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Futures of Fixing

Exploring the life of product users in circular economy repair society scenarios

Svensson-Höglund, Sahra; Thorslund, Minna Laurell; Richter, Jessika Luth; Olsson, Anna Richter; Jensen, Charlotte Louise; Quist, Jaco; Russell, Jennifer; Dalhammar, Carl

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Futures of Fixing

EXPLORING THE LIFE OF PRODUCT USERS IN CIRCULAR ECONOMY REPAIR SOCIETY SCENARIOS

This report was developed under the project 'Creating a repair society to advance the Circular Economy: policies, networks and people (CREACE)'.

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Executive Summary

A Circular Economy (CE) constitutes one pathway towards realising sustainable production and consumption. Here, the repair of broken products (compared to replacement) constitutes an important strategy to keep products in the economy for longer, thereby reducing waste, as well as the need to extract resources and emit pollution in the manufacture of a replacement product. In today's world, repair does not necessarily constitute the natural response to product breakage. However, increasing legislative efforts and grassroots movements are attempting to change that and make repair accessible, affordable and culturally acceptable. The question is what such a society – where repair is normalised – would be like.

In this report, we utilise Future Studies methodology to outline and explore a realised state of a CE Repair Society, where product repair is normalised. Taking the perspective of the individual product user, we seek to understand what life in such a society could be like, foremost in terms of financial cost, efforts required, and socio-cultural aspects, such as the relationship to products. These insights are currently lacking in the research on CE and repair. The focus of this work is on electronic devices and appliances, as Information and Communications Technology (ICT) constitutes the fastest growing waste stream in the world. As ICT is also essential for digitalisation that is said to be a part of creating a sustainable future for all, it is also part of the solutions.

Our exploration is centred on understanding possible implications of two contemporary policy choices – the type *of repair market governance* (i.e., who controls the repair market; centralised vs. distributed) and the *ideology of the sustainability transition* (i.e., technologically-driven vs. relying on behavioural change) and what effects these choices might have on the everyday life of product users. As such, four different scenarios are explored using a multi-stakeholder participatory workshop. To aid in the imagination of these alternative realities, we employ a so-called bifurcation point in the form of a fictive tax reform, introduced following the 2008 financial crisis, that increased the price of newly manufactured products and decreased the price of repair. Our stakeholder groups were then asked to explore "alternative 2021" realities, from the perspective of the four different CE Repair Society Scenarios. To systematically trace the implications of the policy choices onto the life of product users, the workshop was guided by a multilevel systems framework. Using speculative fiction elements, four scenario narratives were then developed.

The main findings from this report consist of the range of roles that different stakeholders can take, and how that impacts the repair market and experience of product users. To enhance the quality of life of product users, having a system of repair that offers alternative repair options is key, to suit different preferences. It is also important to have basic DIY capacity in times of crisis.

The Scenarios outlined in this report constitute conceptual extremes of future repair societies, meant to showcase distinctly different societies where repair is normalised, and, as such, the implications of choices made today to realise such a society. To this point, the Scenarios are meant to showcase possible implications of policy choices and various stakeholder positions; they are not meant to be realistic possible or plausible futures, but tools to facilitate the exploration of the future of repair. The workshop participants' thoughts on the general desirability of the scenarios are captured, including thoughts on environmental and social sustainability, and resilience.

Future Studies posits that the creation of these types of future visions can facilitate the development of shared goals (including what is undesirable) and investment into the process of realising a CE Repair Society. It is our hope that this report will spark the imagination of stakeholders to envision, strategize and start taking the necessary steps towards, their preferred repair future.

What type of a CE Repair Society do we want?

"THE FUTURE IS ALWAYS BEGINNING NOW."

Mark Strand

1. Introduction

Circular Economy (CE) is considered a key strategy in order to achieve the UN Sustainable Development Goal 12, *Responsible consumption and production* (United Nation, n.d.). The idea of a CE is that the value of materials and products should be sustained and recovered through the creation of circular material and product "loops" (European Commission, 2015). Product repair restores product functionality and prolongs product lifetimes, thereby slowing product loops and leading to decreased waste and resource usage in the manufacturing of a replacement. However, for repair to take place, products must be designed with quality and repair in mind, and stakeholders engaged in repair activities (International Resource Panel, 2018; Cooper, 2005), which is not really the case today (Jaeger-Erben et al 2021; Russell et al 2022).

In the EU, efforts to upscale repair are made within the larger context and goal of realising a CE. A realised CE, when it comes to repair, implies that all needed repairs that are environmentally and economically optimal are conducted, and that repair is normalised in the eyes of all stakeholders (hereafter referred to as a "CE Repair Society") (Svensson-Hoglund et al., 2020). In Future Studies, this is referred to as a normative future (see e.g., Börjeson et al., 2006). In this report, we explore what such a complex future entails, using elements of morphological analysis (Ritchey, 2011). Niskanen and McLaren (2021) made a repair society the case application for exploring the political economy of the CE. However, to this day, there are little insights regarding what a CE Repair Society could look like particularly from the perspective of product users (Svensson-Hoglund et al., 2020).

1.1 THE CE REPAIR SOCIETY SYSTEMS FRAMEWORK

Any meaningful exploration of a CE Repair Society needs to take into account its systemic nature in terms of its multiple levels and the interdependencies between various actors and dimensions. In the context of a CE Repair Society, Svensson-Hoglund et al. (2020) have proposed a *CE Repair Society Systems Framework*, made up of concentric, or hierarchical, system levels organised according to scale with the individual at the innermost level, embedded within the planetary boundaries, see Figure 1 below.

In this multilevel framework, the *Macro-level* consists of the economic system dictating market conditions, as well as the overarching ideology and politics. The *Meso-level* is

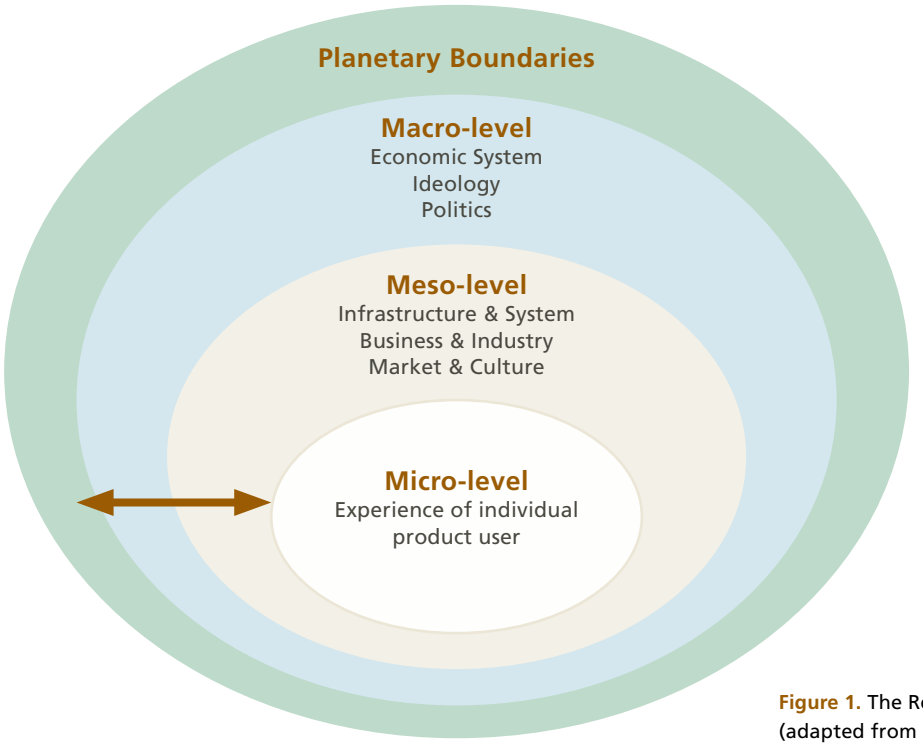

Figure 1. The Repair Society Systems Framework (adapted from Svensson-Hoglund et al., 2020)

composed of three parts: a) infrastructure and systems (e.g., policy and access to spare parts); b) business and industry (e.g., profitability in repair and product design); and c) culture and market (e.g., social norms and knowledge and availability of repair information) (Svensson-Hoglund et al., 2020), as well as civil society and community. All of these parts are interlinked (Svensson-Hoglund et al., 2021). Lastly, the *Micro-level* is the "immediate setting" (Svensson-Hoglund et al., 2020; Bronfenbrenner, 1977), in which the product user experience of repair engagement takes place. This both impacts, and is impacted by, the higher system levels, denoted by the double-arrow in Figure 1.

1.2 ROLE OF REPAIR IN THE LIVES OF PRODUCT USERS

When a device breaks, the user usually has four choices: 1) repair it themselves (Do-it-yourself – DIY) or get help from a repair community (Do-It-Together – DIT); 2) contact the retailer, manufacturer or their authorised network for them to conduct the repair; 3) reach out to an independent repairer, or: 4) discard the broken device. Regardless of who conducts the repair, so-called "necessities" must be available, such as any tools, schematics, manuals and spare parts that are needed to successfully complete the repair (Svensson-Hoglund et al., 2021; Cooper and Salvia, 2018).

The individual product user is often assigned the role as the ultimate decision-maker of whether repair of a broken product will take place or not (see e.g., Svensson-Hoglund et al., 2021). However, as is apparent in the CE Repair Society Systems Framework (Figure 1) above, the individual is part of a larger system dictating the nature of the repair options (Jaeger-Erben et al., 2021; Russell et al., 2022); the user experience of repair at the micro-level is made up of conditions, such as physical access to a repairer, availability of spares, and the broader culture around consumption, as well as personal factors, such as the user's level of preferences for newness and product attachment, as well as what is deemed possible and reasonable efforts, or, as Ackerman et al. (2018) calls it, "perceived abilities". The latter is heavily impacted by cultural norms and values around consumption. Hence, it is important to look at the system at large and understand the individual's experience in it.

Today there are numerous barriers to products being repaired: disadvantageous user preferences, such as an affinity for novelty and newness; high prices of repair relative to replacement; and legal barriers, such as Intellectual Property Law and contractual clauses issued by the product manufacturer that hinder third party repairs. These barriers impact both users, manufacturers and their authorised repair networks, as well as DIY users and professional third party repairers. To remedy these barriers and upscale repair activities, various policy tools are implemented in both the EU and the US, such as mandatory design requirements, prolonged product warranties and tax alleviations on repair services (Svensson-Hoglund et al., 2021). In addition, organisations, such as IFixit [1] and FixitClinic [2] in the U.S., U.K. Restart Project [3] and Repair cafes [4] (started in the Netherlands), have as their goal to empower individuals to be able to repair their own devices.

While many factors influence the repair experience, this experience in turn impacts the life of individuals. First of all, access to technology and the objects required to participate in society is essential for a sense of well-being (Sen, 1999; Sirgy, 2018). Moreover, repair can be perceived as both boring, frustrating, as well as socially and personally rewarding (Lefebvre, 2019; Lee and Wakefield-Rann, 2021; Lopez Davila, 2021). Lastly, as a product user's quality of life essentially lies in the balance between resources invested into all of life's domains, such as family, work, finances and leisure (Sirgy et al., 2020), repair can take up too much time, effort and financial resources (Hobson et al., 2021); This can lead to less resources being available for the remaining life domains, which causes an overall decrease in quality of live. As such, the impact that repair has on the life of product users is arguably determined by: **1) behavioural aspects** (e.g. the time and/or effort it takes to locate a repairer, tools/manuals needed, obtain repair skills, and considering repair quality and data security); **2) financial aspects** (cost of repairing); **3) socio-cultural aspects**, such as norms, attitudes and emotions related to products, as well as the repair process (see e.g., Jaeger-Erben et al., 2021; Lefebvre, 2019; Lopez Davila, 2021)

[1] https://www.ifixit.com

[2] https://fixitclinic.blogspot.com/

[3] https://therestartproject.org/

[4] https://repaircafe.org/en/

1.3 OBJECTIVES, RESEARCH QUESTIONS AND SCOPE

The purpose of any economic system and government should ideally be to promote a high quality of life for the people (Bok, 2010; Stiglitz et al., 2010). As such, it is important to better understand the user experience of repair when it is normalised to support sound policy making aimed at realising a CE Repair Society (Svensson-Hoglund et al., 2020).

As "the effect of policy interventions cast their shadows into the future" (van Asselt et al., 2010b, p. 7), the objective of this project is to explore the impacts of contemporary policy choices on the everyday life of product users living in a realised state of a CE Repair Society. The insights gained can support policymakers and other stakeholders in making informed decisions, by illuminating the implications of contemporary policy decisions through explorations of different versions of a realised CE Repair Society. Insights about multiple possible futures can help identify unintended consequences of policies (Svensson-Hoglund et al., 2020; van Asselt et al., 2010b) and support stakeholder accord on the most desirable vision, which enables the development of strategic and holistic policy pathways (van Asselt et al., 2010a; Wilkinson, 2017). An enhanced understanding and public agreement on the goal also serves to increase the legitimacy and public buy-in in transition efforts, hence enabling that future (Ramos et al., 2019; see e.g., van Asselt et al., 2010a).

We focus specifically on repair of electronic devices and appliances, as these represent the fastest-growing waste stream in the world, with e-waste reaching 48.5 million tonnes in 2018 (World Economic Forum, 2019). Less than 20% of e-waste is recycled appropriately, and e-waste continues to grow (Forti et al., 2020). In a society where repair is the normative response to product breakdown, this waste stream would be drastically reduced.

The characteristics of a CE Repair Society are heavily impacted by both the type of repair market governance (i.e., centralised or distributed) as well as the ideology behind the sustainability transition (i.e., driven by behavioural change or technological solutions), separately and in combination. These characteristics need to be better understood in terms of the different possible societies that they give rise to, particularly on the impact on the key aspects of the user experience of repair (i.e., behavioural, financial and socio-cultural aspects). As values and norms in CE future studies constitute a gap (Welch et al., 2017), the elaboration of the same constitutes an important contribution.

As such, this project attempts to answer two research questions:

1. How do the different characteristics of a realised future state of a CE Repair Society, and the various configurations of such characteristics, impact the key aspects of the product user's repair experience?
2. What are the opportunities, challenges and trade-offs with these characteristics and the different configurations?

For the interested, the scenario narratives of different CE Repair Society Futures can be found in Part II, while Part I contains the methodology and workshop results.

PART I: METHODOLOGY, WORKSHOP RESULTS AND ANALYSIS

2. Methodology

For this project, we wanted to explore multiple variants of futures as the possible results of contemporary policy making, specifically focussing on what life in different versions of a CE Repair Society might be like for product users. To this end, we developed a set of future CE Repair Society scenarios. In the following sections, we outline and motivate our methodological choices, including a two hour long participatory digital workshop with 14 participants, divided into four groups, each exploring a different version of a society in which repair is normalised.

2.1 2X2 SCENARIO MATRIX AND DRIVERS

To generate multiple possible CE Repair Society futures, we selected the matrix approach, introduced by Kees van der Heijden (2005), which is the most commonly used scenario planning technique for policy (van Asselt et al., 2010a). The technique uses two sets of drivers to create a 2x2 matrix, where each quadrant represents a unique combination of drivers. These four states each make up a scenario, which essentially consist of: "stories that describe alternative ways the external environment might develop in the future. Each scenario explores how different conditions might support or constrain delivery of policy and strategy objectives." (UK Government Office for Science, 2017, p. 50).

The scenario drivers, axis, or "critical uncertainties", are usually selected for being particularly important for the policy area in question, but also for having an uncertain outcome. Although there are systematic, collaborative methods for identifying the relevant drivers for scenario matrices, such as Axes of Uncertainty (2017, p. 46), we relied on two comprehensive literature review articles on repair (Svensson-Hoglund et al., 2021, 2020) to distinguish drivers that represented a high degree of uncertainty and a high degree of impact.

In morphological analysis, a form of normative futuring, "... the total set of relationships contained in multi-dimensional, non-quantifiable problem complexes" are systematically structured and analysed (Ritchey, 2011, p. 83) which fits with the research goal of understanding multiple possible system conditions in which repair is normalised. In Scenario development, morphological analysis provides structure and relevance (Johansen, 2018) with the aim to "... develop exploratory

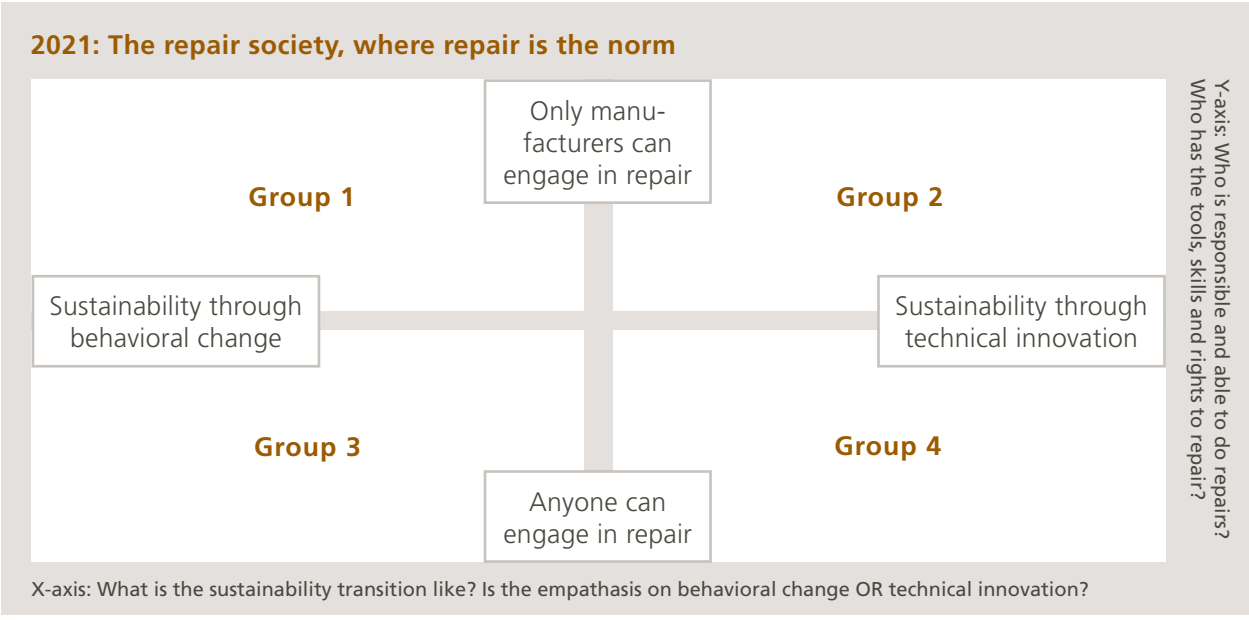

Figure 2. The 2x2 matrix.

scenarios in a systematic and transparent way, while bringing in diversity and addressing complexity and uncertainties." (Delpierre et al., 2021, p. 4). For this, we use the 2x2 matrix, in addition to the Repair Society Framework (Figure 1) as a design tool for scenario construction (Quist and Vergragt, 2006; Quist, 2016).

Importantly, Kees van der Heijden's (2005) traditional scenario development approach consists of understanding the implications of factors that cannot be influenced inside the system, hence are external to it. Our drivers, on the other hand, are arguably more internal to the repair system, particularly the governance of the repair market governance, but also the paradigm regarding the sustainability transition as it translates to norms of groups and individuals within the repair system. To address this, we briefly discuss the driving forces behind our drivers in section 4.2. In accordance with Morphological analysis, we focus on scenario configurations and certain dimensions of each scenario (Ritchey, 2011) according to Table 1. See also Appendix A.

Next, we discussed what we understood each driver to mean and what the two extremes of each driver entailed, in order to ensure a shared understanding and definition of each. These were used to create the 2x2 matrix and four scenarios (Figure 2).

2.1.1 DRIVER 1: REPAIR MARKET GOVERNANCE STRUCTURE

For this driver, we were guided by the questions "Who is responsible and able to do repairs?" and "Who has the tools, skills and rights to repair?". In a centralized market governance structure, repair of products is handled by product manufacturers and their authorised network of repairers, and they alone control knowhow, information, tools and parts required to have the ability to repair. In a distributive market, anyone can engage in repair.

For their repair scenarios, Niskanen and McLauren's (2021) selected a similar spectrum, but instead of the centralization being handled by the manufacturer, they explored centralization handled by the government (with digitalization enabling decentralisation of repair). However, we deemed it more relevant to explore the amount of control granted to the manufacturer since this question is highly relevant today; the current repair market governance is subject to change, moving towards more distributive (e.g., through the EU Ecodesign Directive). Many manufacturers, including Apple and Google, object to these changes as they prefer to remain in control over the repair market of their products (USPIRG, 2021). Nevertheless, the EU is gradually granting access to repair necessities for professional repairers outside of manufacturer networks, but not to DIYers. In the US, so-called "Right to Repair" bills have been proposed at the state level. New York State recently passed the first one, obliging product manufacturers to make spares, tools and manuals available to anyone (NY Senate, 2022) – opening up the repair market. The passing of this state law is expected to impact the entire US repair market (Wiens, 2022). In addition, the U.S. consumer protection agency has recommended that steps are taken to make the repair market more distributive (U.S. Federal Trade Commission, 2021). However, this transition into a more distributive market governance is taking place without an understanding of the long-term implications (Svensson-Hoglund et al., 2021).

REPAIR MARKET GOVERNANCE STRUCTURE	
Distributive repair market governance **= Anyone can engage in repair** Everyone has easy and affordable access to the spare parts, tools and information needed to repair products, and anyone is permitted to engage in repair either at home, or as a commercial business.	**Centralised repair market governance** **= Only manufacturers can engage in repair** Repair of products is handled by product manufacturers and their authorised network of repairers, and they alone control knowhow, information, tools and parts required to have the ability to repair. Other, unauthorised, actors are prevented from engaging in repair.

IDEOLOGY OF THE SUSTAINABILITY TRANSITION	
Behavioural change The belief and trust in society that we will solve the sustainability challenges we face primarily by changing our behaviour (i.e,, lowering consumption levels and changing our consumption patterns). For repair, this implies more acceptance for the process of repair and reduced consumption of ICT products and appliances. This approach is sometimes referred to as "sufficiency" or "techno-pessimism". It implies a lessened appetite for novelty.	**Technical innovation** The belief and trust in society that we will solve the sustainability challenges we face primarily through technological innovation (e.g. electric cars). For repair, this implies that tech innovations are employed to facilitate the repair experience and enable high consumption levels (in some form). This approach is sometimes referred to as "efficiency", "ecomodernism" and "techno-optimism". It implies a continued high appetite for novelty.

2.1.2 DRIVER 2: IDEOLOGY OF THE SUSTAINABILITY TRANSITION

For this driver we were guided by the questions "What is the ideology behind the sustainability transition?" and "Is the emphasis on behavioural change OR technical innovation?". Usually, studies of the future tend to exaggerate the transformative role of technology as a driver of change, whilst underestimating the effects of social changes and how relationships between people can evolve (Raudsepp-Hearne et al., 2020). To this effect, repair activities can either become more complex as products continue to incorporate more advanced product features and "high-tech" repair solutions, or the development can go in the opposite direction of more simplicity in product designs and overall consumption reductions (which repair enables since, if successful, it eliminates the need to replace). While the EU has committed to reducing overconsumption (Anastasio, 2021), the U.S. and most other countries are committed to the opposite approach (Ellen MacArthur Foundation, 2015). In essence, we seek to understand the difference in implications of the lives of individuals from the normalisation of repair taking place under the ideology centred on behavioural changes vs. innovation (that make major behaviour change superfluous).

The ideology behind the sustainability transition constitutes an important crossroad in the realisation of a CE Repair Society and the respective implications of these approaches must be better understood, not least in combination with the implications of market governance structures.

2.2 SCENARIO FRAMEWORK

To populate the scenarios, we employed a participatory approach, using a workshop with 14 participants (see section 2.4). To consider the larger system that the repair experience is a product of (Russell et al., 2022), and account for the fact that scenario planning relies on systems thinking to understand the actors, factors and relationships at play (Wilkinson, 2017, p. 20), we used the CE Repair Society Systems Framework in Figure 1 (Svensson-Hoglund et al., 2020) as a so-called "design tool" to systematically construct the scenarios (Quist, 2016; Quist and Vergragt, 2006). Specifically, the framework is used to organise the workshop; based on the three levels of the framework, we divided the workshop into three phases: 1) Societal-level explorations (i.e., Macro and Meso level in Figure 1); 2) Individual-level explorations (i.e., Micro-level in Figure 1), and 3) Challenges and opportunities with these identified conditions. For each part, we formulated sets of questions to guide the explorations (Table 1).

This multilevel approach constituted a systematised method akin to Wangel et al.'s (2019) "process of transformation", looking at higher system conditions to discern the implications at the (lower) individual level. The use of dimensions at each level (see light grey headlines in Table 1) is taken from morphological analysis that centres on the exploration of multiple aspects and configurations as possible solutions (Ritchey, 2011). In this regard, the employment of the multilevel framework (Figure 1 and Table 1) allowed us to overcome

Table 1. Supporting questions for the three consecutive workshop parts.

PART 1	PART 2	PART 3
SOCIETAL LEVEL (MACRO AND MESO) QUESTIONS **Market Description** How are electronic devices and appliances designed and developed? What are the main considerations? What does marketing look like? What aspects and values of products are promoted? Is "repairability" mentioned? **Infrastructure** Where are repairs done? Are transports needed? If so, how do they work? Where do you go, is it close to your home, or do you maybe get it picked up? **Culture** What does the use of older and repaired things say about a person and their identity, social status and level of "success"? Is the goal of the repair to hide the fact that it was once broken, or to make the repair visible and even pretty?	**INDIVIDUAL LEVEL (MICRO) QUESTIONS** **Behaviour** Your cell phone or fridge breaks, what do you do? How do you go about getting it repaired? What type of support, services or tools are available to you? What is the process of repair like in terms of time, effort and the knowledge required? **Financial Cost** Is repair affordable? **Relationship to products and the practice of repair** How do you as a consumer feel about the repair process? How do you as a consumer feel about using the repaired item?	**BRIEF SCENARIO ASSESSMENT** What are your main insights? What do you like about the world, and what do you dislike?

a common challenge in future studies, namely to adequately capture the multilevel nature, as well as both the socio-cultural and techno-economic elements, of a system (Raven, 2017). The questions, or prompts in Table 1 constituted guidance for the workshop groups; the participants were not asked to specifically answer each of the questions, but to freely explore each system level, first on their own and then in discussion with the rest of the group. By semi-directing the scenario development in this way, we took into consideration potential drivers that had not been included in the 2x2 matrix (see Roura-Pascual et al., 2021).

The scenario assessment (Part 3 in Table 1) was included to understand the different stakeholder ideals and the participants' thoughts on the desirability of each of the scenarios. As such, we sought to capture the embedded controversy between stakeholder interests.

2.3 COUNTERFACTUAL SCENARIOS

Asking workshop participants to speculate about the future is not an easy task, as there are so many unknowns. Also, when asking people to think specifically about what life and everyday practices might be like for humans in the future, we are urging them to use their imagination; are they to picture themselves in the future as any human, or as themselves? If so, should they simply place their current selves in that future, or are we asking them to factor in what their actual age would be in year x? These are just some of the many complicating factors in participatory futures approaches.

Inspired by Pargman et al. (2017) and a currently ongoing research project at KTH Royal Institute of Technology (KTH, n.d.), we based the workshop explorations on so-called counterfactual scenarios. According to Pargman et al. (2017, p. 170), counterfactual scenarios can be used as:

"thought experiments whose main function is to defamiliarize us with what is taken for granted. Such scenarios invite us to explore plausible parallel paths, thereby making it possible to imagine futures that are essentially different from the path-dependence of an unyielding historical past. Such futures enable us to grapple with a present that is saturated by the inertia of past decisions and the sunken costs of existing infrastructure."

A hypothesis in the ongoing KTH research project is that it is easier to imagine human everyday practices and experiences in an alternative state of the world if all things other than the counterfactual are kept constant. So, rather than asking the workshop participants to imagine what a future CE Repair Society might look like, we decided to ask them what CE Repair Society in 2021 might have looked like, provided that developments in the past had taken a different turn from a given point in the past, a so-called bifurcation point. For this, we chose to use the 2008 financial crisis, and introduced the alternative course of events to the workshop participants as follows:

"Now it's time for us to briefly travel back to 2008, and the financial crisis that hit the globe and caused bankruptcies of states, banks, companies and people; and mass unemployment in a number of sectors that lasted for years.

In the year before, the IPCC released "Climate Change 2007, the 4th assessment report". It was the largest and most detailed summary of the climate change situation ever undertaken. It created debate, but ultimately didn't lead to any of the massive changes that its findings told us were needed.

This is where our alternative story begins, where we are going to pretend that the EU & US chose to actively respond to the two crises with regulations that stimulated a transition towards a repair economy."

To retain valuable materials in the economy and reduce price volatility, global dependence and environmental impact, tax reforms were introduced, which increased the cost of new and decreased the cost of repair.

To facilitate the participants immersion into this alternative reality, we decided to record a fictive 2 minute long BBC World News story, where a news reporter described the actions of the EU and US, and what they might entail (Figure 3). The news story was created as a piece of speculative fiction describing the counterfactual scenario (Oziewicz, 2017) in order to boost the suspension of disbelief in the participants.

Again, this study is on normative futures in that repair is normalised, with elements of morphological analysis in that we are exploring different such states.

2.4 THE WORKSHOP

2.4.1 The Participants

Stakeholders constitute a rich source of knowledge, and, since their interests are affected, their involvement in scenario development increases the legitimacy and support for the results (Quist et al., 2011). Such participatory approaches can involve both experts (see e.g., Roura-Pascual et al., 2021; UK Government Office for Science, 2017) as well as "regular"

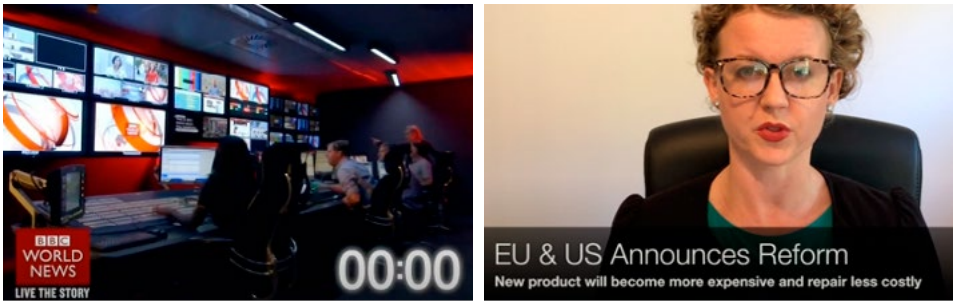

Figure 3. A fictive video with a news story about the reforms to encourage repair. The full video can be seen here: https://youtu.be/_VNxXYppo6Mw

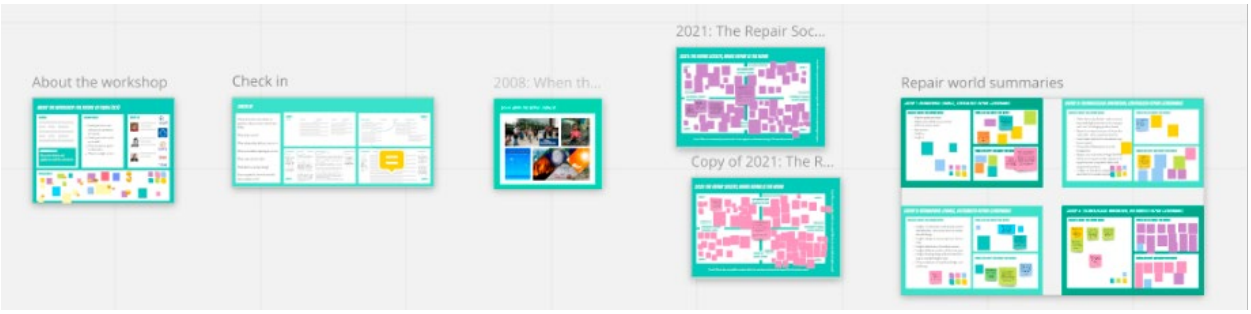

Figure 4. The Miro Board with an overview of the workshop process from left to right.

citizens, or non-experts, as they can bring additional perspectives, offer criticism and reveal assumptions. Non-experts also contribute to the legitimacy of the results as suggested pathways for the future (van Asselt et al., 2010a); the inclusion of both experts and non-experts and the exchange between these actors serves to ensure that a wide range of perspectives are considered, which decreases the prevalence of blind spots (c.f. Gray, 2018, p. 465 on workshops in general; van Asselt et al., 2010a). Furthermore, wide participation can also create collective images of the future as a basis for action (Ramos et al., 2019). Given our interest in experts, practitioners, and "regular" product users, we included representatives for all key stakeholders in a Repair Society; product users, product manufacturers and their authorised network, government/policymakers, and repairers/Do-it-Yourselfers (DIY) (Svensson-Hoglund et al., 2021).

Participants were recruited using LinkedIn networks, and primarily academic researchers and consumer representatives responded. The FixitClinic was approached for volunteers who could speak to the community repair perspective. To include practitioners, such as repairers and manufacturers, we used listservs for organisations with an interest in electronics and repair (e.g., the Circular Electronics Initiative[5]). Personal networks were also consulted for participants to represent primarily the product user perspective.

We ended up with a very diverse group of 14 individuals (in addition to one participant that acted as a co-facilitator, and the three organisers) from Sweden, Denmark, and the USA.

To allow for the creation of four diverse working groups, the participants were labelled as either "Academic", "Business", "Product User" or "Community Repairer''.

To make the group participants feel more comfortable to speak their mind, despite their different perspectives (Gray, 2018, p. 465), and get to know each other a little, we initiated the workshop with a check-in exercise, where the workgroup participants shared stories of recent personal repair experiences with each other.

2.4.2 Workshop Data Collection

A detailed workshop script allowed us to ensure time management and the provision of necessary information. A canvas and web whiteboard called Miro was developed, with designated spaces for each step of the process, see overview in Figure 4 above.

During each of the three workshop phases (i.e., societal, individual and scenario assessment – see Table 1), participants were asked to write down their thoughts on postit notes, and then discuss with their group. The breakout sessions were also recorded with the permission of the participants, to ensure that the facilitators could partake in the group discussion and concentrate on facilitation, instead of taking extensive notes. One facilitator was present in each of the four groups to ensure that they could make progress (e.g., providing Miro support and reminding the group of the prompts, as well as scenario conditions).

[5] https://tcocertified.com/circular-electronics-initiative/

2.4.3 Workshop Data Analysis

The data analysis began with gathering all PostIts for each of the workshop parts captured in Figure 4. To make sense of the PostIt notes, we listened to the recordings of the workshops to better capture the insight of the participants. This raw data was then coded into the dimension it pertained to (e.g., "Market" or "Culture" – see Table 1).

Many workshop participants had issues grasping, or remembering the three sets of premises in the scenario exploration: 1) the respective scenario drivers; 2) the normative assumption that repair is fully implemented, and; 3) the bifurcation point explaining how repair had come to constitute the norm (i.e., tax reform lowering costs related to repair and increasing the price of newly manufactured products). Overall, we tried to interpret such misaligned ideas in light of the premises, but sometimes we were forced to either move the idea to a different scenario or omit the ideas completely due to the lack of relevance. However, we made substantial efforts to incorporate suggestions that were not fully aligned with the premises in order to reflect stakeholder concerns. These are described below.

First, some participants forgot the normative assumption that all repairs that are environmentally and economically feasible are taking place, and instead looked for what could be regarded as "loop-holes". For example, one participant brought up the risk of "greenwashing" in the form of false marketing of repairability in the product design. Such concerns regarding the extent of the normalisation of repair were incorporated into Scenario 2 where modular product upgrading has become a way to circumvent repair requirements. Secondly, several participants mentioned the competing option of low-cost replacement, but that is against the premise of the alternative present (i.e., the bifurcation point in 2008, making repair less costly and the buying of new products more expensive). As such, these comments were removed. Similarly, many participants spoke of internalised environmental and social costs to increase the cost of new relatives to repair. However, given the 2008 tax reform, the price of new had already been increased. We chose to consider this last point by introducing a further price increase (see Scenario 3). Thirdly, stakeholder ideas did not always reflect the particular scenario drivers in the participant's scenario. An example is discussions on strategies that product manufacturers use to make products feel "new" in a scenario that was (supposed to be) characterised by behavioural change. These types of inputs were generally handled by moving the insight into a scenario where it constituted a better fit. However, in response to comments on the difficulty for DIYs in high-tech innovation, regardless of permissibility and access to necessities, we turned Scenario 4 into what some would refer to as a state of semi-distributive market governance; repairs are being conducted solely by professionals. Lastly, some comments concerned non-repair related circular economy strategies, such as recycling, reuse and refurbishment, which were deemed to be outside the scope of the report. As such, most of these thoughts could not be included, but we did include refurbishment strategies and the advantage for manufacturers to control the material embedded in products through take-back agreements (Scenario 1).

In addition to managing the above misalignments, we also had to add details regarding the PSS models; in every group, PSS models were brought up, without any details on how they were structured. PSS models can take many forms, in some ownership is not transferred to the user, who is instead paying for usage or a result (i.e., use- or result-oriented services). In other PSS models, the product is sold to the user and the service consists of e.g., take-back at end-of-use (i.e., product-related services) (Tukker, 2004). To account for these differences, we added clarifying details to each scenario regarding the specific nature of the PSS model.

We were also required to "fill out the blanks" in terms of dimensions (Table 1); one group, for example, did not touch upon socio-cultural aspects at all in their discussions, despite being prompted by the questions and the facilitator. This might be because the participants' had more of a technical background and did not feel competent reflecting on cultural influences. Some groups also preferred to discuss the higher systems-level aspects, and did not arrive at any clear implications of these systems features on the experience of the individual (i.e., the micro level). This is presumably due to a lack of habitude in considering how repair market conditions are experienced by the individual product user. It could also be the result of their interests and/or ideology in terms of what is deemed important for the upscale of repair. To remedy this, we engaged in the first round of "process of transformation" (Wangel et al 2019) by translating higher system conditions onto the implications at the individual level in a structured manner (e.g., using the descriptions of the infrastructure and repair service provision, we could make conclusions about the level of convenience for users to engage in repair) – see Appendix A.

We were also required to make certain choices as some groups came up with diversified alternatives within the same scenario (see Table 2), such as more than one type of business model of manufacturers.

Table 2. The Different Possible Pathways within the same Scenario

	SCENARIO 1 Centralised Governance Behaviours Drive Sustainability Transition	SCENARIO 2 Centralised Governance Technology Drives Sustainability Transition	SCENARIO 3 Distributed Governance Behaviours Drive Sustainability Transition	SCENARIO 4 Distributed Governance Technology Drives Sustainability Transition
MARKET				
OEM Business model	Repair is convenient since the OEM brands compete on the repair experience and users switch to the provider offering the most convenient service VS. Repairs are inconvenient in absence of repair competition (switching provider is more difficult)	No user involvement in repair VS. Users are asked to conduct smaller maintenance and repair measures Costly repair (manu-facturers sees repair as value-capture) VS. Cheap repair (source of competition)		Manufacturers use PSS models and/or extended warranties to try to re-centralize repair market VS. OEM Business models centres on sale of necessities, not repair services
Product Design	Modular Design (since no competition on repair, goods can be made highly repairable) VS. Specialised and complex (can prioritise other design goals and deal with the consequences in internal repair) High-quality and longevity VS. Constant modular upgrades			
Repair Marketplace				Repair is a widespread hobby and so easy that anyone can do it VS. High-tech products are too complex to repair and too time-consuming for DIYs
CULTURE			Decoupled sense of self from possessions VS. Identification and pride in repaired items and repair skills Product are valued for the function they provide (low attachment) VS. Products are valued for uniqueness and personali-zation (high attachment)	Repair as a burden on the poor VS. Freedom to lower cost of living and be empowered

This constitutes an interesting finding (i.e., that many different, or even parallel, pathways were possible within one scenario), but we decided to treat these alternatives as mutually exclusive and pick one, which is further outlined in the next session.

2.4.4.Scenario Development

To keep the scenarios straightforward and easy to grasp and compare, we decided to turn each scenario into its own distinct pathway. This entailed the identification of main themes and the transferring of workshop data findings between scenarios. We also added our own insights according to these themes. This choice implies that the depiction of the scenario conditions are but one possible alternative (see e.g., Table 2), particularly with regards to how the stakeholder chooses to act, and should be regarded as such. To this point, the Scenarios constitute conceptual extremes meant to showcase the implications of the drivers and various stakeholder positions; they are not meant to be possible or plausible futures, but tools of exploration of the future of repair. This choice was guided by the research questions and overall objective to create a better understanding of the differences between the scenario characteristics as policy choices in terms of implications on everyday life of product users.

In developing the scenarios, we used the dimensions from Table 1 (based on the Multilevel Framework in Figure 1) and the, in the data, emergent sub-dimensions for structured and comparable scenario building. The Tables in Appendix A provided a "skeleton", allowing us to organise the findings into foundations for each scenario. To develop these further, the Tables in Appendix A was used in a "top-down" process where we traced the effects of higher system level conditions onto the lower level – allowing us to systematically discern the nature of the Key Aspects of the Repair Experience in each scenario.

This process of systematically tracing the implications of conditions downward in the system was repeated to ensure coherence between system levels and the covering of all dimensions. If we discovered gaps or inconsistencies, we altered and added. This approach made the scenario matrix and drivers (Figure 2) serve as "foundation" to create common ground and prevent overlap; the scenario matrix constituted a procedural tool (van Asselt et al., 2010b, p. 66f) for discovering possible and diverse CE Repair Society characteristics. The complete scenario characteristics are outlined in Tables in Appendix A which were used to create the scenarios. See Section 2.1 for a description of the theory behind this methodology.

Once the scenarios were finalised, we identified similarities across the four scenarios and moved them to a separate introduction to avoid repetition and focus on the differences (i.e., where the scenarios offered varied conditions).

2.4.5 Narration and Storytelling

To make the scenario foundations (Appendix A) come to life, we turned each scenario into a descriptive narrative. "Narratives structure human comprehension, and shape our ability to imagine and achieve transformed futures…." (Veland et al., 2018, p. 41). As a research tool, its foremost advantage lies in how complex ideas can be communicated, without the science jargon that would otherwise accompany the presentation and make it largely inaccessible to regular people. To this point, since "we cannot have a conversation about something we cannot see", the use of stories constitutes "a prerequisite for public participation" in shaping futures (Raven, 2017, p. 165). Stories do influence public policy making (Jones et al., 2014). Inspired by particularly research on energy and climate futures (see e.g., Jack and Ivanova, 2021; Moezzi et al., 2017; Mourik et al., 2021; Raven, 2017) we included elements of storytelling, or speculative fiction, or prose science fiction, to improve the narrative flow.

We finished by giving each scenario a descriptive name and image, to highlight their differences (Figure 5).

The combined process of workshop data analysis, scenario development and narrative creation is depicted below in Figure 6.

2.4.6 Scenario Assessment

The Key Aspects of the Product User's experience of repair were defined in the Introduction. In terms of behavioural aspects, we were interested in details on the efforts needed to engage in repair, such as transporting or waiting, and resources that might be available to individuals to reduce the behavioural cost. As to financial aspects, the narrative was scanned for indications on the price of product and repair as a service and/or necessities. Lastly, the scenarios were assessed for any details on socio-cultural aspects, which consist of norms, attitudes and emotions related to both products in general and the practice of repair. It should be noted that Key Aspects constituted dimensions at the Individual system level (see see Table 1 above and Tables 9–12).

These Key Aspects constituted the focus of the assessments of the scenarios, especially for how each driver, and their configurations (i.e., scenarios) seems to impact these Aspects.

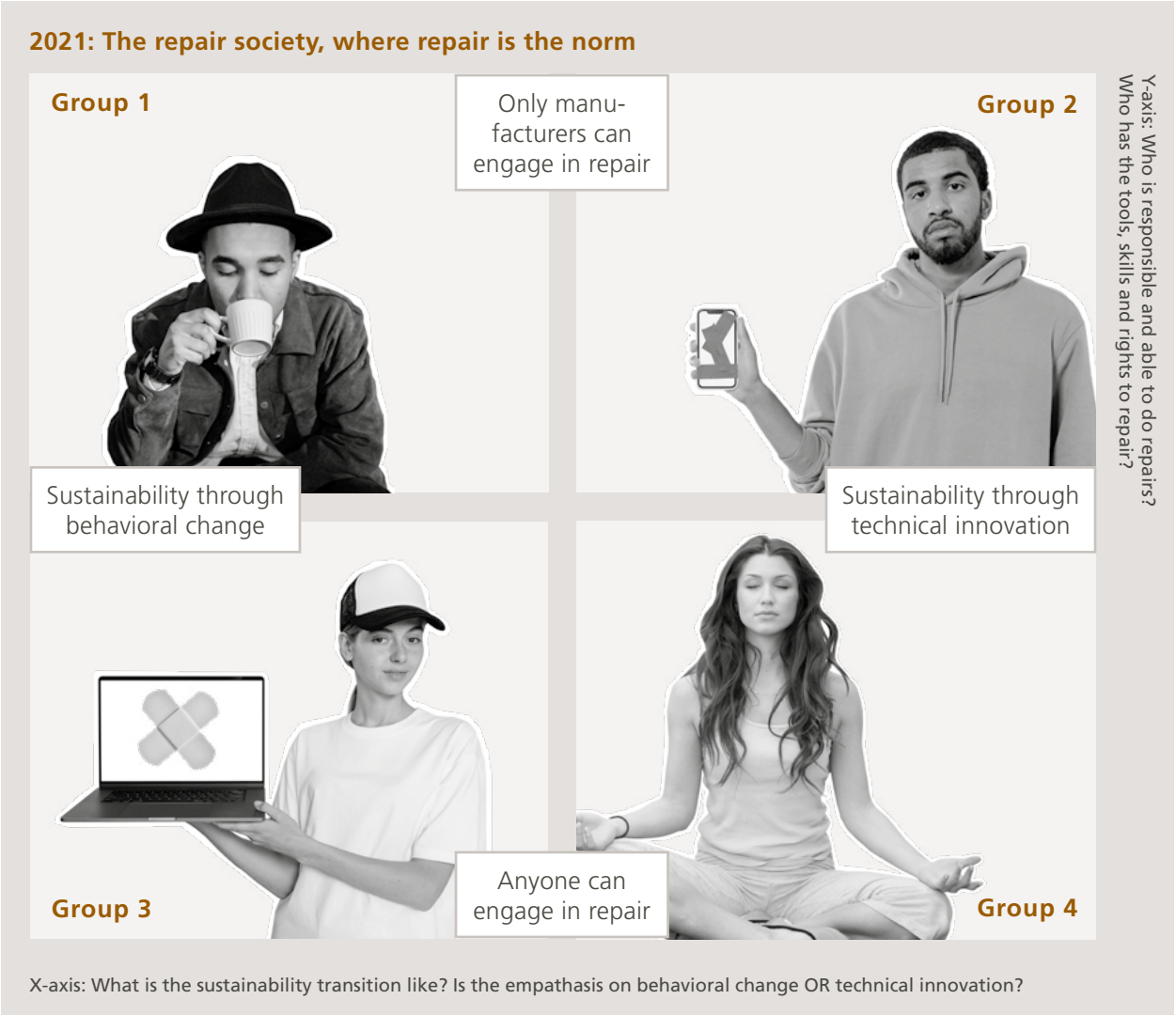

Figure 5. 2x2 Matrix with Scenario Images

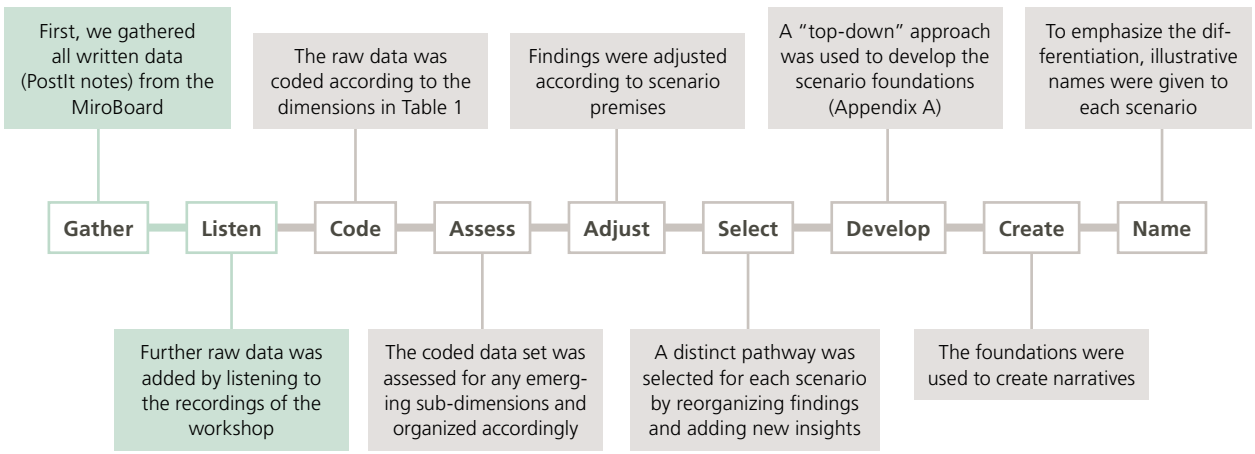

Figure 6. Workshop data analysis and scenario development process.

PART II: THE SCENARIO NARRATIVES & ANALYSIS

These four scenarios are meant to capture the experience of product users living in a society where repair is normalized, under different conditions. In two of the scenarios, the repair market is governed by the product manufacturer, while in the remaining two anyone can conduct repairs. Also, in two of the scenarios the ideology behind the overall sustainability transition is tech-driven, compared to driven by behavioral change, as in the other two scenarios.

As described in Part 1, the following scenario narratives are the result of two rounds of speculation. First, we asked a group of repair stakeholders to provide us with their ideas of what a future where repair is normalised could be like, based on each of their unique perspectives (i.e., to speculate). Thereafter, we as the report authors used these ideas as inspiration for our own process of speculations, resulting in the outline of four conceptually extreme and purposefully distinct scenarios of a repair society. As such, the Scenarios constitute conceptual extremes meant to showcase the implications of the drivers (as policy choices) and various stakeholder positions; they are not meant to be possible or plausible futures, but tools for exploring the future of repair. The choice to create the scenarios in this fashion was guided by the research questions and overall objective to create a better understanding of the differences between the scenario characteristics in terms of implications on the everyday life of product users.

3. Results: Scenario Narratives

Each scenario constitutes a version of an alternative present. In each scenario a tax reform was introduced in 2008 that increased the price on newly manufactured ICT and appliances, while taxes related to repair were lowered, decreasing the cost of repair. This is done in response to the 2008 financial crisis and climate threats, with the ambition to develop more sustainable management of resources. As a consequence, repair has been normalised, but under very different conditions.

While the narratives below are focusing on the differences, the scenarios also have many commonalities. The increase in the price of new ICT products and appliances, coupled with the decrease in the cost of repair services, has made repair the norm. As such, products are designed to last and with repairability in mind. Engaging in repair constitutes a normal part of life for individuals; it is a habitual go-to when dealing with broken devices. With new products being so expensive, today's behaviour with cars, a high-ticket item for most people, can provide an illustration of the behaviour and mindset in this alternative present; the tendency is not to discard and buy new as soon as something breaks (as is often the case today e.g., with mobile phones), instead people fix the default themselves, or take it to a mechanic. Another analogy is how we today view the refill of consumables; we expect to change tires on our cars, add detergent to our washing machines and refill our coffee machine with coffee grind – it constitute a normal feature of the daily usage of these products, we don't expect anything less than putting in the effort that it takes – and in these alternative futures it is the same with repairing products. Moreover, it is acknowledged that replacing a broken product can take a lot of work, e.g., replacing a refrigerator requires that it is emptied, carried outside, and disposed of. Repairing the refrigerator is much more convenient.

Across scenarios product development and marketing efforts focus on durability features since users don't want to be bothered with a product breakage. As such, advertisements show photages of e.g., a cell phone being dropped on rocks, falling into water, or being driven over by a car – and it still powers on afterwards. Products are claimed to "never break'', showing footage of a sad repair technician sitting by the phone waiting and no one calls.

Across the board, repair service providers, PSS providers and product manufacturers can experiment with strategies for value-capturing of repair services, which likely result in intricate systems of tiered services – leaving the wealthy with better products and services, and the less affluent with lower quality and inferior services. To this point, depending on what is permissible, black markets for repair services as well as necessities can exist. While no user protection is offered (at least not traditional), it can at the same time provide the only affordable alternative for individuals with financial issues who experience a product breakage. Presumably, the more restricted and expensive repair is, the greater the need for alternatives.

Now, let's look at the four CE Repair Society Scenarios and the diverse conditions they offer.

3.1 SCENARIO 1: MANUFACTURERS TAKE CARE OF BUSINESS

The 2008 financial crisis left people with a bad aftertaste of the greedy Wall Streets-rulers of the world. People called for a return to values such as honesty, integrity and social good. This popular movement, coupled with the tax reform raising the price of newly manufactured products, forced ICT and appliance manufacturers to go through a complete makeover. They quickly realised that if they did not step up and take full responsibility for the longevity of their products, including their customers' repair experience, legislators would intervene or competitors take over the growing aftermarkets of their products. Moreover, using PSS models with take-back schemes, manufacturers realised that they could control materials embedded in products to be used in the manufacturing of new. Brands emerged with a new purpose; their new long-term profitability strategy consisted of providing product-as-service (PSS), with repair included, competing for their customers' life-long loyalty and affiliation. Repair became central to the value offering of product providers and a way to "stay in touch" with their customer base. Only a few brands survived the transition and the market state is close to an oligarchy with only a few players.

The cultural transition affected leaders and employees in the company, pushing brands to start taking stands on social issues. This development has led to a new kind of a marketplace where some brands are more conservative/right-winged in their values, while others are more liberal/left-winged. This means that in addition to competing on the quality and durability of their products and repair services, the basis of competition for brands also extends to their values; product users are acquired and retained by brands sharing and expressing aligned values. As such, user confidence is now built not only by ensuring a satisfactory product experience, but also through sharing values. In this regard, the choice of which brand to affiliate with is a "Vote with your Wallet".

The manufacturer brands have turned into heroes in the eyes of the public due to their community engagement and the high-quality customer service following the introduction of the tax reform and the rough transition phase. Product users have turned into followers of their chosen brand and there is an immense trust and near worship of brands who care for their customers and their communities. With only a few brands to choose from, entire families and even communities pertain to the same brand's customer base. People can even feel animosity towards users of other brands, similar to supporters of competing sports teams.

Products, in and of themselves, are acquired for their functionality, which incentivizes longevity in design, product development and marketing. The PSS models, in addition to warranties and repair service plans for non-PSS sales, allow manufacturers to maintain control of the repair market. They don't sell spares, tools nor make information available to third parties and product design is specialised to deter

KEY FACTS:

▶ **Centralised Market Governance:** PSS models, extended warranty and repair service plans tie product users to the manufacturer's authorised repair network. The public narrative is that only the manufacturer can conduct satisfactory repairs.

▶ **Behavioural Change drives the sustainability transition:** Users bring malfunctioning products to their local authorised repair centre. People own fewer devices and care about societal and environmental issues that their product brand stands for.

▶ **Driver of the normalisation of repair:** Manufacturers want to control the product experience, their brand, and material embedded in the products, which include making repair an accepted element of their PSS model.

▶ **Prominents Feature**

- Products are primarily functional, with rare modular upgrades. Focus is on functionality and durability.
- Due to the longevity of products and the sociocultural meaning of product brands, the choice of product provider constitutes a long-term commitment. It includes considerations not only for product features, but also of what the brand represents; how well does the brand align with the user's personal values and social context?
- There is a complete confidence and trust in "your" brand, to the point of worship.

third-party repairs. Users are also contractually bound to not allow any unauthorised party perform work on their devices. But that is of little importance since the public narrative is that no one else but the manufacturer is capable of offering satisfactory repair services – anything else would be blasphemy.

Users bring their malfunctioning devices to their local repair centres, or service staff get dispatched from there for in-home repairs of larger appliances. Spending time at the local Repair Centre is a social and fun experience, with outgoing staff at the front end. Coffee and tea are free, with plenty of seating areas for brand loyalists to convene. User engagement efforts consist of maintenance events, held at the local repair centres, where those who are interested are taught how to conduct basic maintenance tasks. Actual repairs, however, take place behind closed doors. The goal is for repair to be invisible to the product user.

Products are standardised per brand for ease of repair. As manufacturers only engage in PSS models or other plans covering repair, they don't need to employ specialised design features to deter third-party repairers. While products are designed to be upgradable, such upgrades are rare. Focus is on providing longevity and timelessness. As a consequence of the focus on functionality and brand-loyalty of users, manufacturers repair at least as much as they refurbish; unless the fix is quick, users are offered a refurbished product in replacement of the broken one, which is fixed and then handed to someone else. The advantage is that the waiting time is close to zero. However, if the user is attached to the broken product, they are given the option to wait and it might cost extra to get the product back within an acceptable time frame. This fosters attachment to the brand, not specific products.

Social values, such as loyalty, reliability and family, are central in the culture. The level of materialism is rather low, which makes people own fewer items. However, status and socioeconomic class is still visible in the type of product people have and the repair services they have access to.

Financial Aspects: Products are somewhat expensive to acquire, but users understand that they are paying for more than a product – they are supporting the kind of world they want to see. PSS subscription costs are more financially advantageous for users than buying the product. Some still prefer to buy, but still sign up on repair service plans. The cost of both PSS and service plans depends on the type of product (high-end vs. basic) and the level of repair service. Repair of one's own product costs extra.

Behavioural Aspects: Manufacturers have authorised representatives in most towns, and most users have a repair centre close by, as a consequence of brands' strategy to protect their role as the sole repair provider and preempt legislative involvement on geographic coverage of repair service offerings. Depending on the plan, the accessibility of the service ranges from high-end, 24/7 service availability to longer waiting times, with some customers even being responsible to transport the product to a repair centre. The hybrid-model, where a refurbished product is offered as replacement, decreases waiting times. The general sentiment of users is that the provider is doing what they can to help.

Socio-cultural Aspects: In addition to providing functionality, the products embody the user's relationship to the brand. As products last for long, the choice of brand is important and signifies something about you – you choose a brand "camp" when you buy something. Which brand represents a better world, in your mind, and what will your friends think of your choice? Due to the hybrid model with refurbished products as replacement, users are less attached to their products; it is more about the brand. Visiting the local Repair Centre is a fun experience, making the repair experience (that is often quick due to the refurbishment programs) a positive and social one.

Table 3. Scenario 1: Stakeholder Voices on Challenges and Opportunities

	PRO'S	CON'S
USER	+ Owning fewer products for longer has the potential to ***reduce the total cost of living***	- Manufacturers have great discretion regarding what is repaired or not, and how. The decision is likely based primarily on profitability. - Without insights into the repair process, or options for a second opinion, there might be distrust, both regarding quality and price. - Could become expensive since there is no competition and "lock-in" effects due to the high price of new products, making switching brands expensive.
	+ Users experience a ***sense of belonging*** with a brand	- With the public narrative to simply trust and rely on manufacturers comes unevenly distributed power, disfavoring the individual; manufacturers dictate the market conditions and displeased individuals have nowhere else to turn.
SOCIAL	+ Brands are truly ***serving their communities*** on a range of issues	- Low transparency regarding product design and repair leads to lack of knowledge and understanding about product functions or repair. This lowers the resilience of communities in the event the local repair centre has to shut down - The extreme branding can have a divisive social effect
ENVIRONMENTAL	+ Focus on ***product longevity*** and long innovation cycles reduces waste + ***Higher price on devices*** reduces the number of products in each household.	- Low transparency into product design and repair operations means that holding manufacturers accountable for resource efficiency is difficult.

SCENARIO 2: POLICYMAKERS HAVE REPAIR IN HAND

3.2 SCENARIO 2: POLICYMAKERS HAVE REPAIR IN HAND

Economic growth continues to be regarded as the main vehicle for human prosperity, which spurs product innovation. The introduction of the tax reform in 2008, which increased the price of new products and decreased the cost of repair, failed to have the intended effect of increasing repairs and circulating resources in the economy. Instead, manufacturers, users and third-parties alike kept finding and exploiting loopholes, such as buying new ICT in separate parts and assembling them domestically. Hence, legislators had to intervene. With product users hungry for the latest and greatest product experiences, manufacturers eager to provide them, and legislators wanting a both functioning and profitable repair market, a compromise quickly emerged: manufacturers were awarded monopoly over the aftermarket of their products. This compromise made manufacturers obliged by law to provide adequate repair services, which users have no choice but to accept. To continue to offer their users exciting newness, within the obligation to repair, product manufacturer restructured their business models to centre on the provision of modular upgrades in lieu of entire new products as upgrades. A dedicated surveillance authority ensures that providers live up to the legal repair mandates – balancing profitability and resource efficiency.

All electronic devices and appliances are designed with advanced modularity, allowing for easy module swapping and upgrades. The product "frame" is durable, and new frames are rarely introduced. However, new modular upgrades are launched regularly, offering both aesthetic and functional upgrades; some are true advances while others are just "new". The users don't care either way, they are genuinely excited by each new launch. This (modular) innovation moves so quickly that by the time a module breaks, it is often time to upgrade to a new one anyway. The surveillance authority permits this as it leads to economic growth.

Products are only made available through PSS models, where repair is incorporated. As users' choice of brand and product frame is based on the attractiveness of upgrades, manufacturers have little incentive to improve the repair experience. It is a necessary evil to take your device in for repair and it can take long to get it back – compared to upgrading which is smooth and exciting.

Manufacturers are completely separated, with brand-specific designs, and no interoperability between their modules. Unauthorised third-party repairs are punishable by law.

KEY FACTS:

▶ **Centralised Governance:** Policymakers have tasked manufacturers with the repair of their products to ensure continued product innovation and high levels of sales.

▶ **Technological solutions driving the sustainability transitions:** Modular product designs allow for easy repair in the form of modular replacement.

▶ **Driver of the normalisation of repair:** Legislators enforce repair obligations through market surveillance authorities who use audits to ensure that all repairs that are environmentally and economically feasible are conducted.

▶ **Prominents Feature**

- Products are designed according to Fairphone's principles, but the design of each brand is unique.
- Repair takes place primarily as modular upgrades.
- The culture is highly materialistic.

The culture is highly materialistic and people display status through module upgrades, both in terms of function and product aesthetics, such as colour and shape. Many affluent people don't wait until their product is broken and instead buy new modules and even frames as soon as they are released. Such spending habits are, however, out of reach for most people because of the high prices following the tax reform.

Financial aspects: Repair services are offered in price-tiers as part of the PSS plans, with ranging price points. The cost depends on the level of convenience and speed that the user can and wants to pay for; top-tier plans come with modular upgrades as soon as they hit the market, while the basic plans ensure financial accessibility of repairs (sometimes as late upgrades), but also entail e.g., longer waiting times.

Behavioural aspects: As a condition for the repair monopoly, each manufacturer is obligated to offer a network of authorised repairers with wide geographic coverage to ensure repair availability, even in rural areas. However, little is done to make lower-tier services pleasant for users, and it can be time consuming. The required effort and waiting times for repair vary greatly depending on the user's willingness and ability to pay. It is much quicker and easier to make a modular upgrade.

Socio-cultural Aspects: Products are valued by users for the novelty they represent in terms of latest upgrades. As such, attachments are fleeting and if users can afford to upgrade, they will. Conspicuous consumption is important, with striking social inequalities in what people have access

to and can display. Because of the hunger for novelty, people's feelings for repair can be likened with those of cleaning your house or brushing your teeth – everyone does it because it is a necessary must, but life would be better if you didn't have to do it. DIY repairs are not legally permitted as they would breach both intellectual property laws and the contract signed with the PSS provider. Although that does deter some people who would otherwise attempt repair, even the simpler ones, the bans are of little significance to most people who are simply not interested in repair or maintenance. They think it is best to leave it to the PSS provider, since repair is more or less covered by them. Repair is, simply put, not a worthwhile way of spending one's time, effort and money. It is better to put time into making money and then spend it on flashy upgrades.

Table 4. Scenario 2: Stakeholder voices on the Challenges and Opportunities

	PRO'S	CON'S
USER	+ Potential for ***high levels of convenience,*** with modular repair and upgrades, depending on location and willingness and ability to pay.	- Lost knowledge on product functioning and repair, creating full dependence on manufacturers.
SOCIAL	+ Potential for ***objective and efficient repair standards*** formulated by policymakers	- The success of repair depends on the enforceability of the repair legislation, which is the work of the surveillance authority. This approach is expensive and burdensome for the legislator and requires trust in the government for it to work. - Every Main Street doesn't have an authorised repairer, and even if they do, that business operates under the rules of the manufacturer. This lowers the resilience of the area, especially those with no local repair centre.
	+ High levels of ***exciting innovation***	- Large disparity between rich and poor in terms of the type of access to products and repair services. Not everyone can keep up with the expensive upgrades and are stuck with older models, lacking certain functions and signalling poverty. Moreover, unequal access to time-effective repair can be detrimental for essential products, such as cell-phones used to run a small business.
ENVIRONMENTAL	+ Modular upgrades as ***less wasteful*** than entire product upgrades	- Modules themselves must be upgradable and repairable to minimise waste.

SCENARIO 3: EVERYONE IS A CHILL FIXER

3.3 SCENARIO 3: EVERYONE IS A CHILL FIXER

With the price of new ICT rising due to the tax reform, people started to repair instead of buying new products. However, the repair infrastructure was deeply insufficient in terms of skills, spares, tools and guides available. In response, people started collaborating with others – near (friends, family, neighbours) and far (online communities) – to solve the repair challenges together. The repaired products were not always pretty, with duct-tape and straps, but what mattered was that it worked and that was seen as a win. Those with repair skills recorded tutorials to help out and joined up with other knowledgeable members of their community to share their skills with those who were interested. The communal repair efforts turned into a social movement, creating local empowerment and a sense of community. Once people could see the possibilities, most realised that the benefits with repair exceeded the efforts required. This shift took place in the context of a larger cultural reevaluation of what mattered in life; materialised "success" and societal economic growth ceased to be societal objectives. Instead, people sought out ways to enjoy life at a slower pace, rich in time and social connections. This meant reduced work weeks, with more leisure time. "Living off less" turned out to mean "more living".

Responding to their constituents' call for coordination of repairability measures, coming from the left and right, legislators took the lead. By both banning and obligating certain design features (i.e., standardisations of product design) and accessibility to necessities, legislators ensured high levels of repairability. In these efforts, little to no consideration was paid to intellectual property interests, as they were considered secondary to the social benefit of product longevity.

Manufacturers embraced the societal changes and immediately followed suit by making longevity and repairability central to their business offerings. Innovation cycles slowed down and profitability is now driven by sales of new, as well as refurbished products and foremost cost-effective necessities, including repair kits and free repair tutorials. Devices are durable and, through the government-led standardisations, they are highly repairable. Manufacturers do not offer repair services themselves; there is no need for repair experts, since their products are so easy to repair. Instead, manufacturers' role in repair is simply to innovate more repairable and durable products, and provide necessities to anyone who wants them. Since manufacturers sell longevity and repairability, that has become the basis of competition; products are marketed as extremely repairable, with repair-centred slogans, such as "Even a caveman could do it!". Brands hire repair influencers to repair their products and promote their repairability. Most employ universal blueprints and open source-based designs, inviting pluralized repair and manufacturing. Tutorial and repair kits are widely available, both from the manufacturer, but foremost from third parties. Tools and various machines are hot commodities provided by both brand manufacturers and third parties. Localised repair cultures and techniques have evolved, including production of tools, spares and modules, which makes for unique localised designs and large variety and creativity in how things are repaired. As such, products are made to be modified and personalised.

KEY FACTS:

▶ **Distributive Governance:** All stakeholders agreed that repair would be a job for everyone.

▶ **Behavioural Change driving the sustainability transition:** Repair is considered a worthwhile effort and repaired items are appreciated. DIYs constitute the most common form of repair and many have it as a hobby.

▶ **Driver of the normalisation of repair:** People wish to make the best with what they have, help each other out and be rich in time and social connections.

▶ **Prominents Feature**

- Stakeholders collaborate harmoniously to maximise the life of products
- Repair techniques and spares exist in a wide variety, and are often unique to the area they were developed in
- People are attached to their products and invest time and efforts to learn how to care for them
- The pace of life is slow, with low levels of materialism

Repair is an enjoyable hobby for many people and DIYs constitute more or less the norm when something breaks. However, in case help is needed, there are plenty of options: there is a repair shop on every corner and every community has at least one state-funded repair cafe where people get help from volunteers and can expand their own repair skills. Education and information about what can be repaired and how to do it are easily accessible. Students learn about repair in school.

Culturally, repair constitutes a way to express yourself, care, spend time with others, help out, and save money for what matters. Overall, there is less of a rush. People take the time to chat with neighbours and conduct repairs together, which strengthens communities as they have an activity to gather around. If you need to borrow a temporary product while yours is getting repaired, someone in the community can often help out. The cultural ideals evolve around quality of

life, communal interests and sustainability. The mentality is that "Nothing is broken, nothing is waste." Uniqueness and durability is valued over novelty. Conspicuous consumption is regarded as vulgar and immoral. "Old" and mended possessions speak of a moral, ingenious, and respectable individual. However, a somewhat materialistic mindset still exists regarding tools and equipment, such as 3D printing for making parts. Having these capabilities provide social status, so people desire these material "attributes". Moreover, some, albeit a minority, find the focus on repair and the lack of newness boring and depriving, and liken it with communism.

Financial aspects: The cost of new products has become more expensive by the further internalisation of social and environmental costs (beyond the tax reform in 2008). This is socially accepted. People buy less stuff. Repair, on the other hand, is not costly. Users save money over time since products last longer. The wide range of repair options available – from low-cost DIY to more costly, but time-saving, professional services – gives people more choice in terms of life goals and priorities, including how much time to spend at work.

Behavioural Aspects: Repair options are extremely accessible, to a dizzying degree. Tutorials and kits are widely available for DIYs. Everyone knows several people who conduct advanced repairs out of their garage for a small charge. Most people belong to a community repair cafe, and have a trusted local repairer they go to for complex or tedious repairs.

Socio-cultural Aspects: Modularity and wide access to unique, locally produced modules and spares allows for more personalised and customised products and product culture. People form strong attachments to their products, especially if they repair themselves. Repaired products are considered beautiful and unique. The activity of repair presents an opportunity for improvements and fine-tuning. As such, most people find it to be an enjoyable activity that can also be social when problem-solving with others. However, some don't appreciate creatively repaired devices and look at repairing the way they do cleaning or doing the dishes; they prefer to use the extra leisure time from reduced work weeks in other ways.

Table 5. Scenario 3: Stakeholder voices on Challenges and Opportunities

	PRO'S	CON'S
USER	+ ***Freedom of choice***, with the wide range of repair options available + A ***joyful***, playful and creative relationship to things and repair + Opportunity to ***save money*** through DIYs	- Quality issues, such as a poorly performed repair or use of low quality spares, can reduce trust in repair. - The burden of investigating options, assessing the quality of spares, tools or repair service providers, and gathering repair information. It can take time and effort to sort through, which can be overwhelming. Certification systems for spares, tutorials and repair services to ensure quality might be needed to reduce the effort. - Some still see repair as a chore, but it can be a "means to an end" in that it saves money for other expenses. - Some think that it is boring to have the same product for so long and detest the lack of product innovation and exciting novelty.
SOCIAL	+ People socialise around repair activities, such as repair cafes. It ***strengthens local cultures*** and a sense of belonging, thereby boosting well-being. + Increased ***equity and economic access*** overall	- Being a high-status fixer requires the availability of funds for tools and equipment, which not everyone has.
ENVIRONMENTAL	+ ***Minimal waste*** from products and spares + ***Maximised product lifetimes***	- Occasional "repairs gone wrong" result in waste - The extensive sale of tools and equipment used but rarely is not resource efficient. One solution could be to set up tool libraries. - Products might be repaired beyond what is environmentally beneficial, such as when more energy efficient options are available

3.4 SCENARIO 4: THE CUSTOMER IS ALWAYS RIGHT

At the introduction of the tax reform, users made it clear that they agreed with the sustainability logic, but expected manufacturers, professional repairers, and legislators to "work things out". Early on, in an attempt to gain control over the product experience and their brand, manufacturers started to make their products available only through PSS models with ownership transfers, inclusive of repair and maintenance services. However, as the manufacturers' internal repair capacities could not keep up with the high demand, and waiting times stretching for days, users would not have it. Brands who did not accommodate third-party repairs in their PSS policies, pricing and relationship to third-party repairers were shunned. People had no desire to have their lives controlled by big businesses anymore, they wanted to and make their own choices. Individualism, high value of one's time and self-actualization as the ultimate purpose in life emerged as tenets of a new post-crisis consumer culture. Consumption moved from products to software, leaving hardware behind as a mere vehicle for what users craved the most: productivity-enhancing and enjoyable functions delivered by software. The repairability of products, and the quality of repair services were, and still is today, primarily driven by merciless user "right" to a "flawless" and uninterrupted product experience, and day-to-day life. Time is the most valuable currency and stuff is simply expected to work and be upgradeable with the latest software.

The product user power and market leverage comes from the wide interoperability and cloud services. This makes it easy for users to pair devices and increase personalised functionality, and for a dissatisfied users to switch PSS provider and brand, without losing any data or time on setups. Any manufacturer who attempts to change this interoperability loses their customer base. Freedom of choice is considered holy. In support of an open competition on repair, legislators mandated manufacturers to make information, spares, and tools available to anyone, as long as it does not interfere with intellectual property rights.

Today, PSS models don't cover repairs. While some PSS providers still offer repair plans, they generally have a hard time competing with the prices and convenience of local repairers. Instead, users choose, and pay, their own repair service provider. Apart from supplying the product, the services provided by manufacturers consist of a take-back agreement, in addition to constant efficiency-enhancing software upgrades and sale of apps. Advanced tech solutions are applied for preventative maintenance, diagnostics and early damage detection to avoid breakdowns in the first place. As a service, the user is also offered instructions and options for how to remedy a detected default, including provision of the names of certified third-party repairers nearby.

KEY FACTS:

▶ **Distributive Governance:** Product users decided that they had had enough of corporate control and demanded unlimited decision-power over the devices in their lives. This makes for high repair standards driven by the market, with no need for legislators to interfere.

▶ **Technological Innovation Drives the Sustainability Transition:** High-tech solutions are employed to prevent breakdown and enhance the convenience of repair services, such as repair robots and drones pick-ups of malfunctioning devices. Product value is delivered through software, such as upgrades and apps, which is a hot commodity.

▶ **Driver of the normalisation of repair:** Products serve a functional purpose, such as allowing for learning or optimising workouts. Users expect an uninterrupted product experience and do not accept to be told when a product is obsolete.

▶ **Prominents Feature**

- Users expect endless software upgrade capacity for new, efficiency-enhancing functions, such as compiling personalised data and proposing improvements.
- Wide ranging interoperability and cloud services allow users to easily swap brands whenever they are dissatisfied, giving them immense power on the product market.
- Plethora of design solutions and fast movement of innovation has made repair an activity solely for professionals.

To further enhance repairability, manufacturers use open source designs, which means a proliferation of product designs and repair services varieties: the amount of bespoken designs and repair solutions make any attempt at standardisation impossible. A successful repair requires technical skills and often access to a 3D printer to make spares. As such, in this high-tech society, emphasis is on repair as a business opportunity and repairs are conducted almost exclusively by professionals. This has led to the creation of a large and diverse professional repair sector that caters to the needs of users to have repairable and upgradable technology that does not compromise on innovation and functionality. Despite wide availability of necessities and open-source design there are some barriers of entry into the repair market: there is a need for specialised, expensive tools, pricey diagnostics and foremost technical skills (of which many are brand-specific). But there are still many providers.

Users are primarily occupied with various forms of self-actualization where devices serve a functional purpose, such as allowing for learning, staying informed of current events,

working out, following a diet, saving time and removing "musts" – all enabled via high-tech software solutions. Products are modular in their design, with durable hardware endowed with large capacity for advanced software upgrades over time. The goal is to provide the user with endless software upgrade capacity for new, efficiency-enhancing functions, such as compiling personalised data and proposing improvements. Brands therefore compete with each other on the product experience (function), with upgradability, durability and repairability being important selling points.

Due to the ease of product switching, one bad review can be catastrophic for manufacturers and the threat of such bad publicity leaves them anxious and extremely accommodating to the needs of their customer base. Just like a negative review of an inconvenient repair poses a threat to the brand, so does a low-quality repair outcome. Manufacturers are therefore keen to ensure wide availability of high-quality repairs. To this point, they sell cost-effective quality spares and tools, and provide detailed repair guides and repair training to third-party repairers. The goal is to support any repairer to be able to conduct a high-quality repair. In an attempt to distance themselves from less serious repair providers only third-party certified providers are recommended to their users.

Advanced technology is deployed to make the repair experience almost invisible to the users. A commercial shows a user sitting in their home in deep meditation while a drone enters through the window and picks up the broken TV, and a repairer silently repairs the dishwasher. Everything is done without disturbing the meditating and self-fulfilled user. So-called Repair Robots are available in public places, where for example diagnostics and minor repairs can be conducted.

A new type of business has emerged that caters to all the product-related needs of individuals and households, with the least possible amount of effort, and their services also include repairs, in addition to acquisition, installation and upgrading – a "one-stop-shop" service provider – for those who can afford it.

Financial aspects: The open competition makes repairs competitively priced, despite the barriers to entry. Nevertheless, you get what you pay for.

Behavioural aspects: Competitively priced repair is easy to find nearby for most people, but perhaps less so in rural areas. Tech solutions, such as preventative measures and access to robots, makes repair very accessible and quick. Some repairers might need some verification, but customer ratings don't lie. Users are highly engaged in both using repair services and mercilessly reviewing them to continuously push for the impeccable service they deserve.

Socio-cultural Aspects: The societal ideals of efficiency and self-actualization means that products are expected to simply work; the focus is on functionality that allows the individual to e.g., save time and be more informed. While some pursuits of the "happy life" are self-serving, others define it as engaging in charity work and community engagement. There is little to no interest and knowledge on how products and repairs work. This leads to a feeling of "entitlement" to a flawless (i.e., uninterrupted) product experience, and – in the event of a malfunction – a smooth and quick repair experience. While DIY proponents try to empower users by releasing repair tutorials and sell repair kits, most feel that repairs are "over their head", or that it is boring and a low status activity.

Table 6. Scenario 4: Stakeholder Voices on Opportunities and Challenges

	PRO'S	CON'S
USER	+ Repair options are ***widely available*** with high levels of convenience to a competitive cost + Users are in a ***position of power*** on the product market by being able to easily switch PSS providers and brands. + High levels of freedom in defining and living a ***successful life*** in terms of possessions	- Repair locations are dictated by profitability, which could leave rural areas without competitively priced repair. - Risk of "entitled" attitude (no care). No knowledge of product functions and repair is a "black box".
SOCIAL	+ ***Maximised efficiency***, enabled by ICT functions, free up time that some spend helping others, such as volunteering	- Society is very much organised into who has access to "the latest and greatest" in functions (software and interoperability) which creates inequality.
ENVIRONMENTAL	+ Products are acquired and held onto for their ***functionality***, which means fewer products are manufactured	- Hardware must be upgradable to support the continuous stream of new software and upgrades. Also, software must be developed with long hardware-capacity in mind.

4. Analysis: The Future of Repair and Product User Experience

In this section we discuss the experience of product users in the scenarios, in addition to other insights gained about what a future where repair is normalised is like.

4.1 INSIGHTS ABOUT THE FUTURE OF REPAIR

4.1.1 Repair Market Governance

As shown by the Scenarios, centralised market governance can be driven either by market (Scenario 1) – or policy (Scenario 2). However, as highlighted by one of the workshop participants, manufacturer incentives to voluntarily set up a well-functioning, affordable repair system are not entirely clear, although depicted in Scenario 1. Arguably, for this approach to offer adequate repair solutions, individuals must be free to turn to another manufacturer for their next product purchase as a way to "weed out" misbehaving manufacturers, as is depicted in Scenario 4. However, changing product brand might not be that easy; "lock-in" effects are in place, such as the individual having: 1) acquired other products of the same brand working together (e.g., Apple computer, phone and tablet); 2) invested into learning brand specific features, such as software (Scenario 1 & 2) and product design (Scenario 3), and; 3) developed social and identity ties to the brand (Scenario 1). In case switching brands is not uncomplicated, users are left with little leverage, which presumably makes it difficult for a market-driven system to succeed in normalising repair in a way that benefits product users. In Scenario 4, this is enabled through cloud services transferring data, in combination with a performance-based relationship to products, void of product attachment and brand relationship.

Some kind of Producer Responsibility, enforced as legal obligations, was deemed more likely than a market-approach by the workshop participants – as depicted in Scenario 2. Notably, such a policy-driven repair approach, enforced by authorities, requires trust in the government, making good governance a necessity to ensure that: "it does not become a bad deal" for users (workshop participant). One such risk was identified as a "Loss-leader" strategy employed by manufacturers; by selling the product itself at a reduced price, they later recuperate the loss by charging inflated repair service prices. In a PSS, this could take the form of hidden, added fees for repair. To counter this, legislators could cap the cost of repair and demand transparency in product and PSS sales. This would, however, require the involvement of legislators and surveillance authorities, as in Scenario 2. On the other hand, repair competition in distributive scenarios would make such a "loss leader" strategy impossible due to the competition from other repair service providers.

As expected, and captured in Table 7 below, civil society and community have a significantly stronger role in repair in distributive governance compared to centralised. However, the Centralised Scenario 1 does offer access to a brand community to connect with while waiting for repairs to be completed.

In terms of the key driving forces behind market governance, it arguably pertains to how the market operates and the influence of politics (i.e., market structure). Ultimately, the division of power in society and the economy determines how markets are governed (Teachout and Khan, 2014). As such, market governance is related to the ideology of those in power, which may include acting government officials and/or financial clout of industrial empires and/or public opinion.

4.1.2 Repair and The Ideology of the Sustainability Transition

In the Scenarios, the ideology of the sustainability transition centers primarily on innovative technology solutions or behavioural change. In tech-driven Scenario 2, a pattern of high consumption levels is maintained due to a shift from upgrades in the form of entire products to modularized ones. The other tech-driven scenario, Scenario 4, materialism is equally present, but must be regarded as more functional since devices constitute means to free-up time and self-fulfilment. Both the tech-driven scenarios (Scenario 2 and 4) have a higher pace of life, while life in the two behavioural change-scenarios (Scenario 1 and 3) is slower and more socially oriented. Importantly, in both these behavioural change-scenarios, individuals could have become more rushed because of the increase in tasks that they are required to carry out (i.e., transport to repair site in Scenario 1 and conduct repairs in Scenario 3). However, given the reductions in consumption levels overall and presumably also in time dedicated to formal work, people are left with more time overall. Moreover, in Scenario 3, it is possible that people responded to the DIY conditions by

becoming increasingly independent to the point of isolating themselves. However, although some individuals presumably would go down that path, Scenario 3 illustrates how repair of the things that make up one's everyday "takes a village"; given the plethora of devices and appliances that exists, the width of skills and special tools that are needed makes it so that not one person can be an expert on all types of repair. Instead, people need each other and are thereby encouraged to collaborate.

Social participation in Scenario 2 and 4 are presumably determined and limited by financial capacity. This is also true for Behavioural Change Scenario 1 as brand-affiliation is a central factor of one's identity and social affiliation – which requires access to funds. Scenario 3, on the other hand, is the only scenario where people are given the opportunity to create a good life for themselves using something other than their financial capacity or purchasing power; they get opportunities to meet their material needs using skills and creativity, if they so choose. Coupled with the view of products as each being unique rather than having to look flawless, repair in this scenario leaves room for a lower cost of living, savings, and/or for other pursuits. Here, social status can come from skills, morality and social connections.

In both tech-driven scenarios, innovative technology is employed to enable repair (e.g., modular design) and make repair less burdensome (e.g., repair robots and drone-pick-ups). Nevertheless, product innovation can also erect barriers to repair, such as the proliferation of product designs in Scenario 4 that shuts out DIY and even some professional repairers, and the modular development in Scenario 2 that makes replacement more preferable when a module breaks. The question is if the benefits delivered through these innovations are worth the reductions in repair capacity that they incur. This issue is linked to the weighting of intellectual property interest against those of repair, such as when claims are made that obligating manufacturers to make repair manuals and schematics publicly available requires that they reveal trade secrets (Perzanowski, 2022, p. 159f).

The key driving forces behind the ideology of the sustainability transition are ultimately the predominant voices (i.e., media, industrial leaders, and government) in the public discourse, affecting how the public engages with the narratives around growth vs. alternative models. This discourse determine how much faith that is put into technical solutions vs. the need for, and desirability of, behavioral changes.

4.1.3 The Sustainability of the Scenarios

Not a research question in itself, or specifically included in our definition of the drivers, but nonetheless brought up by the workshop participants during the third and last section of the workshop (see Table 1) was the question of "How sustainable is each scenario?". On this topic, participants raised issues such as social, environmental, and resilience-related implications of the scenario conditions (see Table 3–6).

As to environmental impact, Scenario 2, with its modular upgrades and repairs, is wasteful – unless the modules are refurbished and used to complete other repairs or upgrades. Although Scenario 4, with the focus on functionality and software upgrades, has potential to be less wasteful in that products (and their modules) are kept in use longer, the challenge lies in ensuring upgradability of hardware so that it does not become obsolete and software development gives rise to waste. Moreover, drone-pick ups and other means of making repair a seamless experience for product users run the risk of giving rise to rebound effects (Zink and Geyer, 2017), threatening the environmental sustainability of this scenario.

As to social sustainability, the behavioural change-Scenarios (1 & 3) entail higher levels of social gains, such as engagement, cohesion and even equity – primarily as a consequence of the lacking prominence of "stuff", particularly in Scenario 3. Moreover, related to the other driver of market governance and sustainability is the lack of resilience in Scenario 1 and 2 as the repair capacity is concentrated with the manufacturer. In this regard, workshop participants raised concerns regarding what would happen if the one repair centre in town shut down. With the lack of insights and knowledge, product function and repair becomes a "black box" for product users (as described by one workshop participant). This danger also applies to Scenario 4 where repairs are only conducted by professionals, albeit to a lesser extent due to the widespread repair capability in this large, heterogeneous group.

4.1.4 Possible Stakeholder Roles in a CE Repair Society

In Scenario 1, users are provided a satisfactory repair experience by a benevolent and socially engaged manufacturer, who is asking for the full trust of their users. In Scenario 2, legislators are controlling the repair market to ensure continued economic growth, which has led to a focus on modular repairs and upgrades. In Scenario 3, repair is a common, creative and communal endeavour for everyone.

In Scenario 4, users are all about control over their own lives and self-fulfilment; they expect their products to work, incentivizing manufacturers to collaborate with third-party repairer to keep their users satisfied. As such, the Scenarios illustrate how the stakeholders can take on very different roles, see Table 7.

The role of legislators in ensuring a flourishing repair market varies, depending on the governance structure. In centralised governance, the challenge essentially consists of "policing" manufacturers to ensure that they offer adequate repair services, at an affordable price, and that individuals accept repair services. Under distributive governance, a similar control effort of manufacturers might be required to ensure that manufacturers do not sabotage the aftermarket by e.g., designing products to be difficult to repair. On the other hand, under distributive governance, there might be a need to introduce market requirements and controls to ensure the quality of repair services and parts available on the market, to ensure continued product user trust in the efficiency of repair.

Regardless of the repair market governance structure, and the PSS structure, there needs to be an adequate balance in terms of the risk-transfer. If repair is low-cost (i.e., low-risk) for users, they might be careless with their devices, while if the user carries all the financial risk of product breakage, manufacturers might not be incentivized to design durable and repairable products and otherwise facilitate repairs. Scenario 1 is an example of how the manufacturer was incentivized to assume risk and responsibility over their products; they sought to protect long-term interests, leading them to align their operations and value offer with what their customer base wanted.

In terms of civil society and communities, product users also organised themselves in different ways. In Scenario 3, neighbours and friends get together to solve the repair challenges themselves. In Scenario 4, product users instead relied on their economic power and, in their individualism, banded together writing reviews and leaving dissatisfactory PSS providers – all in the name of product ownership rights. In Scenario, 1 the brand-following and brand community is perhaps less repair-related. Scenario 2 did not contain any collective product user actions impacting repair. This shows (unsurprisingly) that distributive market governance is more conducive to social action, although the organisation taking place in Scenario 4 on ownership could presumably have taken place in a centralised scenario, depending on the ability to switch manufacturer (see discussion above).

Table 7. Roles of the Stakeholders in each Scenario

	USER	Manufacturer	INDEPENDENT REPAIRER	POLICYMAKER	CIVIL SOCIETY/ COMMUNITY
S1 BC/CG	Follower (of Manufacturer Brands)	Leader		Not essential (since market-driven)	Brand Communities or "The Others"
S2 TD/CG	Upgrader	Supplier of Novelty		Leader	
S3 BC/DG	Active repairer	Collaborator	Enabler	Coordinator (of facilitating measures)	Resource Providers
S4 TD/DG	Expecting and demanding uninterrupted product experience	Follower (of users)	Only professionals and not everyone can keep up with the high speed of innovation	Not essential (since primarily market-driven)	Fellow Guardians of Ownership Rights

BC = behaviour change TD = Technology-driven CG = centralised governance DG = distributive governance

4.2 LIFE WITH NORMALISED REPAIR

In exploring the implications of normalised repair in the lives of individuals, we focus on the Key Aspects of behaviour (i.e., time and effort required to repair), financial cost (i.e., of products and repair), and socio-cultural (i.e., relationship to products and repair engagement). The resulting narratives above contained several implications for these aspects, both from the two scenario drivers, as well as their configurations in the scenarios.

In both the distributive governance scenarios, the price advantage of open competition is clear, attached to a potential increase in behavioural cost in the form of information gathering about options and conduct comparisons, as well as dealing with the risk of lower quality repairs and parts. The two scenarios with centralised governance are arguably more convenient in that the user knows where to go with the repair, with the downside of the user not having options.

Repair in the two technology-driven scenarios were more a "necessary evil" and the overall goal was to minimise the repair involvement (Scenario 2 & 4) – in accordance with the scenario parameter definition. In the behavioural change scenarios, on the other hand, product users are provided with opportunities to find the repair experience somewhat more rewarding; the engagement comes with potentially well-being enhancing socialisation (Scenario 1) and socialisation, autonomy, creativity and skill-building (Scenario 3) respectively. Potentially, this can make up for the higher demand on individual resources, such as time and effort.

Overall, in terms of trade-offs, the categories of behavioural, financial, and socio-cultural aspects in the life of individuals turned out to be somewhat in opposition to each other. E.g., positive socio-cultural outcomes, such as a rewarding repair experience (Scenario 3), are not compatible with invisible zero-effort repair (Scenario 4). However, the latter types of repairs presumably make space for time to spend on other rewarding experiences, freely chosen by the individual. Moreover, lower financial cost could come at the expense of high behavioural cost (Scenario 3), and/or dependence on the manufacturer (Scenario 1 & 2). These interrelations between the key aspects and trade-offs make it difficult to pinpoint opportunities and challenges in a scenario; an apparent downside (i.e., high-effort) might have a positive flip side (i.e., personally and socially rewarding engagement process) (Scenario 1 & 3).

Some scenarios do offer more advantageous conditions than others for high levels of quality of life with normalised repair. Scenario 2, with its emphasis on materialism and modular upgrades must be considered least beneficial - repair, although something everyone does, is perceived rather negatively as people would rather upgrade the module than repair it. Scenario 1, with the close-nit brand communities, could be appreciated by some product users. However, the complete dependence on manufacturers makes fall-outs and other disruption in their repair services provision a risk to reliable repair access. Scenario 3, with prevalent DIY and community repairs, suits some users, while others would not want to put the time and effort into repairing. For this type of product users, Scenario 4 – with its invisible repair services and time for self-actualization – is probably far more appealing. However, in terms of empowerment, some might say that Scenario 3 offered the best conditions. Nevertheless, users in Scenario 4 certainly feel empowered, outsourcing repair at their own term, to spend their time on what they considered worthwhile.

The main implications for the Key Aspects are summarised in Table 8 below.

Table 8. Summary of the key aspects of the Product User Experience

Key Aspects of Product User Experience	SCENARIO 1 Manufacturers Take Care of Business BC/CG*	SCENARIO 2 Policymakers Have Repair in Hand TD/CG*	SCENARIO 3 Everyone is a Chill Fixer BC/DG*	SCENARIO 4 The Customer is Always Right TD/DG*
Behavioural Aspects (time and effort)	Medium-effort, but quick due to refurbishment scheme	Depends on service plan level, but could take time.	Higher effort and can be time consuming	Convenient and quick
Financial Aspects (cost)	Medium	Depend on service plan level	Low (but high cost of products)	Medium
Socio-Cultural Aspects (relationship to products and repair)	Products have a functional value, in addition to embodying the user's affiliation to the brand. Repair is experienced as a neutral, normal part of life, with the local repair centre being viewed favourably.	Products are valued for novelty and repair is regarded rather negatively (modular upgrade is preferable to a repair of the old, malfunctioning one).	Products are full of potential, and shaped by the user's wants and needs. Repair is potentially both socially and emotionally rewarding to engage in, but not for all.	Products are a mere means to a comfortable and accomplished life (defined by the user). Sense of entitlement and self-centeredness. Repair services should preferably be smooth and not disturb the product usage.

* BC = behaviour change TD = Technology-driven CG = centralised governance DG = distributive governance

5. Conclusion, Future Research & Implications of Findings

We set out to better understand the implications on contemporary policy cross-roads on product users' repair experience. To do this, we depicted four scenarios of a CE Repair Society where repair is normalised, with different characteristics. In two scenarios the repair market governance is centralised (i.e., repair activities are only performed by product manufacturer) and the other two, it is distributive (i.e., repair is performed by anyone). These scenarios were configured with a second parameter: the ideology behind the sustainability transition, as centred on either behavioural change or technological solutions, the latter entailing minimal behavioural change.

The objective was to understand how these characteristics of a CE Repair Society impacted product users' everyday life in terms of the key aspects, identified as behavioural, financial cost and socio-cultural aspects. The four CE Repair Society scenarios presented in this report make up deliberately disparate versions of a society where repair is normalised, showing the wide range of conditions, including stakeholder roles, in such a society.

The experience of product users living in these different versions of a realised CE Repair Society were developed using a multilevel systems framework (Figure 1), starting at the higher system level characteristics down to the lower system levels where the individual's experience takes place.

5.1 SCENARIO DRIVERS, CONFIGURATIONS AND EVERYDAY LIFE

The scenario narratives showed how centralization of *market governance* brings lack of options and price-and convenience enhancing competition, but also some safety, predictability and a potentially rewarding relationship with the manufacturer. Distributive market governance, on the other hand, offers opportunities for low cost, high-convenience repairs – except for the effort it entails to select among many repair alternatives and weed out low quality alternatives.

In accordance with their respective definitions, the two *Sustainability Transition* Pathways essentially determined how repair is perceived; in the Tech driven scenarios repair was something to be "overcome" using innovation, while in the behavioural change scenarios, repair was embraced and made the most of through modifications to consumption and repair engagement. These two sustainability pathways point at the need to either make repair "invisible" or create opportunities for repair engagement that is rewarding (e.g., ensure access to community repair settings and high quality spares and instructions to ensure a successful repair). As for the latter strategy, it is important to raise public awareness of these potential well-being benefits for it to be successful.

The four configurations of drivers (i.e., the scenarios) offered vastly different everyday lives, summarised in Table 8 above. Most of these configurations hinged on the role assumed by stakeholders, something which the scenario drivers left relatively open. We discuss this more in Section 5.2 below.

Overall, in terms of trade-offs, the categories of behavioural, financial, and socio-cultural aspects in the life of individuals turned out to be somewhat in opposition to each other; a positive socio-cultural outcomes, such as a rewarding repair experience (Scenario 3), were found to be incompatible with invisible, zero-effort repair (Scenario 4). However, the latter types of repairs presumably make space for time to spend on other well-being enhancing experiences, freely chosen by the individual. Moreover, lower financial cost could come at the expense of high behavioural cost (Scenario 3), and/or dependence on the manufacturer (Scenario 1 & 2). These interrelations and trade-offs make it difficult to pinpoint opportunities and challenges in a scenario; an apparent downside (i.e., high-effort) might have a positive flip side (i.e., personally and socially rewarding engagement process) (Scenario 1 & 3).

In addition to thinking about the life of product users with normalised repair according to the Key Aspects (i.e., behavioural, financial, and socio-cultural), we also invited our stakeholder participants to provide their take on what aspects of a CE Repair Society that was important to them. In response, they raised considerations for environmental impact, social equity and economic access (i.e., access to products to participate in society and repair options in rural areas), and the capacity of communities to bounce back in face of system disruption (i.e., resilience), see Table 3–6. This points at the need for more comprehensive research into the role that repair can play in the well-being of product users – including a broader definition of elements of the

repair engagement that can enhance the quality of life of product users, and under what conditions.

In terms of shared goals for a repair future, preferences will differ both within and between stakeholder groups, including how individual product users would like to live their lives. To this point, conditions offering a wide range of choices on how to engage in repair must be deemed important to sustain high levels of well-being among users. However, as circumstances in life can change, such as loss of income and a pandemic shutting down businesses, "repair preparedness" must also be considered crucial; even people lacking interest in DIY still might need to be able to conduct rudimentary repairs in times of crisis. As such, designing a repair system entirely without product user involvement constitutes a fragile repair system that one day might fail the individual when they need their products to work and replacements are not available. It is important for future research to identify what exactly makes repair systems resilient.

Our findings indicate that our Key Aspects have captured but a fraction of the role that repair plays in the everyday lives of individuals and their quality of life. Future research on this should seek to capture the nuances that might occur, either between people in the same type of scenario narrative, or between life stages – again pointing at the need for a more comprehensive understanding of the relationship between repair and the quality of life.

5.2 IMPLICATIONS FOR REALISING A CE REPAIR SOCIETY

As shown in Table 2, the workshop participants identified several alternative pathways within the same scenario, particularly regarding the strategy and behaviour of manufacturers. This, in addition to the (intentionally) diverse scenarios, points to the most important insight of this report: in terms of the outcomes, the scenario drivers are in fact subordinated to how the stakeholders choose to behave. The drivers permit a wide range of different stakeholder behaviours: users can commit to engaging in repair (Scenario 3) or develop an attitude of entitlement to an uninterrupted product experience (Scenario 4). Legislators can prioritise innovation (Scenario 2), or choose to promote repairability (Scenario 3). Manufacturers can transform their business models to embrace repair (Scenario 3), or focus on controlling the aftermarket of their products (Scenario 1). We have particularly discussed the various roles of legislators and product manufacturers in a CE Repair Society. While we saw legislators take on a burdensome surveying role in Scenario 2, product manufacturers in the three other scenarios were incentivized to engage in repair by their own long-term strategy or market incentives.

In conclusion, for policymakers to successfully upscale repair, determining and incentivizing desired stakeholder roles and market behaviour should be the focus.

These scenario narratives constitute the first of its kind, exploring everyday life in a realised CE with regards to repair. As such, they are but a first step in understanding more about what such a society can entail. It is our hope that this report can be built on by others to provide more in-depth images of different aspects of the life of individuals and society at large with normalised repair. The more we can anticipate, the better choices we can make. Also, the more flexibility we can build in to accommodate for unanticipated changes, the better the outcome.

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APPENDIX A: The Scenario Characteristics

The scenario parameters, i.e., Technical Solutions / Behavioural change and Centralised / Distributive Repair Market Governance, impacted the scenarios differently, as depicted in Tables 9–12 below. Although these scenarios are based on the workshop findings, they have been adjusted and expanded upon to ensure that they each represent distinct pathways (see section 2.4.4).

Table 9. CE Repair Society, Scenario 1

	MANUFACTURERS TAKE CARE OF BUSINESS Centralised Governance Behaviours Change Drive Sustainability Transition
SCENARIO BACKGROUND & SUMMARY	Early on, manufacturers realised that if they did not take full responsibility for the repair experience, legislators would intervene or competitors would take over the aftermarkets of their products. So, manufacturers decided to take charge and fully embrace repairability as a business opportunity and put the consumer before exorbitant profit margins. Their accommodating service in the transition from the policy reform eventually resulted in the public viewing them as heroes, essentially turning consumers into followers of their brand.
SOCIETAL LEVEL	
MARKET DESCRIPTION	Without legislative interference, manufacturers employ PSS models and service plans to keep control of the repair market. They don't sell spares, tools nor make information available to third parties and product design is specialised to deter third parties. The public narrative is that no one else but the manufacturer is capable of offering satisfactory repair services.
(Product Manufacturers') Business Models	PSS models, warranty models, or repair service plans included in product purchases tie consumers to the manufacturer's repair service network. Contractually committed to not use third-party repairs. Providing "functions" not products (incentivizes longevity in design, product development and marketing). Brands compete on the quality of their repair services and durability of products, as much as on what their brand represents. Focus is on developing consumer loyalty and absolute confidence. Consumers are engaged in minor repairs, e.g., in annual maintenance sessions where they get the tools and instructions for how to fine tune and clean devices – making the product feel "new". All other repair operations are secretive and nothing is leaked to the public. The goal is for repair to be invisible.
Product Design	Durable and modular design. Brand-standardised for ease of repair. As manufacturers only engage in PSS models or other plans covering repair, they don't need to employ specialised design features to deter third-party repairers. Products are designed to be upgradable, but such upgrades are rare. Focus is on providing longevity.
Manufacturers Repair Services/Activities (incl. DIY)	Manufacturers have authorised representatives in every town. Their business models and dominating interest to keep the consumers happy makes them ensure wide availability of their services. Product offers and service plans range from high-end 24/7 service availability to cheaper options. The more complex the product design, the higher the cost. Hybrid-model with refurbished product as the replacement product (instead of waiting for repair). Repair of one's own product costs extra. Repair centres are a place for brand loyalists to meet. There is space to socialise and coffee and tea is free.
Repair Services/Activities outside of Manufacturer Networks (incl. DIY)	None existent (no demand and no supply).
Repair-related Markets	N/A

Table 9. CE Repair Society, Scenario 1

INFRASTRUCTURE	Manufacturers prefer that individuals come in with the product or send it to the repair centres. Due to the wide coverage, there is always one nearby.
CULTURE	As products last for long, the choice of brand is important and signifies something about you. People identify with brands and show loyalty – you choose "camp". Immense trust and almost worship of manufacturers who care for their consumers. Social values, such as loyalty, reliability and family, are central in the culture. Due to the hybrid model with refurbished products as replacement, consumers are less attached to their products. Little to no knowledge or understanding about product functions or repair. People are told that it is not needed, the manufacturer takes care of it for them (safe for very minor maintenance and repairs to increase consumer involvement).
INDIVIDUAL LEVEL	
Behaviour	Consumers know where to take their broken product and there is a local option (for most people, but not for many rural areas). The level of convenience (availability, waiting time, etc) depends on which service plan the consumer has subscribed to (high vs. low end). Consumer trust in the quality of the repair is high (as a consequence of OEMs' dedication to consumer satisfaction and confidence).
Cost	The PSS cost is higher due to quality and durability. Extended warranties also increase the upfront cost, while the cost of repair is low to none. Different costs for different service plan levels. If there is a cost to repair (not covered by warranty or PSS model agreement), it depends on the complexity of the product design.
Relationship	It is considered a good investment to get a quality products that last. Due to the high cost of products, people own fewer products. Over time, however, the cost of living is reduced since products last longer and manufacturers share some of the cost savings with the consumers. Consumers have a strong relationship with the manufacturer through their products. Due to the opportunity to socialise at the reaper centre, many people are happy to take their broken product for repair; it is a fun, social experience – especially since products rarely break down.
CHALLENGES AND OPPORTUNITIES	
Repair	OEMs have great discretion regarding what is repaired. Risk that choices to repair-or-not offerings are based primarily on profitability.
Individual aspects	There is little transparency regarding product design and repair. Little to no freedom of choice as there are no other repair options than the manufacturer network. Could become expensive since there is no competition and "lock-in" effects due to the high price of new, making switching brands expensive. Owning fewer products for longer might be economically beneficial and leave the consumer better off. Total cost of living might decrease due to less frequent consumption.
Environmental Aspects	Environmental sustainability is improved due to the longevity of products, but due to the low transparency in product design and repair operations, holding manufacturers accountable for resource efficiency is difficult.
Societal Aspects	Status and socioeconomic class is visible in the type of product people have and the repair services they have access to. With the public narrative to simply trust and rely on manufacturers comes unevenly distributed power, disfavoring the individual; manufacturers dictate the market conditions. Displeased individuals have nowhere else to turn. Without insights into the repair process, or options for a second opinion, there might be distrust, both regarding quality and price. Low resilience in the event that the local centre closes. Sense of belonging with a brand, but also divisive as there are multiple brands.

Table 10. CE Repair Society, Scenario 2

	POLICYMAKERS HAVE REPAIR IN HAND Centralised Governance Technology Drives Sustainability Transition
SCENARIO BACKGROUND & SUMMARY	Due to manufacturers' constant innovation, market incentives were not enough to make manufacturers or consumers fully embrace repair. Hence, manufacturers are now obligated by law to provide adequate repair services. And consumers to accept them. Products are only made available through PSS models, where repair is incorporated; third-party repairs are not permissible. Modular upgrades (function and aesthetics of products) is everything.
SOCIETAL LEVEL	
MARKET DESCRIPTION	The legislator has awarded manufacturers repair monopoly to ensure incentives for continued innovation and growth, which constitute the focus. State agencies are surveying and enforcing manufacturer and consumer obligations to repair. (Modular) innovation moves so quickly that by the time a module breaks, it is often time to upgrade to a new one. The surveying authority mostly permits this, as it generates growth.
(Product Manufacturers') Business Models	PSS models, with repair services provided only by the manufacturer network. Consumers want the latest and manufacturers want to provide it. This has led to a focus on modular upgrades for access to the latest functions and product look.
Product Design	Durability of the product "frame" is central, along with ease of replacement of modules. Products are designed as the Fairphone is today, allowing for easy module swapping by the manufacturer. Fast-paced innovation of modular upgrades. Modules are brand-specific and thereby there is no interoperability between the hardware of product brands.
Manufacturers Repair Services/Activities (incl. DIY)	Repair services & plans are offered in price-and convenience tiers within the PSS plan. Quick turnaround requires premium plans.
Repair Services/Activities outside of Manufacturer Networks (incl. DIY)	None existent (legislation).
Repair-related Markets	N/A
INFRASTRUCTURE	According to law, each manufacturer is obligated to have a network of authorised repairers with wide geographic coverage. Little effort is put into making repair convenient.
CULTURE	Materialistic culture where people display status through module upgrades (function and aesthetics). Low attachment to specific products, emphasis is on having the latest. As DIYs are not permitted, people don't even open up their products or attempt easier repairs. Some are deterred, but the majority don't care too much. It's easier to just leave it to the manufacturer. "Old fashion" low-tech items and their repair have become an artform as the skill is disappearing.
INDIVIDUAL LEVEL	
Behaviour	Low levels of convenience, depending on service plan. Wide geographic coverage due to legislative mandates on manufactures.
Cost	Cost depends on the level of convenience and speed that the consumer can and wants to pay for.
Relationship	Products are a means to showing off. As people upgrade and swap products frequently in order to have the "latest", there are low levels of product attachment.

Table 10. CE Repair Society, Scenario 2

CHALLENGES AND OPPORTUNITIES	
Repair	The product repair often consists of simply replacing the broken module, without attempting to repair it.
Individual aspects	High dependence on manufacturers.
Environmental Aspects	Modules themselves must be upgradable and repairable to minimise waste.
Societal Aspects	The success of this Society depends on the enforceability of the repair policies and the surveillance efforts. Trust in the government is crucial. Burdensome for the legislator. Large disparity between rich and poor in terms of the type of access to products and repair services. Not everyone can keep up with the expensive upgrades and are stuck with older models, lacking certain functions and signalling poverty. Lost knowledge on product functioning and repair, creating full dependence on manufacturers. Every Main Street doesn't have an authorised repairer, and even if they do, that business operates under the rules of the manufacturer. This lowers the resilience of the area, especially those with no local repair centre.

Table 11. CE Repair Society, Scenario 3

	EVERYONE IS A CHILL FIXER Centralised Governance Technology Drives Sustainability Transition
SCENARIO BACKGROUND & SUMMARY	Beginning to repair more, people realised the benefits of being empowered and being able to live off less. Non-monetary definitions of "success" (i.e., low levels of materialism) started to develop and opened up for diverse lifestyles and a slower pace of life. Today, repair constitutes a way to express yourself, care, spend time with others, help out, and save money for what matters. Products are easily repairable and innovation cycles slow. DIYs and community repairs constitute the norm.
SOCIETAL LEVEL	
MARKET DESCRIPTION	Legislators took the lead in standardising product design and the repair obligations of manufacturers, at the cross road between different designs and repair models. Hence, product design is regulated for repairability, as is the sale of original necessities. Legislators have little to no consideration for intellectual property interests. Any limitations to innovation are secondary to repairability and product longevity. Repairs are subsidised by the government, but much of the change in consumer behaviour is due to a fundamental mind shift in societal value systems.
(Product Manufacturers') Business Models	Sale of new and refurbished products. In addition to sales, Manufacturers are only interested in the revenues from selling original spares and specialised tools, so they make their products as repairable as possible and market repairability. Brands compete on repairability – design, repair kits and tutorials. Products are marketed as extremely repairable; "Even a caveman could do it!".
Product Design	Modular, durable and highly repairable design, through standardisation, in accordance with mandatory product design requirements. Products are made to be modified and personalised.
Manufacturers Repair Services/Activities (incl. DIY)	Manufacturers do not offer repair services, they only provide necessities to other repairers, including DIYs and community repairs.
Repair Services/Activities outside of Manufacturer Networks (incl. DIY)	DIYs are the norm when something breaks, but in case a hand is needed, there are plenty of options. There is a repair shop on every corner. Every community has at least one repair cafe where people get help by volunteers and learn repair skills.
Repair-related Markets	Wide demand for tools and machines, such as 3D printing. Tutorial and repair kits are widely available.
INFRASTRUCTURE	Universal blueprints and open source based design, inviting pluralized repair and manufacturing. Localised production of modules and spares means local designs. Education and information about what can be repaired and how to do it are easily accessible. Students learn about repair in school. Repair services are subsidised by the government, and repair community organisations receive state funding.
CULTURE	The cultural ideals evolve around quality of life, communal interests and sustainability. "Nothing is broken, nothing is waste." Repair is an enjoyable hobby for many people. Uniqueness and durability is valued over novelty. Conspicuous consumption is regarded as vulgar and immoral, like fur clothing today. "Old" and mended possessions speak to a moral, indegineous and respectable individual. Localised repair cultures and techniques evolve, along with production of tools, spares and modules. People take the time to chat with neighbours and meet to repair together; it strengthens communities as an activity to gather around. Localised production of spares and tools makes for unique designs and large variety and creativity in how things are repaired. Less of a rush. The Community can help with temporary replacement products until the repair is completed. A minority find repair and the lack of newness boring and depriving and likens it with communism. A somewhat materialistic mindset still exists regarding tools and equipment, such as 3D printing for making parts. Having these capabilities provide social status, so people desire these material "attributes".

Table 11. CE Repair Society, Scenario 3

INDIVIDUAL LEVEL	
Behaviour	Repairs are extremely accessible, to a dizzying degree. Tutorials and kits are widely available for DIYs. Everyone knows several people who conduct advanced repairs out of their garage for a small charge. Most people belong to a community repair cafe, and have a trusted local repairer they go to for complex or tedious repairs. Research to ensure a high-quality repair can take time (e.g., check makers of spare).
Cost	The cost of products is made more expensive by the internalisation of social and environmental costs. This is socially accepted. People buy less products. Repair is state- subsidised and not considered costly. Consumers save money over time since products last longer, giving people more choice in terms of life goals and priorities (e.g., work less).
Relationship	Modularity and wide access to unique, locally produced modules and spares allows for more personalised and customised products and product culture. People form strong attachments to their products, especially if they repair themselves. Repair means a chance for improvements and repaired products are considered beautiful and unique.
CHALLENGES AND OPPORTUNITIES	
Repair	Quality issues, such as a poorly performed repair or use of low quality spares, reduces trust in repair. Thorough research might be needed.
Individual aspects	Wide range of options to suit most preferences. A joyful, playful and creative relationship to things. Repair might feel like a chore for some, while others see the benefits. Freedom of choice, but also the burden of investigating options, assessing the quality of spares, tools or repair service providers, and gathering repair information. It can take time and effort to sort through, which can be overwhelming. Much is habitual. Some think that it is boring to have the same product for so long and detest the lack of product innovation and exciting novelty. Some hate to repair, like cleaning or doing the dishes.
Environmental Aspects	Minimal waste from products and spares. However, the occasional low quality repairs that result in waste is an issue. The extensive sale of tools and equipment to any and all who want to repair and “show off” is not resource efficient. One solution could be to use tool libraries.
Societal Aspects	People socialise around repair activities, such as repair cafes. It strengthens local cultures and a sense of belonging, thereby boosting well-being. Increased equity, but the ability to be a high-status fixer requires funds for tools and equipment, which not everyone has.

Table 12. CE Repair Society, Scenario 4

	THE CUSTOMER IS ALWAYS RIGHT Distributed Governance Technology Drives Sustainability Transition
SCENARIO BACKGROUND & SUMMARY	A large and diverse professional repair sector caters to the needs of consumers to have repairable and upgradable technology that does not compromise on innovation and functionality. Repairability is primarily driven by merciless consumer demand on a "flawless" and uninterrupted product experience and day-to-day life. To cater to the consumers, manufacturers collaborate with any and all third-party repairer, promoting primarily those with certification to ensure high quality and avoid any damage to the product brand that can come out of a bad repair.
SOCIETAL LEVEL	
MARKET DESCRIPTION	As long as it does not interfere with intellectual property rights, manufacturers are obligated to make information, spares, and tools available (and they happily comply). Open source designs mean a proliferation of product designs and repair services. Lots of bespoke designs and repair solutions make standardisation impossible. Access to 3D printers and technical expertise is a must. As such, in this high-tech society, emphasis is on repair as a business opportunity; repairs are conducted almost exclusively by professionals. Wide interoperability and cloud services make it easy for consumers to pair devices, increase personalised functionality and also to switch brands in response to bad service.
(Product Manufacturers') Business Models	PSS, with the consumer responsible for maintenance and repair. Offer additional repair plans, but manufacturers have a hard time competing with the prices of local repairers. Manufacturers compete on the product experience (function), with upgradability, durability and repairability being important selling points. Consumers don't want to have any issues and have access to the latest functions. Due to the ease of product switching, one bad consumer review is catastrophic. As a consequence, manufacturers are very protective of their brand. This provides incentives to ensure high-quality repairs by selling low-cost, quality spares and tools, and provide detailed repair manuals to third-party repairers. To avoid breakdowns in the first place, advanced tech solutions are employed for preventative maintenance, diagnostics and early damage detection – with instructions and and options for how to remedy the default (including list of certified local third-party repairers).
Product Design	Modular and durable hardware, with a huge capacity for advanced software upgrades over time. The goal is to provide the user with endless software upgrade capacity. Brand-specialised design and repairability solutions. High-levels of interoperability between software and cloud services (for connecting devices and reducing impact of losing the device/data on device).
Manufacturers Repair Services/Activities (incl. DIY)	Manufacturers offer certain repairs, many of which third-party repairers find unprofitable, but struggle overall to compete with the price and fast turnover of local repairers. Availability of Repair Robots, such as today's vending machines, in various public places make diagnostics and minor repairs very accessible and quick.
Repair Services/Activities outside of Manufacturer Networks (incl. DIY)	Despite wide availability of necessities and open-source design the need for specialised, expensive tools, pricey diagnostics and foremost technical skills (of which many are brand-specific) presents some barrier of entry into the repair market. But there are still many providers. Repair locations are dictated by profitability.
Repair-related Markets	A new type of business has emerged that caters to the needs of consumers, ensuring optimal product experience, including repair. DIY proponents try to empower consumers by releasing hardware repair tutorials and sell repair kits, but most feel like such repairs are "over their head" or boring and "low status".
INFRASTRUCTURE	Repairers compete on offering the most convenient high-tech home repairs and diagnostics solutions.
CULTURE	There is little to no interest and knowledge on how products and repairs work. This leads to a feeling of "entitlement" to a flawless (i.e., uninterrupted) product experience and the latest module upgrade. The societal ideals are efficiency and products are expected to simply work; the key is function and added functionality that allow the individual to e.g., save time and be more informed.

Table 12. CE Repair Society, Scenario 4

INDIVIDUAL LEVEL	
Behaviour	Repair is easily accessible, and might be overwhelming to some. Need to verify the expertise of professionals. Since profitability dictates the geographic coverage of these services (a bad review from a rural consumer is less hurtful), rural consumers might have lower access than urban consumers, depending on the repair capacity of their local area.
Cost	The open competition makes repairs fairly cheap despite barriers of entry. Consumers are in a position of strength; if a PSS provider charges excessively for repairs, or incorporates it into the PSS fee, there is always the competition.
Relationship	Consumers have a sense of entitlement, products should just work and repairs be cheap and quick.
CHALLENGES AND OPPORTUNITIES	
Repair	Despite high-tech devices, repair options are widely available.
Individual aspects	High levels of convenience and competitive pricing on repair. Position of power on the product market by being able to easily switch PSS provider and brand. Risk of "entitled" attitude (no care). No knowledge of product functions and repair is a "black box". Repairers could be located only in larger cities, making drop-off services require extended travelling, especially for rural consumers.
Environmental Aspects	Hardware must be made to be upgradable to support the continuous stream of new software and upgrades. Also, software must be developed with long-hardware capacity in mind.
Societal Aspects	Society is very much organised into who has access to "the latest and greatest" in functions (which creates class divides.

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