you in the visualization? (Max. 2 choices)**

- ☐ Knowledge about data usage
- ☐ Presentation form
- ☐ Data storage
- ☐ Possibility to refuse
- ☐ Parties that have access
- ☐ Confidentiality and control over data
- ☐ [ ] Ohters

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5. Informed consent for Evaluation

Informed consent for the evaluation

We invite you to participate in a research study, "Visualizations as a tool to enhance the transparency of ICT data sharing," conducted by Jinze Shang from TU Delft's IDE. The study aims to increase transparency and awareness regarding privacy data-sharing within TU Delft's ICT services.

Your participation involves exploring an interface and answering questions based on your experience. This will take approximately **40 minutes**. The collected data will be used to analyze the interface's usability and user experience.

We assure confidentiality and anonymity in handling your data, which includes your job title, education background, and user behavior. No personal data such as IP addresses will be visible in the analysis results. All data will be securely stored and anonymized.

Participation is voluntary, and you can withdraw at any time or choose not to answer specific questions. For any queries or concerns, please contact Jinze Shang at j.shang@student.tudelft.nl. Thank you for considering participation in this study.

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated __/__/____, or it has been read to me. I have been able to ask questions about the study, and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves participating in the audio-recorded interview after the questionnaire. I also understand that the audio will be transcript into text. The text will be stored securely and anonymously for a maximum of 6 months, after which it will be destroyed.	☐	☐
4. I understand that there will be no financial compensation for my participation in this study.	☐	☐
5. I understand that the study will end in approximately 40 minutes	☐	☐
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. I understand that taking part in the study also involves collecting specific personally identifiable information (PII), including my first name, email address, and associated personally identifiable research data (PIRD), including job title, sector, and user behaviors.	☐	☐
7. I understand that some of this PIRD is considered as sensitive data within GDPR legislation, specifically [*see points below*]	☐	☐
List the relevant issues: e.g.: • *religion, political views* • *Data concerning criminal activities will/may be collected and processed* • *Research has a Data Processing Impact Assessment (DPIA) in place*		
8. I understand that the following steps will be taken to minimize the threat of a data breach, and protect my identity in the event of such a breach: - All the audio will be transcript into text - All the audio will be stored securely and anonymously in TU Delft Project Data Storage - All the audio will be destroyed after 6 months	☐	☐

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
9. I understand that personal information collected about me that can identify me, such as my name, sector, job title, and user behavior will not be shared beyond the study team.	☐	☐
10. I understand that the (identifiable) personal data I provide will be destroyed after the research is finished.	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
11. I understand that after the research study the de-identified information I provide will be used for the reference of design outputs and master thesis.	☐	☐
12. I agree that my responses, views or other input can be quoted anonymously in research outputs	☐	☐
D: (LONGTERM) DATA STORAGE, ACCESS AND REUSE		
13. I consent to the de-identified information I provide during this study being stored in the 4TU Research Data Repository for a minimum of 10 years after the study has concluded.	☐	☐

Signatures

_____	_____	_____
Name of participant [printed]	Signature	Date

I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Jinze Shang	Jinze Shang	30.06.2023
Researcher name [printed]	Signature	Date

Study contact details for further information: Jinze Shang, j.shang@student.tudelft.nl

No more privacy regulation frustration
- take control with our survey!

Questionnaire for **ICT staff** in TU Delft

You are invited to participate in a research study titled "Visualizations as a Tool to Enhance the Transparency of ICT Data Sharing". This study is being conducted by Jinze Shang from IDE. It aims to improve the data sharing transparency for sustainable ICT services on research staff **laptops in TU Delft**. The questionnaire will take you approximately **15 minutes** to complete.

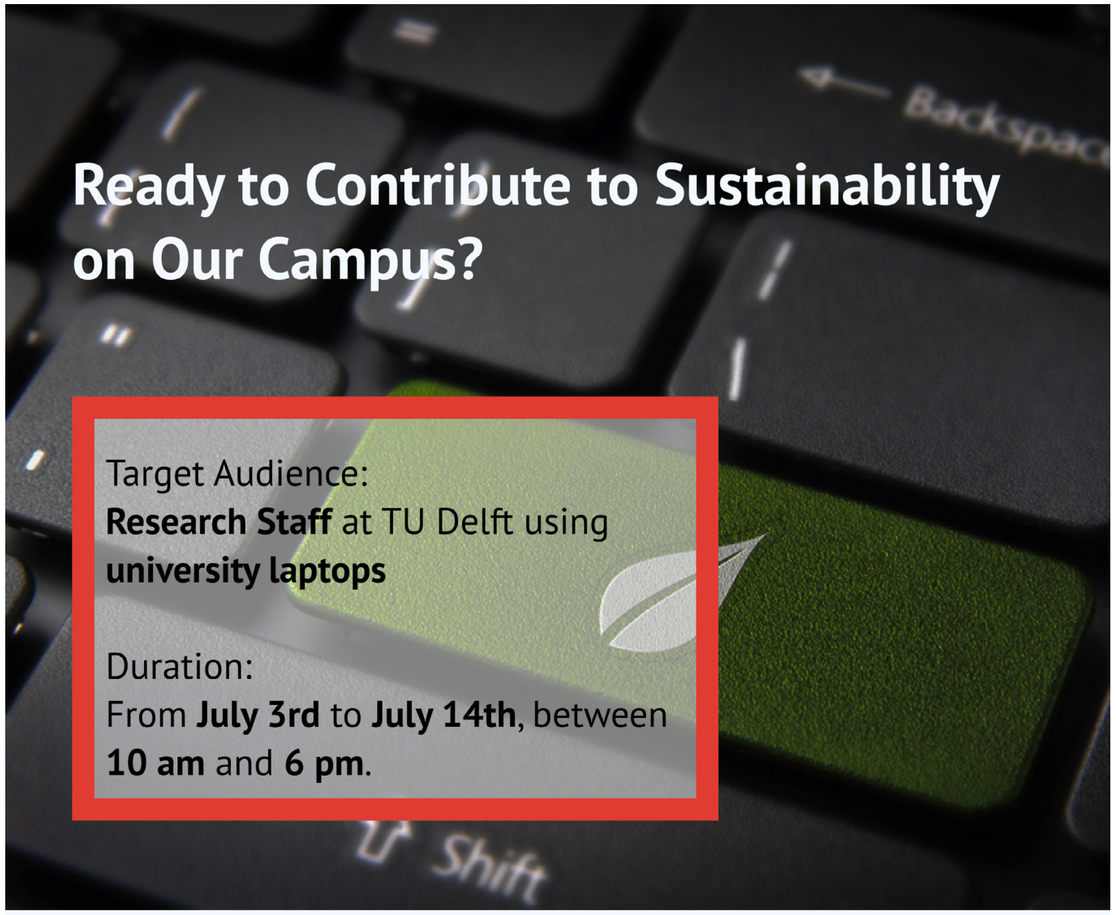
IF YOU HAVE ANY PROBLEMS, PLEASE CONTACT
J.Shang@student.tudelft.nl

Do you feel you data privacy is respected at work?
Do you think something should be improved?

Questionnaire for **research staff** who using the **laptop** from TU Delft

You are invited to participate in a research study titled "Visualizations as a Tool to Enhance the Transparency of ICT Data Sharing". This study is being conducted by Jinze Shang from IDE. It aims to improve the data sharing transparency for sustainable ICT services on **research staff laptops** in TU Delft. The questionnaire will take you approximately **10 minutes** to complete.

IF YOU HAVE ANY PROBLEMS, PLEASE CONTACT
J.Shang@student.tudelft.nl



You are warmly invited to take part in a **user evaluation** of a user interface (UI) for ICT sustainable service in TU Delft. This study, conducted by Jinze Shang from IDE, aims to enhance the transparency of data sharing for sustainable ICT services on laptops utilized by Research Staff at TU Delft. The evaluation will take place on campus and will take approximately **30 minutes** to complete.

Book a time slot

If you wish to participate or have any questions, please feel free to contact **J.Shang@student.tudelft.nl**

Your participation is crucial!

7. Questionnair for Final Evaluation

Intro 00

Context: User evaluation of a UI for ICT sustainable service at TU Delft.
Duration: Approximately 20 minutes.
Introduction: Participate in a study conducted by Jinze Shang from IDE to enhance transparency in data sharing for sustainable ICT services on TU Delft laptops.
Task: Open the provided link and explore three different processes for the laptop in TU Delft.
Feedback: Fill in the scales to provide your evaluation.
Link: https://cloud.protopie.io/p/67eddf43de455f8f230d3992

Choose number

Choose a number

- 1 - Repair
- 2 - Reuse
- 3 - Return

Repair

Context Introduction
Repair:
If your laptop is under warranty, you can request a repair from the University's ICT service. They will collect device data for sustainable management. You'll need a temporary laptop during the repair period.

Task
Your laptop has issues. Use the interface to send a repair request to the ICT service.

Understandability

01.The repair request process is easy to understand.

Strongly disagree ○ ○ ○ ○ ○ ○ ○ Strongly agree

02. The explanation of data collection is clear to me.

Strongly disagree ○ ○ ○ ○ ○ ○ ○ Strongly agree

03. The explanation of consent request is clear to me.

Strongly disagree ○ ○ ○ ○ ○ ○ ○ Strongly agree

Awareness

04. I am aware of the possibility of this data being accessed by third parties (repair company, etc.).

Strongly disagree ○ ○ ○ ○ ○ ○ ○ Strongly agree

05. I am aware of the sustainable contributions resulting from my shared data.

Strongly disagree ○ ○ ○ ○ ○ ○ ○ Strongly agree

Willingness

06. The interface design makes me curious about how my data will be used for sustainability purposes.

Strongly disagree ○ ○ ○ ○ ○ ○ ○ Strongly agree

07.Overall, the interface design makes me willing to share data.

Strongly disagree ○ ○ ○ ○ ○ ○ ○ Strongly agree

User experience and interface

08. I find the visual explanations of data usage with icons to be trustworthy.

Strongly disagree ○ ○ ○ ○ ○ ○ ○ Strongly agree

09. The customizable selection of shared data categories gives me a sense of control over my data.

Strongly disagree ○ ○ ○ ○ ○ ○ ○ Strongly agree

10. The badges make me want to share more data.

Strongly disagree Strongly agree

11. The progress bars make me want to share more data.

Strongly disagree — Strongly agree

12. The E-monster element makes me want to share more data.

Strongly disagree — Strongly agree

13. I would recommend this interface to collegues.

Strongly disagree — Strongly agree

14. I think TU Delft can benefit from such interface.

Strongly disagree — Strongly agree

Reuse

Context Introduction

Reuse:
ICT Services offers repurposed laptops for temporary use during repairs. They also collect device data to manage the laptop's lifespan, including pre-maintenance and component replacement.

Task

Your laptop has been physically sent for repair. Use the interface to request a temporary, reused laptop.

Understandability

01.The request for a reused laptop process is easy to understand.

Strongly disagree — Strongly agree

02. The explanation of data collection is clear to me.

Strongly disagree — Strongly agree

03. The explanation of consent request is clear to me.

Strongly disagree — Strongly agree

Awareness

04. I am aware of the possibility of this data being accessed remotely by ICT service in TU Delft.

Strongly disagree — Strongly agree

05. I am aware of the sustainable contributions resulting from my shared data.

Strongly disagree — Strongly agree

Willingness

06. The interface design makes me curious about how my data will be used for sustainability purposes.

Strongly disagree — Strongly agree

07. Overall, the interface design makes me willing to share data.

Strongly disagree — Strongly agree

User experience

08. I find the visual explanations of data usage with icons to be trustworthy.

Strongly disagree — Strongly agree

09. The customizable selection of shared data categories gives me a sense of control over my data.

Strongly disagree — Strongly agree

10. The badges make me want to share more data.

Strongly disagree — Strongly agree

11. The progress bars make me want to share more data.

Strongly disagree Strongly agree

12. The E-monster element makes me want to share more data.

Strongly disagree Strongly agree

13. I would recommend this interface to collegues.

Strongly disagree Strongly agree

14. I think TU Delft can benefit from such Interface.

Strongly disagree Strongly agree

Return

Context Introduction

Return:
Once you've transferred your data to a new laptop, the original one needs to be returned. ICT service will collect device data to decide the next steps for the old laptop, such as reuse or recycling.

Task

After transferring and removing all data from the old laptop, use the interface to send a return request to the ICT service.

Understandability

01.The return request process is easy to understand.

Strongly disagree Strongly agree

02. The explanation of data collection is clear to me.

Strongly disagree Strongly agree

03. The explanation of consent request is clear to me.

Strongly disagree Strongly agree

Awareness

04. I am aware of the possibility of this data being accessed by ICT service in TU Delft.

Strongly disagree Strongly agree

05. I am aware of the sustainable contributions resulting from my shared data.

Strongly disagree Strongly agree

Willingness

06. The interface design makes me curious about how my data will be used for sustainability purposes.

Strongly disagree Strongly agree

07. Overall, the interface design makes me willing to share data.

Strongly disagree Strongly agree

User experience

08. I find the visual explanations of data usage with icons to be trustworthy.

Strongly disagree Strongly agree

09. The customizable selection of shared data categories gives me a sense of control over my data.

Strongly disagree Strongly agree

10. The badges make me want to share more data.

Strongly disagree Strongly agree

11. The progress bars make me want to share more data.

Strongly disagree — Strongly agree

12. The E-monster element makes me want to share more data.

Strongly disagree — Strongly agree

13. I would recommend this interface to collegues.

Strongly disagree — Strongly agree

14. I think TU Delft can benefit from such Interface.

Strongly disagree — Strongly agree

SUS

System Usability Scale (SUS)

01. I think that I would like to use this system frequently.

Strongly disagree — Strongly agree

02. I found the system unnecessarily complex.

Strongly disagree — Strongly agree

03. I thought the system was easy to use.

Strongly disagree — Strongly agree

04. I think that I would need the support of a technical person to be able to use this system.

Strongly disagree — Strongly agree

05. I found the various functions in this system were well integrated.

Strongly disagree — Strongly agree

06. I thought there was too much inconsistency in this system.

Strongly disagree — Strongly agree

07. I would imagine that most people would learn to use this system very quickly.

Strongly disagree — Strongly agree

08. I found the system very cumbersome to use.

Strongly disagree — Strongly agree

09. I felt very confident using the system.

Strongly disagree — Strongly agree

10. I needed to learn a lot of things before I could get going with this system.

Strongly disagree — Strongly agree