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A Toolkit for Exnovation by Design

"The easiest way to save resources and energy and to reduce waste is to use less. This means consuming less, buying less, being green, making do with what we have already - establishing an imperative to rid ourselves of all the unnecessary gadgets and duplications that so hideously clutter up our lives."

Victor Papanek, The Green Imperative, 1995

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Master Thesis
Design for Interaction

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Faculty of Industrial Design Engineering

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Preface

I first stumbled upon the word exnovation, when I read a book by German philosopher Richard David Precht. He described a dystopia in which the digital revolution completely decoupled humanity from the real world. Everything was up to preventing a disaster and thus reversing all failed technological developments. Since then, exnovation never let go of me.
I initiated this graduation project because I saw the ecological crisis as a warning for designers not to keep creating new (more sustainable) things, but to clean up the unsustainable ones. This project gave me a completely new perspective on the capabilities and possibilities of design. Even sustainable design can be so much more than just bringing the next "sustainable" innovation into the world. I hope that this thesis can inspire other designers to question their own work more often and to be less harmful. For our common future.

Due to COVID-19 I decided to complete the entire graduation project remotely. The last time I was in Delft is almost 2 years ago by the end of this project. The separated situation did not make it easy for me. Therefore I would like to thank those who made this work possible:

First of all, I would like to thank my supervisors. Thank you Conny and Roy for providing me the freedom to explore this unusual subject and for your guidance throughout the entire project. Sometimes I had the feeling you were the only people that could follow my thoughts and that pushed me to keep working on this. You motivated me to maintain my vision while not losing sight of the details. Thank you for all the inspiring discussions and your enthusiasm. Without your valuable input, this project would be a very different one.

To Lea, thank you for listening to all my philosophical monologues, theoretical considerations, ideas and reflections. Thank you for putting up with me saying the word exnovation a million times. Thank you for always being there for me and all your support and care.

To all the designers and iPhone owners who contributed to this project by testing my prototypes and taking part in interviews. All your extensive feedback was most enriching for me.

To all friends and fellow students from TU Delft that made these challenging studies an unforgettable time. To all the people I had the chance to meet on my master journey. No matter if in Delft, Umeå, Stockholm or elsewhere.

And above all to my dad. I am endlessly grateful for everything you gave me in life. I miss you.

Executive Summary

With noticeably mounting indications for climate change the fatal consequences of human activities become more and more apparent. The majority of our everyday life products hold their share in the pollution of the environment. By unearthing resources, processing, transporting, use and disposal. Here, industrial designers and innovators have long been a substantial contributor to the problems we face and many inadvertently still are. Now, production and consumption must change as quickly as possible to prevent the worst effects of the ecological crisis and to keep the earth habitable in the future.
In this context, designers often try to improve the current situation by inventing and innovating greener solutions. However, sustainable design efforts are not enough, as long as we merely focus on innovations which keep exploiting resources, fill "sustainable" market niches, cause rebound effects and offset environmental gains. Given the urgency, we now need to focus more on mitigating the impact of existing unsustainable products.
This goes under the umbrella of exnovation. In recent years, the term has gained traction and is increasingly perceived as an essential element of sustainability transitions. It targets the removal or reduction of existing technologies, products, structures etc.

This graduation project aimed at exploring exnovation efforts in context of design. The initial research phase focused on how designers can facilitate the exnovation of products in the most harmless way possible. Literature review showed that not only the environment itself should be taken into account, but designers must also persuade the users of products in order to achieve a lasting effect. Only when considering the consumer behavior and the product's related practices, uses, and other interconnected aspects an exnovation can be successful. The research resulted in a compilation of several independent approaches, methods and leverage points for design action.

The second phase was an investigation of a real exnovation case. The removal of the charging adapter from the Apple iPhone box served as subject of an analysis. The study showed that users were not willing to give up the adapter for sustainability concerns for several reasons. Based on the findings and the previous research, several design interventions were developed that aimed at increasing the acceptance for exnovation. These interventions were tested with participants to inform the final design.

The final outcome is a digital toolkit for designers. It walks the user through various factors to consider when exnovating a product. After the user answers a set of questions, the most suitable exnovation strategies are presented. These strategies emphasize design possibilities, considerations and give tips. In this way it does not only sensitize designers about the topic in general, but also inspire further steps for the particular product exnovation.

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01

The Introduction

Introduction. This chapter introduces the project and argues for the relevance to deal with exnovation in design. Besides the domain, it also presents a test case that will be conducted on Apple iPhone charging adapters. This is followed by design goal, project aim and scope including initial research questions. Moreover it contains the report structure and gives a reading guideline for the following chapters.

Motivation & Relevance

Innovations in Times of the Ecological Crisis

With noticeably mounting indications for climate change the fatal consequences of human activities become more and more apparent. No matter if melting of the polar ice, droughts, thunderstorms, wildfires or floodings - extreme weathers pile up due to an increased atmospheric concentration of carbon dioxide and other greenhouse gases caused by fossil fuel use and land-use change (IPCC, 2021). Many difficulties of the manmade world can be traced back to fossil fuel use, but it is by far not the fundamental problem of the ecological crisis. It is our ravenous, ruthless greed for production and consumption that brought the planet off balance. The majority of our everyday life products hold their share in the pollution of the environment. By unearthing resources, processing, transporting, use and disposal. Here, industrial designers and innovators have long been a substantial contributor to the problems that we face and many inadvertently still are.

"There are professions more harmful than industrial design, but only a few."

Victor Papanek, 1972

But at large, times have changed and ecological awareness is rising clearly. Fortunately, we have achieved a consensus that we need to act fast if we want to preserve a habitable planet. This requires us to fundamentally change our attitude towards production and consumption and transform our way of life towards a more sustainable, eco-friendly one as soon as possible.

Designers and non-designers are challenged to create a future corresponding those goals. And they work hard on it.
In this context, we aspire to improve the current situation by inventing and innovating greener solutions to reach more efficient use of resources for the good of both the environment and the human. With this mindset it is apparent, why most of the applied transformative efforts have been focussing upon "the new" as of yet, while approaches, that deliberately include the "existent" have rather fallen short (Heyen, 2017). However, the present appetite for the new obscures the complexity of transformation processes which the society is currently facing (Arnold et al., 2015). Thus it is necessary to challenge whether it needs more than innovations for transformation.

A common concern is, that innovations benefiting from more efficient technologies could give rise to changed behavior and a consumption rebound, which thus offsets part of the environmental gain. (Greening et al., 2000, Hertwich, 2005) Moreover, innovations do not always suffice in order to replace established non-sustainable structures. In practice, they often even fill new market niches, without replacing other structures at all. Therefore we also need to emphasize the phase-out of non-sustainable technologies, infrastructures, products and practices. (Heyen, 2017)
The past years, exnovation has been gaining attention in theory of sustainable transformation as a generic possibility for the discontinuance of existent technologies or to reduce production and consumption. What sounds destructive in the first place, can make a considerable impact on reaching sustainability goals by identifying maldevelopments and by questioning the necessity of certain products.

Test Case

Apple Charging Adapter

The intentional, sustainability-based termination of products is a rare field but slowly comes into view of responsible economy.
As part of their environmental efforts, the technology company Apple decided to cut their environmental impact by removing the charging adapter, that used to be shipped with every new iPhone. In this way, they can avoid mining a significant amount of materials from the earth, and have eliminated the emissions that come from processing and transporting the chargers. (Apple, 2021)
This example is used to examine and analyze the feasibility, opportunities, chances and challenges of exnovation in an industry that calls for action yet has shown few efforts towards sustainability so far.

Fig 1 - Apple charging adapters used as test case.

Research Questions

Initial research questions cover the following:

1. What is exnovation (in design) and why is it a valid concept?

2. How can designers contribute to the successful removal or reduction of products and artifacts?

3. What do designers need to bring to the table in order to exnovate?

4. What kind of knowledge, guidance and assistance do designers need to exnovate?

5. How can people be involved and persuaded about the necessity of the exnovation?

This graduation project researches the implementation of exnovation by design on the basis of a test case on Apple iPhone charging adapters. The end result is a digital toolkit in form of an interactive website that sensitizes designers for exnovation.

Project Aim & Scope

Exnovation by Design

In sustainability, the preference for innovations has obscured the complexity of transformations and overshadows exnovation as a suitable concept. Hence, this graduation project aims at shining a light on exnovation through design. It focusses how designers can contribute to a future vision, that deliberately tackles and acknowledges the controlled termination of products. Explorations on the exnovation capabilities of the design discipline give answers to the question what it takes to facilitate a successful removal or reducution of non-sustainable products on the market.

In order to investigate the underlaying theory and principles in practice, the project is accompanied by a concrete example. In a case study, Apple iPhone chargers serve as a subject to exnovation to identify specific leverage points, instruments, challenges and opportunities. Research findings help to generate an interactive digital toolkit for designers acting as guard rails, that set the direction in the exnovation process and create an initial framework for the designer. It raises crucial questions, illustrates opportunities to intervene and points out generic challenges and pitfalls that may be faced.

Target Group

The target group for this project are people who work with creative processes that go beyond human-centered design for reasons of sustainability. The methodology aims at such with the expertise and / or interest in experience design.
It is for people that are aware of the necessity to break new ground of sustainable thinking. For those who are motivated to tackle and change our stance towards infinite consumption and waste of resources.

Limitations

Generally, exnovation can be motivated by a multitude of reasons such as cost-reduction, simplification, process optimization or portfolio realignment to mention just a few of them. This project, however, solely aims at sustainability as the initial and fundamental driver for exnovation efforts. Moreover, the project's subject of exnovation is limited to physical artifacts and disregards other forms of products, digital applications, services, systems, infrastuctures, technologies or similar.
Other than that, this project does not explore the tasks and requirements ***how*** to identify or determine products that should be exnovated and it does not discuss the question on ***what*** should be or should not be exnovated.

Phase 1

In the first phase I research theory under the umbrella of exnovation in relation to sustainability and design by conducting a literature review of present knowledge, methods and applications.

Phase 2

The second phase is an investigation of a real exnovation case. The removal of the charging adapter from the Apple iPhone box is analysed and new design interventions are tested with participants to gain qualitative insights and inform the final design.

Phase 3

In the third phase, the findings are synthesized and the final design is developed. In 3 loops the toolkit is qualitatively tested, evaluated and refined and a final conclusion is drawn.

01 Introduction

The first chapter introduces the goal, aim and scope of the project and argues for its relevance.

02 Sustainability Transitions

The second chapter presents an overview of current sustainability efforts to overcome the environmental crisis. It illustrates why people are drawn to creating new rather than eliminating old.

03 Exnovation

The term exnovation is introduced and first approaches discussed how designers can contribute to the successful removal or reduction of products and artifacts.

04 Design for Exnovation

This chapter takes a closer look at what it means to design for exnovation. It explores the required mindset (04.1), discusses design activity (04.2) and approaches human factors (04.3).

05 Test Case: iPhone charging adapter

The removal of the charging adapter from the Apple iPhone box are used as real-world test case. It starts with an in-depth analysis of the exnovation (05.1) which informs 6 redesigns to intervene in the process (05.2). The redesign interventions were tested with iPhone 12 users to gain insights for the feasibility of design for exnovation efforts (05.3).

06 Synthesis

The generated knowledge from the prior two phases is contextualized and implemented in an exnovation model with 8 strategies. This model is used for the toolkit.

07 Toolkit

In this chapter, the final toolkit is presented first. In the following, three loops of usability testing illustrate the changes that led from the first draft to the final design.

08 Project Conclusion

A final conclusion of the project outcomes including limitations, recommendations for further research and personal reflections.

Report Structure and Reading Guideline

The graduation project is divided into 3 main phases: Research, Test Case and Toolkit Design. These phases are indicated by the respective colors. The table on the left gives an overview of the report structure and briefly introduced each chapter.

Process Overview

The process of this project is inspired by the research through design (RtD) method to achieve a successful transfer from theory to practice. The primary research is followed by a loop of formative design activities. Explorative prototypes help to verify theory, generate new actionable knowledge and contribute to answering the initial research questions as well as addressing the design goal (Stappers & Giaccardi, 2017). The findings of the previous steps help in the conception of an exnovation model. This serves as the basis for the final design, which in turn is tested and improved within 3 design loops.

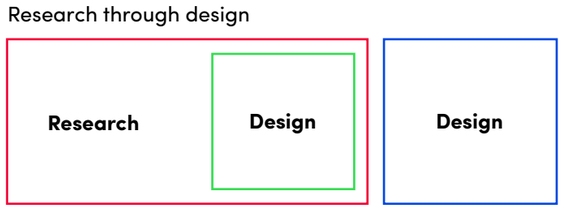

Fig 2 - Research through Design Method based on Stappers & Giaccardi (2017)

02

The first chapter represents a literature review around the frictions in sustainability transitions. In a broader sense the chapters aims at the question:

Why is exnovation a suitable concept?

The review was started with a pearl growing search method on keywords using the term exnovation to identify relevant knowledge directly concerned with the subject (e.g. Heyen, 2017). The search was then expanded to adjacent keywords (phase-out, divestment etc.) related to exnovation. Further literature review was conducted using the snowball method.

Sustainability Transitions

Introduction. The following chapter presents an overview of current sustainability efforts to overcome the environmental crisis. It is argued that the way innovations are applied in many cases are not sufficient to cope with the problems we face. It is then explained why people are naturally drawn to deal with the new and why exnovation is a suitable concept although intended elimination has received little attention so far.

The Fundamental Driver

Ecological Crisis

That there is a pressing need to act against the ecological crisis is nothing new. Considering the urgency, however, it cannot be repeated often enough. Not only climate change but also other environmental problems such as biodiversity loss, air, soil and water pollution and overuse of land are growing threats to the Earth system and its Planetary Boundaries. The sum of human activities has reached such an alarming extent, that the Earth System could be irreversibly damaged. (Rockström et al., 2009) In the course of this, our interaction with the world and thus both production and consumption must change as quickly as possible in order to be able to prevent the worst effects and to keep the earth habitable in the future. This is where sustainability comes into play.

Fig 3 – Planet Earth | Photo by Daniel Olah on Unsplash

Current Situation

Sustainability in Production and Consumption

When considering sustainability, we mostly have somewhat an idea of what it might represent. Among other definitions, one in particular found widespread recognition: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987) Although there exists a handful of scientific definitions, in theory the general meaning is quickly described, but in practice it is a vage subject difficult to define or measure. Humans have indeed developed a well distinct awareness to protect the basis of existence for future generations, but in daily life, the ecological crisis is mostly a problem of others. In fact, there is a common expectation that it is with economy and particularly manufacturers to minimise the ecological footprint of goods they produce. The hope bases on eco design, material research, renewable energy etc., and almost always production is requested to change. Consequently, more often industries try to follow that request by coming up with greener solutions and products, that claim to be better for the environment. The bold communication of little achievements appears like self-congratulation and tends to downplay the crisis behind. The customer is confronted with the alleged improvements in such a strong dose, so it becomes increasingly obscure to estimate the actual environmental gains. When a car company states ‚on their way to zero' they have engineered an eco-friendly electric vehicle (EV), they are likely to not communicate the emissions from production and processing, the consequences of unearthing lithium, the use of resources, the proportionality of a vehicle carrying tons of material, much less the little longevity or repairability. It is the sheer complexity that makes it absolutely inscrutable for a layman to understand the total ecological impact. It is the difficulty to distinguish between real ambitions and greenwashing. But in the end, it is the most striking essential that persuades the customer: For our planet, an eco-friendly electric car is better than a combustion engine car powered by fossil fuel.

This understanding of sustainability is a narrow frame, since it is focussed on technology only and does not consider consumption as a core driver for the ecological problem. Sustainability should also aim to teach individuals to have a respectful relationship with the environment. It is in the hands of every individual car user to decide for what purpose or distance they drive the car and to assess whether alternative means of transport could be more appropriate or resource-saving. By a profound self-reflection, one might even come to the conclusion that relinquishing the product is the best personal option.

Voluntary austerity and abandonment for the sake of sustainability remains an exception though and the hope for greener innovations keep the economy alive. Nevertheless, designers and innovators have the ability to influence the ways people are faced with and how they perceive their material surrounding. In the following, I will touch on three paradigms that play important roles for sustainable development.

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Paradigm I

Growth through Efficiency

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Paradigm II

Reduction through Sufficiency

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Paradigm III

Sustainment through Circularity

Paradigm I

Growth through Efficiency

The endeavour for efficiency is one of the drivers of economies. Whenever it is possible to improve performance, it implies progression. It is therefore only natural to apply this principle to ecological issues as well. Efficiency for the purpose of sustainability has already been successfully studied scientifically and introduced in practice. This is how the concept of eco-efficiency came into being. The idea here is to ensure growth in productivity while reducing the resources used (Schmidheiny, 1992). This means, when reconsidering the whole product lifecycle, including better production conditions and disposal, energy, material and waste can be saved. Since such a way of thinking is considered to be beneficial for both, the economy and the environment, and thus for people in general, the growth through efficiency paradigm is one of the most widespread. The driving force behind many new businesses is to do something good for the environment by rethinking existing products, services or structures and making them more efficient. The previously mentioned example of electric vehicles reflects the approach: a new or untapped technology reaches a stage of market maturity where it can demonstrate clear advantages over existing, old technology, and those advantages are made available to the mainstream. When used as intended, this makes an EV lower in emissions than the internal combustion engine car (ICE) without making significant differences for the end user. In many cases, the increase in efficiency even brings expanded opportunities for the user to a certain degree.
At the same time, however, more efficient innovations are likely to lead to greater overall consumption. This is called the Jevons Paradox. The advantage of increased efficiency is being exploited in such a way that a rebound effect occurs. The absolute footprint is thus larger than the previous one and equalizes the ecological gains. (Greening et al., 2000; Hertwich, 2005).

"Eco-efficiency is achieved by the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the Earth's estimated carrying capacity."

World Business Council for Sustainable Development (WBCSD)

Paradigm II

Reduction through Sufficiency

Sufficiency has long been an integral pillar of buddhism as a spiritual approach. The idea is to live modestly and appropriately in harmony with nature. Through reflection, self-control, training and patience, knowledge can thus be gained about frugality, which is often considered difficult to practice. In times of ecological crisis, the basic idea is experiencing a rebirth - also in the western world. In recent decades, eco-sufficiency has become a global movement. As a bottom-up principle, small, independent groups in particular are forming to strive for the goals of sufficiency. Be it through sharing of tools or vehicles, autarky in food supply or restriction in living space, as the trend of Tiny Houses shows. Even though it is human nature to strive for more - or presumably because of this - sufficiency is enjoying increasing reputation. Under the motto "small is beautiful", the right measure is being critically questioned (cf. Schumacher, 1973). The starting point is the awareness that the current lifestyle of most people in the Western world goes far beyond the "measure of sufficiency". The essence is to conserve the available resources without limiting one's own quality of life or satisfaction (Wuppertal Institute for Climate, Environment and Energy, n.d.).
Simply consuming less, however, is not necessarily seen as a saving measure of sustainability as long as production continues. This is because, similar to the rebound effect of efficiency, lower demand in the short term would potentially trigger a reduction in prices and thus an increased incentive for others to buy. (Alcott, 2008) When the sufficiency strategy is also adopted by business, it can offer pioneering benefits. If companies decide to slim down their product portfolios and reduce production to an appropriate level out of their own motivation, sufficiency is key.

"The easiest way to save resources and energy and to reduce waste is to use less. This means consuming less, buying less, being green, making do with what we have already - establishing an imperative to rid ourselves of all the unnecessary gadgets and duplications that so hideously clutter up our lives."

Victor Papanek, The Green Imperative, 1995

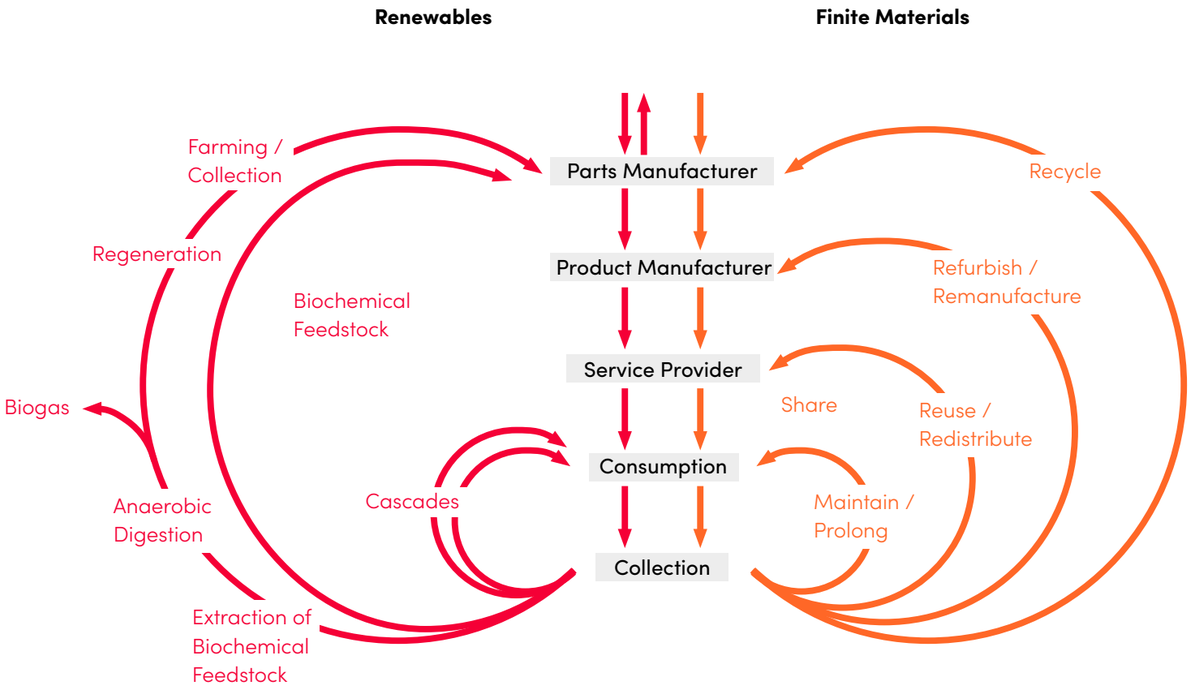


Fig 4 - Circular Economy Systems Diagram (based on Ellen McArthur Foundation, 2019)

"The circular economy is an industrial economy that is restorative or regenerative by intention and design."

Ellen MacArthur Foundation, 2013. Towards the Circular Economy vol.2.

Paradigm III

Sustainment through Circularity

The idea of circular systems is mostly known as Circular Economy and has been gaining traction the last decades. In contrast to the traditional linear approach, products are not made primarily from new resources and left on themselves at the end of use (make, use, dispose), but instead perform in closed loops.

The concept rests on two principles: Recycling old goods into new materials and reusing goods through repair, refurbishment or remanufacture (Stahel, 2016). This allows for the development of new goods and the sustainment of the economy, while protecting the environment and drastically reducing resource consumption. The most important requirement is to prevent or minimize losses, which means that old goods have to be withdrawn at the end of life to create something new, unless their raw materials are renewable or biodigradable. The resources of old goods from the "technical nutrients" cycle (Figure 4) hence need to be recycled into new materials with equivalent properties as the old. (Bocken et al, 2016) Under these circumstances, product innovation can only work through consistent return of old resources. The consumer electronics company Apple demonstrates its efforts to become a circular company in a media-effective way by giving customers incentives and opportunities to return products such as the iPhone or Macs. This way they can be refurbished or recycled (Apple, n.d.-a).

Pro-Innovation-Bias

In the public debate on reducing emissions and thus meeting climate targets, the main focus is on ways to improve efficiency (electricity, resource consumption, etc.), i.e., to improve the current situation through innovative solutions. However, the fact that sustainable innovations do not exclusively bring benefits is an underestimated issue. To take the example of EV's:

The large-scale use of batteries not only makes their use and production continuously more efficient, but also cheaper. As a result, the technology is attracting interest from other application fields, leading to new innovations. With further development, e-motors and batteries found their way into the bicycle segment or micro mobility. This has resulted in the development of novel products that seek to fill new niches. The attractiveness and promise of the technology eventually lead to the situation described as the Jevons Paradox (→ p. 24, Growth through Efficiency). E-scooters are an example of this. The basic idea was to compete mainly with the car in urban infrastructures as a more sustainable alternative and to provide an incentive for the use of public transport. In fact, however, the e-scooter is mainly used for routes and use cases that would otherwise have been managed on foot or by bicycle.

Recent studies show that e-scooters do not show any relief or improvement for mobility and infrastructure, but rather burden them even more and actually contribute to the climate problem due to their production, wearout, vandalism, and the complicated collection and recharging of the batteries. (Moreau et al, 2020, Hollingsworth et al, 2019).

On the one hand, it is therefore the responsibility of innovators and designers to carefully assess the consequences of new products, systems, or services. On the other hand, however, user behavior often leads to the problems mentioned above.

Rogers (1995, p. 236) speaks of "overadoption" when a person adopts an innovation even though experts would advise against adopting it. In the case of e-scooters, for example, overadoption occurs when a user decides to use an e-scooter to get to the supermarket, even though she has always walked before. The reasons for this are probably convenience, ecological ignorance, or the "bigger-than-self" problem (Crompton, 2010). Here, individuals do not see themselves as having the responsibility or power to contribute to sustainability through their behavior.

Fig 5 - Studies show that e-scooters actually contribute to the climate problem. | Photo by Jonas Jacobsson on Unsplash

About Intended and Unintended Elimination

Unintented - Creative Destruction
Although there is a present preference to deal with the new, to construct, invent and innovate, human history is full of cases, where products have been eliminated, removed or negated, be it a conscious decision or inadvertently.

Horse carriage, cassette tape, typewriter and telephone booth

All these are artifacts with which the current generations are familiar. While they have not disappeared entirely, they have been spared from the mainstream. Carriages are the most likely to be seen for nostalgic reasons, but their time as the transportation of choice is over. The production of the other items will probably run towards zero. The reason for the end of such items is obvious: at a certain point, they have been replaced by better alternatives. No matter if by cars, CD's, computers or mobile phones. Technological progress has produced more practicable, cheaper, more efficient and more effective innovations, which people have gradually adopted. The now disadvantageous things were decommissioned over time. Usually, this happened voluntarily and without conscious intent. Increased attention to the new resulted in a turning away from the old. A sneaking process, whose extent becomes clear only with some temporal distance.
The findings are not new: The first theoretical publications on the subject appeared in German-speaking philosophical and intellectual circles in the early 20th century. Inspired by Nietzsche's ideas, the economist Werner Sombart formulated the term "creative destruction" in 1913 and established the concept in economics profession. Schumpeter developed a framework for creative destruction in 1939 that is widely recognized today. (Reinert & Reinert, 2006) He refers to the process of industrial change which "incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one." (Schumpeter, 1942, p. 83) Applied to today's context, it is the awareness that whenever new technologies, goods, or structures emerge, they push previous ones into extinction.

Fig 6 - New technology pushes previous ones into extinction.

Intended - Enforced Termination
Instead of leaving the destruction of manmade things with fate of creating new, people have started playing with the idea of deliberate negation. Certain advantages have been leading people to several efforts of planned elimination. To the greatest extent, those efforts are in the light of sustainability, for reasons of health protection, safety and conservation of nature.
The first half of the 20th century was marked by technological advances through the use of a number of novel materials. At the same time, scientific research also increased significantly. Thus, in the second half of the 20th century, more and more the environmental impacts of harmful substances were discovered, including:

ozone depleting substances, asbestos, leaded fuel, insecticides and phthalates

These substances had long since found their way into everyday products when their use was restricted by legal means.

One of the most striking examples is the substance chlorofluorocarbon (CFC), which was used primarily as a coolant in refrigerators. In 1974, chemists F. Sherwood Rowland and Dr. Mario Molina published that CFC could contribute to ozone depletion in the stratosphere, but environmental hazards continued to grow and it took several years for scientific evidence to show that an ozone hole had indeed emerged (Elkins, 1999). As a result, in 1987, with the Montreal Protocol, 27 nations had agreed to reduce the production of ozone depleting substances. 3 years later, the elimination of CFCs was targeted by 2000 (Elkins, 1999). Nowadays, its application is banned in most countries and it has been replaced by other substances. Thus, the ban did not have a direct impact on the end users of affected products, but rather aimed at an overarching problem. However, awareness of the harmfulness of man-made items has continued to grow, leading users to adapt their behavior in some cases. Examples of this are temporary or spatially limited driving bans for cars or smoking bans in public places. On the other hand, the sale of environmentally harmful products has also been regulated. These include the phase-out of incandescent light bulbs and the latest ban of single use plastic bags and cutlery.

03

Exnovation

Introduction. This chapter takes up the aforementioned interest in elimination and discusses initial scientific considerations that deal with the termination phenomenon. In this context, the term “exnovation” is introduced and described in more detail answering the research question “What is exnovation (in design)?”. In addition, first approaches for how designers can contribute to the successful removal or reduction of products and artifacts are given.

The chapter represents a literature review around exnovation as an approach to sustainability. In a broader sense the chapters aim at the questions:

What is exnovation?
How can design contribute to exnovation?

The review was started with a pearl growing search method on keywords using the term exnovation to identify relevant knowledge directly concerned with the subject (e.g. Heyen, 2017). The search was then expanded to adjacent keywords (phase-out, divestment etc.) related to exnovation. Further literature review was conducted using the snowball method.

Evolution of the Termination Phenomenon

With increasing interest in research of the fundamental principles behind innovation, termination has often been mentioned as a side issue that should be investigated further. Scientists from the field of organization management were the first to study the impact. In respective literature, authors write about the rejection or discontinuing of innovations (Zaltman et al., 1973), a management of termination (Albert, 1984) or a reversal of increase by regulation, economic incentives, and institutional changes (Freeman, 1996).

Among those termination explorations, John R. Kimberly, a professor of management with research interests including managerial innovation, organizational change and organizational design, introduced the term exnovation in 1981. Kimberly defined exnovation as "that process whereby an organization decides to divest itself of an innovation that it had previously adopted" (Kimberly & Evanisko, 1981, p.710).

As a fundamental driver, he states that innovations always have a finite lifespan and that many questions remain open about the state after their end including the lack of knowledge about the concomitant post adoption behavior. According to him, exnovation can also be seen as an opportunity or making room for the introduction or adoption of a new innovation.

In the following decades, the term remained largely unnoticed in innovation theory and appeared only occasional, primarily in connection with health management. In recent years, however, the term has partially found its way into the German-speaking region or German sustainability research. The original context, which refers to organizations, has been disregarded and only the core statement has been taken up, namely the idea that there is a process which aims at the conscious rejection of an established innovation. While a variety of reasons and drivers may underlie this process, sustainability research certainly focuses on the exnovation of standards that are harmful to the environment and health or which are unsustainable. Heyen et al. (2017, p. 326) write, "Expanding on Kimberly's definition, we understand exnovation as the purposive termination of existing (infra)structures, technologies, products and practices."

Outlining the Terminology

As described previously, the term exnovation is not the only attempt to give the phenomenon of termination by design a fixed expression. A number of other theoretical definitions as well as empirical descriptions have developed. These terms are not completely identical, but often have large overlaps and have similar intentions:

A commonly encountered term is ***phase-out.*** It describes targeted and gradual or incremental removal, emphasizing the time-stretched process. Phase-out is often mentioned in the context of widely used technology whose termination is difficult to achieve all at once, such as electricity generation from fossil resources.

The term ***divestment or divestiture***, originally from finance, is used when a stakeholder decides to jettison from a previously used technology, product, etc. The focus here is on the awareness of the own decision and the individual's ability to act.

In innovation theory, the act of stopping a behavior is referred to as ***disadoption or de-adoption***. Based on the understanding that people adopt innovations (cf. diffusion of innovation theory), the antonym emerged to describe the opposite process, i.e. the case when people stop using an innovation voluntary.

In addition to these words, there is a multitude of other terms such as ***discontinuance or discontinuation***. It is often being used to describe the act of stopping an activity or practice in legal matters, or out of strategic reasons. Decision-making and the underlying arguments and influences are in the foreground, when taking this perspective. Cessation, withdrawal and other expressions are aimed at similar situations.

The word ***outnovation*** has an almost identical semantic appearance to exnovation, but is rather understood as the antithesis of traditional invention. Outnovation is based on the idea of "thinking outside the box", i.e. inventing unconventional solutions that are not primarily aimed at normative expectations.

In the field of design, the terms ***elimination design, undesign*** (Pierce, 2012) and ***designing away*** (Tonkinwise, 2014) have emerged, among others, which deal in depth and specifically with the possibilities that designers can use to deliberately evoke change aimed at reduction or elimination of outcomes through design.

Semantic Advantages

Designers are usually familiar with the idea of innovation, so from a design perspective the word exnovation offers the potential to approach sustainable design processes in a somewhat accustomed but new way. Most advantageous here is the binary relationship to innovation: the term was derived from the Latin word innovare, which means "to renew." The "in" stands for into, while the "ex" in exnovation is Latin for out of. This creates a metaphor for the fact that introducing something new can also mean taking something out of what already exists. The expressions are also universally understandable in many languages, and the play on words makes it quick and easy to understand the subject matter. Furthermore, it illustrates the active, transformative nature of the termination process without implying the distrustful character of regression and prohibition.

More than Undesign

While exnovation describes generic change through termination, undesign focusses primarily on the specific field of approaches for designers through which this change is and can be created . The broader framing of exnovation allows for additional examination of the overall societal context, individual psychological factors and the intersections to other disciplines involved.

Fig 7 - Photo by Markus Spiske on Unsplash

Arguing for Exnovation in Present Sustainability Transitions

There is a common consensus that sustainability transitions are not happening fast and extensive enough in order to reach goals of emission reduction and species protection as the UNFCCC's Paris Agreement.
The current inability to tackle the ecological crisis and all its consequences for human kind "will not be attributed to a lack of innovation, however, but rather to a lack of exnovation." (Davidson, 2019, p. 254) So innovation is not enough for sustainability. That is why the concept of exnovation gained traction and is more and more being perceived as an indispensable element of those transitions. Heyen, Hermwille and Wehnert (2017, p. 237) argue

"the transition literature on socio-technical system change (see Markard et al. 2012 for an overview) has clearly focused on early transition phases, niche development and the early diffusion of innovations (Stegmaier et al. 2014). In contrast, the more advanced phase of 'breakthrough' and a corresponding destabilization of the existing system have received much less attention or, as in the work by Turnheim and Geels (2012), have been studied in cases where exnovation occurred through technical advances and shifted demand but was not intentionally governed (Kern and Rogge 2016)."

Design Involvement

In order to overcome the exnovation inability, Heyen et al. (2017) created four categories for approaches and requirements for exnovation governance that opposes path dependencies, addresses resistance against change, and initiates deliberate steering. These categories are Actor Interactions, Instruments for Termination, Instruments for Socioeconomic Adjustments and Time Horizon. While these criteria are primarily intended for implementation through public and governmental forms, the underlying idea can be applied to other actors as well. A modified version is presented that highlights the design perspective and its involvement as follows:

Actor Interaction

Achieving exnovative change requires, above all, supporters. People who are committed to it and carry it out. Those can be, among others, political entities, environmentalist organisations or innovators of sustainable alternatives. Designers typically act as agents of change (innovators) and thus become part of the potential actor interactions. When multiple parties team up they have the possibility to form a coalition in order to have clout and push through the exnovation. A coercive approach, however, has a high risk to cause conflicts, lose support and loyalty of other stakeholders, or even end in legal dispute. A preferable but more difficult solution is a consensus with all stakeholders. Although it is ambitious to reach a compromise, designers should try to get all affected people on the same page without neglecting individuals.

Instruments for Termination

According to Heyen et al. actors have three instruments: Incentives, Bans or Standards. These instruments are not necessarily separable and can be combined or mixed.

A ban is the most invasive option where designers would be concerned with the indirect or subsequent effects and consequences rather than designing for the exnovation. Examples are the previously mentioned ban of incandescent light bulbs and single use plastic bags and cutlery. In those cases designers are challenged to alleviate negative consequences, ensure a seamless transition and to come up with alternatives.

Incentives can be used to persuade stakeholders, customers and users. Designers could try to trigger their intrinsic motivation towards voluntary acceptance of exnovation. Potential incentives should make it easier to divest from a product and could include rewards, benefits or other compelling advantages.

Standards are design interventions that have an indirect implication. Through new standards, users can be nudged to adopt an intended behavior. An example of this is Apple's decision to no longer install an audio plug in the iPhone 7. Users were thus encouraged to switch to wireless headphones.

Time Horizon

Bans appear to be short-termed exnovation processes, which can be taken into account when customers are prepared, products have little financial value or impact in its system, where alternatives are on-hand or a long period of termination is ecologically unacceptable.

This contrasts with long-term phase-outs where the exnovation process is stretched due to particular hurdles, such as legal regulations, slow behavior change, reluctance to exnovation or the lack of alternatives. Another variable is the determination of an end date: While some processes are assessable and certain, others can be complex and highly dependent on the market situation or customer acceptance. In those cases, it is difficult to almost impossible to define a fixed end date.

Conclusion

Exnovation is a generic concept with many sides and aspects that seek for further research. In this way, it illustrates the complexity of sustainability transitions in general and in terms of design in particular.

It can be summarized that the design discipline is not redundant in exnovative processes, but even a contributive component that can act as facilitator between stakeholders with conflicting interests. This is an ordinary responsibility, which can often be found in design processes. It it consequently a matter of studying the context, identifying influencing parameters and making the right decisions in order to apply the appropriate solutions. In addition, there seems to be a certain range of specific instruments designers can make use of. Therefor, these instruments and the general function of design for exnovation will be investigated in more detail in the following.

04

The chapter represents a literature review around design as a discipline to tackle exnovation. In a broader sense the chapter aims at the questions:

What is necessary to design for exnovation?

For the chapter design for exnovation the paper Undesigning Technology: Considering the Negation of Design by Design (James Pierce, 2012) was used as starting point. By means of snowballing, references were traced back in order to find further relevant knowledge contributions.

Design for Exnovation

Introduction

This chapter takes a closer look at what it means to design for exnovation. It is divided in 3 sub-sections.

04.1 Taking the Exnovation Mindset. The first part deals with the research question "What do designers need to bring to the table in order to exnovate?" It investigates the understanding of design in this context as a way of thinking rather than a tool.

04.2 Design Activity. In this section possibilities will be discussed how concepts of eliminative design can be applied in practice. It aims at the question "What kind of knowledge, guidance and assistance do designers need to exnovate?"

04.3 Approaching Human Factors. The third section focusses on research about people that are confronted with the exnovation. Initial research question is: "How can people be involved and persuaded about the necessity of the exnovation?" This includes knowledge about their motivation and design for behavior.

04.1 Taking the Exnovation Mindset

Approach

In order to better address the leverage points designers can use in the exnovation process, it is valuable to understand the force of design. Designers are often seen as the people who have the imagination to envision how we should, want and will live in the future. They are visionaries who have the ability to actively shape the future. This philosophical ideal not infrequently competes with the actual, poisoning position of design in a business-oriented world. Thus, Victor Papanek (1972) concludes, "There are professions more harmful than industrial design, but only a few."

Design is Manipulative
The destructive power of a designer can indeed be immense. Not only are precious resources taken from the planet with each new product she dreams up, but the implicit, immaterial level in particular plays a critical role: Every product can be seen as an attempt to manipulate how we live, because whenever potential customers are presented a new product, its designers have fundamentally shaped their attitudes and values by the message it conveys. (Buchanan, 1985). It is hence important to know that designers in this way diffuse their imaginations and beliefs. In terms of exnovation, what seems like blunt elimination at first sight, can be considered a subconscious impulse towards sufficient living at large.

Acting instead of Making
Tony Fry refers to Hannah Arendt's characterized problem of "substitution of making for acting" when he claims that design action has less and less the visionary traits mentioned above. "Design action [...] brings objectified things into being without the designer recognizing that what has been realized is world making or negating." (Fry, 2009, p. 25) Thus design practice takes an executive character rather than an imaginative one. Once a designer acts on a commercial brief, the open-ended scope of the vision becomes significantly narrower. Ethical, social, and environmental demands are lost and the impact on the world is disregarded (Fry, 2009). The nature of design for exnovation as an action-exercise re-establishes those values and is therefore an answer to the make-problem.

"It is tempting, if the only tool you have is a hammer, to treat everything as if it were a nail"

Maslow, 1966, p. 15

Weighing the Consequences of Design
For successful exnovation, people usually have to be offered incentives, rewards or alternatives. The top priority is that these interventions achieve a better overall environmental and social balance than the subject they are intended to eliminate. Although it is core of designing to consider potential consequences like those, in times of omnipresent interconnected technology designers naturally fail to predict the total impact of an intervention. Raising the right questions, however, might be a small step towards bridging this gap. Baumer and Silberman (2011) articulate three pivotal concerns that are not only valid for use of technology but design interventions in general:

Could the intervention be replaced by modest and less resource-intensive approaches?

Does the intervention cause more harm than the situation it is meant to address?

Does the intervention merely solve a posed problem formulation instead of addressing the actual underlying problem?

04.2 Design Activity

Spectrum of Negation

For a more precise understanding of the ways in which designers can deliberately eliminate, James Pierce in 2012 established a theoretical framework with basic principles for the intentional negation of technology. At the core of his work are four ways in which designers can "undesign." These range from obstacles making it difficult to use technologies, to the complete deletion of them. The word "technology" refers not only to highly complex systems and functions, but in the broadest sense to all kinds of artifacts and their context.

Inhibition
As design has a persuasive character, it can be used to change people's actions and behavior (→ p. 52, Behavior). In inhibition, it is used to hinder people from doing something or to dissuade them from doing it. For example, water wastage can be reduced by visible feedback at the water tap or driving can be restricted by speed bumps. In addition, possibilities for self-inhibition can be given, such as iPhone sleep mode or driving mode to avoid distraction. Overall, the focus is on the individual interaction of users with their environment.

Displacement
In contrast to inhibition, displacement is intended not only to restrict people from using a design, but also to specifically prevent them from doing so. This is done by moving the design from a conventional position to one that involves significant additional effort for the user. In urban areas, for example, parking spaces in front of the house can be moved to the edge of the city to make driving less attractive. The existence of a design is not completely rejected, but its use is made considerably more difficult.

Erasure
In erasure, a design and its use are completely eliminated. Pierce describes this form more as theoretical undertaking. He notes that under free conditions it is a matter of debate whether a society wants to abandon a technology altogether. Nevertheless, there are notable examples where a conscious decision was made against a technology. Japan in the 17th and 18th centuries decided for the sword and against the use of guns.

Foreclosure
Foreclosure is a special form of erasure that aims to eliminate design that has not yet reached market maturity or been established, i.e. has not yet become an innovation. It targets inventions, concepts or ideas whose diffusion could have a recognizable impact on people and the environment. Design for foreclosure is intended to pre-empt the establishment of such designs. This type has so far been applied to products with harmful and toxic substances such as fertilizer, toys or food.

Pierce gives a valuable framework, however he does not explicate erasure in similar detail as inhibition and displacement. It seems as he uses the term erasure as synonyme for an immediate ban of a design. This appears to be misleading because it neglects important factors.
Erasure can be equally implemented by means of coalition, coercion, or consensus (→ p. 38, Design Involvement). The time horizon plays a critical role here. Users can be gradually accustomed to the disappearance by means of phase-out. An example of erasure in a product context is the incandescent light bulb. It was gradually eliminated and only after a longer transition phase without a serious alternative did the LED become suitable for mass use as an energy-saving alternative. Moreover, erasure can be carried out gradually, for which means of inhibition and displacement can be applied as well. Only the goal is the decisive difference: inhibition and displacement intend reduction, while erasure (and foreclosure) target complete elimination.

→ Habit

In his undesign framework, Pierce aims primarily at changing or influencing the behavior of people. This is particularly important, since people quickly get used to a product and take it for granted. Products become part of a routine in everyday use due to their convenience. Hence, in most times people only give up their use, when an alternative proves to be more practical, easier or more efficient. (Fry, 2009)

Intervening in the Designed World

Often single products are interconnected, so it is difficult or even impossible to look at established products in isolation. Rather, they are part of a larger system which they affect and in which they have certain relationships. With each new product that is launched, the existing system is changed to some extent. This creates new constellations, new "problems" or "opportunities", which in turn call for new solutions. The system is thus a natural invitation for progressing development and follows path dependencies. So if there is a will to take an established product out of the system, the dependencies of a path will be broken. The higher the product in the hierarchy, the more elementary its function and the larger the intervention.

If we look at the example of a generic bicycle, we see several paths branching out in follow-up innovations (Figure 8). There are multiple components which

have been invented to be used with the bicycle, such as the saddle, handlebar, pedals, etc. These elements are in turn the basis for further objects, which exist because of the latter subcomponents. These include grips for handlebars, covers for saddles or splashguards for bicycle wheels. Not only further products but also a complex infrastructure has developed around the bicycle. Examples are bicycle lanes, riding training for children or distribution through bicycle stores.
If, in a theoretical case, the rain cover for the saddle is to be eliminated, the consequences would be relatively manageable, since it plays a minor role in the construct of dependencies. If, however, the bicycle as a whole is eliminated, the effects would be far greater, since all subsequent paths would be affected at the same time and the existence of further products would be called into question. It is therefore particularly important to have a comprehensive picture of the overall context and the consequences of the intervention.

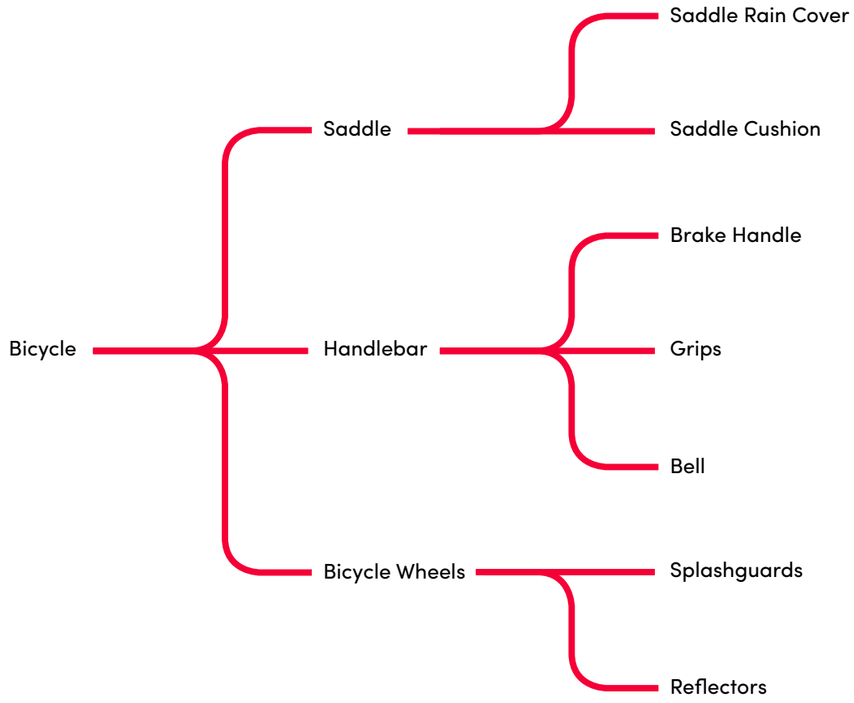


Fig 8 - Path dependencies of a bicycle.

→ **Functionality**

The dependencies illustrate that a product normally fulfils certain purposes. Some products are considered particularly functional because they serve these purposes very well. If the functionality of a product is perceived as being exceptionally distinctive, it is usually considered indispensable. Thus, people would have to cope with significant restrictions if they were to waive it.

The effort required for successful exnovation of longer-established products would be many times greater, as it involves a drastic cut in people's expectations of function. According to Tonkinwise (2014), possible approaches for this can be found in various design disciplines:

Eliminative Communication
By means of communication design, exnovators can question the status quo in an activist and critical way, point out moral aspects, emphasize the advantages of an exnovation and present disadvantages of the current situation.

Converging Design
Product designers can try to aim for a net reduction of the total amount of objects by combining functions of multiple products and bundling them in one. This was done with the smartphone taking over functions of mobile phone, music player or calculator.

Restructuring
Sustainable exnovation should avoid creating new alternatives when possible. Sometimes it is enough to only rethink or restructure what already exists and bring it to the focus again. Tonkinwise gives powerful examples such as the cold room as a substitute for the refrigerator, or homes with shared facilities that make privately owned products redundant.

Dematerialization
Rapid technological development uncovered the need for service design. Existing objects can be replaced by services or digital applications. In this way precious resources can be saved, even though digitalization has negative consequences as well (high energy consumption of server farms etc).

Dispossession
Resources can also be saved by making more efficient use of them through more intelligent solutions. Everyday products can be designed for sharing purposes through the targeted use of services. For example, the focus is no longer on owning a car, but on the availability of a means of transportation when needed. Rarely used tools can also be easily purchased jointly and their use organized.

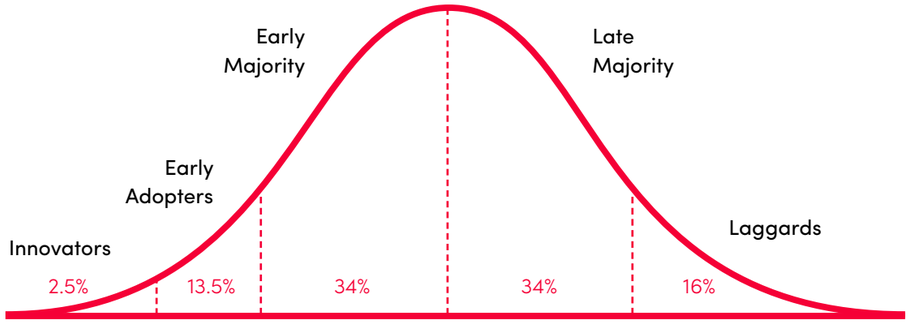


Fig 9 - Diffusion of Innovation Curve based on Rogers

Learning from Innovation

There is an immense body of knowledge about innovation of all kinds and in many fields. Hence, it is worth to be aware of the driving forces and principles behind innovation.
In the context of design, innovation is often misunderstood in everyday usage. The term is applied when an idea, concept or design is considered unique or novel. In fact, however, the first emergence of a novel idea is the definition of an invention and should be distinguished from innovation as the first commercialization or establishment of an idea (Fagerberg, 2003). It can often take a long time for an invention to become an innovation. The process is not linear, not precisely defined and has no clearly definable steps, but is characterized by a multitude of unpredictable influences (Kline & Rosenberg, 1986).

Diffusion of Innovation and Exnovation
Nevertheless, there are certain criteria that are beneficial for innovation. The best known work in this area goes back to the innovation researcher Everett Rogers. With his diffusion of innovation theory (DOI) (Figure 9), he developed a concept that describes how an invention, idea or product spreads over time in a special population (Rogers, 1995). In this process, recipients (adopters) accept (adopt) the invention at different times, depending on certain influences. Rogers has defined five groups of adopters with different human factors that influence how inclined or averse someone is to the innovation.
Innovation and exnovation share the fact that people have different degrees of acceptance, motivated by values and beliefs. This knowledge can help to address the exnovation more precisely to the actual target group. Nevertheless, the diffusion of an exnovation cannot be described by the same adoptor groups as in innovation, since it depends on other criteria. (→ p. 50, Motivation for Exnovation). This is because the process by which people accept an exnovation, as opposed to innovation, depends more on the strategy in which it is carried out. A ban or penalty can force averse people to discontinue the use of a design at the same time as inclined people. Such strategy is not available in innovation theory.

Innovation Attributes Adapted
In DOI Rogers defined criteria that make it more likely for an idea, product etc. to become an innovation. The so called innovation attributes are supposed to increase the perceived value of the innovation. When used to enhance the sucess rate of exnovation, they appear to be equally valid:

1. Relative Advantage: Is the exnovation perceived to be better than the current situation? This is particularly difficult if the main advantage is a non-tangible sustainable effect.
2. Compatibility: Does the exnovation correspond with the values, experiences, and needs of the target group? The impact should be sufficiently well-known.
3. Complexity: Is the exnovation difficult to apply and understand? The exnovation should be realistic and comprehensible for the target group.
4. Trialability: Is it possible to test or experiment with the exnovation before committing to it? People may be more open if they can experience the consequences in advance.
5. Observability: Does the exnovation have visible and obvious results? People are more willing to discontinue the use of a design if the consequences are clear and transparent.

→ **Valuation**

With the innovation attributes, Rogers aims to make the product (the innovation) more valuable, in other words more interesting, attractive or desirable. It has become an established practice in design. Regardless of whether values were consciously evoked by the designer, people attribute subjective qualities to certain products. This results in a dependency that makes it difficult to detach from the product.

04.3 Approaching Human Factors

In design, as in most cases, the best methods and creative skills are worthless if the exnovation is not accepted by the target group. Therefore, it is important to know the target group and their demands in order to tailor the intervention to them in the best possible way.

Motivation for Exnovation

People are driven by motivations. Motivation serves to pursue personal goals, i.e. as a reason in which particular way a person acts or behaves. This also includes whether or not it is possible for them to refrain from using a product. The motivation for attending an exnovation is influenced by attitudes and values.

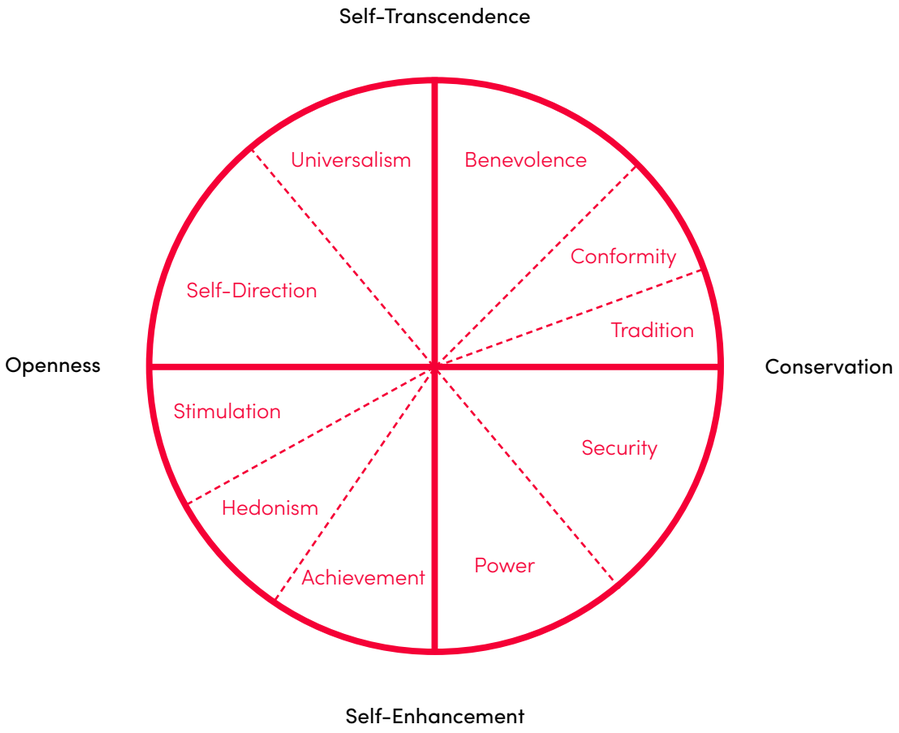


Fig 10 - Circle of Human Values based on Schwartz

Attitude
An attitude is a state of mind, a settled way of thinking or feeling about a special object, action or situation. Consequently, there is a close relationship between attitude and motivation, which are interdependent (Peak, 1955). If people have an aversive attitude towards sustainability, they are difficult to convince because this attitude is often based on fundamental values that are opposed to sustainability. Here, it is more effective to address their personal values than to try changing or influencing attitudes.

Values
Every person has certain values, such as justice, independence, security, etc., that she feels are important. In contrast to attitudes, values are abstract goals that go beyond particular actions or situations and operate as standards or criteria. (Schwartz, 2006). The order and weighting of the importance of specific values varies from individual to individual. In science, 10 basic human values have been established that are valid beyond single cultures. These stand in a dynamic relation to each other. (Figure 10) Those who strive for personal wealth and authority usually place less emphasis on social justice and equality and vice versa. In general it can be said that there are two orthogonal dimensions: Self-enhancement opposing self-transcendence and openness to change opposing conservation. (cf. Schwartz, 2006)

Exnovation Values
The generic exnovation contains three properties that correspond more with certain values. The closer the set of values of a target person, the greater the chance to persuade her. These properties are as follows:

1. Exnovation is a transformative process that initiates and strives for change. Thus a target person should be open to change.

2. Exnovation for the sake of sustainability strives for protection of nature and preserving the basis of existence in the present and in the future. Therefore, a target person should esteem values that transcend personal interests.

3. The third property is the attachement to the exnovated technology. Depending on the technology's position in the system, people attach certain values to it.

If a target person does not have those values in first place, it can be beneficial to study the values that have more weight to her. These values must be revealed and consciously triggered. For example, a person that values safety and social order can be rather persuaded by means and arguments which appear to establish such condition. Hence, the argumentation has to be incorporated into the prompts to relinquish.

Behavior

The exnovation of a product is at the same time always an alteration of the behavior of people who are in a relationship with it. With exnovation, we want people to perform two specific behavioral changes:

1. The abandonment of a product, for which a target behavior must be activated (persuasion) and, or

2. the termination of the use of a product, i.e. preventing a target behavior from happening (dissuasion)

To understand how this works, we need to get a picture of what it takes for the desired behavior to be performed. Brian Jeffrey Fogg (2009) has defined a model with three interdependent criteria that lead to persuading people to perform a desired behavior: Motivation, Ability and Prompts (Figure 11).

Motivation
A person must be sufficiently motivated to adopt a behavior. In other words, they must have an interest in abandoning a product. This interest is usually anchored in personal goals, which is either influenced by attitude or more deeply rooted in human values (→ p. 50, Motivation for Exnovation). If a behavior is to be stopped, the motivation to continue performing this behavior should be as low as possible.

Ability
Since people are reluctant to change habits, it must be made as easy as possible for the person to perform a target behavior. Fogg suggests six "simplicity factors" that must be present for ability to occur. These are Time, Money, Physical Effort, Brain Cycles, Social Deviance and Non-Routine. Depending on personality, resistance to individual factors may be higher or lower. Abandoning a product should

1. take as little time as possible,
2. cost as little as possible,
3. involve as little physical effort as possible,
4. require as little mental effort as possible
5. be as socially conforming as possible, and
6. be as habitual as possible.

Prompts
A prompt is an intervention that tells the person to perform a behavior. Such a prompt can either motivate a behavior, make a behavior easier, or remind a behavior.

In order to discontinue the use of a product, the motivation and ability must be as high as possible and a prompt must specify the target behavior.

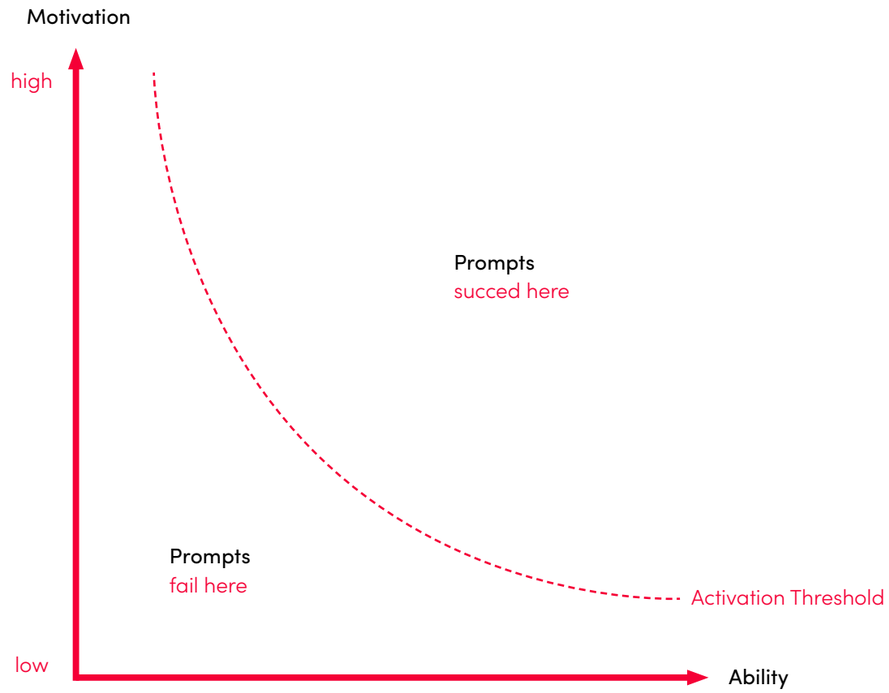


Fig 11 - Fogg Behavior Model

Conclusion

Exnovation can be seen as a kind of guard rails that set the direction and create the framework for the designer.
To carry out the exnovation successfully, any problems that may arise should be identified early on and addressed in a systematic manner. In general, the typical problems can be traced back to the following criteria: Cuts in functionality, loss of habits, or valuation of the product that is to be eliminated. In all cases, designers must consider normative adjustments in addition to general feasibility. Since exnovation is of a limiting character, it must be supplemented by a gainful side. Only then will people develop the openness that is needed for change through exnovation. It it therefore a juggling of restricting and stimulating factors, where persuasion and dissuasion are inseparably intertwined in the exnovation process.

05

Rationale
To obtain an empirical basis for the designerly consideration of exnovation, the case study will examine a product that has already become subject of exnovation. As mentioned before, most of the existing exnovative approaches refer to harmful substances, technologies, behaviors or structures, but so far not so much to objects and thus only indirectly affect the end consumer. The removal of the charging adapter from the iPhone box is one of very few examples where the end consumer is deliberately provided with one less product. In addition, sustainability and environmental protection are claimed to be the major reasoning for this. Moreover, the charging adapter is a low-complexity product that has limited interactions with the environment. It has only one function, electrical charging, which means that potential dependencies of separate functions can be disregarded. Considering the essential parameters and variables, this makes it well suited for an investigation in the exnovation context. The clearly and narrowly defined usage scenario makes it easier to identify and ensure the smaller number of influences on the product and its exnovation, thus making the results more robust.

In many cases of exnovation, data is not sufficiently available, but the charging adapter removal is a case for which background information is provided by the manufacturer as well as by external parties.

Test Case:

iPhone Charging Adapter

Introduction. This chapter describes the case study of an actual product exnovation. With the release of the iPhone model 12, Apple announced that no charger will be included in its scope of delivery anymore to fight e-waste. The case study is divided into three parts: Analysis, Redesign and User Interview & Testing.

05.1 Analysis. In this section, an in-depth analysis of the removal of the iPhone charging adapter, including conducted activity and its impact, is presented.

05.2 Redesign. Based on the analysis, opportunities for improved exnovation were identified and transferred into design interventions.

05.3 User Interview & Testing. The redesign interventions were tested with iPhone 12 users to gain insights for the feasibility of design for exnovation efforts.

Subject

Product & Context

what was exnovated?

Reason for Exnovation

what caused the exnovation?

Activity

Actors

who initiated the exnovation?

Process & Timing

how was it exnovated?

Undesign Principle

according to Pierce's frame

Design Action

role and responsibility of design(ers)

Impact

Challenges

what had to be considered?

Alternatives

availability of alternatives

Consequences

benefits and drawbacks

05.1 Analysis

Approach

The analysis of the charging adapter removal was carried out according to 9 criteria and is divided into 3 parts: Subject, Activity and Impact. The first part examines the product itself, its context, interactions and dependencies, and the reasons for the exnovation.
The second part highlights the activities that led to the elimination of the product, including the actors, the process and time horizon, and the use of design competencies and resources. The third section describes the impact, i.e., what challenges and consequences of the exnovation emerged and what alternatives are available.

Subject

Product and Context

Since the first iPhone in 2007, the consumer electronics company Apple, like other competitors, has always delivered its smartphones with headphones and charger and thus established a standard. With the release of the iPhone model 12 in September 2020, Apple announced that from now on neither EarPods (headphones) nor a charger will be included in its scope of delivery, but only a USB-C to Lightning cable (Apple, 2020). At the same time, the scope of delivery has also been reduced for all newly produced iPhone 11s, Apple Watches and iPads.
Apple states that over 2 billion iPhone charging adapters were shipped by the launch of iPhone 12, and over one billion iPhone units were in active use in the first quarter of 2021. (Apple, 2020; Kastrenakes, 2021)
According to surveys, approximately 90% of prior iPhone owners upgrade to a new one as they state that they intend to stay with Apple and do not intend to buy their next smartphone from another brand (CIRP, 2021). A study by reBuy in 2020 illustrates the number of shelved mobile phones (not in use but still not disposed of) across 27 countries. The amount of shelved mobile phones per capita was at 0.77 in the Netherlands, 1.02 in Germany, 1.24 in the United Kingdom and 1.31 in Sweden (reBuy, n.d.). This implies that a significant number of iPhone users are likely to have more than one iPhone at home, no matter if in use or not, and thus already own more than one charging adapter. This

Fig 12 - Apple iPhone charging adapter

initial situation plays a significant role in the consequences of the exnovation. If we take a closer look at the product itself, it becomes clear that the charging adapter is not a standalone product, but can only perform its intended function in combination with another device. As transformer it is necessary for charging the mobile phone. So it is a peripheral that is not an integral part of the iPhone, but is needed for its function. The function, i.e. the power supply, can be achieved in other ways, but alternatives are less established. The certainty that users will most likely already have a suitable adapter when buying a new iPhone is therefore essential for the function of the new device.

Reason for Exnovation

The removal of the charging adapter was first introduced as part of Apple's environmental efforts. As stated in the annual Environmental Progress Report in 2021, Apple's entire footprint from the supply to the use of products is supposed to become carbon neutral by 2030 (Apple, 2021). In order to achieve this goal, one of their approaches is to search for possibilities to reduce waste and minimize the use of materials (Apple, 2020). In this way they identified the charging adapter as a potential lever to cut the environmental impact:

> *"Power adapters use the largest amounts of certain materials, including plastic, copper, tin, and zinc. Since removing them from iPhone and Apple Watch packaging last year, we've avoided mining a significant amount of materials from the earth, and we've eliminated the emissions that come from processing and transporting them. Using smaller, lighter packaging lets us ship more boxes at once, which helps reduce our carbon footprint. Leaving out those adapters was a bold change for Apple, and a necessary one for our planet." (Apple, n.d.-b)*

Through smaller iPhone boxes, 70% more units per shipping pallet can be transported and by the reduced production output, Apple cuts e-waste and estimates to save 861,000 metric tons of copper, tin, and zinc ore.

However, it should be noted that in this particular case, where a default peripheral is being removed from the box contents, an increased margin can be achieve when maintaining or even lifting the price. Especially since multiple versions of charging adapters are still being sold separately. Also the included lightning to USB-C cable can be seen as subtle attempt to nudge customers buying a new generation charger, because the cable does not work with the old chargers. The credibility of Apple's environmental efforts can also be questioned as they oppose the EU's demands to use USB-C ports as a uniform standard for consumer electronic products across all brands to reduce e-waste (Weaver, 2021).

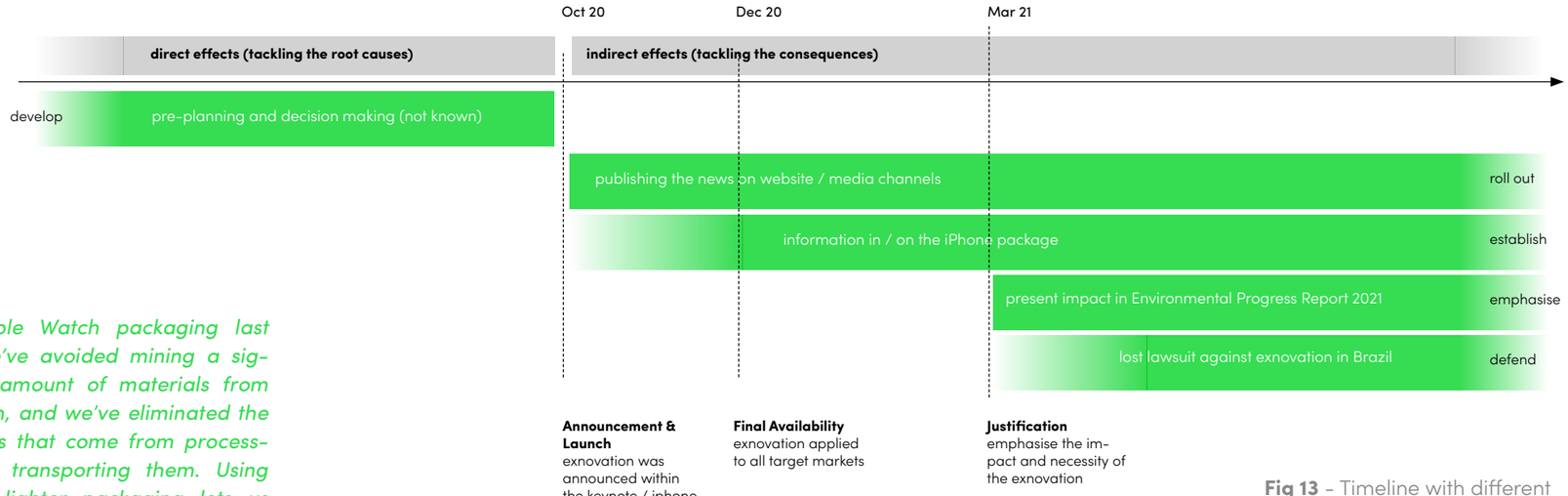


Fig 13 - Timeline with different undertakings in relation to the removal

Activity

Actors

The removal was initiated by the manufacturer itself. Nevertheless, the exact units, departments or people remain unknown. It is likely that the idea was explored for several reasons and supported by various stakeholders within the company. The move was announced by Lisa Jackson, Vice President of Environment, Policy & Social Initiatives (Apple, 2020). This shows that Apple employs a dedicated unit to develop strategies to become more environmentally friendly.

Process and Timing

The exnovation process can be categorized in two phases: Prior to and after the launch (Figure 13).

The first phase was concerned with the development of the removal including pre-planning the intervention, decision-making and estimating of the impact. The preparations also include the necessary steps to seamlessly integrate the exnovation into the user experience and to remove potential obstacles. The focus is thus primarily on preparing the direct effects. At which date Apple set the cornerstone for the exnovation remains unknown.

With the release of the iPhone 12 on October 13, 2020, the removal was announced in the keynote. From that point on, the exnovation had taken place as an immediate action with no transition phase or gradual erasure. So potential buyers had no possibility to buy the iPhone directly with the charging adapter. The iPhone was available 2 months later in all target markets worldwide and thus the removal was noticeable for all customers. Apple's task from then on was to spread the removal and to communicate and establish it in the market by publishing it on their website and other media channels. Due to minor resistance, an attempt was made to justify the decision within the Environmental Progress Report in March 2021, while a legal dispute was opened in Brazil with the aim of forcing Apple to supply charging adapters. (Business Insider India, 2021). France also invokes a law that requires the headphones to be included (Warwick, 2020).

Undesign Principle
According to Pierce's spectrum of negation the charger removal is a form of displacement. This is, because Apple prevents the use of new charging adapters by removing it from the iPhone package. However, its existence is not being completely negated, because it is still available for customers. Also a newer generation of chargers with USB-C instead of USB port was introduced. In case iPhone users want to get a charging adapter, they need to buy it separately for an additional fee. Spending more money might hinder people wanting a new one and could eventually cause that old chargers are not abandoned but reused. Moreover, Apple removed the routine expectation that smartphones always come with a charging adapter and thus challenged an established practice.

Design Action
Due to the lack of background information, the required design action described is limited to visible activities or interventions in the first place and complemented by assumed action that would benefit the exnovation. The focus is rather on the activities than the question whether designers were responsible for them.

Visible Direct Action
It is known that in July 2020, before the actual removal, Apple launched a survey asking iPhone users who had recently upgraded to a new one what they did with the old charging adapter (Sykes, 2020). This suggests that Apple wanted to get an idea of user behavior and the need to keep producing new adapters.
Another direct design task was to redesign the cable that comes with the iPhone 12. This has been given a USB-C interface after the removal.

Visible Indirect Action
As a consequence of the removal, the package composition had to be rethought, due to the saving of volume. In addition, an information was added to the box that the charging adapter can be bought separately. This was also subject of communication efforts including advertising and visual storytelling on the website and during the online purchase process.

Assumed Direct Action
The survey shows that Apple evaluated if the product is really dispensable with the user in mind. It can be assumed that some activities were aiming at a desirable, seamless user experience. The usability and experience may have been planned through scenario user testing and user journeys. Also the consideration, design and testing of alternative charging options, sales strategies or possibilities to reduce e-waste, as well as replacements for the charger or adjustments in the system may have been realized with the help of design methods.

Impact

Challenges
The removal was accompanied by a number of challenges that were already foreseeable in advance and required special attention. Based on feedback from users and the media, it becomes clear that Apple did not fully master or address some of these issues. The most important aspect probably was to convince stakeholders and users about the necessity of the removal. Since ecological reasons are given, it was a top priority to create awareness of the need to conserve resources and protect the environment. Frugality in favor of ecological values must be placed above other interests such as the unreflected consumption of goods. This is a difficult task that also requires encouraging users to continue using their old charging adapters. Even with the new iPhone. So it is necessary that customers rethink their consumption.
On the other hand, it must also be assumed that customers do not own a charging adapter, whether due to wear and tear or a brand change. In this case, it must be ensured that customers have easy access or purchase options for new chargers.
Another unanswered question is whether the desired reduction effect has actually occurred, or whether customers have simply purchased additional chargers separately from Apple but also from third-party suppliers.

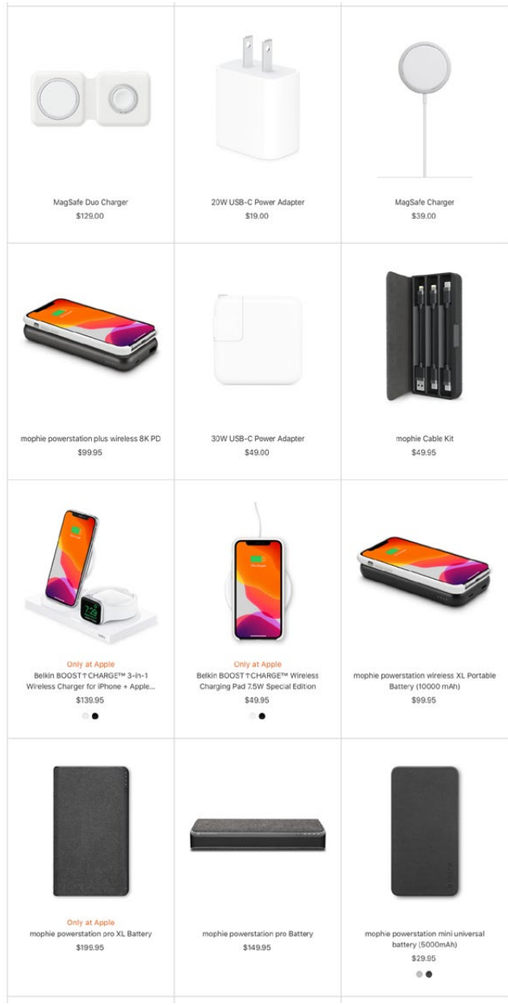


Fig 14 - Alternative charging options in the Apple Online Store

Alternatives
Due to the fact that iPhones still require any kind of charging possibility, there is an obvious need for alternatives. As previously depicted, the charging adapter can still be purchased separately since the removal. Also a newer charger generation with USB-C which allows for faster charging was introduced by Apple. In the online store, this is positioned more prominent as the standard version. The list of further alternatives from Apples and third parties is long and contains multiple other charging options for tailored use cases, these include multi charger dock, charging cases, car mounts, inductive charging options etc. (Figure 14). Often USB(-C) ports with charging function are even integrated in wall sockets, furniture and electronic products. Another underestimated option represents the possibility to charge smartphones with the USB(-C) ports of computer, laptops etc.

Consequences
The removal came with a number of intended and unintended consequences, some with positive, others with negative effects:

Benefits
Central point are the realized environmental savings. Less waste of resources for potentially unused products, decreased e-waste but also smaller packaging. This helps to ship more iPhone boxes by less means of transport.
Beside all material gains the removal is also an implicit statement for behavior change towards cautious consumption. Because the adapter is available separately only, it becomes an active decision to buy and use it if needed. In this way the consumer is prevented from not using but just shelving the product. From the manufacturing perspective it is a step towards use-oriented production and eventually motivated other companies to follow this step. Samsung adopted the idea with its Galaxy S21, Xiaomi with the Mi 11 (Siddiqui, 2020; Peckham, 2021).

Drawbacks
Apple missed to pointedly communicate the motivation and reasons for the removal and did not spend enough efforts on flagging the consequences for the user. This caused partly angry, undiscerning customers and critical press comments noting the non-transparent and non-comprehensible move. Especially because customers are used to the iPhone price that used to include accessory, so now it seems they get less for their money. It emerges the impression of a tied selling method, where a company provides a product on the condition that customers need to buy another one. In Brazil, Apple lost a lawsuit because of this impression. The judge aggred with the lawyer's argument: "This protection to the environment that Apple says it has is selective protection. It is relative protection because the manufacturer has not stopped selling the accessory. It has not stopped manufacturing the charger." (Sharma, 2021). Indeed it does not seem as Apple would stop producing the chargers nor starting an initiative to scale back old, dispensable chargers. Although the ratio of Apple chargers to iPhones can most likely be reduced by the removal, it remains uncertain whether the absolute number will decrease or at least remain the same.

Conclusion

From the analysis, it becomes clear that the removal entails some hurdles that should be thought through in the exnovation process. In principle, it can be assumed that a certain proportion of consumers reject or criticize the exnovation. Other buyers, on the other hand, were not informed and expected a charger to be included in the scope of delivery. This led to legal action taken against the company. It shows that the process is not linear and that Apple should plan an agile, iterative procedure to address resistance that arises at short notice.
The impression is that Apple has assessed the situation correctly and that the existing abundance of chargers is actually sufficient to not deliver any more chargers unconditionally. The remaining alternatives on the market also allow the customer to simply buy more if necessary. In fact, the main problem is not the removed functionality, but much more the distrust of the Apple brand. Many users are not aware of the sustainability concept as an official reason, and if they are, they usually doubt it. It is rather assumed that Apple earns higher profit margins due to lower material, production and transport costs. Basically, users feel exposed to Apple and dependent on their decisions.
All of this speaks for a clear lack of trust and transparency as well as a need to catch up in communication.

05.2 Redesign

Interventions: Aim and Framing

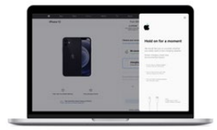
The analysis showed that people did not accept the exnovation as it was undertaken by Apple. Therefore, I want to find out to what extent the implementation of the exnovation needs to be changed so that it becomes more succesful and iPhone buyers agree to it. Within various interventions, I want to explore opportunities that may lead to the desired buyer behavior.
Considering the analysis results, removing the functionality of the charger is not the core problem. Instead, the motivation for people to do without the adapter is low because Apple does not provide any valid reasons. At the same time people are not able to decide for (or against) the removal at all. According to the Fogg behavior model, there is an urgent need for appropriate prompts that increase both motivation and ability. (→ p. 52, Behavior).

With the interventions, various prompts will be tested. The focus is on communicating possible behavioral changes and educating people about sustainable effects. In particular, the expectation towards the unconditional consumption of non-essential products will be tackled. Buyers shall also be convinced of the authenticity of the intentions to protect the environment.
While Apple has focused on displacement with its exnovation strategy, several options are now to be designed. The interventions range from inhibition to displacement to erasure. Foreclosure is disregarded in this case, since the charging adapter is a product that is already fully developed for the market.
By means of inhibition, the iPhone buyer should be given the individual choice to decide for or against the adapter. By displacement, the buyer is required to take additional action if she wants to have a charger. In the case of erasure, the customer no longer has the option of getting an adapter from Apple.

Leverage Points and Prompts

In the following user testing, the aim is to find out which type of intervention is most likely to convince potential customers of the removal. Therefore, six concepts will be presented that embody different levers in order to increase the success of the exnovation.
According to Rogers' innovation attributes (→ p. 48, Learning from Innovation), charger removal primarily lacks observability, i.e., a clear, visible result (Lever 1) and a relative advantage, i.e., the perception that doing without the charger is better (Lever 2,4,6). There is also no form of trialability, as buyers are not given the opportunity to "test" or exclude the removal (Lever 2,3). In addition, motivation should be increased by installing a targeted pleasure (Lever 4). Fogg's simplicity factors, in reversal, are intended to be deliberately used to suppress desire for a charger and make ownership unattractive (Lever 2,3). Since buyers respond to new contexts with attitudes shaped by values and beliefs, different triggers should be purposely set for interested and averse people (Lever 5,6).

01
Environmental Campaign



02
Optional Charger

Inhibition

03
Donation

04
Return System

Inhibition

Displacement

05
Apple Gift Card

06
Local Gift Card

Erasure

Erasure

01

Environmental Campaign

Lever 1
The first lever is communication. By means of advertising, transparent explanation and arguments for the removal, the purpose shall become observable, tangible and comprehensible. Customers shall be persuaded by adjusting wrong expectations and beliefs, opposing worries and rebut doubts.

Concept 1
Apple is known for its minimalist way of communicating, using the clearest and simplest visualizations possible. These are complemented by short explanatory and convincing words or sentences. Concept 1 picks up on this style by using the exnovation as a marketing campaign detached from the iPhone purchase process and making it attractive to people interested in Apple. In this way, environmental awareness can be linked to Apple's values and sustainability efforts can be transported beyond the buyer base.

This concept could be used for inhibition, displacement erasure and foreclosure and is likely to be combined with other levers.

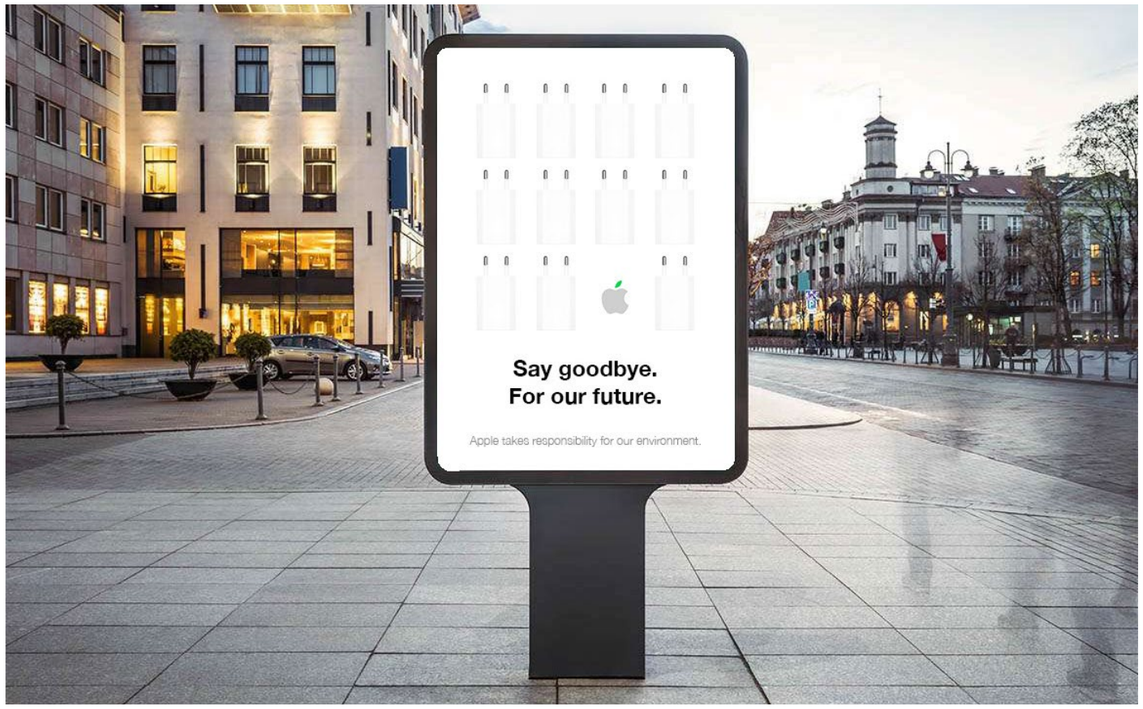


Fig 15 - Concept 1 - Environmental Campaign

02

Optional Charger

Lever 2
By providing the instant option to buy an additional charger, customers have the choice to decide freely if they want one. Thus the ecological responsibility is with each individual. However, by positioning a "cost barrier" and providing tips how to go without, they are gently nudged into the desired behavior.

Concept 2
Concept 2 offers the option of buying a charging adapter during the purchase process of the iPhone on the Apple website. Here, the abandonment of the charger is selected as the default option. In addition, a short verbal and visual indication of the reason for sustainability is given. If the buyer chooses the option to order an additional charger with the iPhone, a pop-up window appears asking her to reconsider her decision. In addition, arguments and possibilities for further use of existing chargers are given.

Inhibition: charging adapter is instantly available, but must be bought and the customer is encouraged to decide responsibly.

Prototype
https://bit.ly/3pQihlx

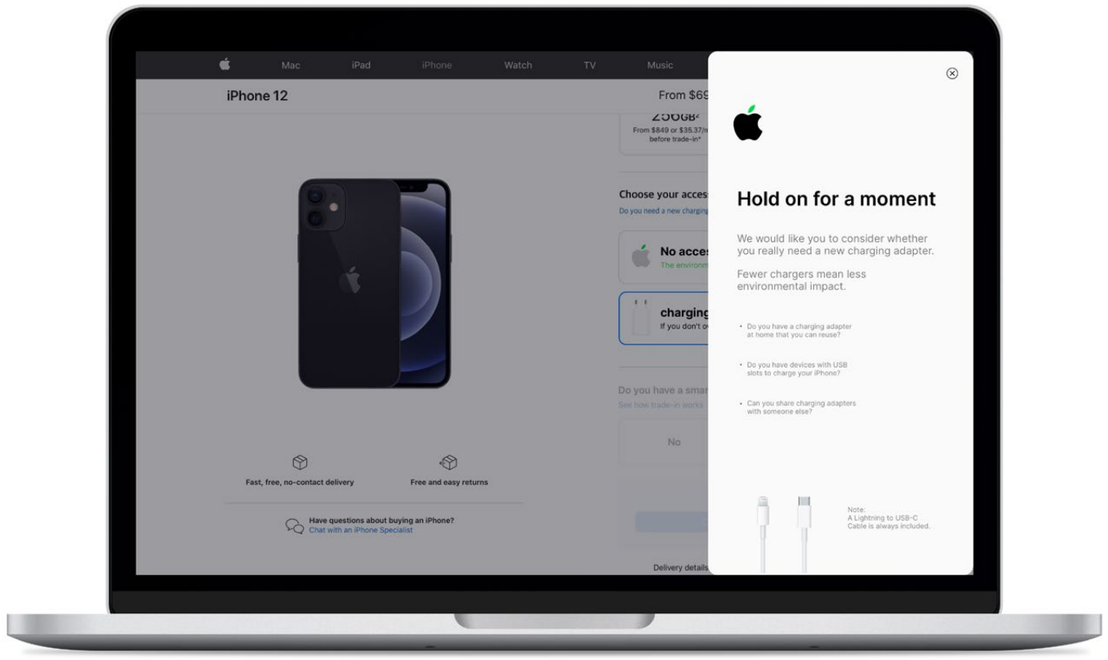


Fig 16 - Concept 2 - Optional Charger

03

Donation

Lever 3
This concept is based on Fogg's "social deviance" factor. A social appeal is presented during the purchase process, which is supposed to trigger sense of responsibility. Customers would have to go against the norms in order to receive a charging adapter.

Concept 3
This concept is based on the idea that people develop a motivation to engage in desirable behavior because of social expectations. After completing the purchase process on the Apple website, the ecological advantage of removing the charging adapter is pointed out. The buyer is expected to waive the charger and instead donate the equivalent amount in favor of an environmental organization. Although it is possible to refuse the donation and keep the adapter, the subordinate positioning indicates that this is an undesired behavior.

Inhibition: charging adapter is instantly available, but requires the customer to be socially deviant.

Prototype
https://bit.ly/3lCaeHu

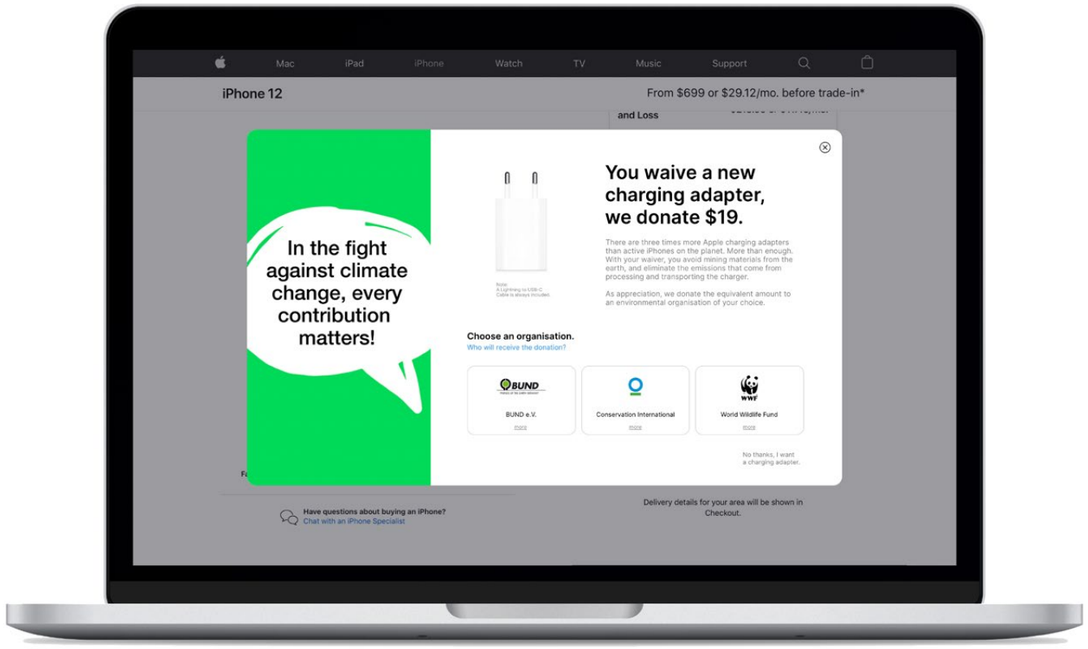


Fig 17 - Concept 3 - Donation

04

Return System

Lever 4
This lever aims at pro-active customer involvement. By installing a reward for the request to fulfil a required action, customers may be stimulated to be part of the environmental efforts. Hence positive emotions of the personal accomplishment can be linked with sustainability.

Concept 4
This concept, like the first one, is a campaign aside from the purchase process. It is assumed that the iPhone will be delivered without a charger and that the majority of buyers will already have several adapters. Users then have the opportunity to actively participate in environmental protection by returning old charging adapters. If the customer brings 2 of his old adapters to an Apple Store or authorized retailer, he will be rewarded with a more efficient adapter of the new generation for free. This helps recycle unneeded resources and ensures that the most environmentally friendly option is used.

Displacement: However, this concept could be used for inhibition, displacement and foreclosure as well and is likely to be combined with other levers.

Prototype
https://bit.ly/3lCaeHu

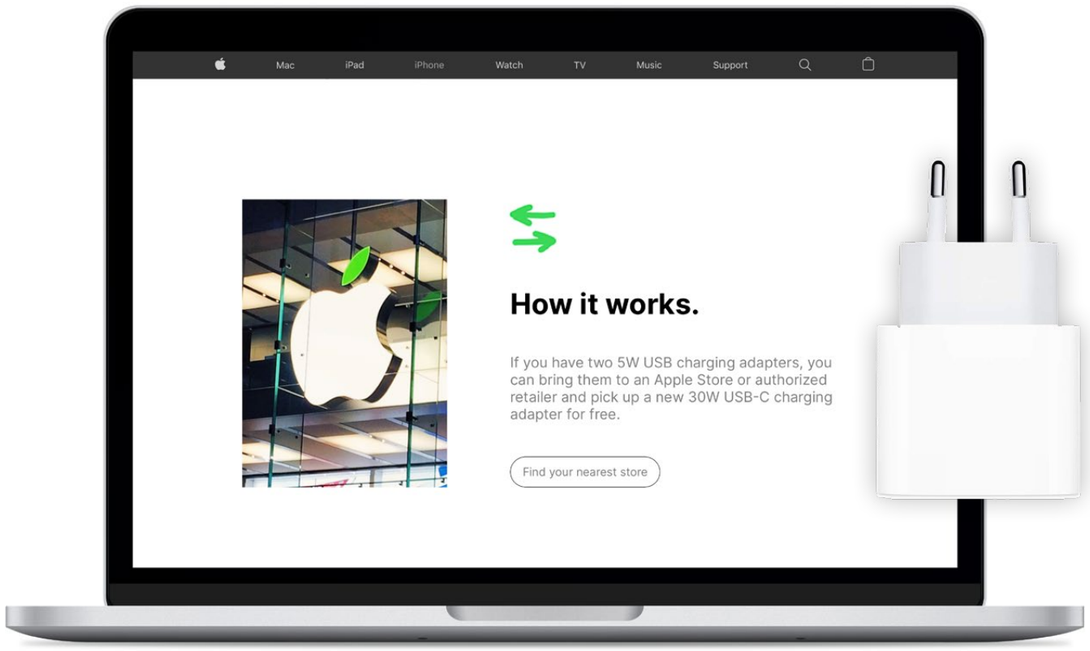


Fig 18 - Concept 4 - Return System

05

Apple
Gift Card

Lever 5
In this concept, the focus is less on environmental aspects but rather on providing a substitute related to Apple with equal worth as the charging adapter. It aims at meeting the needs of customers that are reluctant to sustainability and demand other, familiar incentives.

Concept 5
Concept 5 takes note that there are iPhone customers for whom sustainability is not an important criteria in the decision-making process. Nevertheless, these customers should not be given the opportunity to get a new charger. It is difficult to convince this customer type by ecological or moral means. Therefore, as replacement, they receive an Apple gift card for all digital products such as Apple Music, Apple TV and App Store. The gift card is included in the iPhone packaging, so it does not have to be purchased separately.

Erasure: Apple no longer offers the charging adapter. The customer will be compensated.

Fig 19 - Concept 5 - Apple Gift Card

06

Local
Gift Card

Lever 6
The sixth lever shall make the background of environmentalism relatable to the personal surrounding and increase acceptance. In this way, the theme shall come alive and raise awareness about the relations between personal consumption and its environmental impacts.

Concept 6
The sixth intervention is designed to appeal to people with ecological awareness and an interest in new things. Similar to the previous concept, customers receive a gift card with the iPhone box. It can be used for sustainable businesses in the personal environment, which are described and summarized on the Apple website. It gives the opportunity to support local businesses that are engaged in sustainability transitions. At the same time, an eco-friendly awareness is promoted and established in order to bring customers an understanding of its added value.

Erasure: Apple no longer offers the charging adapter. The customer is being rewarded.

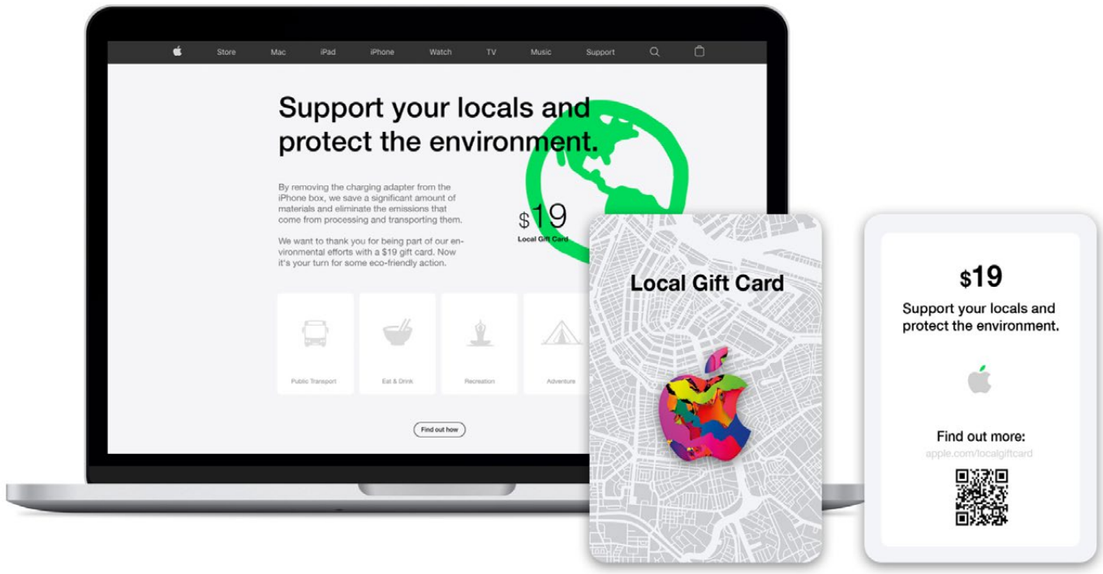


Fig 20 - Concept 6 - Local Gift Card

Development - Learnings from the Design Process

When developing the concepts, it became clear, that most of them could be combined in several ways. Slight alterations and nuances can have great impact on the overall intervention. A combination of multiple interventions might increase the success rate and could be considered to reach a bigger impact. This can be helpful especially due to the difficultly to design for all sales channels (online store, retailer etc). Another frequently appearing constraint is framing. Some concepts expect customers to already own chargers, others do not. Moreover, interventions can aim at reducing only new chargers or also include chargers already produced. Using the undesign framework of Pierce inspires possibilities to avoid a plain ban but make it more a customer decision. However they seem more experimental than expedient and do not help in defining the right strategy.

05.3 User Interview & Testing

Approach and Plan

Test Objective and Goal
The following user study about the exnovation of the Apple charging adapter is divided in two sections probing on the current and imagined situation:

(1) Interview: In the first section, people that own an iPhone 12 and thus are affected by the removal are asked about their experiences. The interview is intended to uncover how users cope with the removal of the charging adapter from the iPhone box and reveal their current beliefs, perception and attitude towards the exnovation.

(2) Testing: The second section involves the new interventions. The concepts are presented to participants for the purpose of giving feedback and evaluating them. In this way, the effectiveness of the redesigns shall be assessed and compared against the current situation. The testing is supposed to reveal the concept with the highest promise to persuade customers and spot their demands in order to accept the exnovation.

Research Questions
Effectiveness - How effective is the intervention overall?
Perspicuity - Do customers understand the intention and reasoning behind the intervention? Is it relatable?
Persuasiveness - Does the intervention obtain acceptance? Is the customer convinced and stimulated to commit to the exnovation?
Satisfaction - Is the customer satisfied with the requirements and rewards that come with the exnovation? Do they like the intervention?
Freedom - Can customers conceive their own opinion? Do they have a choice and feel in control of their decision?

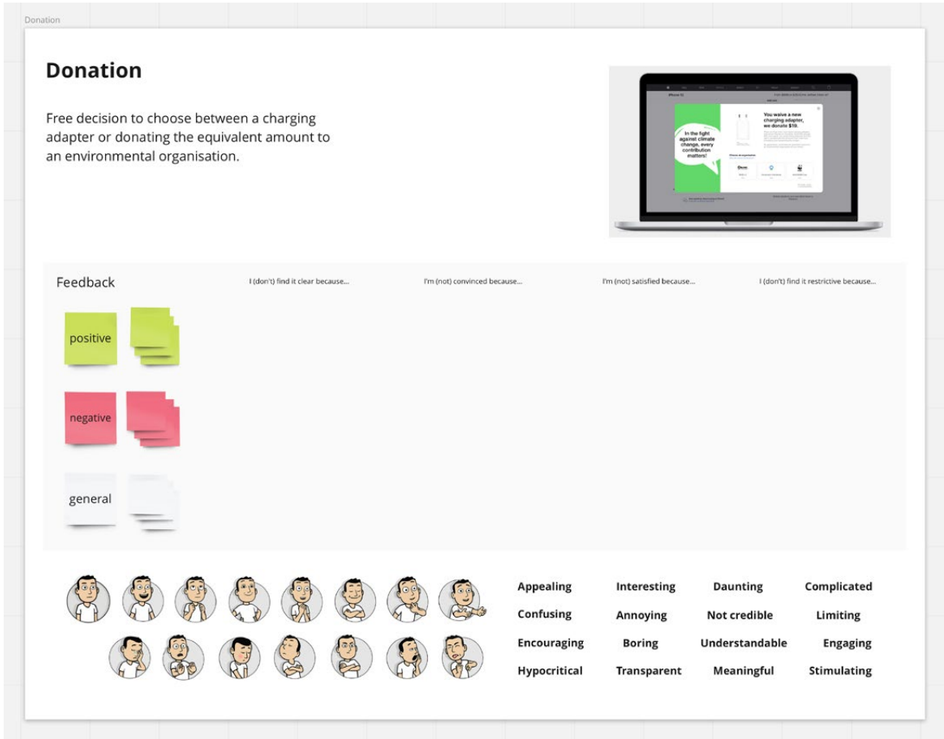
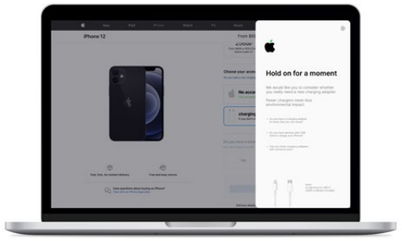


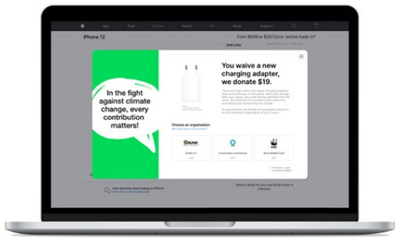
Fig 21 - Single Miro Feedback Template for each concept

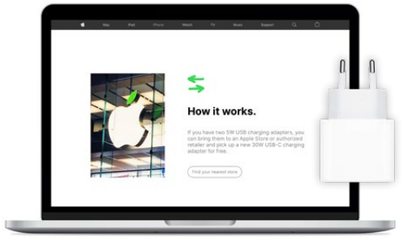
Conduct
The interview and testing take place in an informal manner with open-ended questions to encourage an open conversation. The study is conducted via Zoom video call with five participants that have recently bought an iPhone 12 (mini, max, pro) and hence are effected by the removal of the charging adapter. The sample (n=5) represents a diverse group of people with dissimilar attitudes towards sustainability. Interventions will be screen-shared in a randomized order and after each concept the participant is asked to give qualitative feedback on a Miro board guided by trigger questions, a word cloud and predefined expressions (PrEmo tool, Laurans & Desmet, 2017) for simpler articulation. The test situation, however, cannot fully represent real purchase conditions, which may lead to deviating behavior. Particularly as background information will be provided during the interview and thus may influence participants. Also feedback and insights mainly base on self-reporting of participants which cannot be verified.
(more information on the user interview and test plan can be found in the appendix)

Concept Selection
Tested will be all interventions from the previous redesign phase with the exception of concept 1. This concept of environmental communication is not included because it represents the current situation in parts. Although Apple does not advertise the removal in such an extensive fashion, it certainly uses its effects for marketing purposes (cf. "We reduced our carbon footprint. By thinking inside the box"). Hence, communication is rather a question of amount of advertising resources spent. The impact is difficult to measure, since it relies on monetary resources, range and the fact that customers have seen the advertising.

Results







Optional Charger

"don't have the feeling that I'm doing something good by doing without the adapter" (P3)

"might be confusing for people that are not tech-savvy" (P1)

"clear and understandable" (P4)

"I would forgo because one gets suggestions about alternatives" (P2)

2 Yes · **1** Uncertain · **2** No

7 Effectiveness

Donation

"Animation to donate, at a time when you like to spend money anyway, so you have it left." (P3)

"very relatable" (P3)

"I'm not informed or sure about the appropriate usage of donations. Where does the money go to?" (P1)

"I don't have to think about who to donate" (P4)

3 Yes · **0** Uncertain · **2** No

12 Effectiveness

Return System

"Because I see the result of my action." (P5)

"because: triggers my reward system and I get something better in return" (P2)

"real and authentic sustainability idea. little disadvantages for the customer" (P1)

"It would work fine for me, because I want to charge faster, although I may not need it at all (charge at night)" (P2)

3 Yes · **1** Uncertain · **1** No

15 Effectiveness

Apple Gift Card

"I am worried that I will be tied to a subscription contract" (P3)

"first feeling is .... disappointment. 2nd feeling is "Well, it's really cool that I now get $19. 3. The feeling is stupid, because I'm completely dependent on Apple again" (P2)

"feels like apologizing for a failure to perform" (P2)

"I dont buy into the environmental reasoning, too much marketing" (P1)

1 Yes · **0** Uncertain · **4** No

3 Effectiveness

Local Gift Card

"makes sense and might trigger people to sustainable behaviour" (P1)

"supports other businesses than Apple" (P4)

"it is surprising and not so forseeable as an apple gift card" (P1)

"I found the link of sustainability with locality useful" (P3)

4 Yes · **1** Uncertain · **0** No

13 Effectiveness

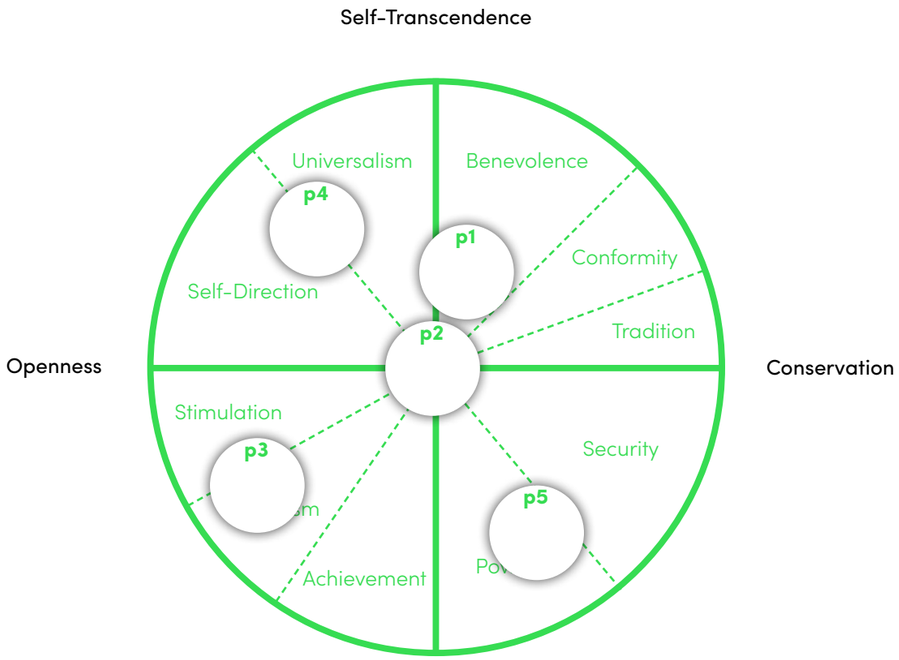


Fig 22 - Participants mapped on Schwartz' Circle of Human Values

Motivation to Accept the Exnovation

p1 He seeks for fairness. If there are obvious benefits not only for Apple but all stakeholders, he can be convinced. The more relatable the advantages the better. Especially when he sees that people around him can easily benefit from the removal as well.

p2 An unbiased stance towards the removal. He requires the right arguments in order to be persuaded. Most important is a clear and transparent explanation, why the removal is a contribution to sustainability.

p3 There should be a personal benefit to the removal. Accepting the exnovation must be attached to pleasure and gratification. If it is exciting to do so, there is great potential.

p4 Likely to accept the exnovation if she sees a general benefit in terms of sustainability. She can be persuaded by transparent communication and actionable information.

p5 Rejects the exnovation if there is no clear benefit for him. At least a relatable and obvious compensation is expected.

Conclusion

(1) Interview
The interview part, which focused on the existing situation, clearly confirms the results of the previous analysis: All 5 of the iPhone 12 users interviewed had owned several iPhones before. They also stated that they accordingly have several original iPhone charging adapters that they continue to use. In addition, many participants own other charging options or third-party products. Most participants spread these among different 'hot spots' at home or other locations. However, a clear picture emerges that the vast majority basically always charge their iPhones overnight and next to the bed. The usage behavior of the charging adapters very much takes the form of a routine that receives little attention and has turned out to be a safe and beneficial way of ensuring enough iPhone battery capacity.
When asked about the removal of the charging adapter from the iPhone box, 4 of 5 participants knew about sustainability being the reason for it. Regardless of the personal attitude towards sustainability and the impact of reducing the production of chargers, all participants expressed great doubt about Apple's rationale and were highly critical of this decision. It is especially an emotional matter because Apple's usual brand values do not seem to be compatible with sustainability. They rather suspected profit increase as the real reason and felt the removal was too drastic and a blunt measure. As a supporting argument, participants always stated that it was not a problem for them, but potentially for many first-time iPhone buyers who did not own a charger. Thus, the personal values problem is dismissed and projected onto the general public as a supposedly functional problem.

(2) Testing
The second part testing for redesigned interventions did not reveal such a distinct picture. However, compared to the previous situation certain factors could significantly increase the acceptance and willingness for the exnovation. In any case, it should be made as simple as possible for the target person to understand the background and to be able to deal with the new situation:
Participants were more convinced, when the intervention clearly aimed at Apple being transparent not only about the impact of the removal but especially about the intentions and expectation. The more believable, tangible and actionable the intervention seems, the more likely that participants can be persuaded. It shows that communication should be the first and most carefully thought through step in exnovation. Furthermore, it is helpful to give some kind of freedom of choice during the purchase process. Through simple action and active elements the intrinsic motivation can be triggered. Another important consideration is to make the intended situation clearly conceivable without the people actually having to think about it. It helped when making clear that it is possible to charge the iPhone without a new charger. The given hints how this could work and what alternatives are there were sufficient enough.

The abandonment should appear easy and doable.
However, much more than expected, the effectiveness or success rate of the interventions depends on personal values, opinion, experience and attitude. Users were asked at the beginning of the interview how they personally feel about environmental protection in general and whether sustainability plays a role in their purchasing decisions for (consumer electronics) products. They were asked to explain to what extent they are willing to adapt to new conditions that come with combating ecological problems. Similarly, the participants were asked to describe their interest in Apple, consumer electronics, technology as well as trends and novelties in these areas. In the course of the test, the participants also indicated the individual motives why they were more inclined towards certain interventions than others (figure 22).

The greatest consensus in participants' opinions was on the local gift card, the return system and the Apple gift card. The first two were rated best among the participants because they gave an unusual personal added value that goes beyond the intangible benefit of general sustainability. They also offered a real appeal to accept not receiving a new charging adapter and involved the iPhone buyers by triggering intrinsic motivation for pro-active behavior. The interventions offered incentives to both more ego-oriented individuals and those concerned about the greater good.
The Apple gift card, on the other hand, was unanimously rejected and seen as an attempt to further integrate the user into the Apple ecosystem. Receiving digital services as a substitute for a physical product was not perceived as credible by most and was partly seen as fraud.

Fig 23 - Photo by Alireza Khoddam on Unsplash

06

Synthesis

Introduction. The theory from the research phase as well as the generated knowledge from the practical test case are compiled to create an exnovation model. First, background information for the model is given and then the two underlying variables, motivation and ability, are explained in detail. These are used to define the situation of the product to be exnovated. In the end, 8 strategies are presented that demonstrate generic design approaches for exnovation, depending on the situation. This model with its strategies is the foundation for the principle of the toolkit.

Contextualization

The redesign interventions were developed on the basis of a number of different theoretical concepts, such as Pierce's framework of undesign.
While the techniques of inhibition, displacement and erasure describe what designers can do to intervene, they do not help with how and why the designer should use a particular approach to the situation. In other words, it appears to be more a design-centered perspective than a human-centered one.
I used levers that integrated Fogg's simplicity factors and Rogers' innovation attributes in order to better tailor the interventions to the actual needs of potential customers. Designing for ability and motivational factors, similar as the Fogg behavior model appeared to be the most fruitful and practical approach. Furthermore, the user test results revealed that personal values and beliefs play a crucial role, whether participants are motivated to accept the exnovation.
In the following, the underlying concept for the exnovation toolkit will be explained in more detail.

Exnovation Model

When designing to persuade people of the exnovation, we might think of two variables that can be addressed:

The first variable is motivation and considers the human as a non-rational user or customer driven by emotions, experiences, beliefs etc. It implies that a person must have a certain degree of motivation towards the exnovation in order to decide for it. If a person is averse to sustainability or afraid of change, the motivation level is low.

The second variable is ability. It involves everything around the product. It determines if the setting makes a person able to accept the exnovation. It can have many reasons why a person is not. This can range from simply lacking information or means to being dependent on a product's functionality.

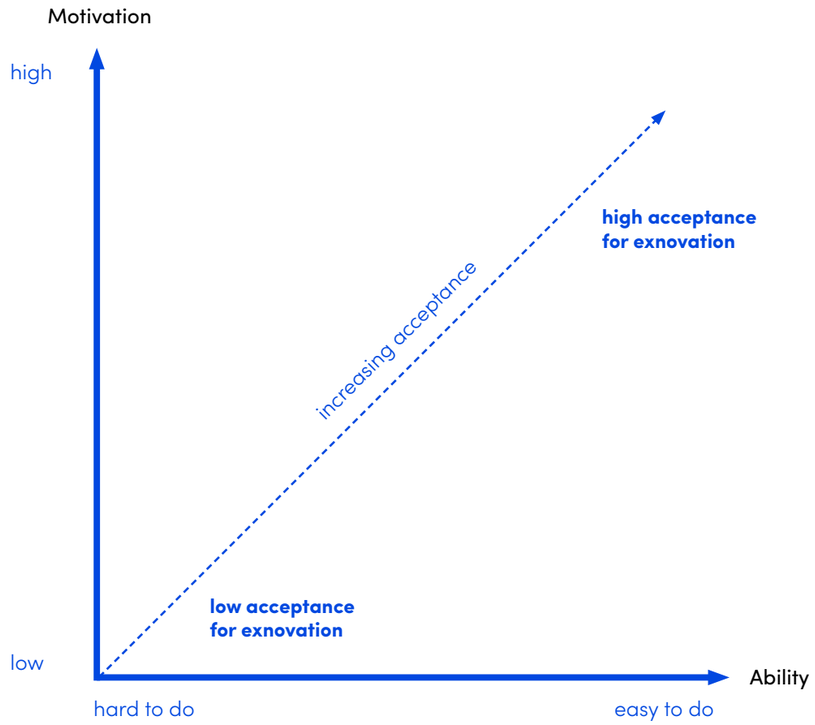


Fig 24 - Exnovation Model based on the FBM

Motivation

As the user testing proves, it is nearly impossible to design one universal incentive that appealed to all participants. They mentioned different motivational reasons why they prefer certain incentives over others. The answers indicate that whether a person is motivated to accept the exnovation is not only dependent on the product but to a great extent influenced by very fundamental personal beliefs. If these beliefs are known, it is more likely that motivation can be increased through targeted incentives.

In this exnovation model, the underlying concept for determining values is the Basic Human Values circle by Schwartz (2006), which is valid universally and across cultures (→ p. 50, Motivation for Exnovation). In this context, single congeneric values can be grouped into basic tendencies. In the following, 4 groups of people are described who show respective tendencies. The inherent values can be expressed to different degrees.

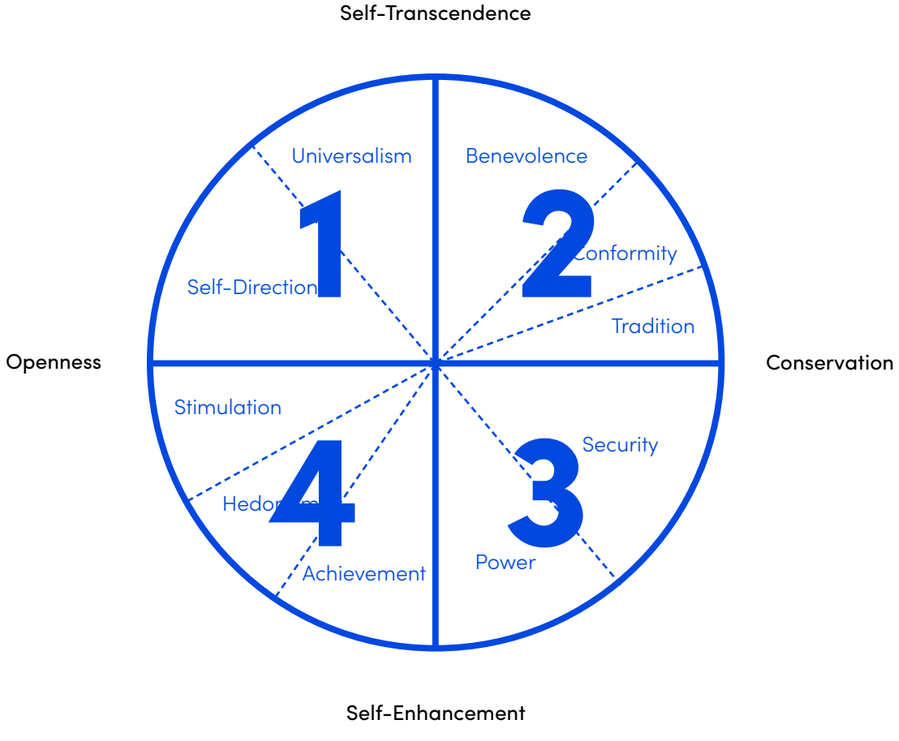


Fig 25 - 4 groups of people with different motivation levels

Type 1 - The Tolerant

Motivation Level 3/3

People of this group value freedom of thought, action and choice. They seek for social justice, equality and are generally liberal.

They are very likely to be ecologically aware and prepared for change. This fact offers great potential for motivation towards the exnovation.

Design efforts should deliberately encourage sustainable behavior and promote the exnovation as a desirable, beneficial and creative lifestyle by which they protect the freedom of all people.

Type 2 - The Decent

Motivation Level 2/3

The welfare of family, friends and people in close contact is important to this group. They are restraint of actions that violate social expectations or norms and value traditional culture or religion.

For these people sustainability might seem to farfetched and therefore is not taking the highest position. It primarily gets into focus if the lives of people in their closer circle are affected. Generally, conformity and tradition must not be neglected by the exnovation.

In order to increase their motivation for the exnovation, design efforts should deliberately address advantages for the ingroup and must be attached to respect and commitment.

Type 4 - The Self-Seeker

Motivation Level 2/3

People from this group like to be stimulated by challenges and novel things, and strive for an exciting life. Personal pleasure as well as sensuous gratification are in the foreground.

Sustainability is of minor importance and not a convincing argument to them. If the exnovation comes with personal advantages, however, they might be open to it.

Design efforts should emphasize newness through exnovation and offer clearly evident gratification for oneself.

Type 3 - The Reluctant

Motivation Level 1/3

Safety and stability of society, relationships and self have importance to the reluctant. Moreover, people from this group value social status and prestige. Also control over people and resources seems worthwhile.

There is a high probability that exnovation of established products for the sake of sustainability is against the values people of this group hold up.

In order to motivate them, it is indispensable to match their beliefs by connecting the exnovation to means of security and benefits that imply personal gains.

Ability

As Fogg argues, beside motivation, people should also have the ability to accept the exnovation, in other words it should be as simple as possible (→ p. 52, Behavior). Three factors significantly influence the ability and have great impact whether it is simple or difficult to accept. Those factors have different levels of impact and each of the individual factors may themselves vary in degree. They can be loosely described in the form of a pyramid structure, with functionality laying the foundation, habit occupying the middle, and valuation forming the top. When functionality is affected, it is likely that habit and valuation are affected as well.

Valuation
Valuation describes the way people attribute special values to the product. This can be the case, when it is perceived as being precious, rare or stands for quality and refinement. So the product means more to them than just its function. It is therefore advisable to compensate for these values with targeted incentives. The product should be made undesirable and its abandonment more appealing than the actual product.

Habit
When people get used to the existence of established products, they tend to approach it in a habitual manner. This can be a subconscious way of using, interacting, or thinking of the product. People are naturally hooked to these habits and the exnovation would break them. Breaking habits, however, should be avoided in any case. Hence, it is important to plan in advance how the consequences can be preempted or mitigated. Best is to change old or foster new habits with rewards in the situation when a person is affected by the exnovation.

Functionality
If the product has certain unique features that cannot be compensated or substituted by other available means, the functionality would not be given after the exnovation. People are unlikely to discontinue the use of a product when it restricts a crucial function or purpose. Thus, losing functionality is the largest obstacle in the exnovation of a product. For this reason, it should be ensured that the desired functionality is maintained even after the product has been exnovated.

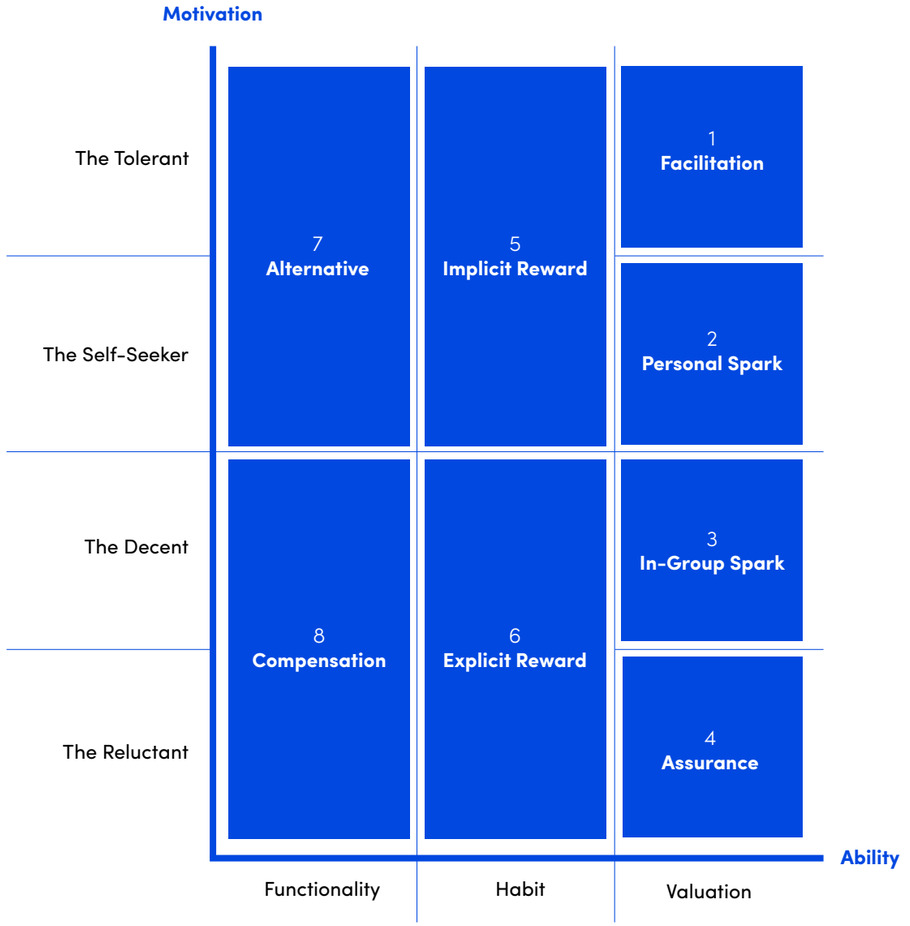


Fig 26 - 8 Strategies depending on the target group's motivation and ability factors.

Exnovation Strategies

The strategies serve as generic guidelines and have certain overlaps with each other. Moreover, they can be combined if for example habit and valuation are affected at the same time or the target group cannot be clearly defined. In order to be able to address extremes in addition to the average target person, it can help to deliberately design interventions that make use of different strategies at once. In the Apple charging adapter case study, one intervention showed the power of combinations. The local sustainable gift equally appealed to participants from various motivational groups. This is because it inspired a sustainable lifestyle, gave the opportunity to support a certain in-group and offered personal benefit in form of pleasure and gratification.

Exnovation Strategies

Valuation

1 **Facilitation**

the tolerant (open to change and self-transcending) | valuation

The first strategy targets the situation with the lowest resistance to exnovation. The target group probably does not need to be persuaded or motivated to agree to the exnovation. They are likely to do it out of their own conviction if they know the sustainability benefits of it. All they need is actionable information, i.e. an indication that they can commit to it. This indication must include why they should and how they can accept the exnovation. A facilitating design can trigger the desired acceptance while also making it easier to do. Accepting the exnovation should become easier than rejecting it.

2 **Personal Spark**

the self-seeker (open to change and self-enhancing) | valuation

If the product inheres a significant value, the target group is unlikely to relinquish this value. Sustainability as main argument for the abandonment of the product might not be convincing here. Hence, people lack motivation to accept the exnovation. In this case it can help to design an "exnovation value" as a spark that is exciting and inspires personal benefits or puts the advantages for individuals in the foreground. It may be advantageous to trigger pro-active behavior with a novel incentive or reward. This can on the one hand realize the demanded feeling of autonomy and on the other hand attract their explorative nature or stimulate their personal interest. By making the acceptance an alleged individual decision, personal control over the situation can be implied.

3 **In-Group Spark**

the decent (conservative and self-transcending) | valuation

Similar as the personal spark does this strategy aim at the situation when the product inheres a special value and when sustainability is not a convincing argument. In this case, however, it is more appropriate to design an "exnovation value" that inspires benefits for the in-group. This puts the advantages of that particular circle of people in the foreground. For example, it may be expedient to tie positive consequences of the exnovation to the welfare of the in-group, i.e. by making the commitment to exnovation a simultaneous dedication to the in-group. Equally applicable are means that render the rejection of the exnovation a socially deviant behavior.

4 **Assurance**

the reluctant (conservative and self-enhancing) | valuation

Assurance is a strategy that can be used when there is a high risk that the target group does not appreciate sustainability as main argument for the abandonment of the product. People clearly lack motivation to accept the exnovation. Hence, it can help to design a motivational element that assures the stability of the situation after the exnovation. Since people of this target group do not want to take risks, it is important to frame the exnovation as a secure event with fixed and foreseeable outcomes. Moreover, the target group is inclined to put the advantages of individuals in the foreground. Providing a personal benefit or reward can help to trigger pro-active behavior.

Habit

5 **Implicit Reward**

the tolerant and self-seeker (open to change) | habit

Although people are open to change, they are likely to reject the exnovation because it would break their habits. This is to be avoided in any case. Instead, the habit should be displaced so that the product is no longer involved. To achieve this, the new intended habit should be equally simple to adopt. Here, the most promising approach is to reward the person every time in the situation in which she actually used the product. In order to stimulate changing the routine, this reward should be inspiring and unexpected. The target group is open for unusual approaches, so there is an opportunity to displace the routine.

6 **Explicit Reward**

the decent and reluctant (conservative) | habit

This strategy works in a similar way as the implicit reward. It acknowledges that the exnovation would break the target group's habits. Since the target group is fairly unmotivated, the habit should not be broken but replaced in any case. Again, the product must no longer be involved in the desired habit, but should be substituted by an intervention that has a similar character and effect. The new habit must be at least equally easy to adopt. In order to make people change their routine, it is important to give the target group a secure feeling and create a sense of familiarity. This makes it easier to to foresee the consequences.

Functionality

7 **Alternative**

the tolerant and self-seeker (open to change) | functionality

Although people tend to be open to change that comes with the exnovation, they feel dependent on the product's functionality. In this case the product should not be just erased, because there is a high risk to alienate people and arouse opposition. Instead, it must be equally offered an intervention that reaches for an alternative so people feel at ease with the exnovation. The future situation should still meet the functional needs. This, however, does not require to preserve the product but can be achieved by new and unconventional means. Of course, these alternatives must then have a better environmental balance than the exnovated product. A potentially eco-friendly approach is to dematerialize the product and replace it by a service or digital application. Moreover, people may also be open to dispossession, i.e. sharing products instead of owning them. Sustainable exnovation, however, doesn't solely mean to come up with newly created alternatives or incentives, but can also take shape of rethinking or restructuring of what already exists.

8 **Compensation**

the decent and reluctant (conservative) | functionality

The compensation strategy should only be used when both motivation and ability are so low that people will definitively reject the exnovation. In this case, the product must not be erased, but a situation with compensatory character must be created. In order to make them feel at ease with the exnovation the future situation should imply a sense of stability and familiarity. Either averse people could be slowly and gently accustomed to the abandonment or, if necessary, compensated by direct and obvious replacement. The future situation must still meet the functional needs and be clearly communicated as such. Also the compensation must then have a better environmental balance than the exnovated product. Typical of the strategy is an extended phase-out, which allows the target group to adjust individually. Possible interventions that can facilitate compensation is converging design, which just renders the material product superfluous but not the functionality and rethinking or restructuring of what already exists.

07

Toolkit

Introduction. This chapter is dedicated to the design of the exnovation toolkit.

07.0 Final Design First, an overview of the framework and user flow of the final toolkit is given. Then, the function and individual steps of the prototype are explained in more detail.

07.1-3 Loops In the following, three loops of usability testing illustrate the changes that led from the first draft to the final design. In each loop, the toolkit was tested by designers using real products they have developed. The results led to adjustments that were tested in the next loop.

07.0 Final Design

Conception

The idea behind the toolkit is to confront designers with the topic of exnovation in design. It gives a practical approach to the complex and theoretical topic. In this way, it provides an opportunity to reflect on and evaluate the personal impact as a designer on the example of concrete products. As a starting aid it should sharpen the view and give a more structured and targeted approach to exnovation by design. The aforementioned exnovation model with its strategies forms the basis for this. In order to obtain a systematic approach for the exnovation of a product, users will be guided step by step through the factors of motivation and ability. The final exnovation strategy is supposed emphasize design possibilities and to inspire potential consideration and further steps.

The toolkit is a digital service, built in the form of a website. This allows a good accessibility in all working situations. It can be used for remote working such as team meetings and client workshops and can be combined with common tools (video calls and remote collaboration). In addition, a digital form offers the possibility to make the toolkit „smarter" by allowing it to perform background tasks independently and thus let the user focus on content.

Requirements

The toolkit should

- *inform the designer about exnovation.*
- *make clear why exnovation belongs to the area of responsibilities of the designer.*
- *provide suggestions that ease framing the design intervention.*
- *inspire further exploration.*
- *suggest a strategy how to design for the exnovation of a chosen product.*
- *be universally applicable to common products but may not suit all products.*

Phase 1

Information

At the beginning, the user will be informed about the topic of exnovation in general and about the use of the toolkit in particular. This is to raise awareness for beginners of exnovation and to create the basis for a smooth process.

Phase 2

Input

In order to obtain a suitable exnovation strategy, the user must first enter the respective inputs for the topics motivation, functionality, habit and valuation. On this basis, the system calculates in the background which strategies have the greatest correspondence with the input and appear most applicable for the given situation.

Phase 3

Output

In the final phase, the user is presented a summary of each topic, as well the eight strategies. This output is supposed to simplify the product's exnovation and serves as rough direction to be able to design more target-oriented.

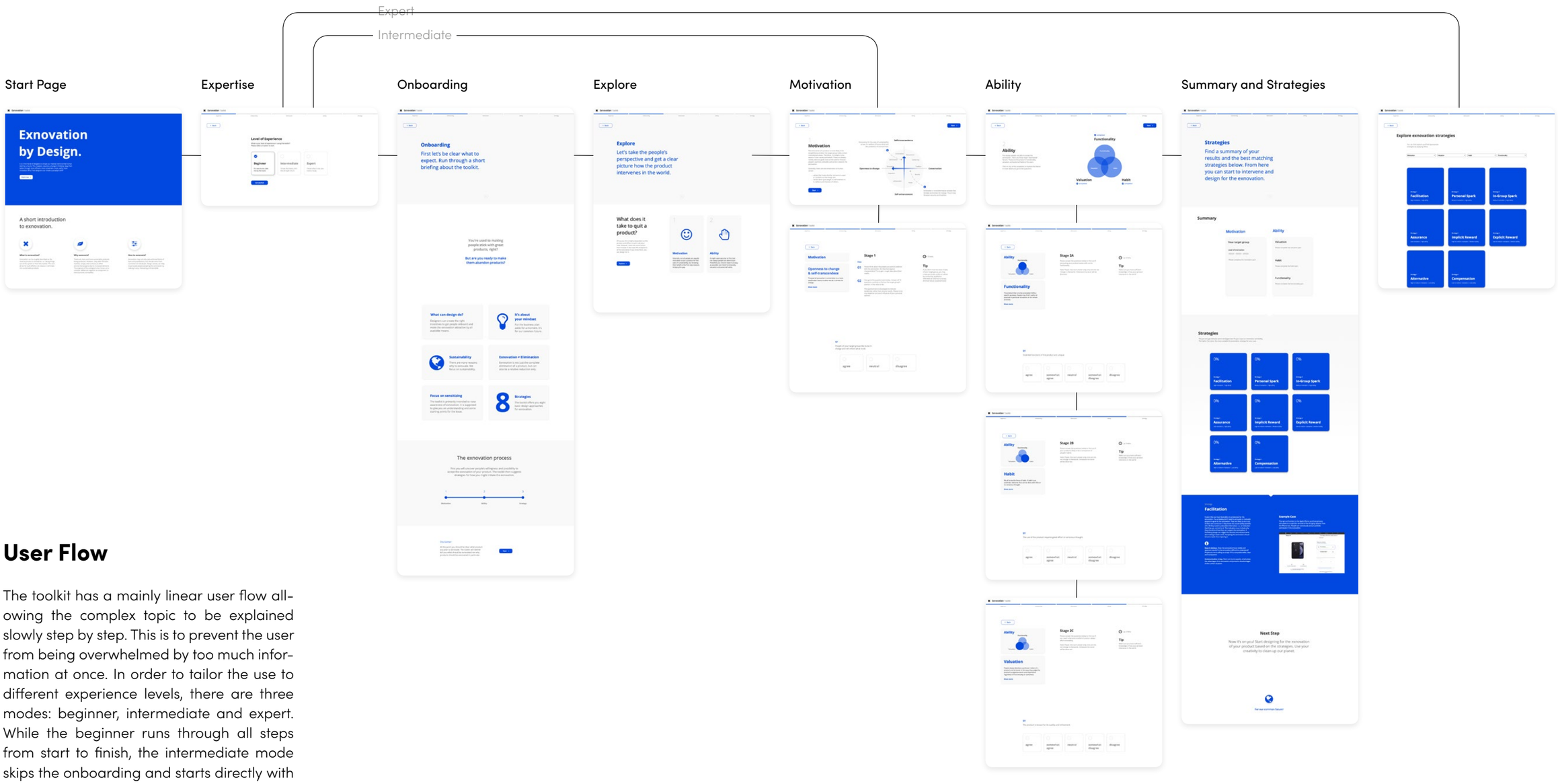
Start Page → Expertise → Onboarding → Explore → Motivation → Ability → Summary and Strategy

Fig 27 - Linear User Flow

Phase 1 - Information

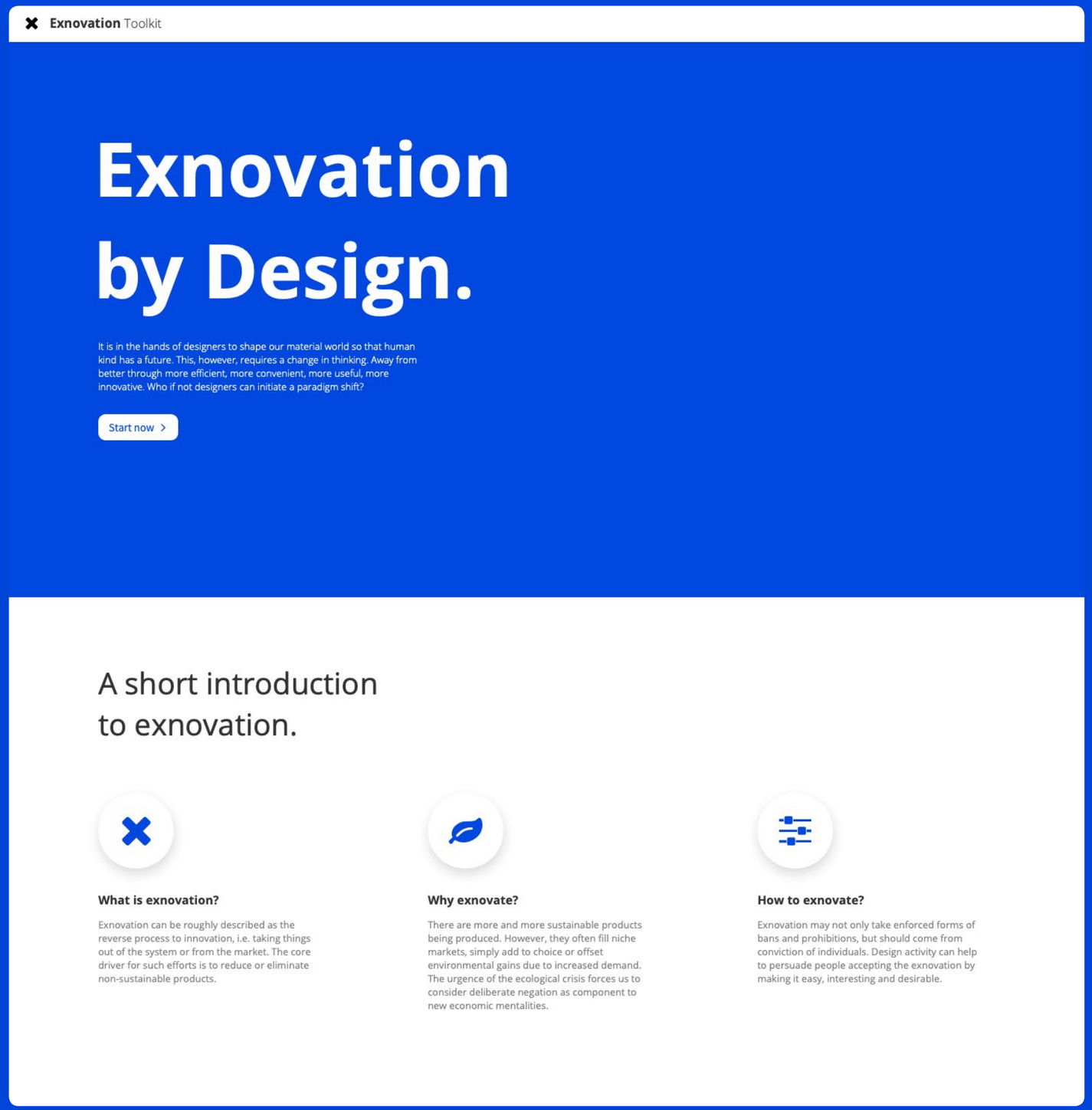
Phase 2 - Input

Phase 3 - Output



User Flow

The toolkit has a mainly linear user flow allowing the complex topic to be explained slowly step by step. This is to prevent the user from being overwhelmed by too much information at once. In order to tailor the use to different experience levels, there are three modes: beginner, intermediate and expert. While the beginner runs through all steps from start to finish, the intermediate mode skips the onboarding and starts directly with the input part. In the expert mode only an overview of the 8 strategies is displayed. Here it is possible to use filters to narrow down the selection of suitable strategies.

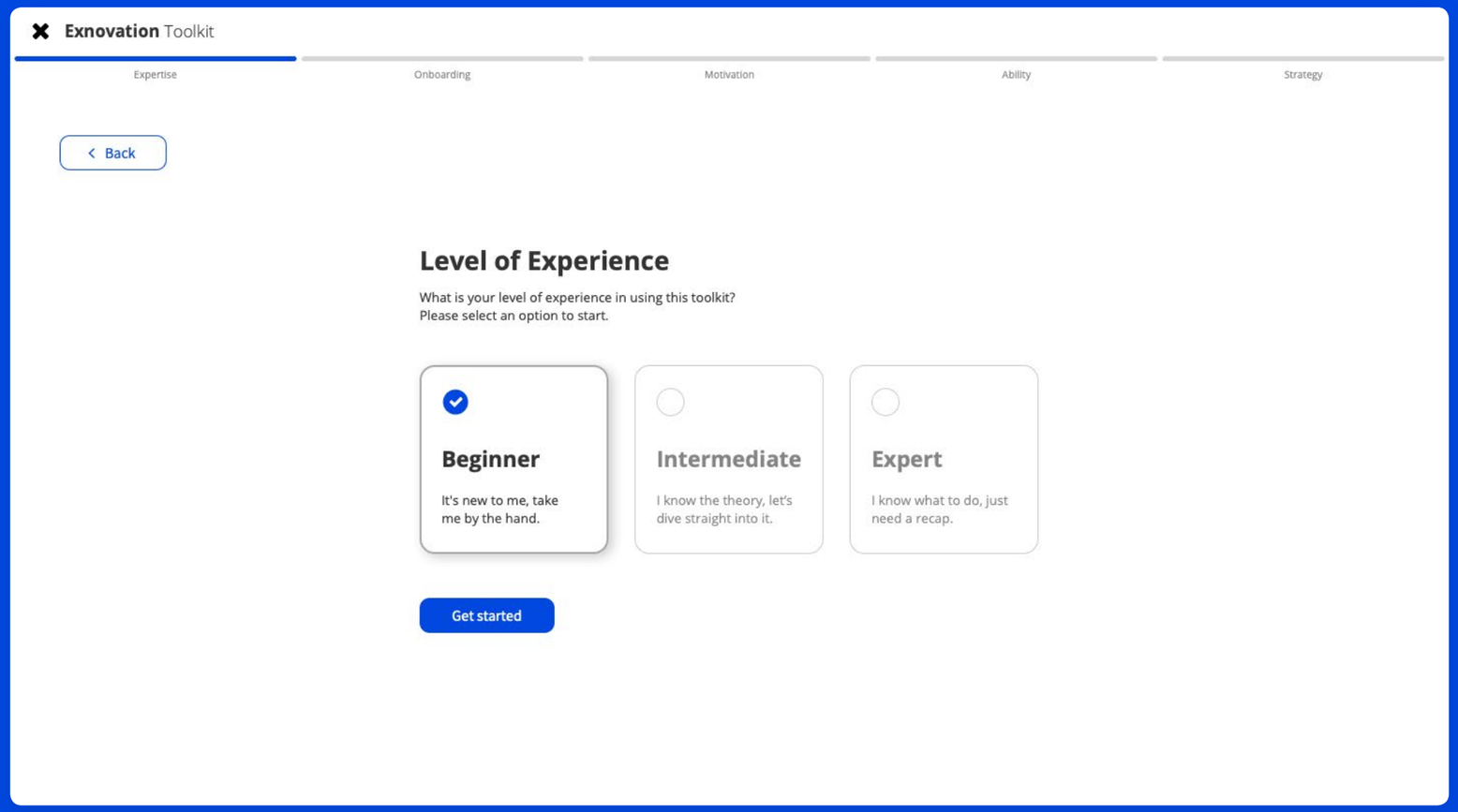


Information

Start Page

The start page gives initial, fundamental information about exnovation in general, in case users did not have any touch points with the subject yet. It is supposed to encourage designers to be concerned with an unconventional approach to sustainable design. By clicking the start now button, users are directed to the expertise page.

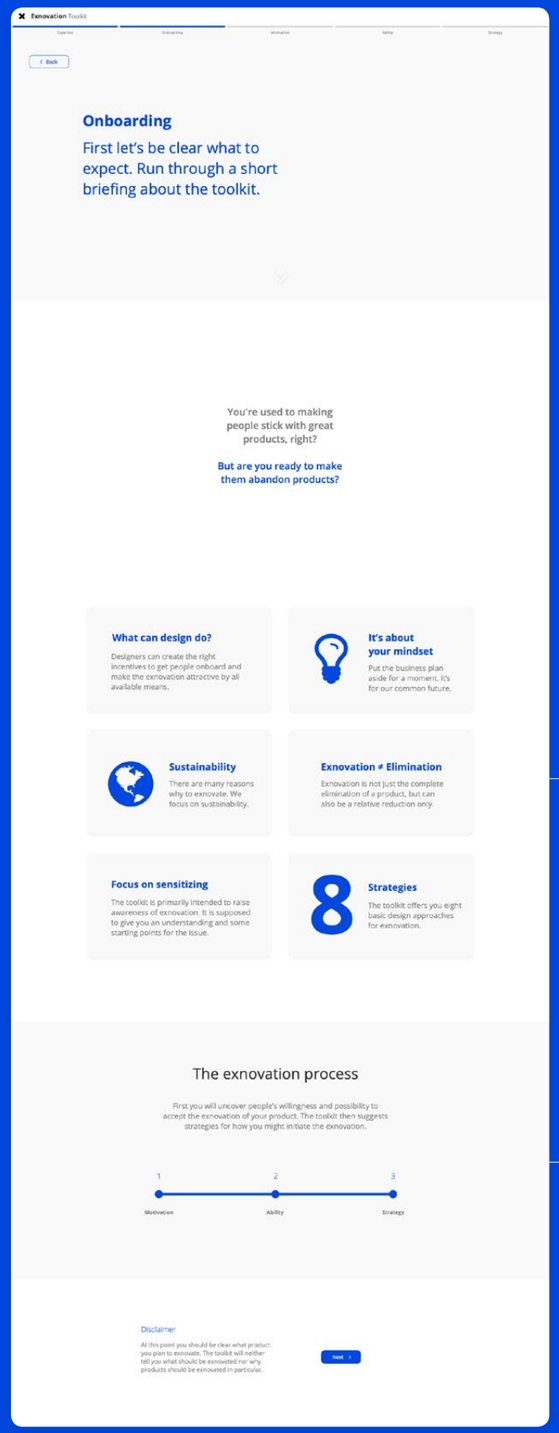
See the full Prototype:
https://yxffs4.axshare.com

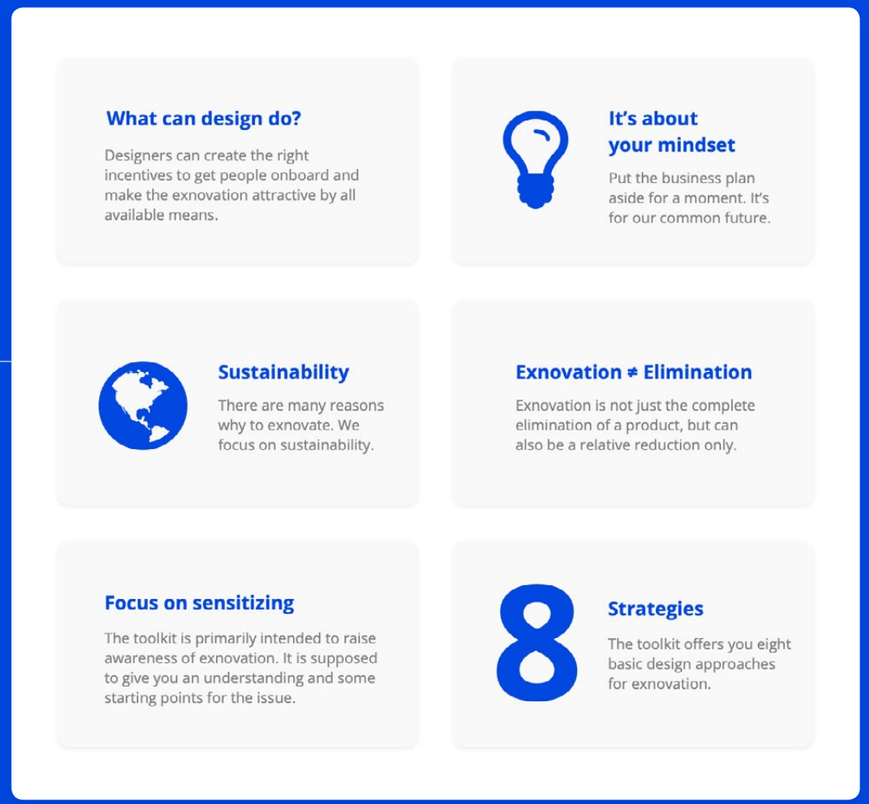


Information

Expertise

On the expertise page, users indicate their level of experience. Depending on what level they go for, they are directed to different stages in the process as shown in the user flow. This is to avoid a prolongued process for people that already know the background information and the process.

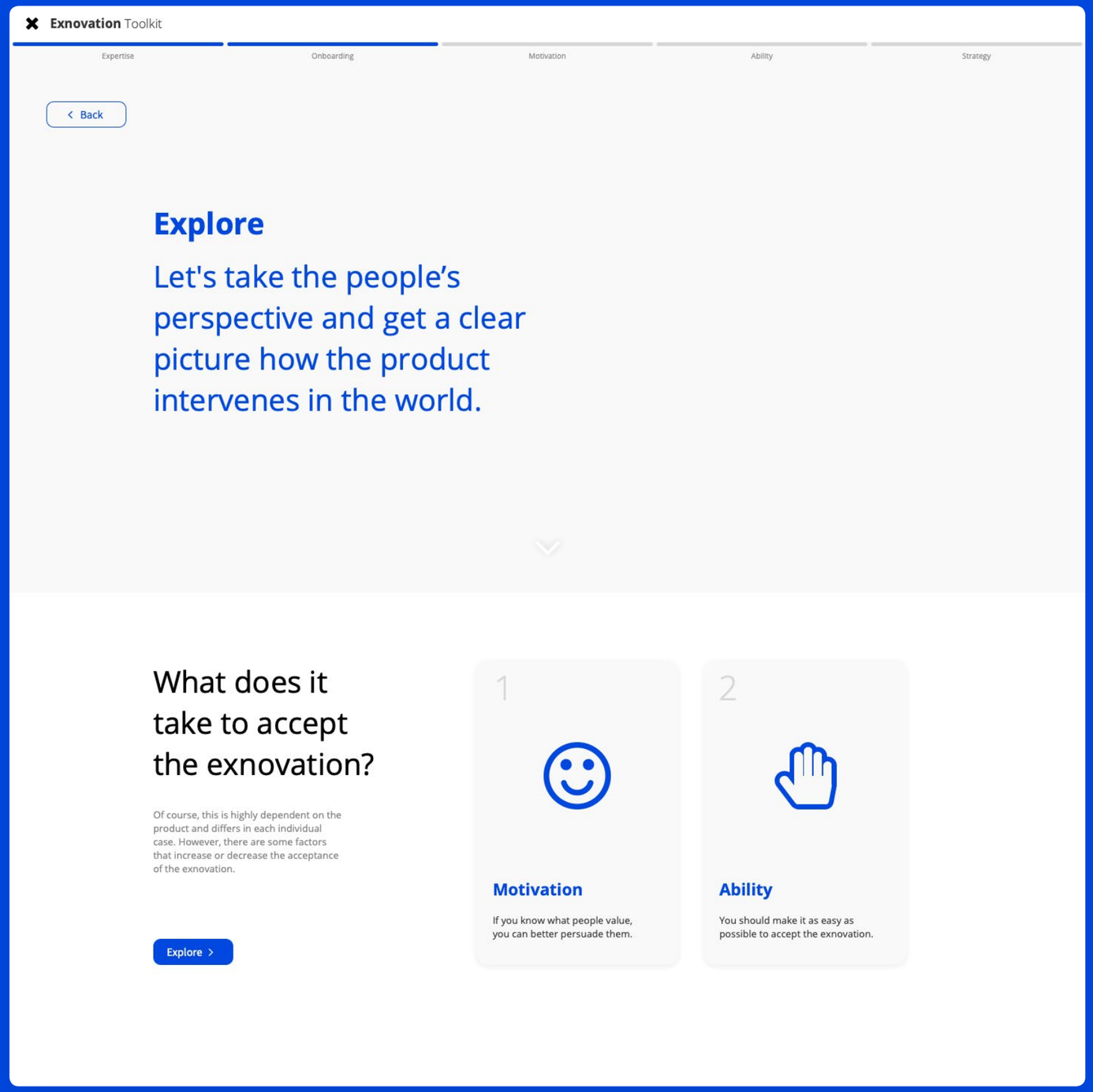




Information

Onboarding

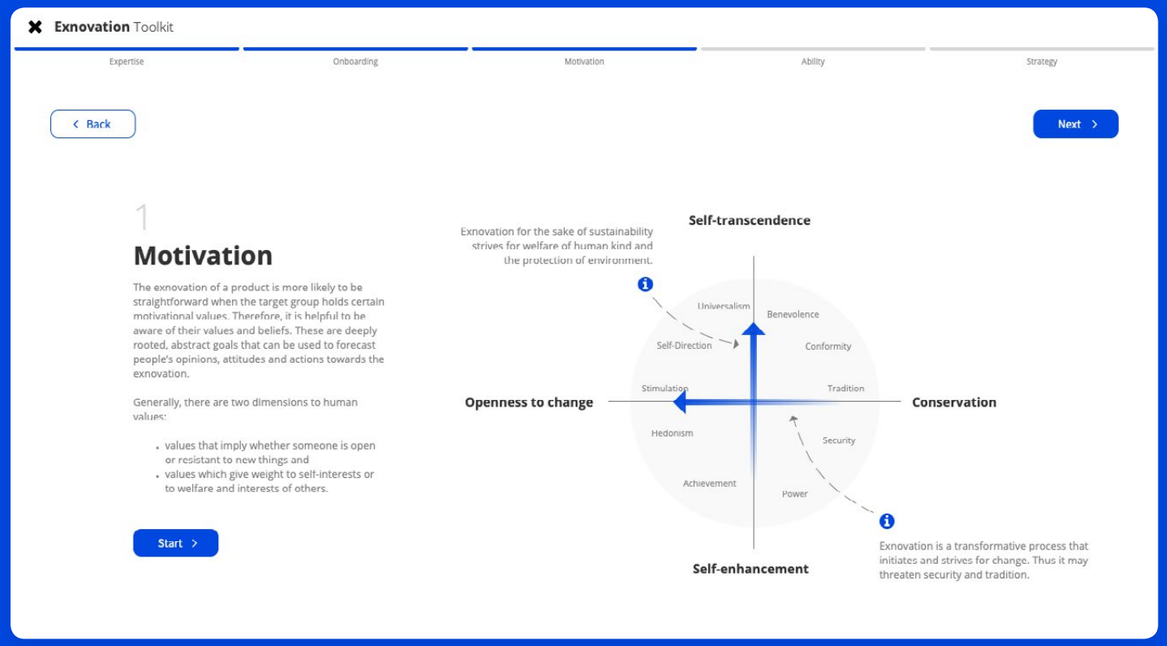
The onboarding section contains the most important background information in a short and understandable way. It should give the user a rough idea of what to expect and point out what will be covered in the following part. It also mentions the essential keywords and the basic structure of the process. Furthermore, it points out that a product as a test object is required in order to use the toolkit.



Information

Explore

This page prepars the designer to take a human-centered approach and gives a brief introduction to the following two steps motivation and ability.



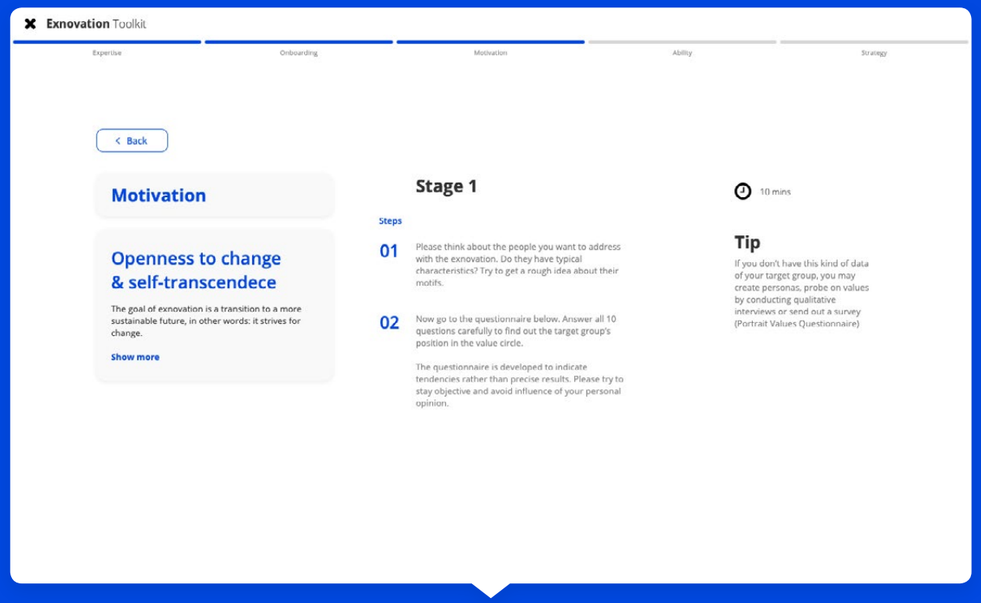
Input

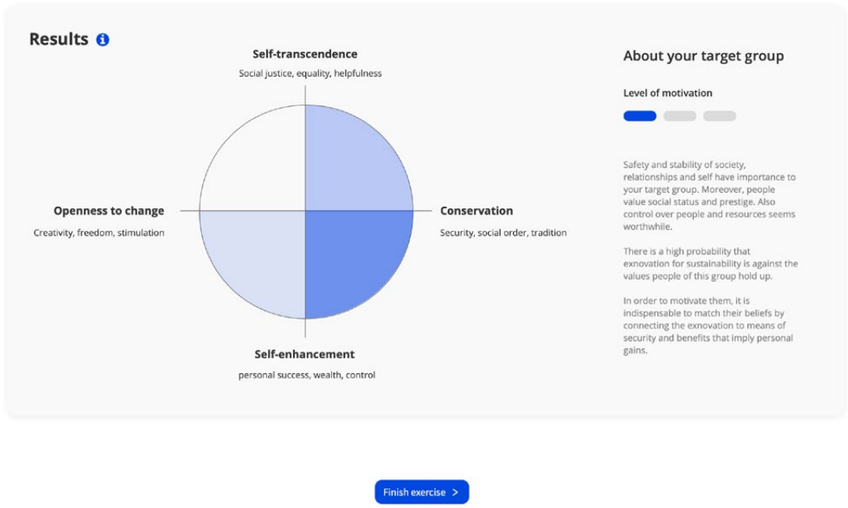
Motivation

The motivation topic is divided into two pages so that the user is shown new knowledge first and demanded to give input second. On the first page, the underlying human values model is briefly explained and exnovation for sustainability is positioned within.

By clicking on the button the user gets to the interactive part with more information and a 10-question form. Here the designer has to assess the target group of the exnovation. Each of the statements targets one of the values in the model and can be answered with „agree", „neutral" and „disagree". The statements are transferred from the short-form Schwartz Portrait Values Questionnaire. After completion, it is shown with which of the quadrants the target group is matching the most.

1. People of your target group like to be in charge and tell others what to do.
2. Being successful is important to them. They like to stand out and to impress other people.
3. Having a good time is very important to your target group. They really want to enjoy life.
4. They look for adventures and like to take risks. They want to have an exciting life.
5. People of your target group are curious and try to understand everything. They think it's important to be interested in things.
6. They think it is important that every person in the world should be treated equally. They want justice for everybody, even for people they dont know.
7. They always want to help the people that are close to them. It is very important to them to care for people they know and like.
8. They think it is important to do things the way they learned from their family. They want to follow their customs and traditions.
9. They believe that people should do what they're told. They think people should follow rules at all times, even when no one is watching.
10. The safety of their country is very important to people of your target group. They want their country to be safe from its enemies.

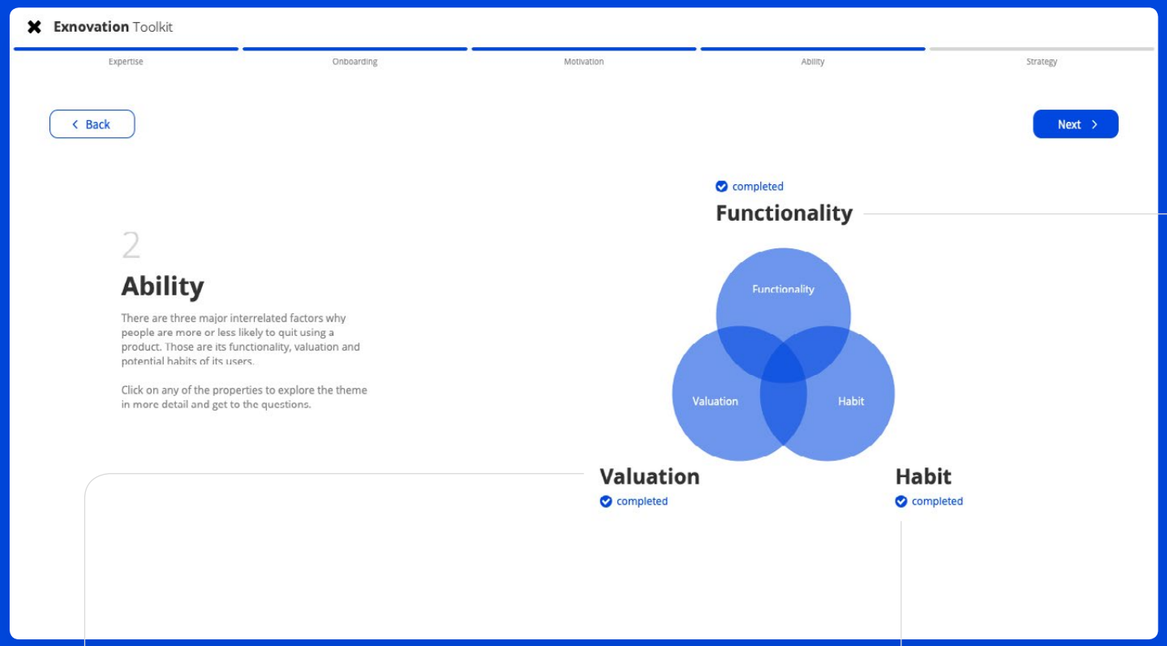


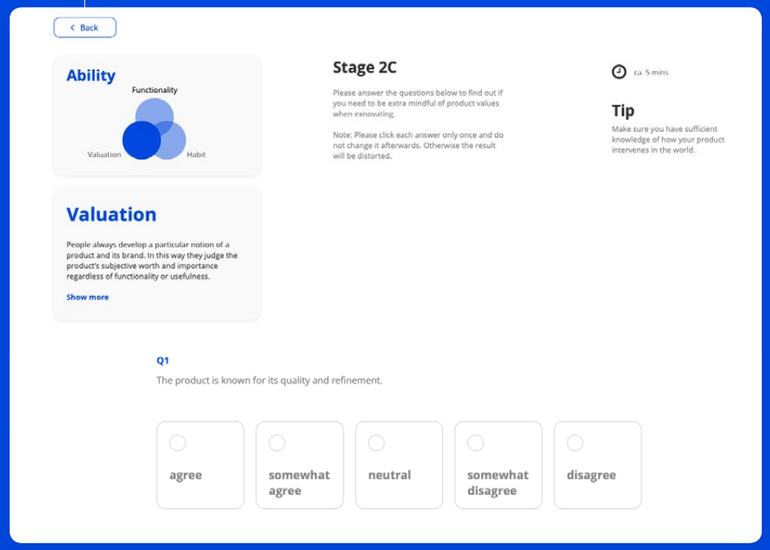


Input

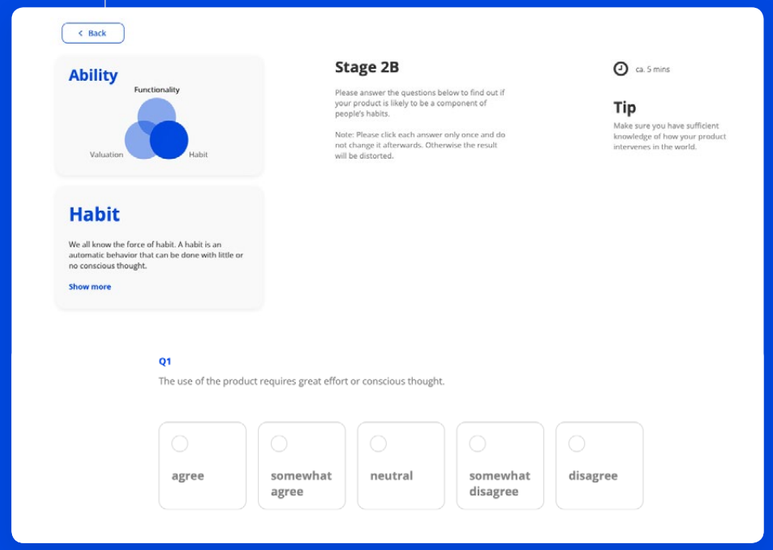
Ability

The following section is the topic of ability. The three factors functionality, habit and valuation are visualized as three overlapping circles to emphasize their dependency. The user can jump to each of the individual factors by clicking on the respective circle. There, further details are given and a short questionnaire with 5 questions are displayed. At the end a result window appears and after a single factor has been processed, it is displayed as „completed" on the ability page.
In the first testing loop, users were asked to perform open-ended exercises in which they had to analyze the current situation in more detail. In the second loop, these were replaced by the above-mentioned questionnaires with closed questions in order to simplify the process. The final loop these questionnaires were refined with statements and a 5-point likert scale (→ see Loop 1-3).

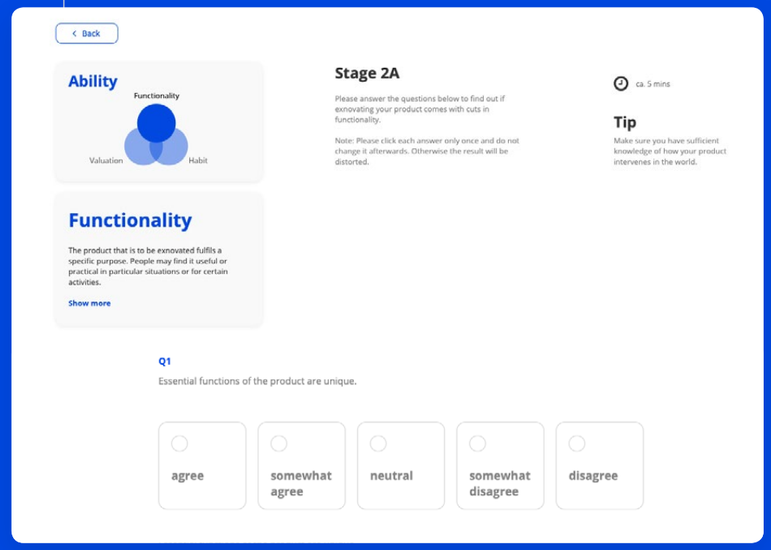




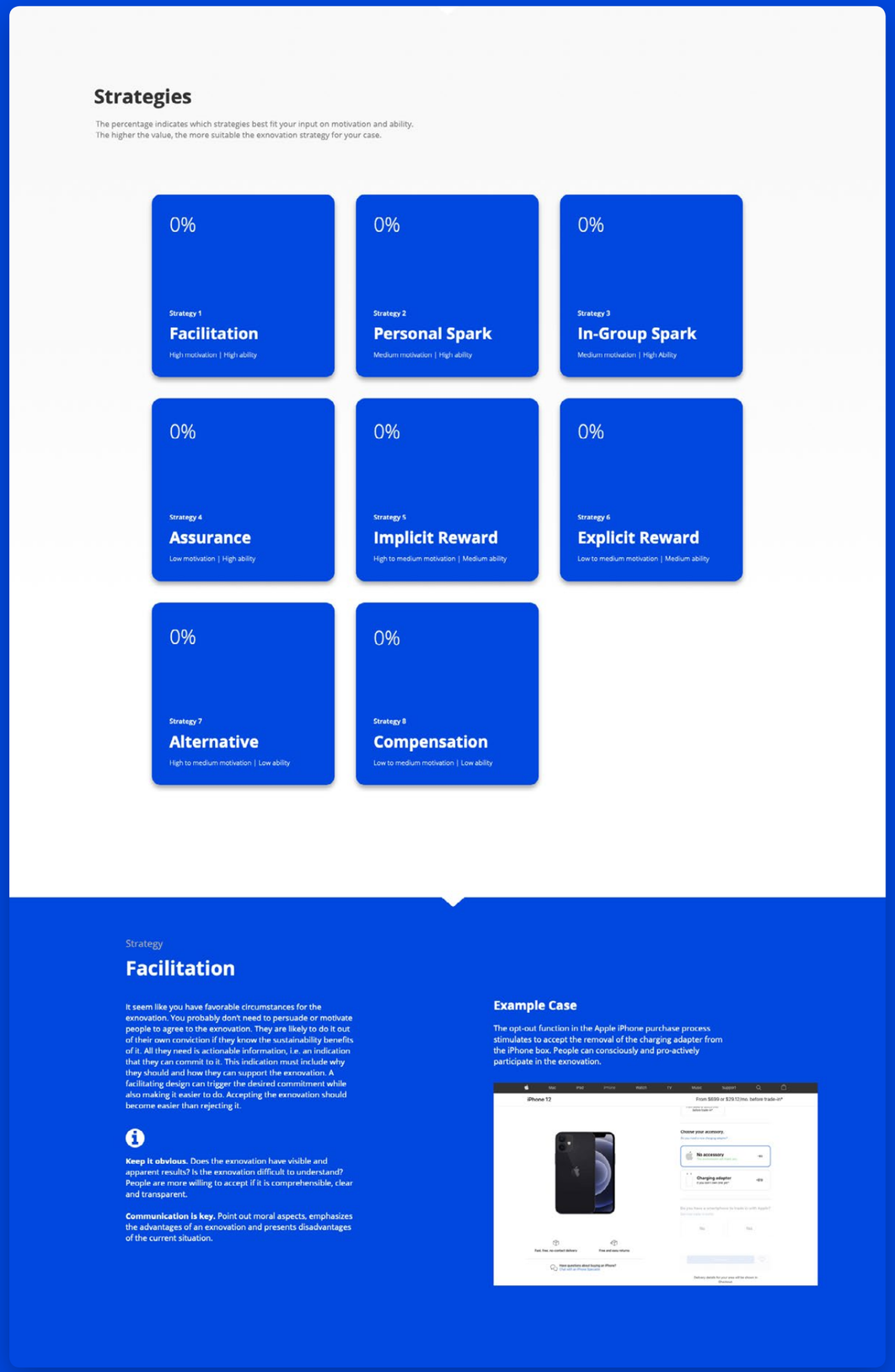
1. The product is known for its quality and refinement.
2. The product has a good reputation.
3. The product is considered precious.
4. It is considered fashionable or stylish.
5. The product benefits from a positive brand value.



1. The use of the product requires great effort or conscious thought.
2. People have common routines involving your product.
3. People no longer want to do without your particular product.
4. It is easy to use the product again and again.
5. The product satisfies certain cravings of users.



1. Essential functions of the product are unique.
2. There are alternatives or substitutes for the product.
3. Users ca do without your particular product.
4. There are other products, services, systems that are dependent on your product.
5. The functionality of your product can be replaced by other means.

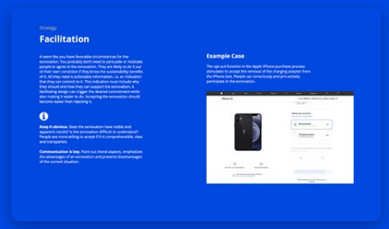


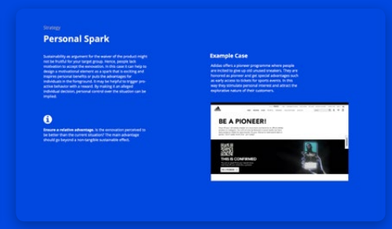
Output

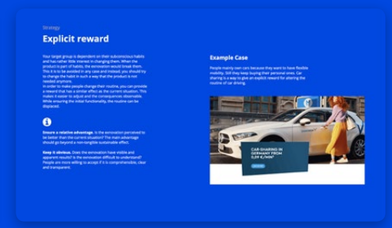
Strategies

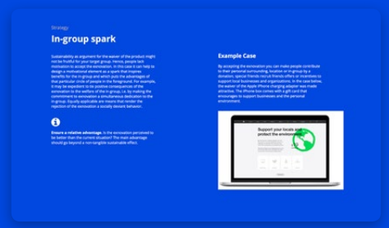
In the last step, the user is given a short summary that describes the target group and its motivation. The results for functionality, habit and valuation are also displayed.
This is followed by an overview of all strategies, displayed as blue tiles. For each strategy, there is an indication to what percentage it is applicable to the given input. This shows how likely it is that the respective strategy will work with the given product.

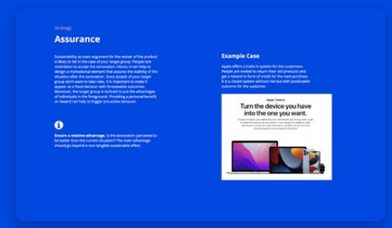
When clicking on a tile, its content will be displayed underneath the overview. Background information and initial design opportunities are supplemented by example cases and further notes worth knowing. It can be used as a starting point to ideate around design solutions for the exnovation. Moreover, it is possible to browse through all the strategies for inspiration or if motivation or ability factors can not be clearly defined.











Toolkit Testing

Test Objective and Goal
Test objective is a prototype of the exnovation toolkit designed in axure rp. The prototype is hosted on the software's cloud representing an interactive digital website. The testing aims at finding out if the prototype helps designers framing a desired exnovation intervention and designing for it. Moreover, it tests on the requirements, that were described in the beginning of the toolkit conception.

Methodology
The testing session will kick off with an introduction to the background and the focus of the graduation project, a brief explanation of the testing's goal and the consent form.
The participants are then asked to open the prototype and follow the steps indicated in the toolkit. While interacting with the prototype, they are encouraged to think aloud in order to understand their thoughts (Concurrent Think Aloud Method). After each exercise, they answer a short questionnaire and give feedback.
The researcher stays in the background, observes the situation and only answers question when really necessary.
When the session is over the researcher conducts a Retrospective Probing by asking questions about the participant's thoughts and actions. A final reflective questionnaire is handed out. The length of the sessions is 60 minutes.

Participants
In order to get reliable feedback, the testing is directed at least three experienced designers or design teams that have developed a real product which is on the market and can serve as subject for the testing. The chosen products should be different from each other in order to test diverse scenarios.

Location and Equipment
The test takes place as a remote interview via Zoom video call. The participant will be given a link to the toolkit prototype and a miro board with room for exercise notes. This board also includes consent form, questions for each exercise and the final reflective questionnaire.

Limitation
The test situation is not supposed to represent an exhaustive exnovation process with in-depth investigation and a final and binding strategy for the product. It only probes if sufficient information is given to enable a targeted exnovation design process and if the toolkit can serve as an initial framework.

Results
The following results are divided in three loops since the feedback within the first two loops led to changes of the prototype. In the initial prototype the ability section including functionality, habit and valuation contained open-ended "exercises". These exercises were aimed at the designer looking at each factor in detail to get an as holistic picture as possible. The idea of these tasks was to allow the designer to look as closely as necessary at the current situation of the product. An iterated version with closed questions was then tested in loop 2. In loop 3, these questions including the logic in the back-end were adjusted.

Research Questions

Effectiveness

- *Does the toolkit help to approach design for exnovation?*
- *Are the strategies applicable to various types of products?*

Perspicuity

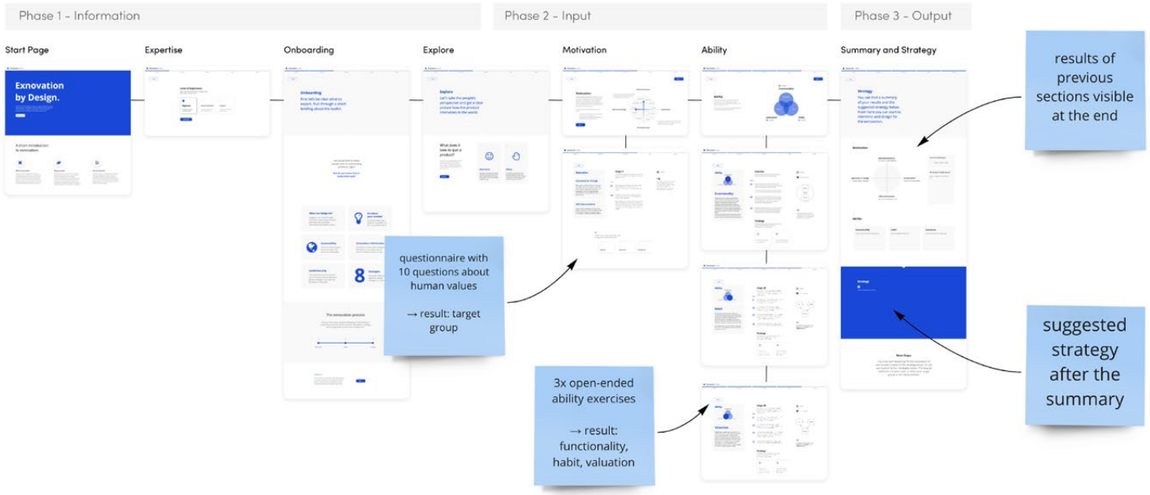
- *Is the given information sufficient?*
- *Is the process understandable and coherent?*

Stimulation

- *Is it exciting to use the toolkit?*
- *Do users feel inspired and motivated by the toolkit?*

07.1 Loop 1

Fig 28 - Key factors of the initial design



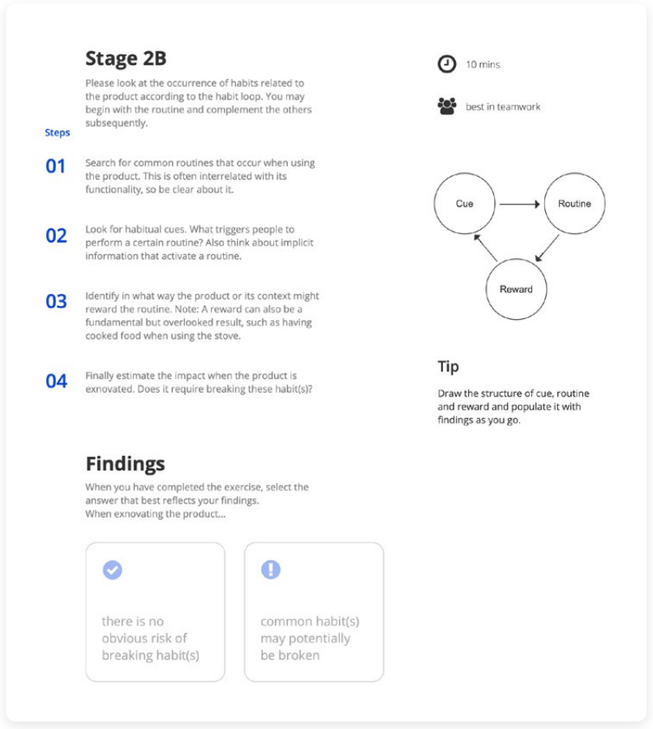


Fig 29 - Ability task with extensive open-ended exercises.

Initial design

In the first draft of the toolkit, the motivation section consisted of a questionnaire with 10 questions. In the ability section, on the other hand, there were 3 open-ended exercises (Figure 29) that gave the designer considerable freedom. These tasks were intended to allow the designer to deal intensively with the individual factors. On the final page, the user gets an overview of all results and one suggested strategy (Figure 30).

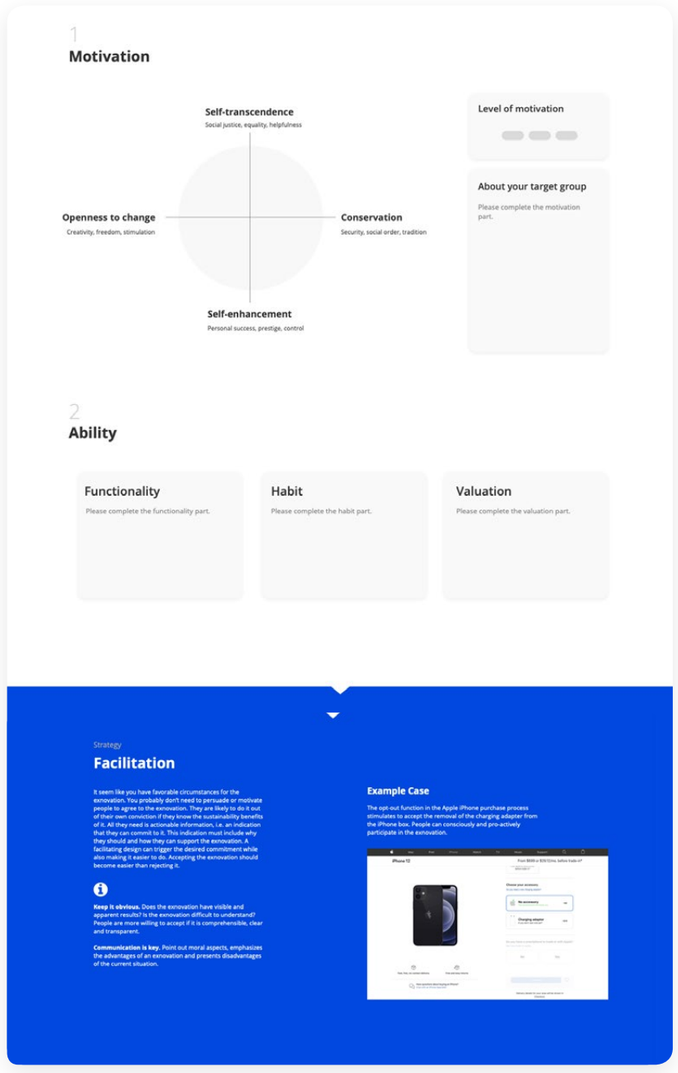


Fig 30 - Final page with all interim results and a suggested strategy.

Results

The first test session was conducted with two designers (p1 and p2) from an agency that, among other things, develops household appliances for well-known brands. The product they targeted to exnovate by the help of the toolkit was an electric stove with touch interface. For data protection reasons, the name of the agency and the product are not disclosed.

Effectiveness

4/5 helpfulness of toolkit

4/5 support of toolkit

4/5 helpfulness of strategy

Perspicuity

4/5 ease of use

4/5 clear and understandable

1,5/5 predictability

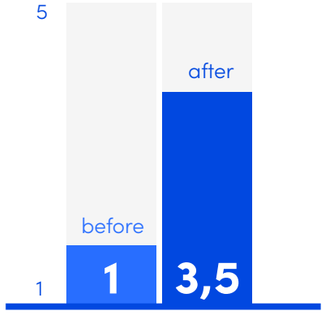
Stimulation

5/5 inspiring

5/5 motivating

4/5 satisfied with outcome

5/5 use it again



growth in expertise

>60 mins

participants required a lot of time to feel confident with the exercises

time to reach strategy page

explicit reward

the suggested strategy was matching the product and its situation

suggested strategy

Feedback

"I liked the suggestions it gives!" (p1)

"I found it interesting to talk in depth about a topic and to find aspects I didn't consider in the first place" (p2)

p1

p2

"it is quite a lot of complex information to digest, even though I have the feeling it can't be done more convenient when it comes to designing the toolkit. many times it was difficult to differentiate between function and product or product and detail or functionality... language is a very difficult thing by itself" (p2)

"the example is very helpful to understand the strategy" (p1)

"I think the toolkit isn't only valuable if you want to exnovate (which is an interesting concept in theory but complex in reality). it could also be used as a kickoff tool for projects or evaluation tool to challenge a design" (p2)

"I liked the 'motivation' questionnaire in the beginning" (p2)

Discussion

Perspicuity
Based on the feedback from the open discussion and the reflective questionnaire after the testing, it seems that the toolkit is comprehensible, but requires a lot of attention and concentration. The explanations in the onboarding are easy to understand, also the questionnaire about the motivation of the target group is clear.
From the ability step on, however, it changes and great effort is demanded from the user. The participants state that many terms are used, some of which describe very specific things and are difficult to understand all at once. In the session, it took some time until the participants felt competent enough to work out the tasks. These were perceived to be very open to interpretation and required a lot of individual reflection from the user due to the complexity of the subject. This is contrasted with the narrowing closed question at the end, which only allowed for two answers. This gave the impression that all the comprehensive investigations were then pressed into one simple answer. This impression was supported by the fact that users do not receive any further confirmation or feedback after completing the task.

Basically, the toolkit was rated as very unpredictable. It is not foreseeable what to expect in the next step or what the result will be in the end. This is also due to the complexity of the tasks that are handled outside of the toolkit and thus significantly interrupt its flow again and again.

Stimulation
Even though the use of the toolkit was not so smooth, the test participants were quite satisfied and stated that they would definitely use it again. In the questionnaire, the prototype was rated as very motivating and inspiring and that the outcome was satisfactory. This is most likely not due to the toolkit's method, but mainly due to the fact that the topic is considered to be more and more important and few steps have been taken in this direction. The participants said the toolkit is particularly interesting because it not only calls for eliminating products, but also shows ways in which this can be done in a socially responsible way.

Effectiveness
Participants indicated that the toolkit encourages a methodical approach and is a clear aid to think through exnovation in a structured way.
During its use, however, a lot of time was spent on the ability tasks in order to analyze the current situation, although the designer were sufficiently familiar with it already. So this analysis would not have been necessary for the resulting strategy. In fact, the actual exnovation strategy that was proposed at the end has fallen short. Less attention was paid to it, because the participants were still busy trying to analyze the current situation and thinking about the extent to which the product is valuable, causes habits, or offers functionality. Only when asked the participants tried to apply the strategy to the electric stove. At first, it was not entirely obvious how to apply the strategy, but eventually a first design approach emerged, which certainly proved that the strategy could be applied to the product.

Even though the participants stated in the questionnaire that they had gained experience in dealing with exnovation in general, the structure of the toolkit does not yet seem to be effective enough. This is due to the complexity on the one hand and the non-transparent flow on the other.

Conclusion

→ The user flow must be improved by simplifying the tasks and reducing difficult language. The complex open-ended ability tasks should be replaced by shorter and simpler questionnaires equally to the motivation part.

→ In order to improve the low predictability and to make the toolkit more transparent, short feedback and interim results must be given after each stage.

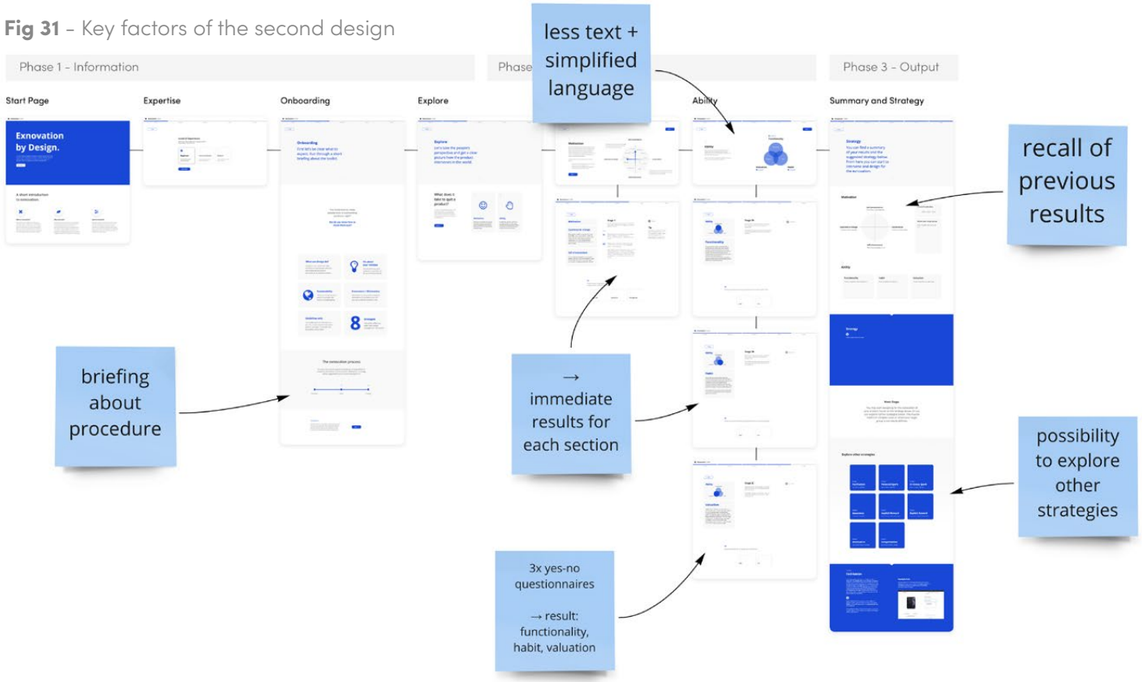
→ The final page should be less static. In case the exnovation strategy does not seem to match the product, there must be at least a possibility to explore other exnovation strategies.

07.2 Loop 2

Second design

In the second version of the toolkit, the open-ended exercises of the ability section were replaced by simple questionnaires with 5 closed questions each. Users could answer yes or no to each question (Figure 32). After each questionnaire, interim results were displayed to provide immediate feedback (Figure 33).
The summary and suggested strategy on the final page were complemented by an overview of all strategies (Figure 34). Here the user has the possibility to explore them and get further inspiration from other strategies.

Fig 31 - Key factors of the second design



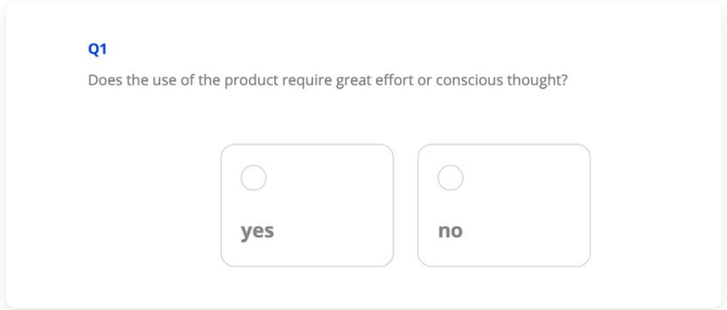


Fig 32 - Simplyfied questionnaire with closed questions.

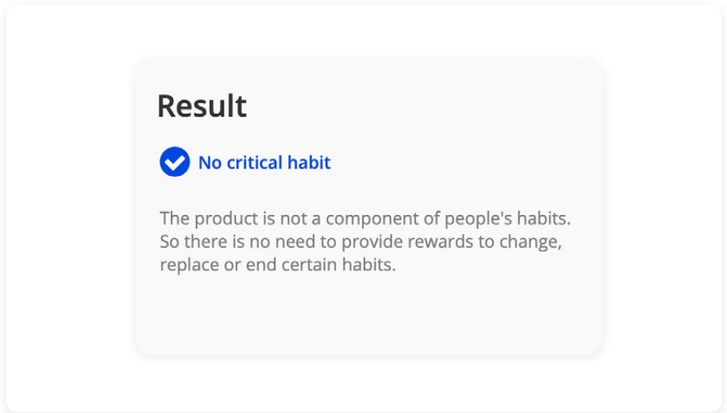


Fig 33 - Immediate results after each questionnaire.

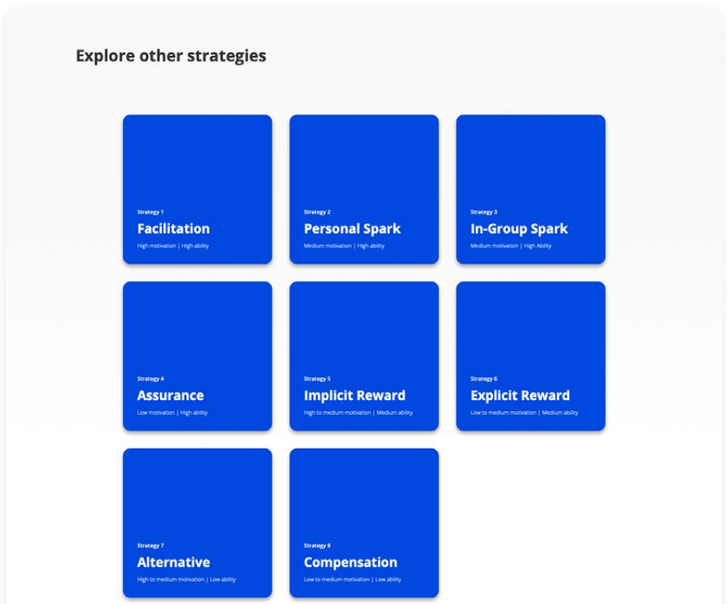
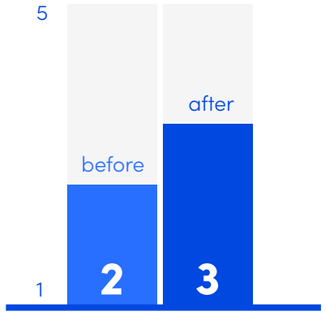


Fig 34 - Immediate results after each questionnaire.

Results p3

In the second loop the learnings from the previous test session led to several adjustments. The iterated prototype were tested with two designers from different companies. For data protection reasons, the name of the companies and the products are not disclosed.

The first particpant (p3) was a product design director from a global design agency. By the help of the toolkit he simulated the exnovation a professional measuring tape from a renowned brand for construction workers.



growth in expertise

12 mins

participant basically just read headlines and avoided long paragraphs.

time to reach strategy page

compensation → assurance

Mismatch of product (situation) and suggested strategy

suggested strategy

Effectiveness

2/5 helpfulness of toolkit

3/5 support of toolkit

2/5 helpfulness of strategy

2/5 suits the product

Perspicuity

2/5 ease of use

3/5 clear and understandable

2/5 predictability

Stimulation

3/5 inspiring

2/5 motivating

3/5 satisfied with outcome

3/5 use it again

Feedback

"I like the idea of having a tool for reducing or getting rid of products"

"I wish it would be more holistic. It lacks the money and client perspective."

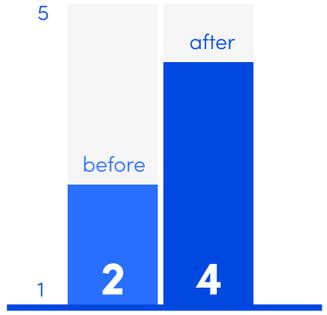
"a lot of text to read, too many words. I prefer bullet points"

p3

"hard to get clients to remove stuff they make money on. reduction is another thing!"

Results p4

The second test session was conducted with an in-house footwear designer (p4) from a performance sportswear company. She simulated the exnovation of a specific running shoe from their product portfolio.



growth in expertise

34 mins

participant read everything very carefully which required some time.

time to reach strategy page

alternative → personal spark

Mismatch of product (situation) and suggested strategy

suggested strategy

Effectiveness

5/5	helpfulness of toolkit
4/5	support of toolkit
4/5	helpfulness of strategy
3/5	suits the product

Perspicuity

3/5	ease of use
4/5	clear and understandable
3/5	predictability

Stimulation

5/5	inspiring
4/5	motivating
2/5	satisfied with outcome
4/5	use it again

Feedback

"I think it's an important and current topic!"

"I get a lot of information like 'you should do this and that' but it takes quit some time until I get to the point to do something."

"I like how it enlightens about exnovation"

p4

"the results of the target group and valuation etc matched really well, just the end was confusing."

"I could really get another view on that topic. It stresses things I haven't thought of."

Discussion

Perspicuity
Observation showed that in both test sessions the toolkit was significantly easier to understand compared to the previous loop. This was especially due to the considerably simpler process in the ability segment. The principle of closed questions was already known from the motivation section and hence there was no longer any critical perspicuity hurdle in the task. Replacing the exploratory exercises also made the entire process much faster and more direct.

The rather low rating of the perspicuity in the questionnaire is caused by the fact that the outcome on the last page was difficult to interpret. Mainly the summary was complex, indistinct and repetitive and therefore confusing two both participants. Moreover, the given input was incorrectly evaluated by the algorithm. Because of this, both testings did not conclude with the expected exnovation strategy. Thus, the output seemed disconnected and unsuitable after the previous interim results.

Stimulation
The open discussion (p4) and observation (p3) clearly suggested that the explorative character with questionnaires around each topic were inspiring and engaging.
This is in contrast to the results from the reflective questionnaire. They showed a low satisfaction rating, due to the fuzzy output page and the mismatched strategy suggestion, as stated by the particpants.

Effectiveness
Since both testings did not conclude with the expected exnovation strategy, I clarified that there were mismatches. So I have pointed out strategies that could potentially be more suitable for the respective target group. This led to p4 finding a promising strategy in the "explore other strategies" section. In this context, she wished to have a simple indicator to check which strategies are most likely to succeed. Moreover, she expressed interest in being able to download the strategies as PDFs for further use outside the toolkit.
In the case of p3, this hint did not lead to the desired result. This was mainly due to the fact that the participant quite obviously did not read paragraphs with essential information and instead tried to get results by headings and skimming the pages. He confirmed this behavior during the think aloud phase and emphasized that he would prefer visuals and bullet points. The prototype expects users, however, to read and understand the provided information in sufficient detail.

Conclusion

→ The actual process flow through the toolkit and the required input seemed simple and understandable. However, this was distorted by the flawed results and the disjointed final part. Therefore, the summary must be shorter and clearer and the algorithm must be adapted.

→ To make the toolkit more resistant to errors, not only a single strategy should be suggested, but the suitability of all strategies should be shown. This ensures that inconsistencies can be compensated for. For more precise results, the ability questionnaires should offer a scale of answers rather than yes and no only.

→ Although the test sessions did not yet run frictionless, they left a positive overall impression. Both participants underlined the importance and added value of such a toolkit and acknowledged a growth in expertise by approaching sustainable design from another perspective.

07.3 Loop 3

Third design

In the third version of the toolkit, the ability questionnaires were refined. Instead of yes or no, users had the possibility to give more precise input by the help of a 5-point Likert scale (Figure 36). In addition, the static suggestion of a single strategy was replaced by a more flexible output. Now an overview of all strategies could be given, showing to what percentage the respective strategy matches the product and the target group (Figure 37). Also the summary on the final page was shortened again, since all interim results were already displayed after each stage.

Moreover, longer text blocks with additional information were shortened. When the "show more" button is clicked, more text is displayed (Figure 38).

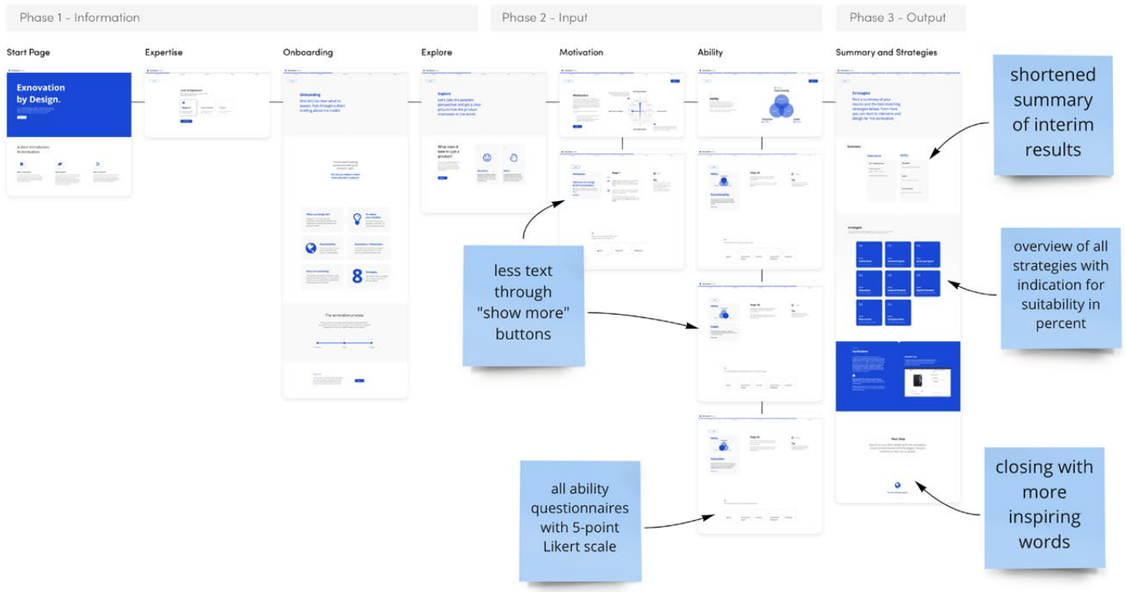


Fig 35 - Key factors of the third design

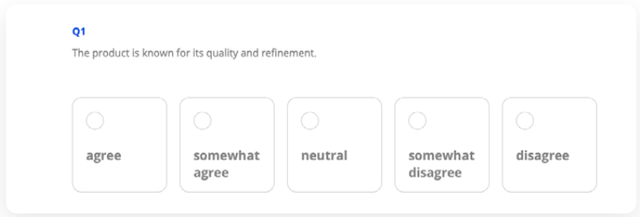


Fig 36 - 5-point Likert scale within the ability questionnaires.

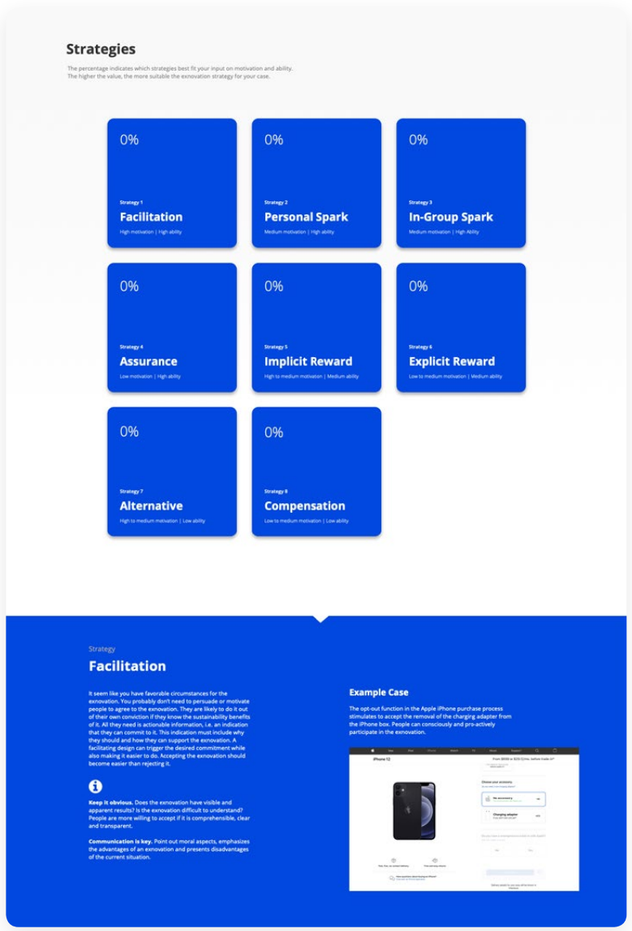


Fig 37 - Overview of all strategies with indication for suitability in percent.

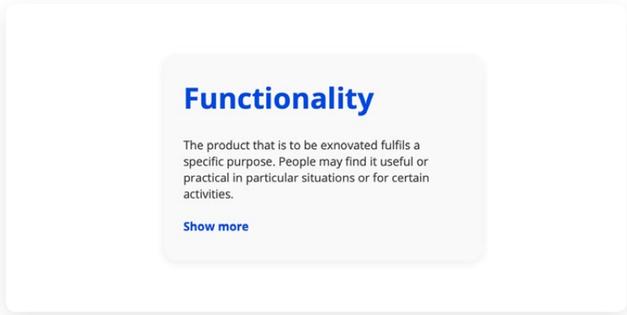
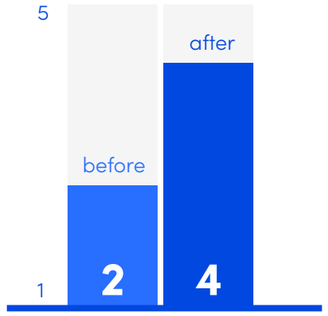


Fig 38 - "show more" button to expand the paragraph.

Results p5

The third loop marks the closing testing in the project. In this loop, the final toolkit was tested, as shown and explained previously (→ p. 104, Final Design). For this I took on the role of an Apple designer and tried to run through the exnovation process using the iPhone charging adapter. In this way, I want to reassure whether the toolkit is applicable to the test case in chapter 5. Furthermore, I can cross-check if the suggested strategies help to design tailored interventions in a more targeted and efficient way.

The strategic focus of this test session was on the effectiveness of the toolkit and its perspicuity in the context of Apple's charging adapter. Unlike in the previous loops, satisfaction was not included. Following results and conclusion are self-reported.



**70% facilitation,
70% personal spark**

the suggested strategies were matching the product and its situation

suggested strategy

Effectiveness

4/5	4/5	5/5	5/5
helpfulness of toolkit	support of toolkit	helpfulness of strategies	suits the product

Perspicuity

4/5	5/5	3/5
ease of use	clear and understandable	predictability

Discussion

Limitations
Since I developed the toolkit myself and thus knew what to expect, I could not have an unbiased opinion. Nevertheless, I tried to keep any prior knowledge and personal feelings out of the role of the Apple designer as much as possible.

Perspicuity
The toolkit comes across as very intuitive to use in the state and it is easy to follow the flow. There are only a few interaction elements on each page and the risk to click on the wrong button is very little. This leads to a low error rate in usability. Since the type of tasks is the same in all areas (questionnaires for motivation, functionality, valuation, habit), there is a high learning curve. So the principle becomes easy to understand.
At the same time, however, attention of users for additional information in separate text boxes may decrease. So there is a high risk, that important information is just ignored because the user focusses on answering the questions only.
Nevertheless, all the content could be applied to the case of the iPhone charging adapter. It gave the impression that the toolkit was highly compatible with this product.

Effectiveness
In this testing, the toolkit led to a matching strategy. The percentage showing the suitability of each strategy gives a significant added value. This makes the output much more transparent and less static. Moreover, the user has the possibility to reach suitable additional strategies much easier and more efficiently without having to read and understand all of them. It gives much more flexibility in the design of the exnovation.

Also, the much shorter summary and clearer structure of the section helps in making the final page look less complex. This allows for a better focus on the actual strategy.

In the case of Apple, the target group was certainly difficult to define in the motivation part. The results at the end of the questionnaire showed that more than one quadrant was affected, but the text next to it described only one of the four predefined groups. This can lead to confusion. However, the percentages on the final page indicate that more than one strategy may be suitable. Especially if the target group is not clearly defined, this indication helps to select the right strategies manually.

Conclusion

→ The toolkit gains considerable added value through the more flexible illustration of the exnovation strategies. The error rate can be reduced significantly. If the result is not entirely clear, it is now possible to suggest more than one strategy. Only in this way was it possible to respond appropriately to the large target group of apple charging adapters.

→ The 5-point Likert scale gives more freedom to the designer in cases where the answers are not clear. The final result is way more precise.

→ Interim results on the ability factors do not indicate to what extent functionality etc. are affected by the exnovation. They must be more distinct. Same goes for the description of the target group in cases where human values are ambiguous.

08

Project Conclusion

Introduction. This chapter presents a final conclusion of the project and points out both the addaed value as well as limitations of research and design. Moreover, further research recommendations and personal reflections are given.

Project Outcomes & Added value

The initial aim of this graduation project was to research the feasibility and implementation of exnovation by design. The literature, therefore, took a deep dive into exploring the rather novel concept of exnovation itself and put it into the context of design. It showed that the urgency to act upon the ecological crisis and the current inability to cope with the consequences make it a highly valid concept. Designers hold skills that not only qualify but even push for a contribution to the removal or reduction of products. For successful exnovation, they need above all the right mindset and awareness in order to get access to fruitful approaches. In this context they need to understand design as a way of thinking rather than a tool.

Moreover, the literature review resulted in a compilation of several independent methods, tips, aids and starting points that are relevant for exnovation. In order to test their application and effectiveness, the test case on the Apple iPhone charging adapters provided useful information. The individual levers and prompts proved to be of great help and added significant value to the removal of the charging adapter. However, during the design process, it was an uncoordinated patchwork of possibilities. Finally, the analysis and redesign followed by user testing helped significantly to identify certain patterns in the exnovation process. Based on the practical first-hand experience, I was able to better categorize the key elements from the research. This resulted in the exnovation model with 8 strategies, which served as the basis for the toolkit.

The research conducted in this project contributes to design for sustainability and customer behavior in a broader sense, but is dedicated to a specific field that has received very little attention in literature so far. Research about design aiming at the negation, discontinuance, removal, elimination or termination of products and technologies is an absolute niche subject. It requires considerably more attention now in times when the effects of climate change are becoming more and more present. Thus, this work not only provides an exnovation model for designers, but also helps to bring the topic more into the awareness of mainstream. The more attention it receives, the better it can be established as part of sustainability transitions.

By sensitizing users, the toolkit makes a clear step in this direction. The evaluation with designers showed that while many were very interested in the topic, they had little to no experience with it. Also, they did not know what to expect. All participants stated they became more familiar with exnovation and experienced an increase in knowledge with the help of the kit. It was able to educate them on why exnovation belongs to the area of responsibilities of the designer and why they should reflect on it. In addition, the participants appreciated that they were given options on how to design for the exnovation of a chosen product. Even if these possibilities were relatively open, they could be used as a starting point. For the majority, the suggested strategy was able to inspire further exploration and might even help framing the design intervention. As suggested by a test participant, the toolkit is not only valuable for the removal or reduction of an existing product, but also inspiring when starting the design process of a new product. It could be seen as an opportunity to forecast the potential impact of new products and to plan for its future exnovation.

If the hypocritical attitude (of the industrialized society) to sustainability should indeed still change, if the paradigm of endless growth through innovation can be challenged, then this work can have a high impact. The longer serious attempts are missing, the more urgent becomes the question of exnovation in the near future. But only if we care about preserving the planet.
Even in the time I have been writing this thesis, several new contributions have been published on this subject. So the scientific consideration of the elimination of the old is gaining in importance.

Limitations

Although the toolkit was aimed at industrial and product designers in general, I noticed that it required a certain openness towards the topic. Users should at least see the necessity for exnovation as sustainable thinking. It was more successful, when the designers were motivated to tackle and change the paradigm of infinite consumption and waste of resources.

This project did not explore how to identify or determine products that should be exnovated and it did not discuss what should be or should not be exnovated. However, these topics often seemed to be closely related. Probably the most present question and the greatest skepticism during all the conversations, interviews and user testing was who would be interested in exnovating a particular product. In other words, why would designers exnovate? Generally speaking, it may seem unattractive (actually unprofitable) for a company to take its own product off the market. But it is not that simple. It can quickly become necessary when regulatory or legal reasons enforce an exnovation. When coalitions are formed that decide on a joint exnovation or if the recycling of resources in a circular economy leads to exnovation. But it is even enough if the product portfolio is too extensive to be perceived as sustainable by the public. Always then designers are asked to facilitate and carry out the process. The fact that these questions kept coming up very often indicates that there is still a great demand for clarification why design for exnovation is valid.

Another limitation in this project was the evaluation. Exnovation is a transitional process that requires time. It is not linear, nor defined as described in the theory and illustrated in the Apple test case. It is likely that designers need to readjust their strategies and the design process in general. This makes it particularly difficult to assess the long-term impact of the exnovation strategies. Given the short time for assessment, I was only able to test the toolkit on usability and gather initial reactions. Here, the focus was more on whether it was able to sensitize designers than on testing the adequacy of the strategies.

To test the robustness of the strategies, a considerably higher number of test participants and more products are required. Due to the small number of participants, not all of the strategies could be tested. Thus, in the current state, there is not enough evidence that the strategies are actually applicable to a wide variety of products. It could not be defined with which product categories the toolkit works particularly well or not at all.
So far, the exnovation model has proven to be helpful for all tested products. Categorizing the motivation of the target group according to human values appeared to be very informative and purposeful. The ability factors functionality, habit and valuation were also useful parameters to analyze the products generically. However, these factors are all qualities, so they are subjective. This made it certainly difficult for me to program the algorithm of the toolkit so that the input always matched the output. This translation needs to be improved.

The exnovation model and strategies do not serve as exhaustive guidelines. Rather, they form a lose structure that can help to design for the exnovation in a better and more targeted way. It seemed as the participants expected more guidance for further explorations.

Future research and Recommendation

First, the exnovation model should be further tested and, if necessary, adjusted or elaborated. Both the human values were condensed to generic groups and the ability factors were strongly generalized in the toolkit. Further research could focus on how to make these categories more nuanced. In this way, the individual products and their target groups could be analyzed more precisely. The resulting strategies could consequently provide more precise assistance. Moreover, it should be examined in greater detail when design for exnovation does not add value or when the negative consequences of exnovation would be greater than the product itself.

This work has focused entirely on physical products. However, design for exnovation appears equally valid for other topics. This project can serve as inspiration and basis for further research in the exnovation in other areas such as services, (infra)structures, systems, practices etc. Here it may be interesting to clarify to what extent the process differs and what challenges and opportunities arise.

Personal Reflections

Sustainability has been an important topic for me for some time, both privately and as a designer. However, the decisive push came during my time as designer in the automotive industry. There, on the one hand, I was fascinated by the huge factories and the immense amount of newly produced cars that left the factories in front of my eyes every day. But on the other hand, it also seemed to me symbolic of the pollution of the environment by man-made things. During that time, I read a book by a contemporary philosopher in which I first stumbled upon the word exnovation. Since then, the concept never let go of me. I had the opinion that designers create too much individual products without seeing the big holistic issue.
Fortunately, my master's thesis gave me the opportunity to relate exnovation to my passion and profession - design - and to examine it scientifically. Overall, I am very happy that I took the decision to work on it. This way, I was not only able to acquire new knowledge, but more importantly, I was able to deeply question what kind of damage I personally can cause with my job but also how I can prevent myself and others from doing so.

Since the topic seemed very theoretical to me, I doubted for a long time whether it was really possible to design a standardized toolkit for it. Especially during the preparation time, I kept thinking that it might not be the right topic for a master thesis after all. But it was my will to actively spread the idea of exnovation, degrowth, sufficiency and frugality that motivated me again and again. In the graduation project, I didn't want to design just another product that was in its own way more sustainable, better or more efficient than others. I wanted to get to the root of sustainable design. Below are a few distinct reflections and recommendations for other students:

Acknowledging limitations and small steps (Exnovate your head!)
I knew from the beginning that the topic of exnovation is very broad. That was exactly what attracted me to explore more and more, to read more papers, to do more research, to try out more. With each step forward, I simultaneously saw 5 other paths that I also wanted to pursue. Suddenly so much seemed relevant and I wanted to make sure everything is considered. It was one of my biggest mistakes to keep giving in to that, because I knew all the time what amount of work I still had ahead of me. No one was asking me to reinvent the wheel, but I was making myself feel that way. It's extremely important to value the small steps and limitations. As my mentor told me early on: "Exnovate your head."

Fuzziness, uncertainty and loneliness
I have probably never worked on such an abstract and complicated topic with so little prior knowledge and guidance. During the project, I certainly felt on my own both spatially and contentwise. I was asking myself if it was a good idea to work on such a controversial topic and the intention to combine design and exnovation.
And then the Covid-19 thing. After my exchange and internship abroad, I slipped into the home office and spent like 24/7 at the same desk. The endless possibilities of a master thesis without a company and the remote working situation is a dangerous mixture. There were no researchers, fellow students or teachers close by to have a quick, informal chat, but also nobody that could prevent me from getting lost in deep dives. This should be well considered.

Zooming in and out
Most of my work has probably been reflection. I always tried to see the big picture after working on very specific things. Because I wanted to create general added value and not just self-actualize in a niche. I can't remember how many times I asked myself the question: "Does this make sense at all?" When constantly searching for certain patterns in the exnovation process of products, I sometimes had too much focus and too little overview. In other moments I had the overview, but no feeling for the details. Only with a little distance do the pieces of the puzzle fall into place or you realize which ones don't fit at all. I think it's important to stick to the initial vision, because a few times I realized the gains of interim results only much later.

References

Albert, S. (1984). A delete design model for successful transitions. In J. R. Kimberly & R. E. Quinn (Eds.), Managing organizational transitions (pp. 169-191). Homewood, Ill.: Richard D. Irwin.

Alcott, B. (2008). The sufficiency strategy: Would rich-world frugality lower environmental impact?. Ecological Economics, 64(4), 770-786.

Apple. (2020, October 13). Apple Event — October 13 [Video]. YouTube. Retrieved November 24, 2021, from https://youtu.be/KR0g-1hnQPA

Apple. (2021, April). 2021 Environmental Progress Report. Apple Inc. https://www.apple.com/environment/pdf/Apple_Environmental_Progress_Report_2021.pdf

Apple. (n.d.-a). Trade In. Retrieved November 24, 2021, from https://www.apple.com/shop/trade-in

Apple. (n.d.-b). Environment. Retrieved November 24, 2021, from https://www.apple.com/environment/

Arnold, A., David, M., Hanke, G., & Sonnberger, M. (Eds.). (2015). Innovation-Exnovation: Über Prozesse des Abschaffens und Erneuerns in der Nachhaltigkeitstransformation. Metropolis-Verlag.

Baumer, E. P., & Silberman, M. S. (2011, May). When the implication is not to design (technology). In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 2271-2274).

Bocken, N. M., De Pauw, I., Bakker, C., & Van Der Grinten, B. (2016). Product design and business model strategies for a circular economy. Journal of industrial and production engineering, 33(5), 308-320.

Brundtland, G. H. (1987). Our common future—Call for action. Environmental Conservation, 14(4), 291-294.

Buchanan, R. (1985). Declaration by design: rhetoric, argument, and demonstration in design practice. Design Issues, 2(1), 4–22.

Business Insider India. (2021, March 21). Brazil fines Apple $2 million for not including charger with iPhone 12 series. Business Insider. Retrieved November 24, 2021, from https://www.businessinsider.in/tech/mobile/news/brazil-fines-apple-2-million-for-not-including-charger-with-iphone-12-series/articleshow/81613304.cms

Consumer Intelligence Research Partners. (2021, October 27). Brand shares, loyalty, and switching. CIRP. Retrieved November 24, 2021, from https://files.constantcontact.com/150f9af2201/44ccad98-6c3f-4f11-8e31-fdd97a7f2eed.pdf

Crompton, T. (2010). Common Cause: The Case for Working with Our Cultural Values. Surrey: WWF-UK.

Davidson, D. J. (2019). Exnovating for a renewable energy transition. Nature Energy, 4(4), 254-256.

Elkins, J. W. (1999). Chlorofluorocarbons (CFCs). The Chapman and Hall encyclopedia of environmental science: Boston, Kluwer Academic Publ, 78-80.

Ellen MacArthur Foundation. (2013). Towards the circular economy. Journal of Industrial Ecology, 2, 23-44.

Fagerberg, J. (2003). Innovation: A Guide to the Literature.

Fogg, B. J. (2009, April). A behavior model for persuasive design. In Proceedings of the 4th international Conference on Persuasive Technology (pp. 1-7).

Freeman, C. (1996). The greening of technology and models of innovation. Technological Forecasting & Social Change, 53(1), 27–39. https://doi.org/10.1016/0040-1625(96)00060-1

Fry, T. (2005). Elimination by design. Design Philosophy Papers, 3(2), 145-147.

Fry, T. (2009). Design futuring. University of New South Wales Press, Sydney, 71-77.

Greening, L. A., Greene, D. L., & Difiglio, C. (2000). Energy efficiency and consumption—the rebound effect—a survey. Energy policy, 28(6-7), 389-401.

Hertwich, E. G. (2005). Consumption and the rebound effect: An industrial ecology perspective. Journal of industrial ecology, 9(1-2), 85-98.

Heyen, D. A. (2017). Governance of exnovation: phasing out non-sustainable structures. Oeko-Institut Working Paper, 2, 2017.

Heyen, D. A., Hermwille, L., & Wehnert, T. (2017). Out of the comfort zone! Governing the exnovation of unsustainable technologies and practices. GAIA-Ecological Perspectives for Science and Society, 26(4), 326-331.

Hollingsworth, J., Copeland, B., & Johnson, J. X. (2019). Are e-scooters polluters? The environmental impacts of shared dockless electric scooters. Environmental Research Letters, 14(8), 084031.

IPCC. (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.

Kastrenakes, J. (2021, January 27). Apple says there are now over 1 billion active iPhones. The Verge. Retrieved November 24, 2021, from https://www.theverge.com/2021/1/27/22253162/iphone-users-total-number-billion-apple-tim-cook-q1-2021

Kimberly, J. R. (1981). Managerial Innovation. In P. Nystrom & W. Starbuck (Eds.), Handbook of Organizational Design (Vol. 1, pp. 84-104). New York: Oxford University Press.

Kimberly, J. R., & Evanisko, M. J. (1981). Organizational Innovation: The Influence of Individual, Organizational, and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations. The Academy of Management Journal, 24(4), 689–713. https://doi.org/10.2307/256170

Lehmann, D. R., Parker, J. R., & SpringerLink (Online service). (2017). Disadoption, Day:26. https://doi.org/10.1007/s13162-017-0093-8

Moreau, H., de Jamblinne de Meux, L., Zeller, V., D'Ans, P., Ruwet, C., & Achten, W. M. (2020). Dockless e-scooter: A green solution for mobility? comparative case study between dockless e-scooters, displaced transport, and personal e-scooters. Sustainability, 12(5), 1803.

Papanek, V. J. (1995). Green imperative. Thames and Hudson.

Papanek, V., & Fuller, R. B. (1972). Design for the real world. London: Thames and Hudson.

Peak, H. (1955). Attitude and motivation.

Peckham, J. (2021, April 8). Why Samsung's Galaxy S21 doesn't come with a charger. TechRadar. Retrieved November 24, 2021, from https://www.techradar.com/news/why-samsungs-galaxy-s21-doesnt-come-with-a-charger

Pierce, J. (2012, May). Undesigning technology: considering the negation of design by design. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 957-966).

reBuy. (n.d.). Mobile e-waste Index. Retrieved November 24, 2021, from https://www.rebuy.de/s/mobile-ewaste-index-en

Reinert, H., & Reinert, E. S. (2006). Creative destruction in economics: Nietzsche, Sombart, schumpeter. In Friedrich Nietzsche (1844–1900) (pp. 55-85). Springer, Boston, MA.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin III, F. S., Lambin, E., ... & Foley, J. (2009). Planetary boundaries: exploring the safe operating space for humanity. Ecology and society, 14(2).

Rogers, E. M. (2010). Diffusion of innovations. Simon and Schuster.

Schmidheiny, S., & Timberlake, L. (1992). Changing course: A global business perspective on development and the environment (Vol. 1). MIT press.

Schumacher, E. F. (1973). Small is beautiful; economics as if people mattered. New York: Harper & Row.

Schumpeter, J. (1942). Creative destruction. Capitalism, socialism and democracy, 825, 82-85.

Schwartz, S. H. (2006). Basic human values: An overview.

Sharma, K. (2021, May 31). Apple Loses Lawsuit! Forced to Deliver Free iPhone 12 Charging Adapter to User. MySmartPrice. Retrieved November 24, 2021, from https://www.mysmartprice.com/gear/apple-loses-lawsuit-forced-deliver-free-iphone-12-charging-adapter-user/

Siddiqui, A. (2020, December 28). Xiaomi launches the Mi 11 flagship 5G phone with Qualcomm's Snapdragon 888. Xda-Developers. Retrieved November 24, 2021, from https://www.xda-developers.com/xiaomi-mi-11-flagship-5g-launch-china-qualcomm-snapdragon-888/

Stahel, W. R. (2016). The circular economy. Nature News, 531(7595), 435.

Stappers, P. J., & Giaccardi, E. (2017). Research through design. In The encyclopedia of human-computer interaction (pp. 1-94). The Interaction Design Foundation.

Steffen, W., Rockström, J., & Costanza, R. (2011). How Defining Planetary Boundaries Can Transform Our Approach to Growth. Solutions: For A Sustainable & Desirable Future, 2(3), 59-65.

Sykes, T. (2020, July 3). Apple survey asks iPhone users what they do with old power adapters. The Apple Post. Retrieved November 24, 2021, from https://www.theapplepost.com/2020/07/03/apple-survey-asks-iphone-users-what-they-do-with-old-power-adapters/

Tonkinwise, C. (2014). Design away. Design as future-making, 198-213.

Warwick, S. (2020, October 21). iPhone 12 in France gets same packaging, bundled inside larger box with headphones. IMore. Retrieved November 24, 2021, from https://www.imore.com/iphone-12-france-gets-same-packaging-bundled-inside-larger-box-headphones

Weaver, M. (2021, September 24). Apple opposes EU plans to make common charger port for all devices. The Guardian. Retrieved November 24, 2021, from https://www.theguardian.com/world/2021/sep/23/apple-opposes-eu-plans-to-make-common-charger-port-for-all-devices

Wuppertal Institute for Climate, Environment and Energy. (n.d.). Sufficiency. Wuppertal Institut Für Klima, Umwelt, Energie. Retrieved November 24, 2021, from https://wupperinst.org/en/topics/well-being/sufficiency

Yin, R. K. (1978). Changing Urban Bureaucracies: How New Practices Become Routinized.

Zaltman, G., Duncan, R. B., & Holbek, J. (1973). Innovation in Organizations. New York: John Wiley and Sons.

Images

Figure 3: Olah, D. (2018). Outer space earth view [Photograph]. https://unsplash.com/photos/HNkgPFBShSw

Figure 5: Jacobsson, J. (2019). Electric scooters parked on sidewalk [Photograph]. https://unsplash.com/photos/q5ZDZPc7Ksc

Figure 7: Spiske, M. (2020). No business on a dead planet [Photograph]. https://unsplash.com/photos/z56L143KBvE

Figure 12: Apple. (n.d.-a). Apple iPhone charging adapter [Illustration]. https://www.apple.com/de/shop/product/MGN13ZM/A/apple-5w-usb-power-adapter

Figure 14: Apple. (2021a). Apple Store Accessories [Screenshot]. https://www.apple.com/shop/accessories/all/power-cables?page=1&f=iphone-13pro&fh=459d%2B52ee05&s=newest

Figure 23: Khoddam, A. (2019). person inside Apple building [Photograph]. https://unsplash.com/photos/z4O-2cuwP8Qg

Appendix

1. Graduation Project Brief

Test Case on iPhone Charging Adapter

2. User Interview and Test Plan
3. Consent Form for Interview and Testing
4. User Feedback Participant 1-5

Toolkit Testing

5. Toolkit Test Plan
6. Reflective Questionnaire
7. Consent Form for Toolkit Testing
8. User Feedback Participant 1-4

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

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

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

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

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

family name: Reichhardt
initials: B. given name: Bastian
student number:
street & no.:
zipcode & city:
country:
phone:
email:

Your master programme (only select the options that apply to you):

IDE master(s): ( ) IPD (★) DfI ( ) SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: ( ) Honours Programme Master
specialisation / annotation: ( ) Medisign
( ) Tech. in Sustainable Design
( ) Entrepeneurship

SUPERVISORY TEAM **

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

** chair: Bakker, C.A. dept. / section: SDE/CPD
** mentor: Bendor, R. dept. / section: HCD/DCC
2nd mentor:
organisation:
city: country:
comments (optional)

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

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

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

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair: Bakker, C.A. date: 23 - 06 - 2021 signature: Conny Bakker — Digitally signed by Conny Bakker Date: 2021.06.23 09:20:08 +02'00'

CHECK STUDY PROGRESS

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

Master electives no. of EC accumulated in total: 30 EC
Of which, taking the conditional requirements into account, can be part of the exam programme: 30 EC
List of electives obtained before the third semester without approval of the BoE:

(✓) YES all 1st year master courses passed
( ) NO missing 1st year master courses are:

name: J. J. de Bruin date: 23 - 06 - 2021 signature: J. J. de Bruin, SPA — Digitally signed by J. J. de Bruin, SPA Date: 2021.06.23 12:35:53 +02'00'

FORMAL APPROVAL GRADUATION PROJECT

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

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

Content: (✓) APPROVED ( ) NOT APPROVED
Procedure: (✓) APPROVED ( ) NOT APPROVED

- adapted planning (graduation in week 20) approved

comments

name: Monique von Morgen date: 06 - 07 - 2021 signature:

A Toolkit for Exnovation in Design: Using E-Scooters as a Case Study — project title

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

start date 22 - 06 - 2021 — 02 - 12 - 2021 end date

INTRODUCTION **

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

With noticeably mounting indications for climate change the fatal consequences of human activities become more and more apparent. Fortunately, we have achieved a consensus that we need to act fast and have to transform our way of life towards a more sustainable, eco-friendly one as soon as possible.
Now, designers and non-designers have to respond and are challenged to create a future corresponding those goals. In this context, we aspire to improve the current state by inventing and innovating greener solutions to reach more efficient use of resources for the good of both the environment and the human. With this mindset it is apparent, why most of the applied transformative efforts have been focussing upon "the new" as of yet, while approaches, that deliberately include "the existent" have rather fallen short (Heyen, 2016). However, the present appetite for the new obscures the complexity of transformation processes which the society is currently facing (Arnold et al., 2015). Thus it is necessary to challenge whether it needs more than innovations for transformation:

A common concern is, that innovations benefiting from more efficient technologies could give rise to changed behavior and a consumption rebound, which thus offsets part of the environmental gain. (Greening et al., 2000, Hertwich, 2005) Moreover, innovations do not always suffice in order to replace established non-sustainable structures. In practice, they often even fill new market niches, without replacing other structures at all. Therefore we also need to emphasize the phase-out of non-sustainable technologies, infrastructures, products and practices. (Heyen, 2016)

The past years, exnovation has been gaining attention in theory of sustainable transformation as a generic possibility for the discontinuance of existent or to reduce production and consumption. What sounds destructive in the first place, can make a considerable impact on reaching sustainability goals by identifying maldevelopments and by questioning the necessity of certain products.

One of the key roles on the route to sustainability is e-mobility with its battery technology. The expansion of this technology has opened many new fields of applications and product categories such as e-scooters. However, research shows that shared e-scooters do not reduce environmental impacts from the transportation system but currently add to the problem. (Hollingsworth et al., 2019, Moreau et al., 2020) Even though incremental innovations keep improving the ecologic impact and lower the carbon footprint, the use case for e-scooters remains the same, because it is meant to be a substitute for walking and cycling. Besides convenience and comfort, the reason might also be in the nature of the product architecture: easy to hop on but unsuitable for long rides and no possibility to carry objects, luggage etc.

With the invasive spread of e-scooters, a heated debate about their usefulness had started. Several countries enacted regulations, some cities banned e-scooters after a trail period due to various causes. How could designers support as exnovators? How could they include design for exnovation in their work to prevent unintended consequences or uncontrolled terminations?

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introduction (continued): space for images

image / figure 1: Innovation and exnovation in balance

image / figure 2: electric micro mobility: e-scooters for sustainability or convience?

PROBLEM DEFINITION **

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

The innovation-bias in sustainability development as described in the introduction has obscured the complexity of transformations and overshadows exnovation as a suitable concept. This graduation project will take a deep dive into exploring the stimuli, enablers and drivers as well as implementation, feasibility and impact of exnovation in design. It focusses how designers can contribute to a future vision, that deliberately tackles and acknowledges the controlled termination of products.

In order to investigate the methodology and principles thoroughly, the project is limited to a concrete example. In a case study, e-scooters serve as a subject to exnovation to identify specific leverage points, instruments, challenges and opportunities. Initial research findings will help to generate a first concept of an interactive digital toolkit for designers, that guides through the process of exnovation, introduces stakeholders and actors, illustrates the steps that have to be undertaken and points out challenges that will be faced. The toolkit will then be iteratively developed and tested by applying it on e-scooters. The gained insights and learnings inform about required adaptations and changes of the toolkit's framework in further iterations.

ASSIGNMENT **

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

In the graduation project I will research the implementation and feasibility of exnovation on the basis of a case study on e-scooters. The end result will be a toolkit for exnovative design in form of an interactive digital service which guides and assists through the process.

The graduation project will be divided in 2 phases:

In the first phase I will research theory of innovation & exnovation, elimination design and undesign by conducting a literature review of present knowledge, methods and applications. Illustrated through the example of e-scooters, I will analyse the implementation and feasibility of exnovative processes as well as the benefits, limitations and usefulness for socio-technical transformation. In order to define the scope of application, expert interviews are supposed to clarify how and to what extend it can be used as a design tool.

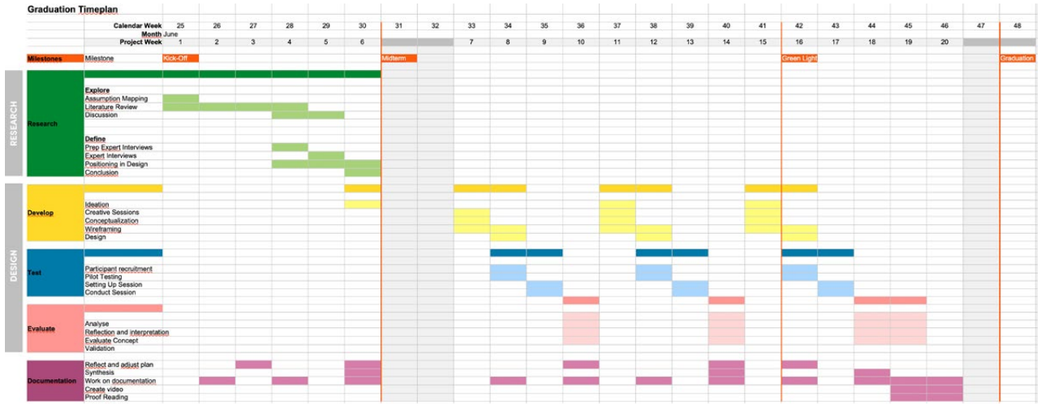
The second phase will be the development of the toolkit in an iterative approach with three cycles. In the first cycle, I will conceptualize and design an initial draft of the toolkit based on my research and test it in the context of e-scooters. After the testing, designers help to asses and co-create the toolkit further as well as stakeholders are involved to validate its impact. The design will be refined, tested and evaluated in two following iterations.

The toolkit itself will be a digital service for designers with guiding principles and interactive elements helping them familiarize with exnovation, adopting such a mindset and planning as well as conducting the exnovation process. By means of a digital service, the toolkit is always available, easily accessible and ready for new ways of remote working.

PLANNING AND APPROACH **

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

start date 22 - 6 - 2021 2 - 12 - 2021 end date



The time plan follows the structure of my graduation project and is divided in two phases: Research, and Design. The project-start is shaped by a literature review and expert interviews to provide a foundation and framework for a fruitful design phase.

The design phase represents the project's core element and is subdivided into three steps - develop, test and evaluate. After designing an initial draft of the toolkit, I will test it with designers and stakeholders on the example of e-scooters and explore the implementation and scope of exnovation within this area. In the evaluate section, I collaboratively analyse and assess insights and transfer them to ideas for the following iteration of the design. This cycle occurs three times.

Dedicated time slots for reflection and adjustments are planned after the half and at the end of each phase. Also, every phase is wrapped up with a synthesis of key insights and gained knowledge. Throughout the whole project, documentation takes place every second week and ends in a final phase before the graduation.

MOTIVATION AND PERSONAL AMBITIONS

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

During the past years as a designer and student, I have noticed a continuous acceleration of innovation rates among products, services and systems. More products and their iterations are launched faster than ever before - often claiming to certainly commit to a better future. Although, a growing number of new inventions and innovations are supposed to tackle or solve present problems such as the climate change, designers still use precious resources to add new creations to the world. So I'm interested in investigating if design competences could be solely used to tidy up our existing world of products, services and structures without inventing new ones. In that way, I want to learn how designers could contribute to designing a future rather than for the future.

My biggest personal learning from the Dfl programme is the appropriate involvement and participation of users, customers, citizens or generally humans in the design process. In my graduation project I want to prove and strengthen my skills in involving people as experts of their experience for democratric design.

Generally, after having worked on a multitude of product-driven, hands-on projects, I want to dive more into the theory behind design and improve my research skills. Within this project I want to focus more on developing design tools and less on actual design execution.

FINAL COMMENTS

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

User Interview and Test Plan

Exnovation of Apple iPhone Charging Adapter

Bastian Reichhardt
Master Thesis 2021
Design for Interaction
Delft University of Technology

Apple iPhone Charging Adapter

User Interview and Test Plan

Test Objective

Test objective is the current exnovation of Apple iPhone charging adapters as well as five redesign interventions in the implementation and execution of the exnovation.

General Goal

(1) Find out how iPhone users cope with the removal of the charging adapter from the iPhone box, understand their current beliefs, perception and attitude towards the exnovation.

(2) Learn about the effectiveness of the redesigned exnovation interventions, compare them against the current situation and reveal demands of users in order to buy into the exnovation.

Research Questions

Effectiveness
How effective is the intervention overall?

Perspicuity
Do customers understand the intention and reasoning behind the intervention? Is it relatable?

Persuasiveness
Does the intervention obtain acceptance? Is the customer convinced and stimulated to commit to the exnovation?

Satisfaction
Is the customer satisfied with the requirements and rewards that come with the exnovation? Do they like the intervention?

Freedom
Can customers conceive their own opinion? Do they have a choice and feel in control of their decision?

Methodolgy

In order to encourage an open conversation with free expression, the interview and test take place in an informal manner. After onboarding and open-ended contextual questions, the interventions will be screen-shared in a randomized order. While presenting, initial reactions and comments will be collected. After each intervention, the participant is asked to give qualitative feedback on a Miro board guided by trigger questions, a word cloud and predefined expressions (PrEmo tool, Laurans & Desmet, 2017) for simpler articulation.

Participants

Five Participants that have recently bought an iPhone 12 (mini, max, pro) and hence are effected by the removal of the charging adapter from the box. The sample represents a diverse group of people with dissimilar attitudes towards sustainability.

Location

Remote interview via Zoom video call. The participant should be in an environment where they naturally use and interact with the charging adapter.

Limitation

The aim of the test will be clarified and contextual information provided during the interview. Thus, participants may be influenced by the given information. The test situation cannot fully represent real purchase conditions, which may lead to deviating behaviour. Furthermore, there is a risk for a say-do gap, since feedback and insights mainly base on self-reporting of the participants. Tacit and latent may not be uncovered.

Interview Guide

The questions below serve as potential prompts and do not need to be asked all of them. The interviewer may steer the subject in certain areas if necessary, but the interviewee takes lead in the conversation.

1. Intro (2 mins)

Hi! I'm a master student working on my graduation in Design for Interaction at TU Delft. I'm researching exnovation (≠ innovation), the intentional reduction or removal of products for sustainability with a case study on iPhone charging adapters.

In order to do that, I would like to understand the experiences and expectations, but also the pains and frustrations of reducing and quitting the use of charging adapters.

We will now have ca. 45 mins together in an open conversation, where I'm basically just curious to hear of and learn from some of your experiences and opinions. Next to a chat, I will share five concepts of exnovation with you to see what you think of them.

I will take some notes of the session (record) for analytical reference but please rest assured that you will remain anonymous throughout the process going forward.

All okay for you? Any questions/considerations before we start?

2. Onboarding (3 mins)

- How old are you?
- What is your occupation?
- Are you tech-savvy?
- What is your attitude towards sustainability?
- What iPhone do you have?
- How many did you have before?
- Where did you buy your iPhone?
- Interested in any other smartphone brand?

3. Current Situation (10 mins)

Purpose of this section is to understand the present charging situation and the participants attitude towards the removal of the charging adapter.

Charging

- Do you have one or more charging adapter? More than one?
- Tell me about how, when, were you typically charge your iPhone.
- Do you use a charging adapter? If yes, which kind?
- Do you use any other means of charging? (inductive, laptop, car etc.)?
- Where do you typically charge your iPhone? (at home, office, transport, public spaces etc.)
- Do you have a fixed spot for your charging adapter? (next to bed, sofa etc.)
- Do you share you charger with someone else? (same household etc.)

Removal

- What do you think of the removal of the charging adapter from the iPhone box?
- Do you know the official reason?
- Did you know about the missing adapter before you bought the iPhone?
- How does it affect you?
- Do you accept, agree on Apple decision? Any thoughts?
- What do you think, how big is the effect / impact of the removal overall?
- Did you experience any differences in terms of functionality? Any problems, frustrations? Any wishes?
- Can you spare the common charging adapter? What would it take to spare it?
- Do you have a workaround?
- Do you have any substitute for the missing charger?
- Did you change your habit of charging in any way? (frequency, timing, location)

Interview Guide

4. Redesign Concepts (30 mins)

In this section the participants react and give qualitative feedback to the exnovation interventions. The criteria below will be covered verbally while the participant fills in the miro board. Each of the concepts will be dicussed separately and compared against each other at the end.

Perspicuity

based on initial reaction, potential errors and participant's mental effort

- is the concept coherent, easy to follow?
- clear guidance, information and story-telling?
- does it leave you with questions?

Persuasiveness

- is the concept convincing to you?
- do you find the concept advantageous?
- would you be willing to buy into the concept?
- would you accept or support the concept?

Satisfaction

- how satisfied would you be with this concept?
- are the rewards exciting / motivating?
- do the requirement burden you?
- how do you feel about this?
- what thoughts come to your mind?

Freedom

- do you feel like you have a choice?
- do you feel in control of your decision or forced into a predefined option?
- is the concept restrictive?

Overall Effectiveness

based on all criteria above and general feedback

- what is your overall impression?
- does it stimulate you?
- do you think the concept is inspiring?
- yes or no?
- would you reconsider buying peripherals?

Additional

participant has the possibility for free expression of thoughts

- any other feedback that was not covered?
- what would be your wish?
- how would you improve or elaborate on the concept?

Comparison

- in which order would you rank the concepts from best to worst?
- which of the concepts resonates most with you?
- which concept are you worried about?
- do you see two or more concepts that could work together?
- would you like to add something before we wrap up this interview?
- Is there anything that we may not yet have addressed but you still think is important?

5. Wrap Up

Thank you for your highly valuable and appreciated feedback!

Redesign Concepts

01
Optional Charger
The charging adapter is optional and can be purchased for an additional charge.

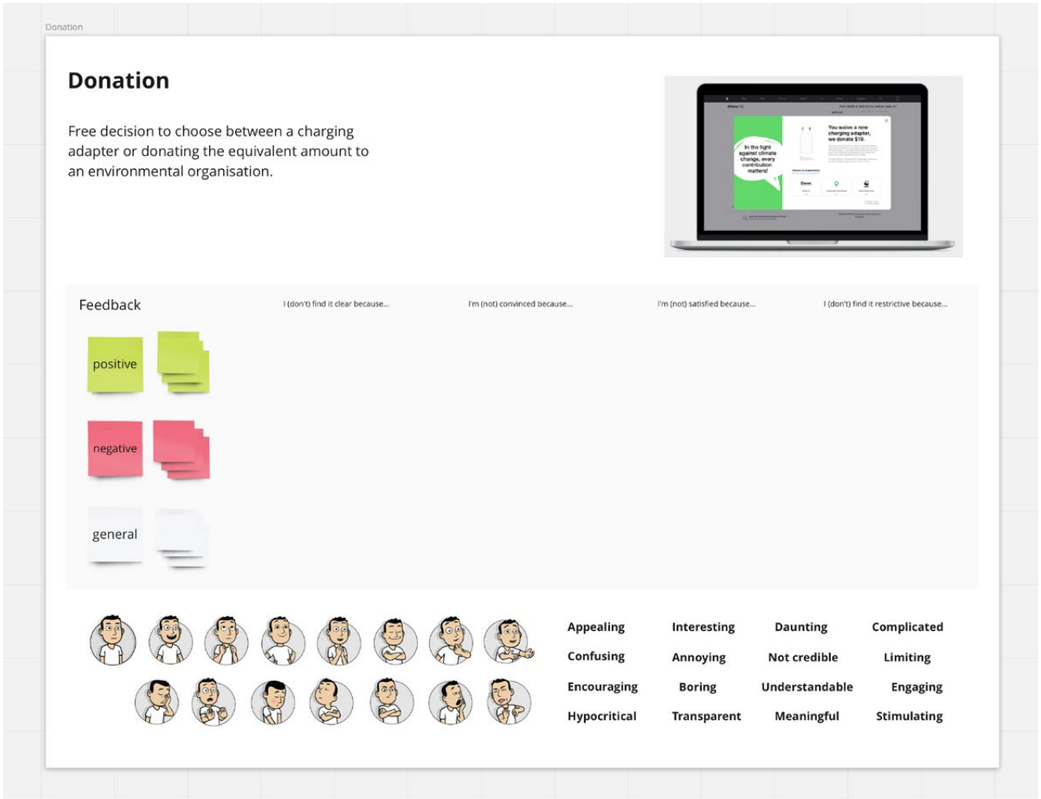
02
Donation
Free decision to choose between a charging adapter or donating the equivalent amount to an environmental organisation.

03
Return System
Return two old charging adapters at an Apple Store or authorized retailer and get one new power charger for free.

04
Apple Gift Card
Apple Store Gift Card inside the iPhone box applicable for all digital services such as Apple Music, TV, AppStore.

05
Local Gift Card
Local Gift Card inside the iPhone box applicable for selected stores that commit to environment-friendly business.

Miro Feedback Board



User Interview and Testing
Exnovation of Apple iPhone Charging Adapters

This User Interview is part of a master graduation project in Design for Interaction at TU Delft, Netherlands. The projects aim is to research exnovation (≠ innovation), the intentional reduction or removal of products for sustainability with a case study on iPhone charging adapters. In order to do that, I would like to understand the experiences and expectations, but also the pains and frustrations of reducing and quitting the use of charging adapters.
Within a 45 mins remote interview in an open conversation, I want to hear of and learn from some of your experiences and opinions. After talking about the current situation, I will share five concepts of redesigned exnovation with you to see what you think of them and to compare them with each other.

Bastian Reichhardt, August 2021

Consent Form for Study on Exnovation of Apple iPhone Charging Adapters

Please tick the appropriate boxes	**Yes**	**No**
Taking part in the study		
I have read and understood the study information, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
I understand that taking part in the study involves a remote interview via zoom video call and written feedback on a miro online board.	☐	☐
I give permission that the interview will be video-recorded. The video will not be shared beyond the study team. The recording will be destroyed by the end of the project.	☐	☐
Use of the information in the study		
I understand that information I provide will be used for research purposes, knowledge / benefits sharing, and reporting.	☐	☐
I understand that personal information collected about me that can identify me, such as my name, will not be shared beyond the study team.	☐	☐
I agree that my information can be quoted in research outputs. This includes verbal statements as well as written comments on the miro board.	☐	☐

Signatures

Name of participant	Signature	Date

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

Bastian Reichhardt		
Bastian Reichhardt	Signature	Date

Study contact details for further information: *Bastian Reichhardt,* [redacted]

Participant 1

Personal

"interested in Apple products but not a fanboy"

general interest in consumer electronics / technology but nerdy

generally values sustainability, lives very frugal, not a victim of consume

generally values sustainability, lives very frugal, not a victim of consumption

is mad about planned obsolescence of most electronic products

"apple can tell me a lot about their production in china being green, when I can't check it"

Current Situation

has had 6 iPhones

one smartphone from another brand in between, sometimes I still use it as secondary phone for special purposes

"I always charge my iPhone at the same spot, next to my sofa. always by day, to prevent the battery from overcharging"

would definitely buy an iPhone again

I have at least 2 or 3 adapters

"have never used the USB-C cable, not even unpacked"

sometimes use inductive charging in car, but prefer cable

"I would buy a magsafe adapter if it would work properly"

Removal

"I think the move is stupid, I don't like that they expect everyone to have a charger already"

heard about the court decision in France, Apple has to include accessory

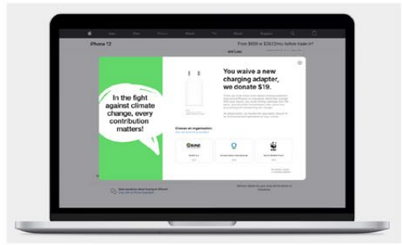
knew it before purchasing, not a criteria not to buy it

"I'm not restricted, because I already have a charger"

would be more understandable, if Apple would use an internationally standardized plug

Donation

Free decision to choose between a charging adapter or donating the equivalent amount to an environmental organisation.



Feedback

positive

negative

general

I (don't) find it clear because...

this raises questions about the opportunity costs, costs of the adapter vs buying price

I'm (not) convinced because...

I'm not informed or sure about the appropriate usage of donations. Where does the money go to?

maybe there are sunken costs on the path of the transaction?

Where does the money go to?

I'm (not) satisfied because...

not Convincing

Not credible

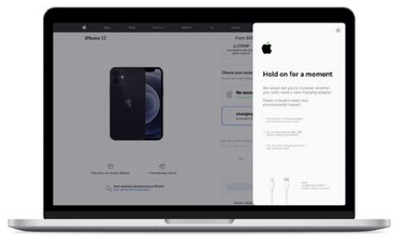
I (don't) find it restrictive because...

Restrictive

not enough projects to choose from. regional projects and organisations would be preferable

Optional Charger

The charging adapter is optional and can be purchased for an additional charge.



Feedback

positive

negative

general

I (don't) find it clear because...

Confusing

might be confusing for people that are not tech-savvy

the concept itself is understandable

I'm (not) convinced because...

it is encouraging to think about sustainability

I'm (not) satisfied because...

Interesting

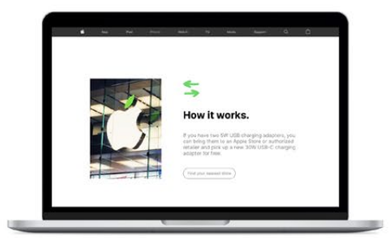
through the hints / prompts it becomes a conscious purchase decision

I (don't) find it restrictive because...

no active commitment to sustainability

Return System

Return two old charging adapters at an Apple Store or authorized retailer and get one new power charger for free.



Feedback

positive

negative

general

I (don't) find it clear because...

Clear

detailed description / explanation of the recycling process to understand the absolute benefit

I'm (not) convinced because...

Engaging

I'm (not) satisfied because...

Interesting

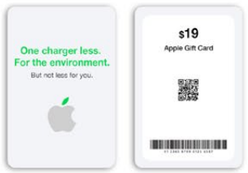
real and authentic sustainability idea, little shadow nudges for the customer

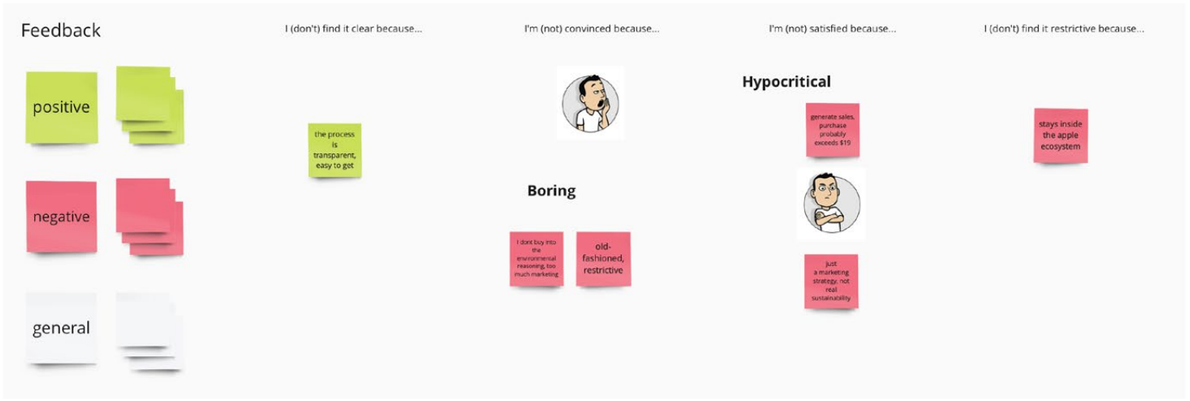
I (don't) find it restrictive because...

for 90% of daily life, I dont see any problems just having one charger

Apple Store Gift Card

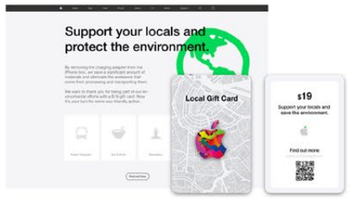
Apple Store Gift Card inside the iPhone box applicable for all digital services such as Apple Music, TV, AppStore.

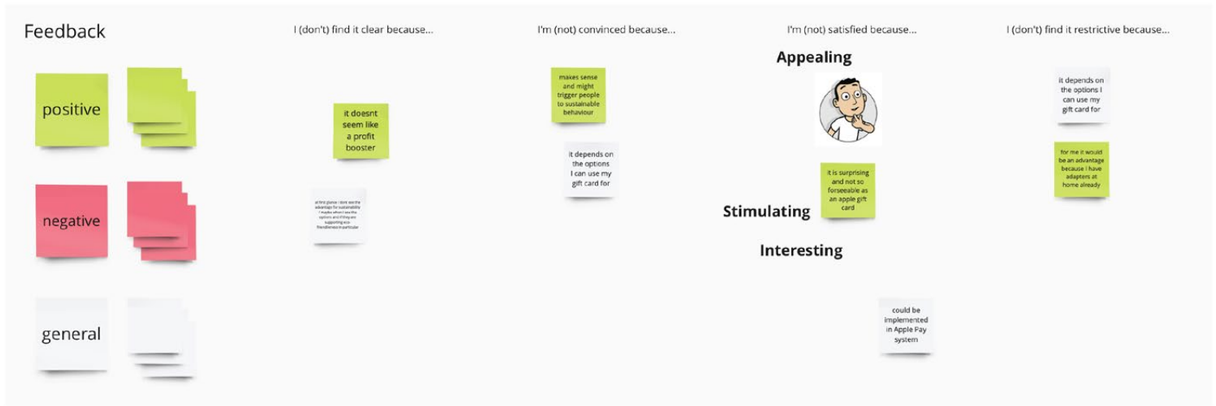




Local Gift Card

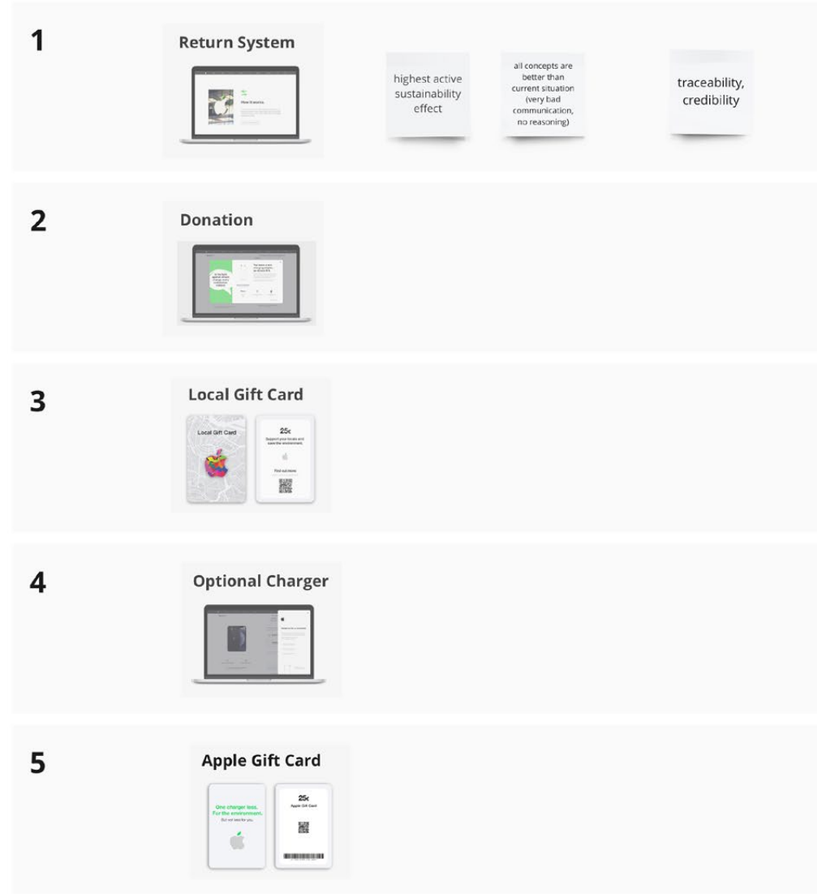
Local Gift Card inside the iPhone box applicable for selected stores that commit to environment-friendly business.





Overall Feedback

rank and compare



Participant 2

Personal

becoming more and more mindful in terms of sustainability, when purchasing etc

tries to repair products or sells them

always buys refurbished Apple products (mac, iphone, ipad etc...)

refurbished is cheaper and they work like a new one. also they are objects of utility

Apple-interested

Current Situation

"I have had 4 iPhones"

"I have one charger per room or even more"

bought additional 3rd party chargers (power chargers)

4 to 5 chargers

charges at night next to bed but sometimes in home office, sometimes in car

charges ipad with the same charger

"I use my iPhone in a way that I always have at least 5% batterie left and charge it then"

Removal

was surprised that there is no charger in the box

checked the website afterwards: information is not very conspicuous

"was annoyed, because I expected a charger, needed to research info on that and didn't get one in the end"

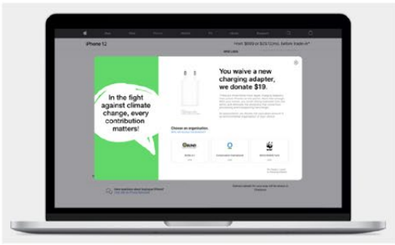
no consequences in daily life but just monetary

"on the one hand Apple makes profit, but on the other hand, the charger is not necessary if you think about it"

"it would be a redundant piece anyway"

Donation

Free decision to choose between a charging adapter or donating the equivalent amount to an environmental organisation.



Optional Charger

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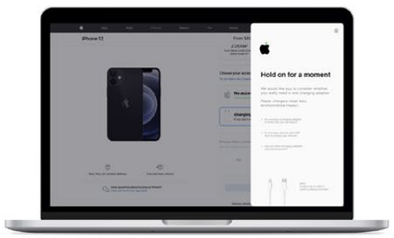
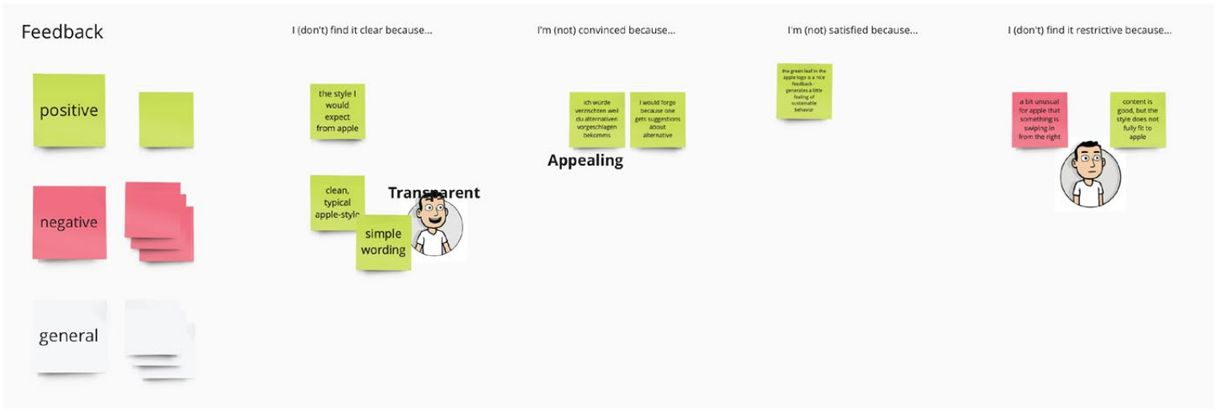
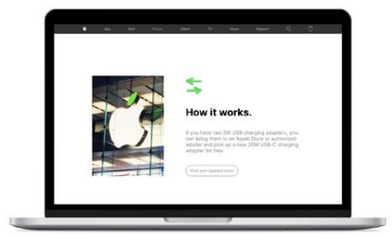
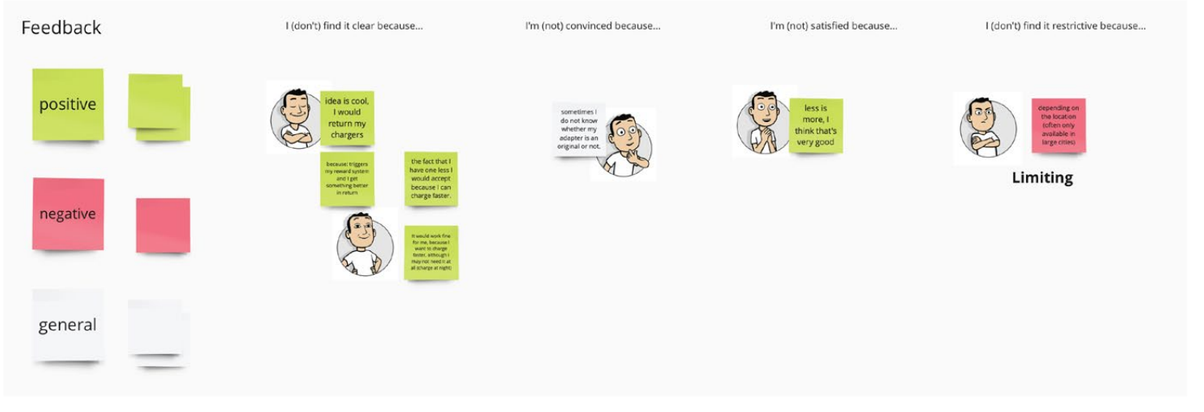




Return System

Return two old charging adapters at an Apple Store or authorized retailer and get one new power charger for free.





Apple Store Gift Card

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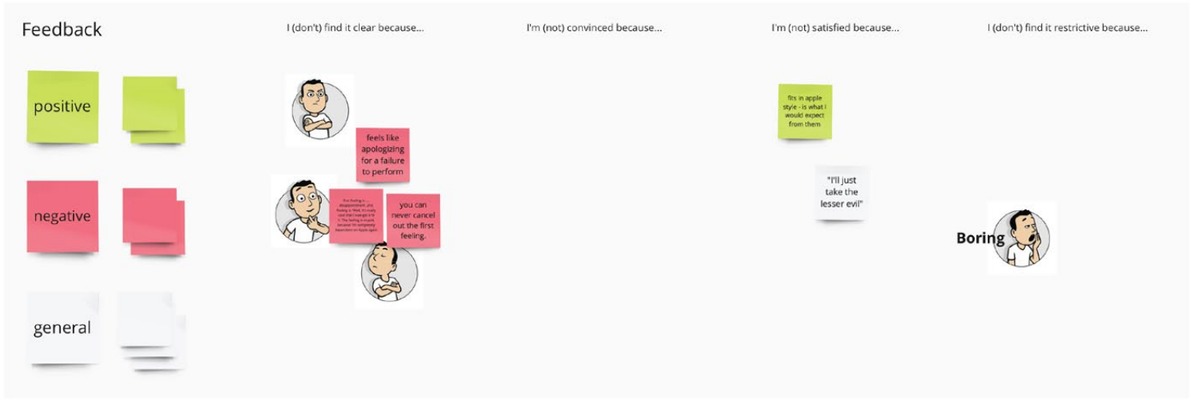
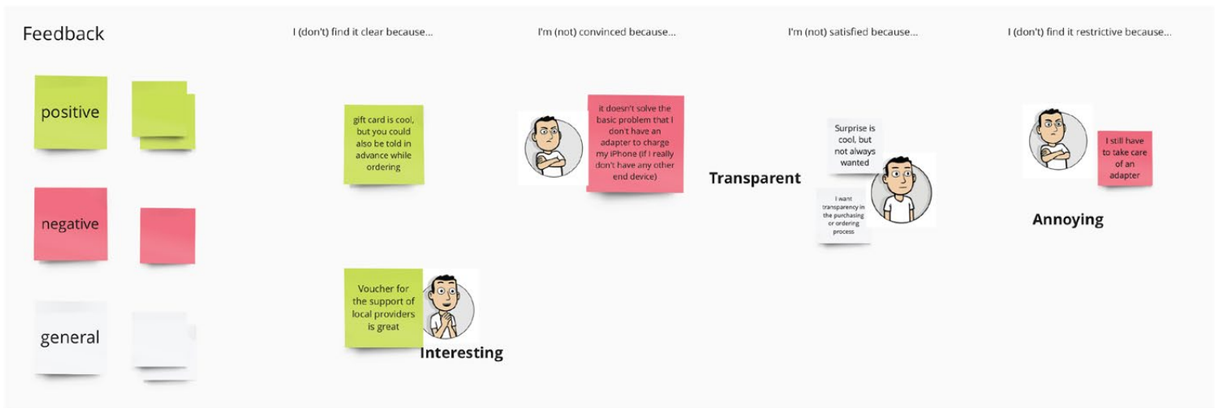


Local Gift Card

Local Gift Card inside the iPhone box applicable for selected stores that commit to environment-friendly business.



Overall Feedback

rank and compare

comments

1

Return System

has the highest value for me personally. I also benefit from my "waiver"

2

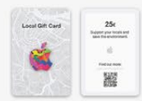
Optional Charger

that meets my expectations very well during the ordering process.

pointing out other charging options is simple and plausible

3

Local Gift Card



could almost be in 2nd position. I can "have a nice meal" from it, but my phone is empty.

4

Donation

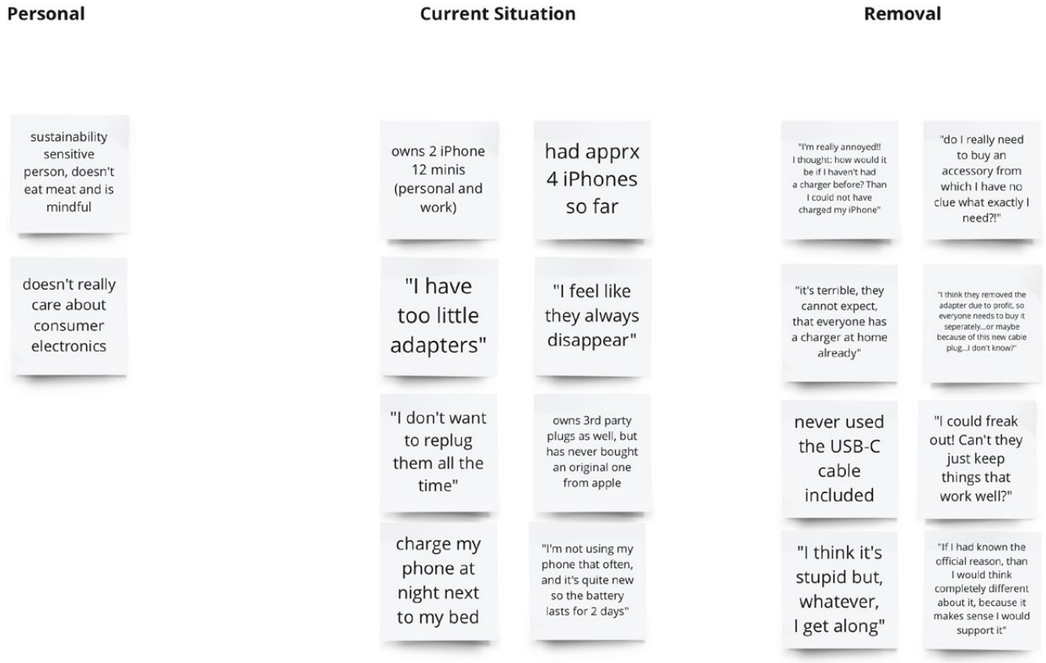
The idea of donations is good, but the virtual implementation and picking me up in a situation where I buy a cell phone and don't want to deal with donations must be resolved

5

Apple Gift Card

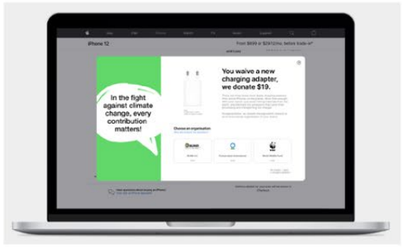
I would be rather disappointed if I got that. there would be a slight aftertaste, even though I just bought a iPhone for $1000

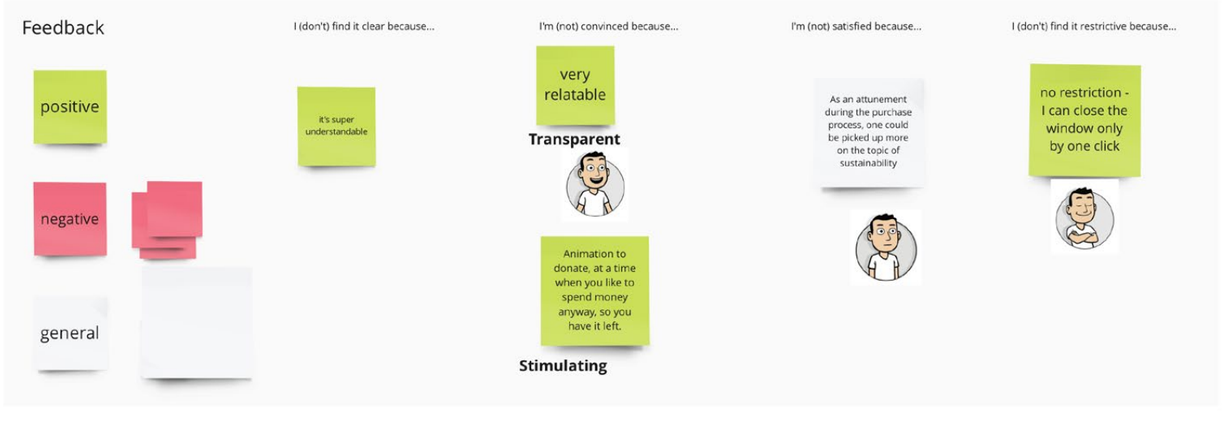
Participant 3



Donation

Free decision to choose between a charging adapter or donating the equivalent amount to an environmental organisation.





Optional Charger

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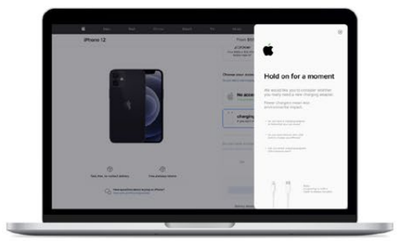
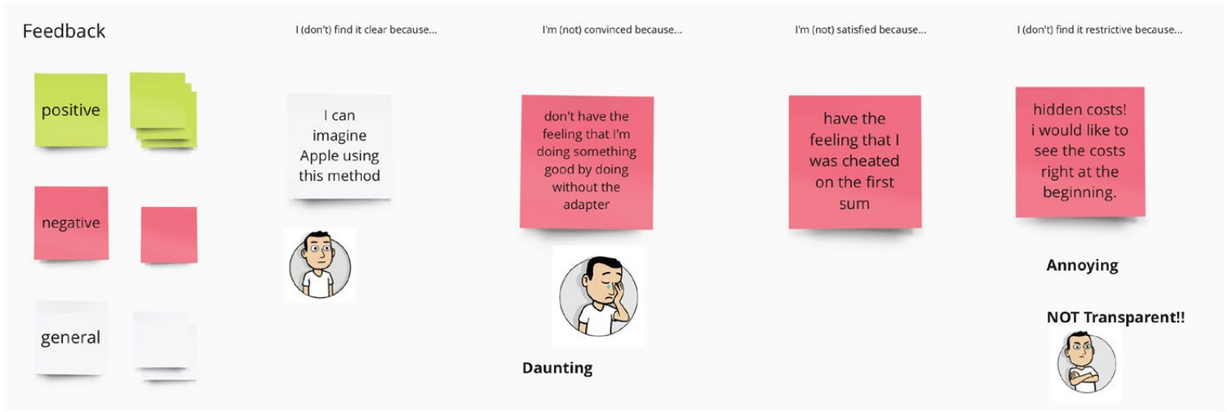
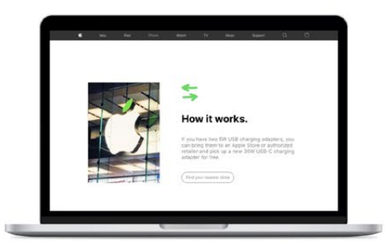
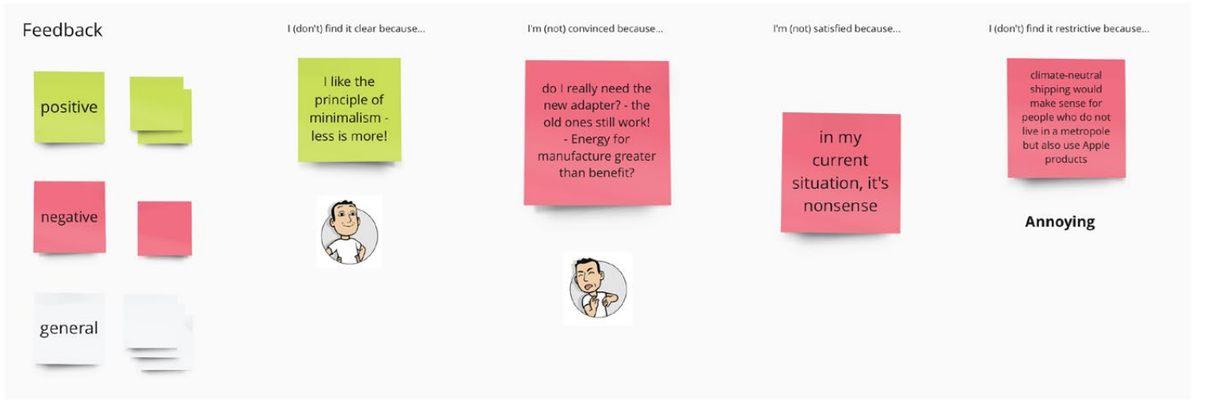




Return System

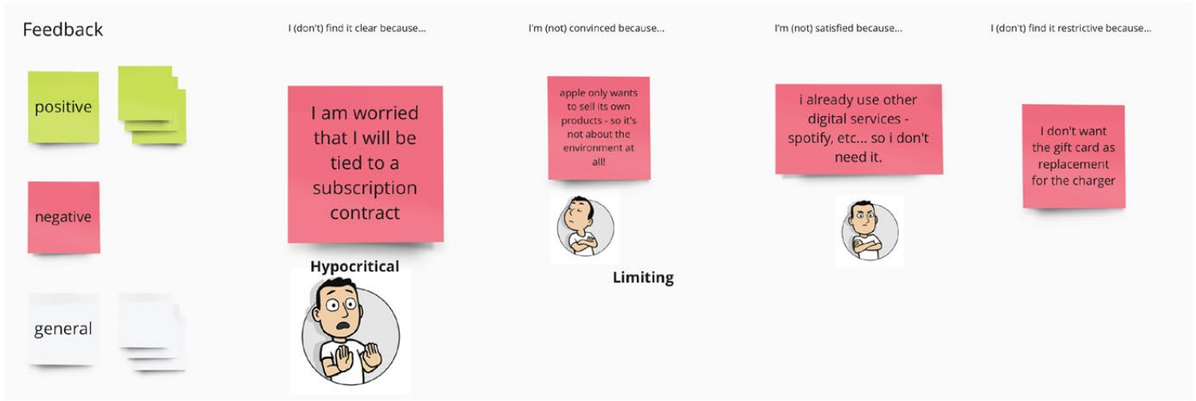
Return two old charging adapters at an Apple Store or authorized retailer and get one new power charger for free.





Apple Store Gift Card

Apple Store Gift Card inside the iPhone box applicable for all digital services such as Apple Music, TV, AppStore.



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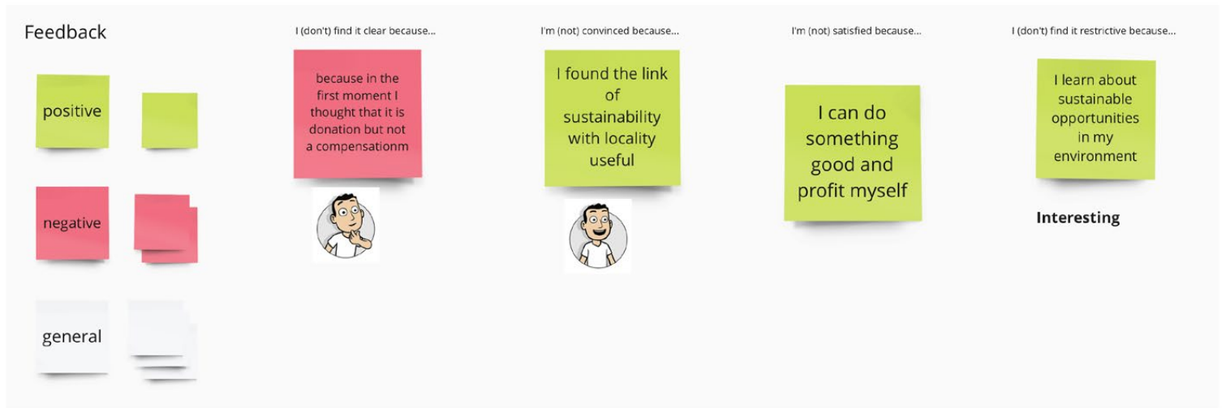
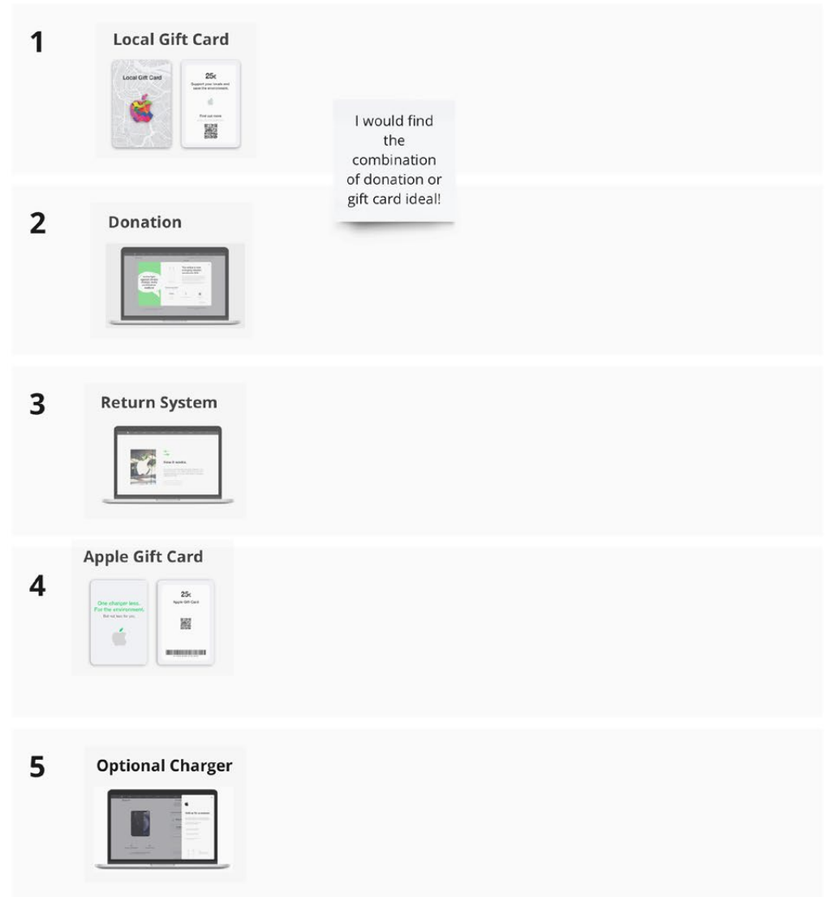
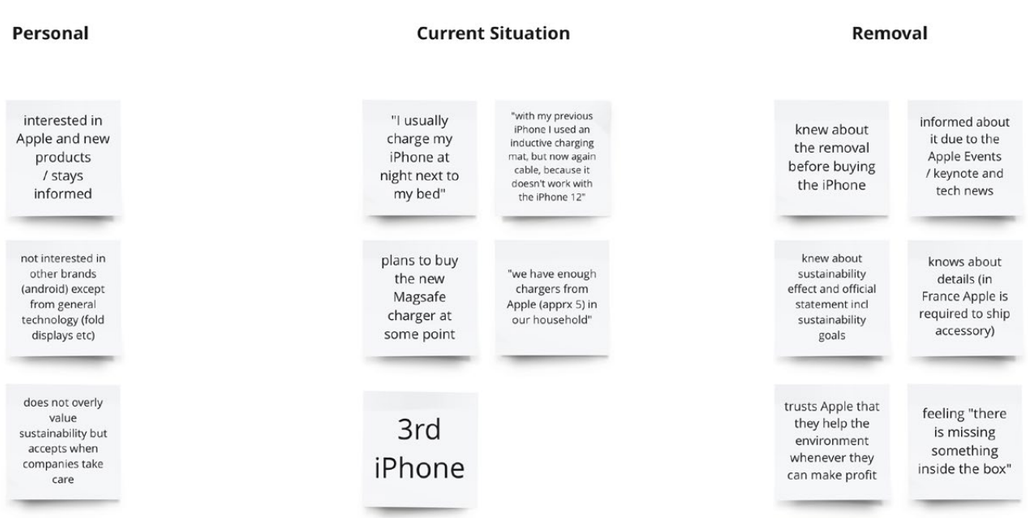


Overall Feedback

rank and compare

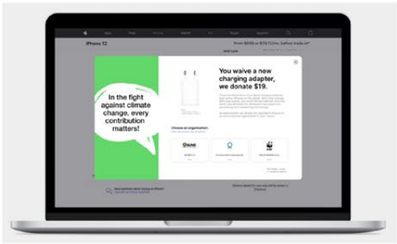


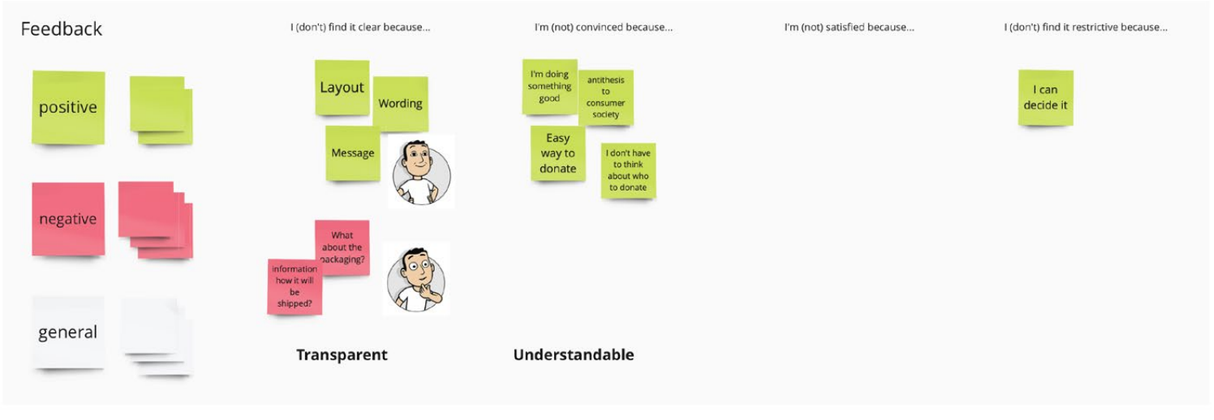
Participant 4



Donation

Free decision to choose between a charging adapter or donating the equivalent amount to an environmental organisation.





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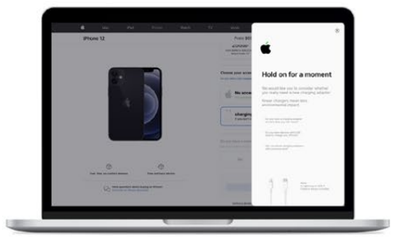

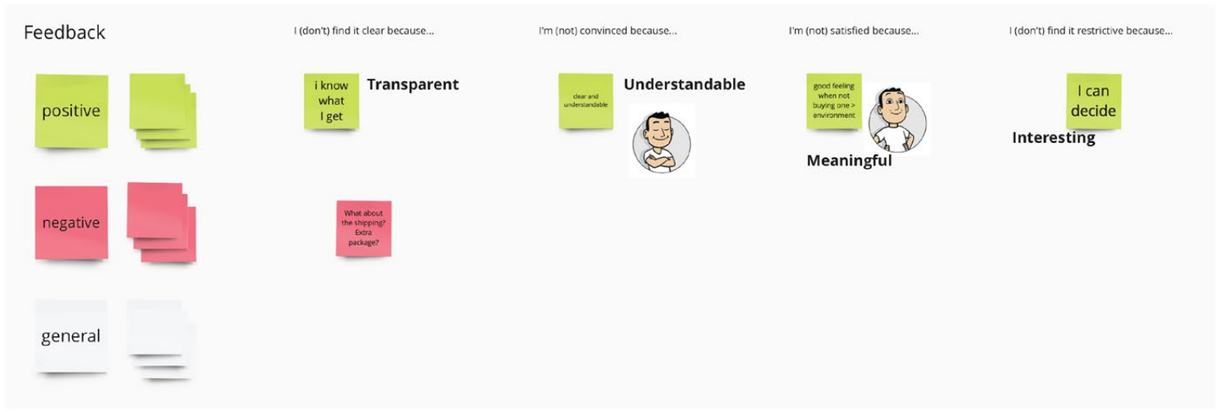

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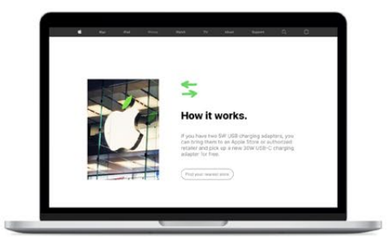

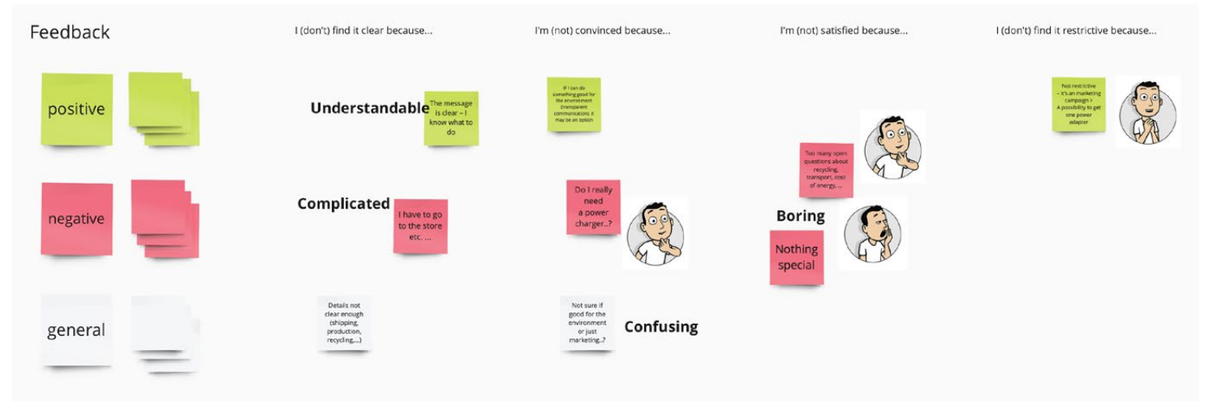

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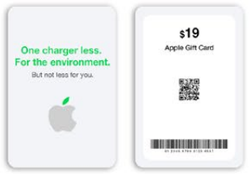

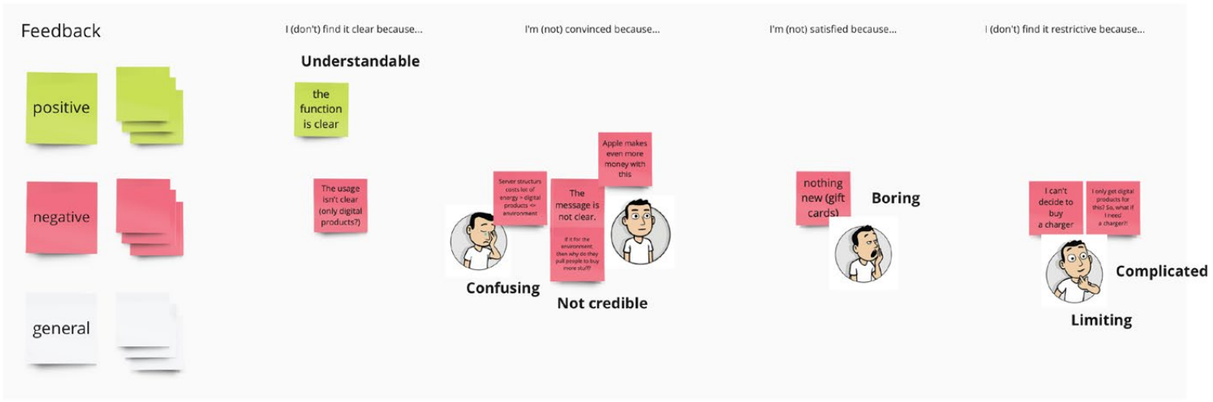

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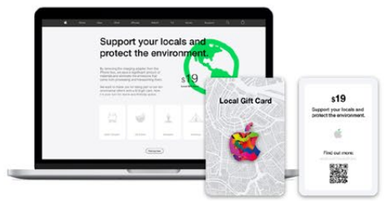
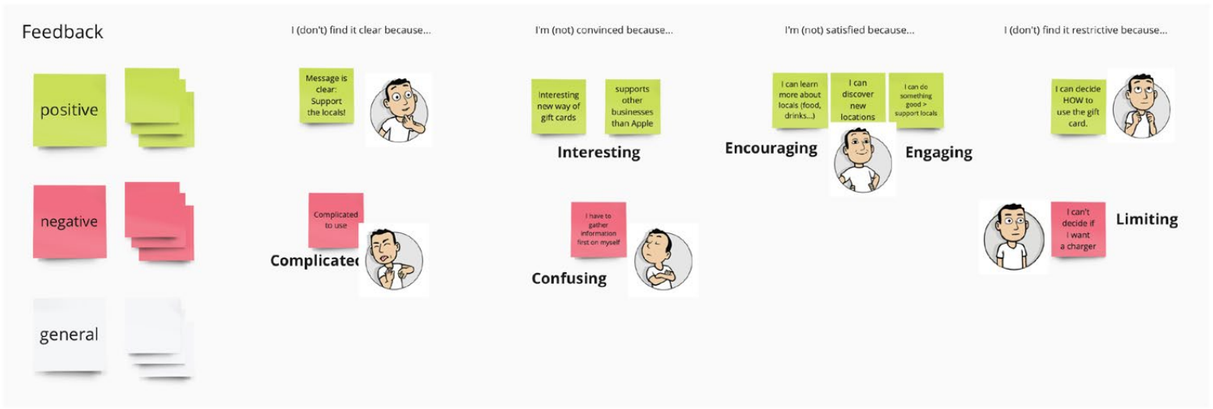
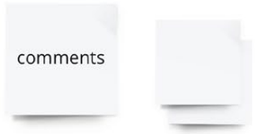




Overall Feedback

rank and compare



Participant 5

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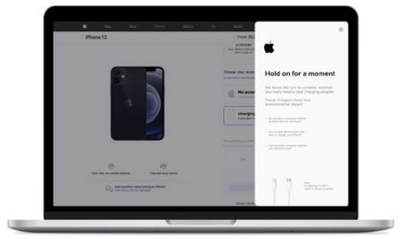

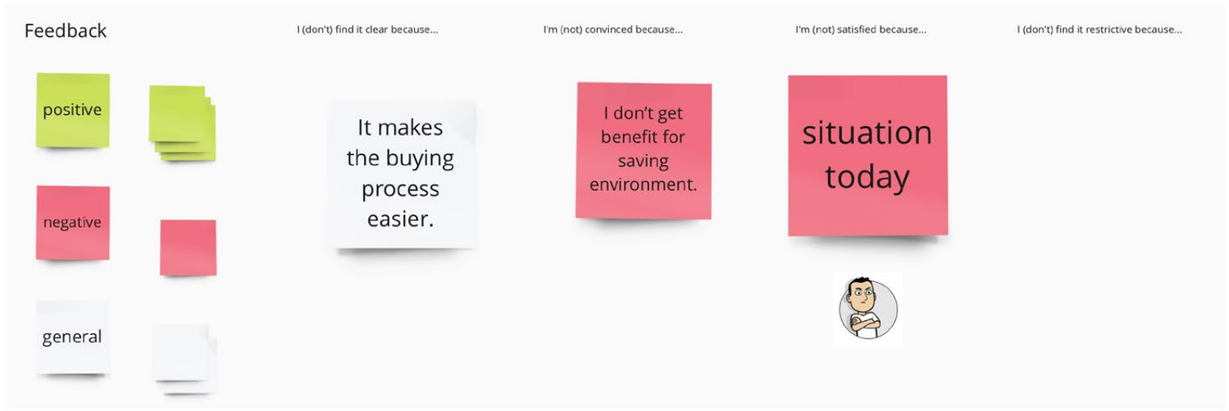

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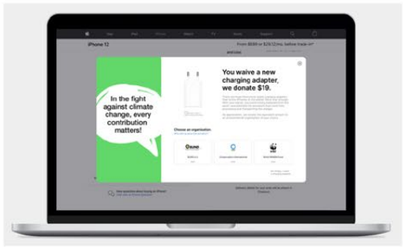

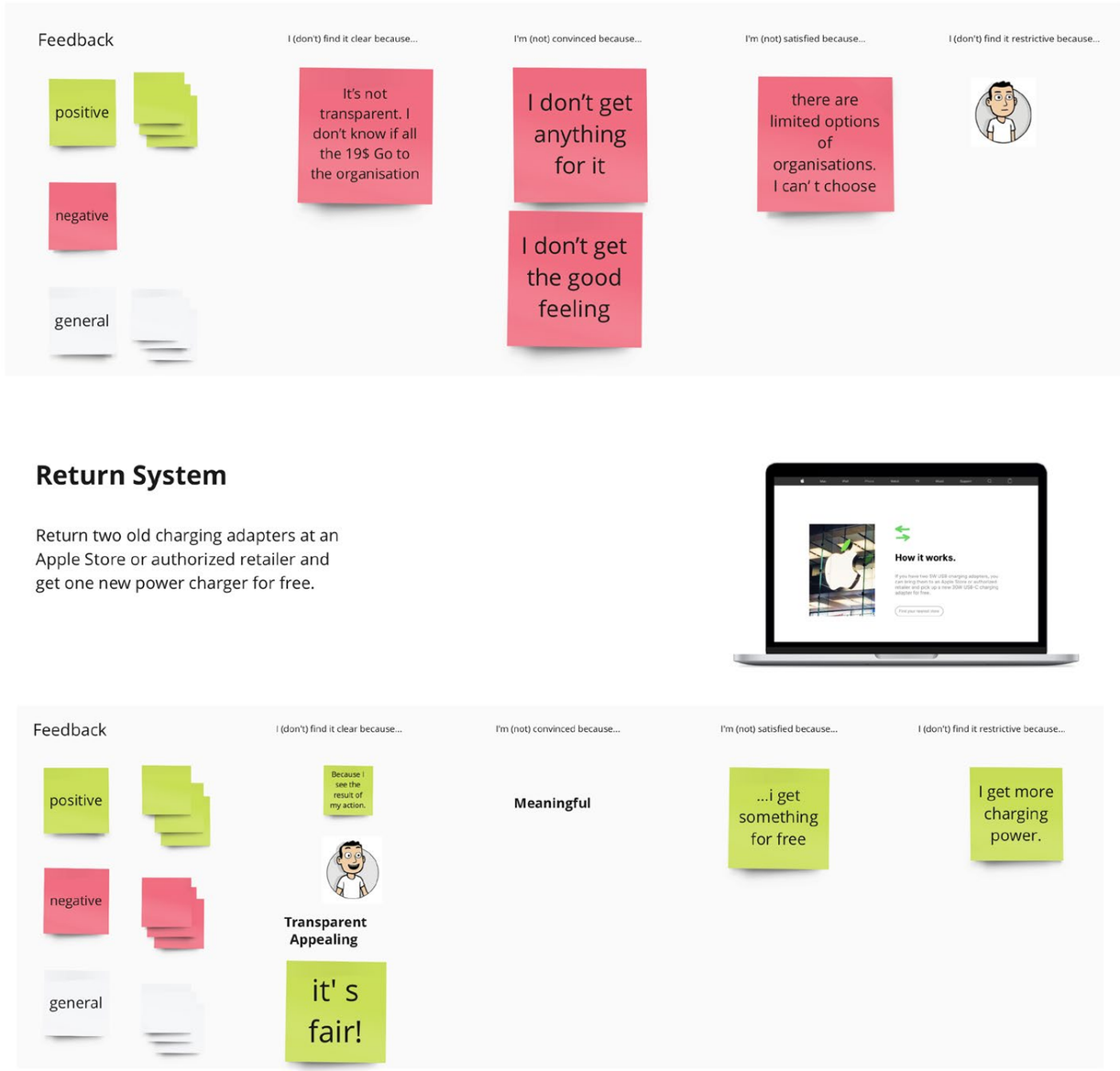

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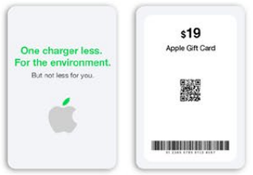

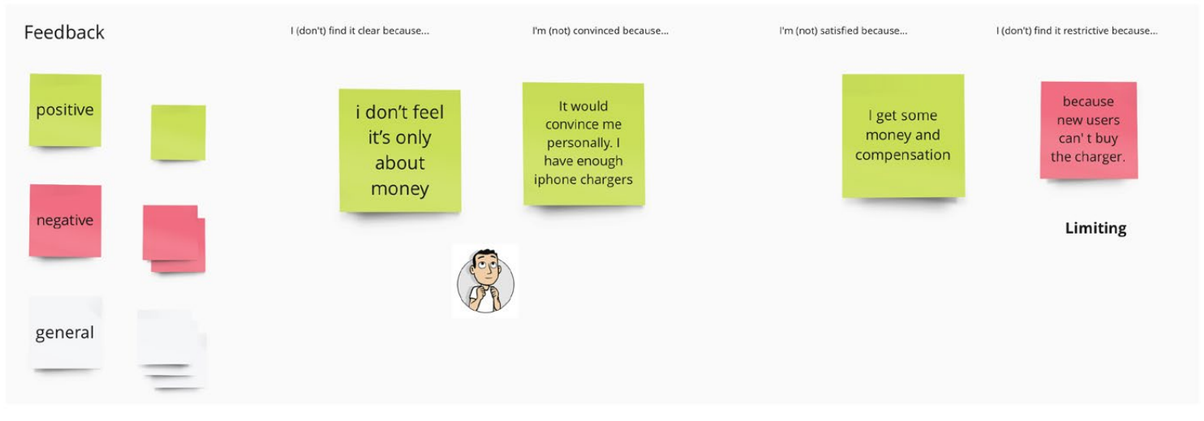

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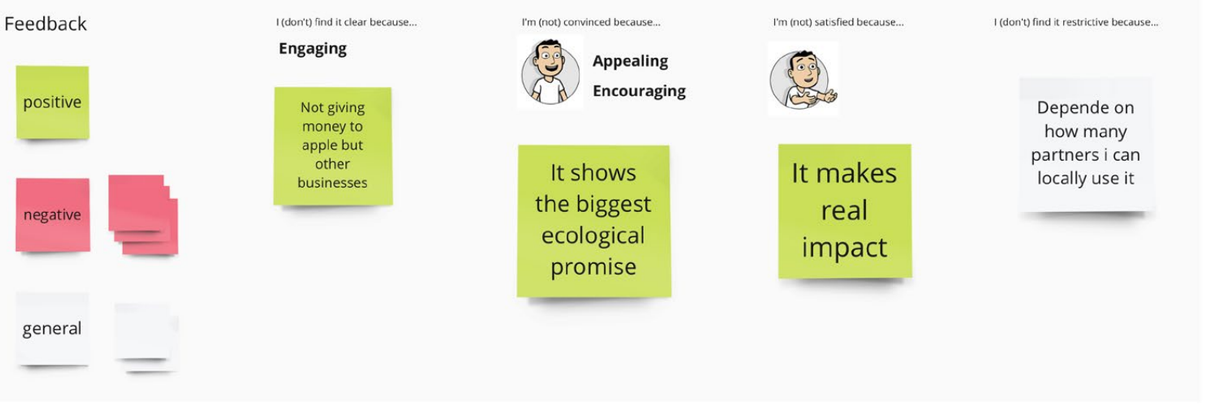

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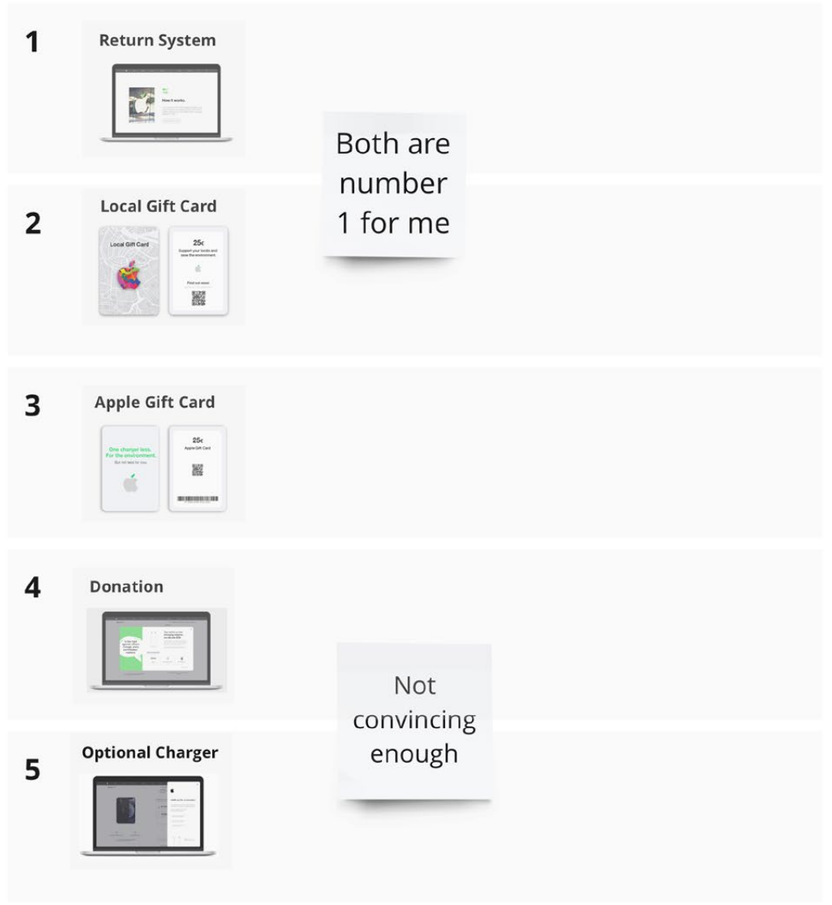
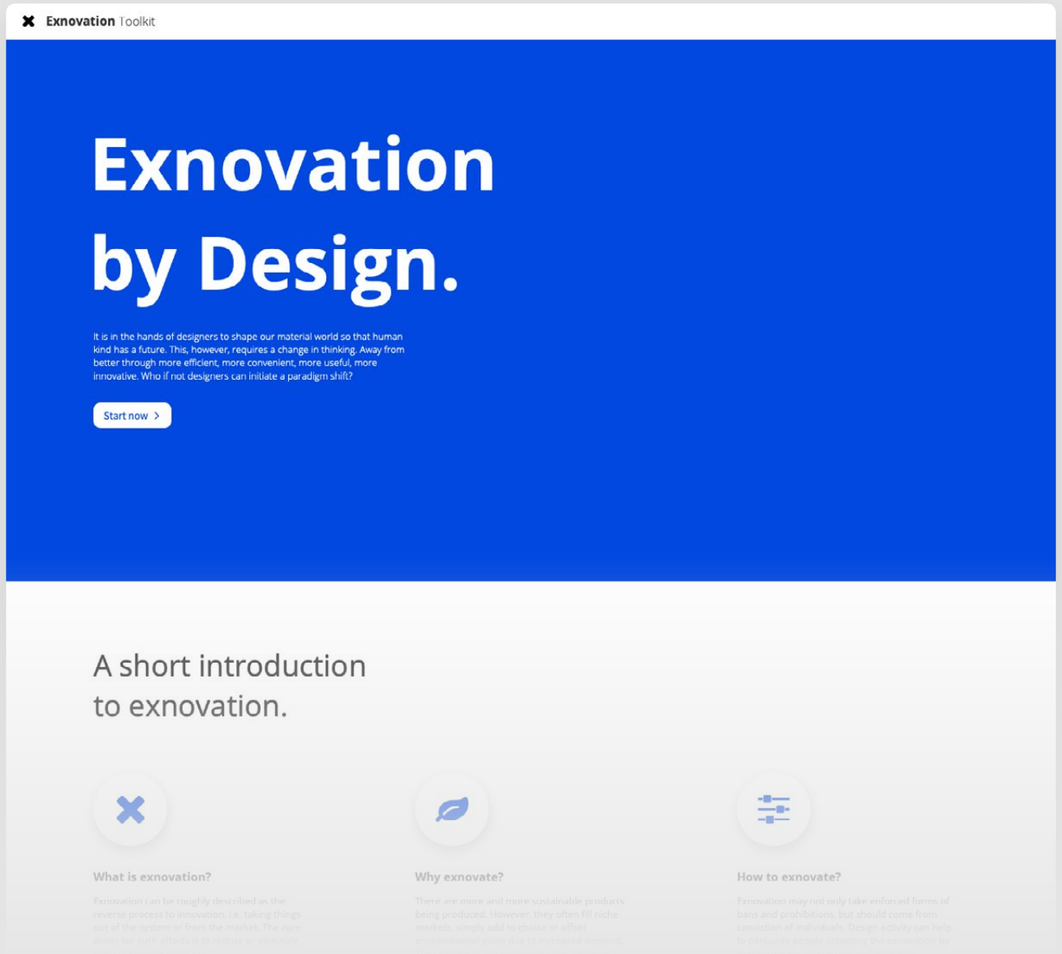


Toolkit
Test Plan

Design for Exnovation Toolkit

Bastian Reichhardt
Master Thesis 2021
Design for Interaction
Delft University of Technology



The Exnovation Toolkit

Test Plan

Test Objective

Test objective is a prototype of the Exnovation Toolkit. It is an interactive digital web application for designers to guide them through the basic steps of exnovating a chosen product. Within four exercises, key aspects are to be explored, followed by a suggestion of one of 8 design strategies that may be appropriate for the particular case.

General Goal

The testing aims at finding out if the toolkit helps designers in identifying crucial influences and challenges of the exnovation, framing the intervention and designing for it.

Research Questions

Effectiveness

- *Does the toolkit help to approach design for exnovation?*
- *Are the strategies applicable to various types of products?*

Perspicuity

- *Is the given information sufficient?*
- *Is the process understandable and coherent?*

Satisfaction

- *Is it exciting to use the toolkit?*
- *Do users feel inspired and motivated by the toolkit?*

Methodolgy

The testing session will kick off with a introduction to the background and the focus of the graduation project and a brief explanation of the testing's goal.
The participants are then asked to open the prototype and follow the steps indicated in the toolkit. While interacting with the prototype, they are encouraged to think aloud in order to understand their thoughts (Concurrent Think Aloud Method). After each exercise, they answer a short questionnaire and give feedback.
The reseacher stayts in the background, observes the situation and only answers question when really necessary.
When the session is over the researcher conducts a Retrospective Probing by asking questions about the participant's thoughts and actions. A final reflective questionnaire is handed out. The length of the sessions is 60 minutes.

Participants

At least three designers or design teams that have developed a product which can serve as subject for the testing. The choses products should be different from each other in order to test diverse scenarios.

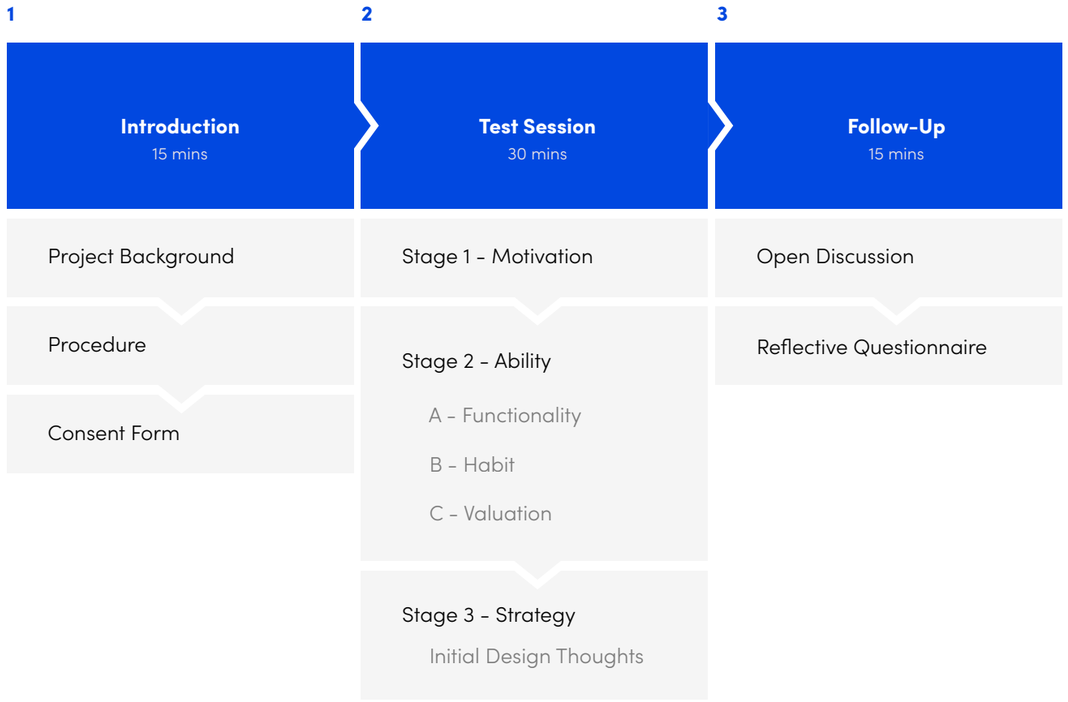
Location and Equipment

Remote interview via Zoom video call. The participant will be given a link to the toolkit prototype and a miro board with room for exercise notes. This board also includes consent form, questions for each exercise and the final reflective questionnaire.

Limitation

The test situation is not supposed to represent an exhaustive exnovation process with in-depth investigation and a final and binding strategy for the product. It only probes if sufficient information is given to enable a targeted exnovation design process and if the toolkit can serve as an initial framework.

Test Procedure



Exnovation Toolkit Testing

What product did you choose?

Meine Antwort

What is the name of the exnovation strategy suggested for you?

Meine Antwort

How would you rate your expertise in exnovation BEFORE using the toolkit? *

	1	2	3	4	5	
low	○	○	○	○	○	high

How would you rate your expertise in exnovation AFTER using the toolkit? *

	1	2	3	4	5	
low	○	○	○	○	○	high

The toolkit helped me designing for exnovation. *

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

I think the toolkit is inspiring. *

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

The toolkit is ease to use. *

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

The toolkit is supportive when exnovating. *

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

It is motivating to use the toolkit. *

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

The toolkit is clear and understandable. *

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

It is predictable. *

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

The exnovation strategy at the end helps me designing. *

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

I'm satisfied with the outcome *

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

The toolkit is what I have expected. *

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

The toolkit suits my product. *

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

I would use the toolkit again. *

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

Please describe what you like most

Meine Antwort

Please describe what you dislike

Meine Antwort

Do you have any recommendations?

Meine Antwort

Any final thoughts or reflections?

Meine Antwort

Exnovation Toolkit Testing

This User Testing is part of a master graduation project in Design for Interaction at TU Delft, Netherlands. The projects aim is to research exnovation (≠ innovation), the intentional reduction or removal of products for sustainability. During the project, a toolkit has been developed that is supposed to support designers in exnovating. Within a 90 mins remote testing, I want to find out about the effectiveness, ease of use and comprehensibility of the toolkit and get feedback for further iterations.

Bastian Reichhardt, October 2021

Consent Form for Study on Exnovation Toolkit

Please tick the appropriate boxes	**Yes**	**No**
Taking part in the study		
I have read and understood the study information, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
I understand that taking part in the study involves a remote testing via video call and written feedback on a miro online board as well as a survey in google forms.	☐	☐
I give permission that the testing will be video-recorded. The video will not be shared beyond the study team. The recording will be destroyed by the end of the project.	☐	☐
Use of the information in the study		
I understand that information I provide will be used for research purposes, knowledge / benefits sharing, and reporting.	☐	☐
I understand that information that can identify my employer, business or client, will not be shared beyond the study team.	☐	☐
I understand that personal information collected about me that can identify me, such as my name, will not be shared beyond the study team.	☐	☐
I agree that my information can be quoted in research outputs. This includes verbal statements as well as written comments on the miro board.	☐	☐
Future use and reuse of the information by others		
I give permission for the data that I provided during the remote session (anonymised transcripts), on the miro board and in the google form to be archived so it can be used for future research and learning.	☐	☐

Signatures

_____	_____	_____
Name of participant	Signature	Date

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

_____	_____	_____
Bastian Reichhardt	Signature	Date

Study contact details for further information: *Bastian Reichhardt,*

Effectiveness

4/5 helpfulness of toolkit

4/5 support of toolkit

4/5 helpfulness of strategy

Perspicuity

4/5 ease of use

4/5 clear and understandable

1,5/5 predictability

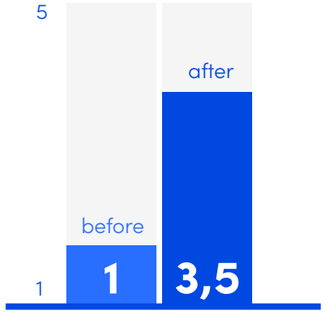
Stimulation

5/5 inspiring

5/5 motivating

4/5 satisfied with outcome

5/5 use it again



growth in expertise

>60 mins

participants required a lot of time to feel confident with the exercises

time to reach strategy page

explicit reward

the suggested strategy was matching the product and its situation

suggested strategy

Feedback

"I liked the suggestions it gives!" (p1)

"I found it interesting to talk in depth about a topic and to find aspects I didn't consider in the first place" (p2)

p1

"the example is very helpful to understand the strategy" (p1)

p2

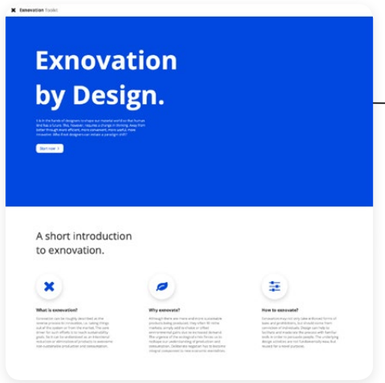
"I think the toolkit isn't only valuable if you want to exnovate (which is an interesting concept in theory but complex in reality). it could also be used as a kickoff tool for projects or evaluation tool to challenge a design" (p2)

"it is quite a lot of complex information to digest, even though I have the feeling it can't be done more convenient when it comes to designing the toolkit. many times it was difficult to differentiate between function and product or product and detail or functionality... language is a very difficult thing by itself" (p2)

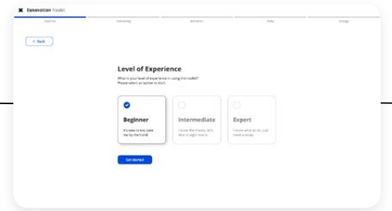
"I liked the 'motivation' questionnaire in the beginning" (p2)

Loop 1

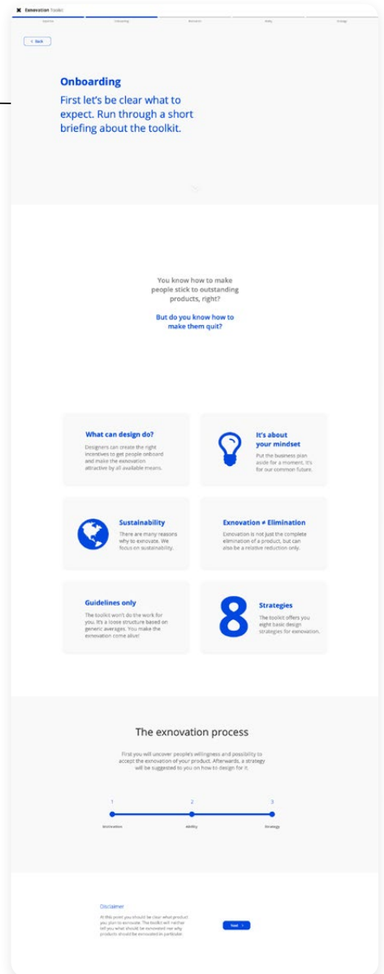
Start Page



Expertise



Onboarding



Information

intro - expertise - onboarding

User Feedback

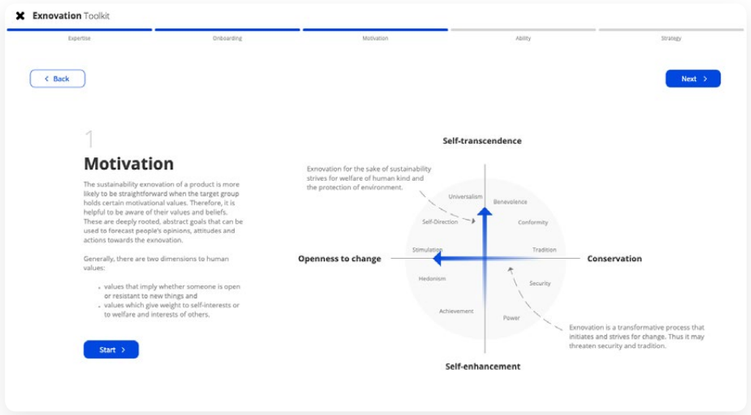
"not much to say, this is all pretty clear. all easy to get."

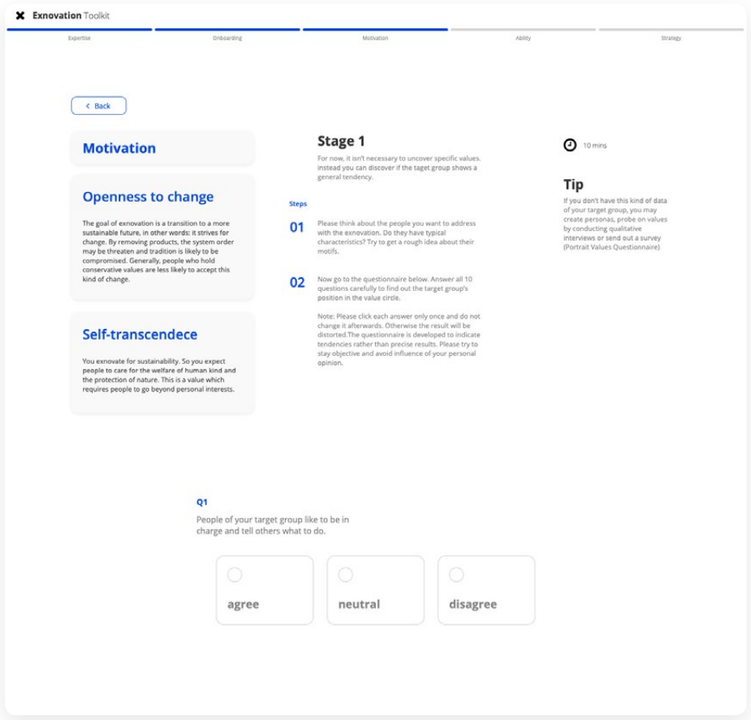
Observation

given information is understandable and interesting

Loop 1

Motivation





User Feedback

"I liked the 'motivation' questionnaire most"

"we have a lot of data about our target group to answer this"

"it's short, fun to think about and easy to understand"

"good to only have 3 options"

"result is similar to what I have expected"

Observation

easy to carry out the task

outcome as expected

given information is understandable

Loop 1

Ability

Stage 2B

Please look at the occurrence of habits related to the product according to the habit loop. You may begin with the routine and complement the others subsequently.

10 mins

best in teamwork

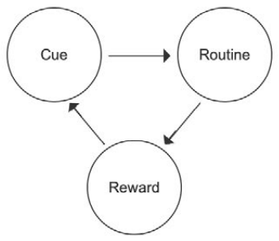
Steps

01 Search for common routines that occur when using the product. This is often interrelated with its functionality, so be clear about it.

02 Look for habitual cues. What triggers people to perform a certain routine? Also think about implicit information that activate a routine.

03 Identify in what way the product or its context might reward the routine. Note: A reward can also be a fundamental but overlooked result, such as having cooked food when using the stove.

04 Finally estimate the impact when the product is exnovated. Does it require breaking these habit(s)?



Tip

Draw the structure of cue, routine and reward and populate it with findings as you go.

Findings

When you have completed the exercise, select the answer that best reflects your findings.
When exnovating the product...

- there is no obvious risk of breaking habit(s)
- common habit(s) may potentially be broken

User Feedback

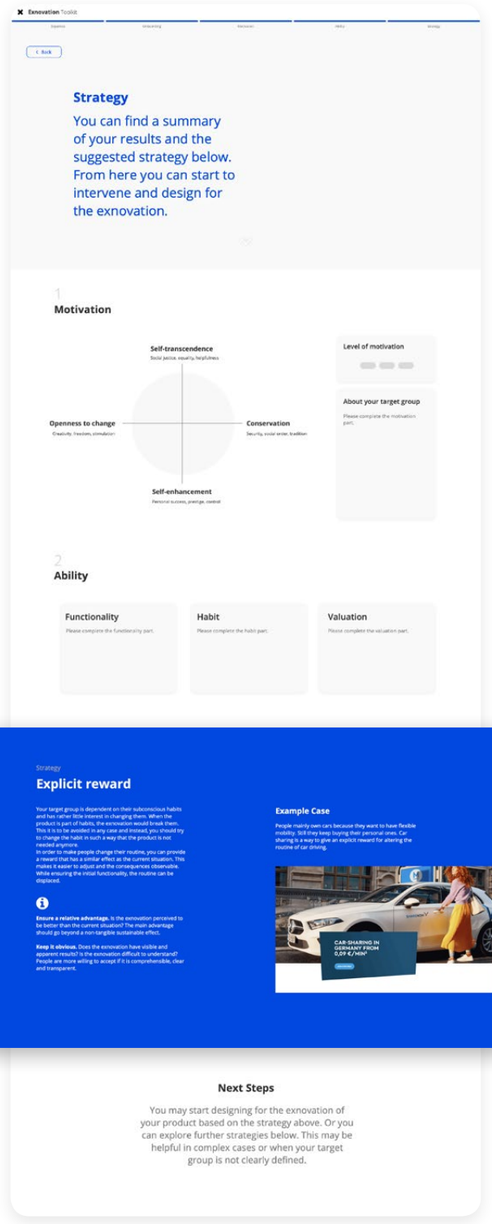
- "remains up to interpretation. hard to answer the finding question afterwards."
- "would be nice to get some feedback after completion"
- "I'm stumbling over the language. irritates me"
- "there is a lot of content info but I still didn't get it"
- "maybe our product is not perfectly matching the toolkit"

Observation

- stricter guidance necessary. less room for interpretation
- don't conclude with a simple 1 or 0 answer
- participants felt insecure whether they do it correctly
- way too long and complex task for the required input

Loop 1

Strategy



User Feedback

"the example is very helpful to understand the strategy"

"for the purpose of exnovation it would help me"

"it's a good argument to communicate change"

"good that it gives an alternative other than just eliminating the product entirely"

"it's a good argument to communicate change"

Observation

strategy seemed to match

the participants got the intention of the strategy

Effectiveness

2/5 helpfulness of toolkit

3/5 support of toolkit

2/5 helpfulness of strategy

2/5 suits the product

Perspicuity

2/5 ease of use

3/5 clear and understandable

2/5 predictability

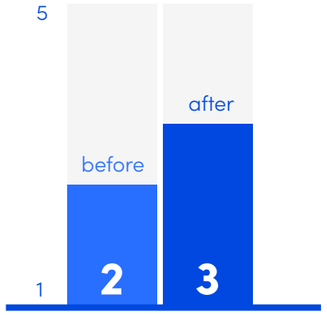
Stimulation

3/5 inspiring

2/5 motivating

3/5 satisfied with outcome

3/5 use it again



growth in expertise

12 mins

participant basically just read headlines and avoided long paragraphs.

time to reach strategy page

compensation → assurance

Mismatch of product (situation) and suggested strategy

suggested strategy

Feedback

"I like the idea of having a tool for reducing or getting rid of products"

"I wish it would be more holistic. It lacks the money and client perspective."

"a lot of text to read, too many words. I prefer bullet points"

p3

"hard to get clients to remove stuff they make money on. reduction is another thing!"

Effectiveness

5/5 helpfulness of toolkit

4/5 support of toolkit

4/5 helpfulness of strategy

3/5 suits the product

Perspicuity

3/5 ease of use

4/5 clear and understandable

3/5 predictability

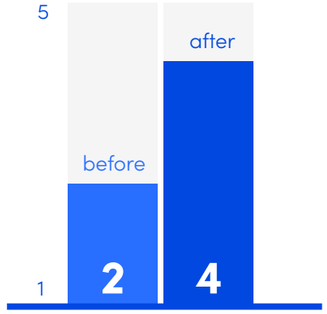
Stimulation

5/5 inspiring

4/5 motivating

2/5 satisfied with outcome

4/5 use it again



growth in expertise

34 mins

participant read everything very carefully which required some time.

time to reach strategy page

alternative → personal spark

Mismatch of product (situation) and suggested strategy

suggested strategy

Feedback

"I think it's an important and current topic!"

"I get a lot of information like 'you should do this and that' but it takes quit some time until I get to the point to do something."

"I like how it enlightens about exnovation"

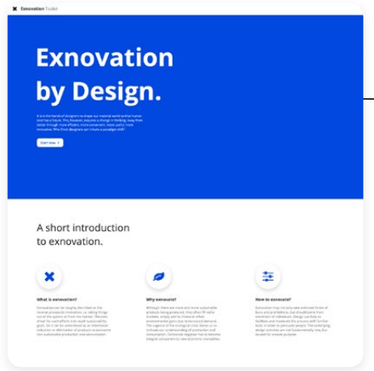
p4

"the results of the target group and valuation etc matched really well, just the end was confusing."

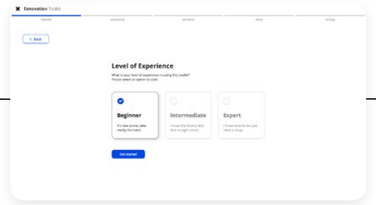
"I could really get another view on that topic. It stresses things I haven't thought of."

Loop 2

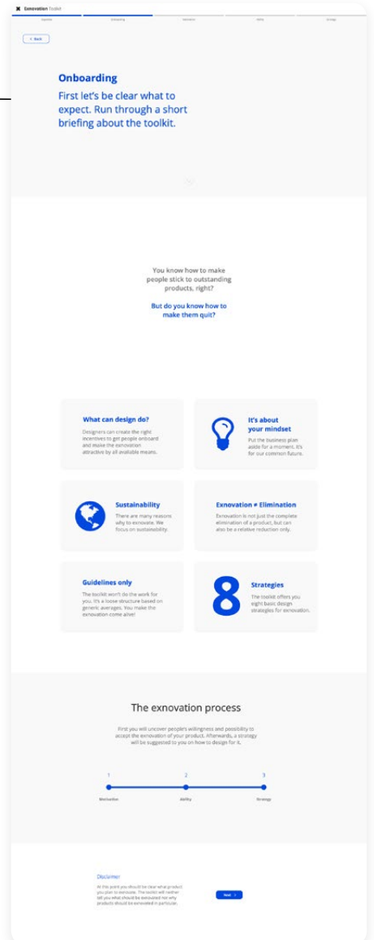
Start Page



Expertise



Onboarding



Information

intro - expertise - onboarding

User Feedback

"it's very attention-catching. stimulates curiosity" (p4)

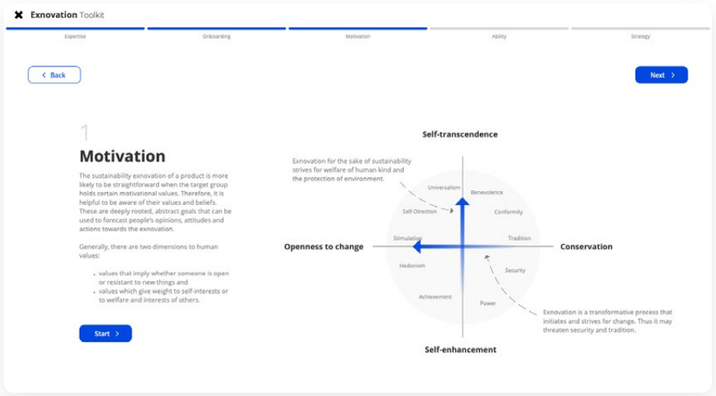
"simple and good amount of text" (p4)

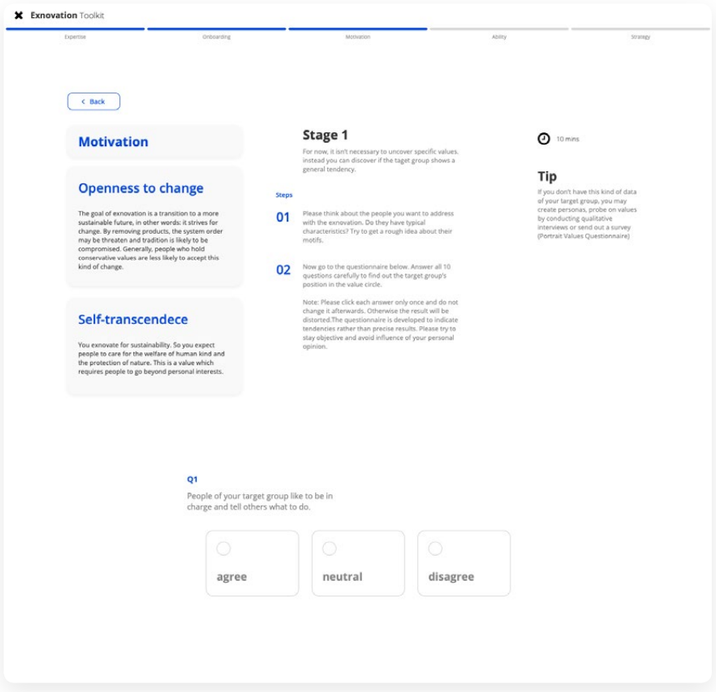
Observation

given information is understandable and interesting

Loop 2

Motivation





User Feedback

"understandable and logical graphics" (p4)

"it's a good amount of questions" (p4)

"the values in the graphic were unclear to me. maybe link to text" (p4)

"it seems like I was pretty right with my estimation" (p3)

"too many single paragraphs, too much text. maybe hide the text and add a „read more" function" (p4)

"ouh lot of stuff to read" (p3)

Observation

given information is understandable but too much

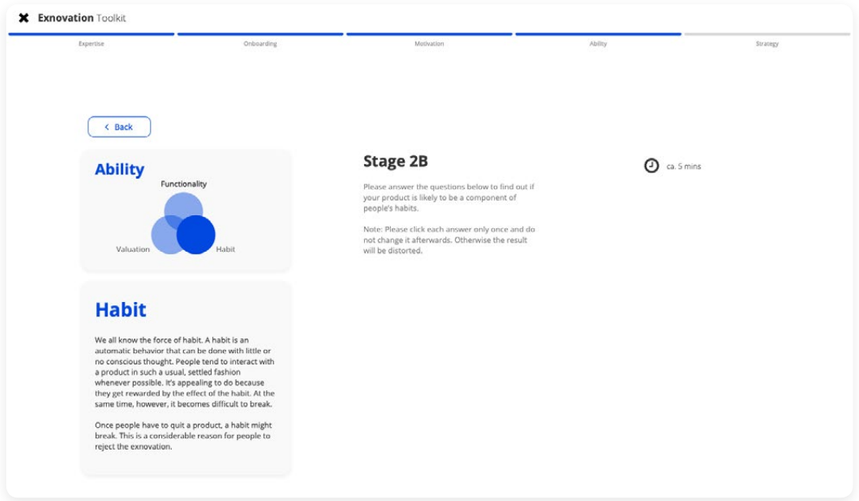
outcome as expected

easy to carry out the task

both participants seemed to enjoy the section

Loop 2

Ability



User Feedback

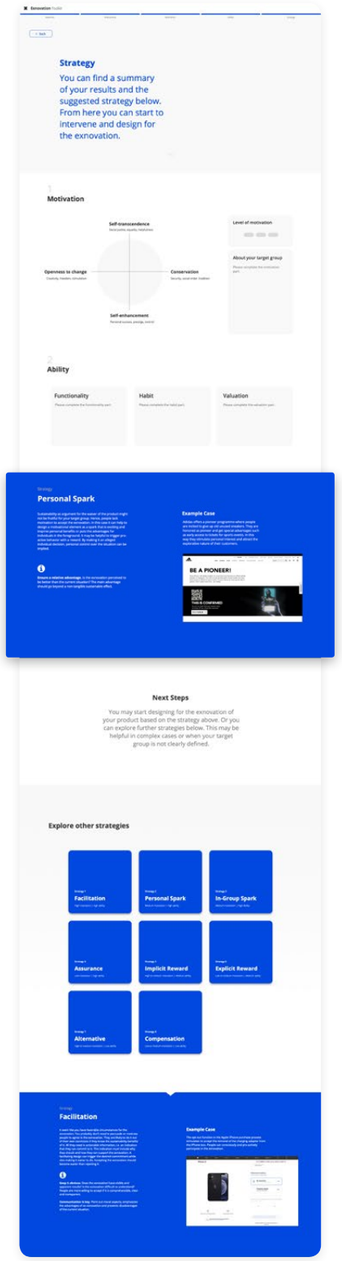
- "split of ability factors is good, obvious relation" (p4)
- "inspiring questions to think about" (p4)
- "result feedback is helpful and interesting" (p4)
- "Some questions are difficult to understand. I was unsure, if I got them right." (p4)

Observation

- results did not always match their intentions
- questions should be refined / more precise

Loop 2

Strategy



User Feedback

"first outcome was confusing, because the strategy didn't fit that well..." (p4)

"I don't know where to start reading. I want a solution by now" (p4)

"... but reading the other strategies, I found a suitable one." (p4)

"I'm a bit confused now to be honest" (p3)

"It would be nice to get something like an overview which strategies match the most. Like 80% personal spark, 60% implicit reward ..." (p4)

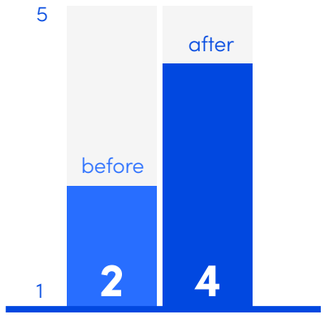
"I wish there was a download button, so I can safe the strategies as pdf." (p4)

Observation

mismatch of strategy and product exnovation in both testing sessions

summary is too prominent, strategy should be emphasized

toolkit testing | participant 5
self-testing as Apple designer



growth in expertise

70% facilitation, 70% personal spark

the suggested strategies were matching the product and its situation

suggested strategy

Effectiveness

4/5 helpfulness of toolkit

4/5 support of toolkit

5/5 helpfulness of strategies

5/5 suits the product

Perspicuity

4/5 ease of use

5/5 clear and understandable

3/5 predictability