Kaunas University of Technology

School of Economics and Business

Overcoming Customer Barriers Towards Circular Innovation: The Case of European Consumer Electronics Companies

Master's Final Degree Project

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Summary

The world's economic system is based on a linear model whose limitations lead to serious environmental problems such as global warming and increasing overshoot of the planet's biocapacity as well as economic problems such as resource scarcity. Therefore, the need for a new economic system is rising. The most discussed and well-known solution is a system transition towards a circular economy which is already advocated by several circular economy policies and regulatory initiatives. However, even if benefits, drivers, and policy regulations exist, the concept is still not widely used. One reason for this are customer barriers towards circular innovations as recent developments of circular innovations show rather low adoption rates. Although companies have significant problems in developing user-accepted circular innovation, there is only a little research on circular innovation and even less on the customer perspective within this context. In order to help companies successfully implement circular innovation as part of their transition towards circular economy, exploration on customer barriers towards circular innovation is required, followed by research on how to foster the consideration of the customers' perspective within the development of circular innovation as well as systematic approaches to identify barriers and develop interventions to overcome these.

Therefore, the general **research aim** is to ground interventions to overcome customer barriers towards circular innovation in the case of European consumer electronics companies. To achieve this aim, the underlying **research objectives** are:

1. to analyse the problematic situation of circular economy and circular innovation implementation in business and academia context with a special focus on the customer perspective.
2. to perform a literature analysis in order to:
    a) lay theoretical foundations for circular economy, circular innovation, as well as behavioural change and innovation adoption theories.
    b) define and categorise customer barriers towards circular innovations.
    c) analyse existing theoretical approaches to systematically identify and overcome customer barriers towards circular innovation.
3. to ground a research methodology to explore approaches to identify customer barriers towards circular innovation and interventions to overcome such in the practical context of European consumer electronics companies.
4. to empirically explore and validate approaches to identify customer barriers towards circular innovation and interventions to overcome such in the case of European consumer electronics companies.
5. to ground interventions and corresponding actions to overcome customer barriers towards circular innovation.

The underlying **research method** includes an extensive literature analysis that grounds research indicators for empirical research. To explore those in practice, a qualitative research design has been chosen, including the combination of expert interviews and a multiple case study analysis of selected European consumer electronics companies. In total ten interviewees, including four experts and six practitioners of four case companies were selected based on a purposeful sampling technique. The interviews were conducted in a semi-structured way following a previously developed interview guide. Furthermore, a qualitative content analysis was performed in order to extract the most relevant information using the software MAXQDA.

Key theoretical findings include the clear definition and differentiation of circular economy as opposed to sustainability as well as its key principles. Furthermore, a clear definition and differentiation of circular innovation as opposed to other related concepts including environmental, sustainable, and frugal innovations is provided. Next to this, the introduction of theories on circular behaviour and innovation adoption theories resulted in the identification of twelve general customer barriers towards circular innovations which were further categorised in psychological and functional barriers as well as their relevance for different circular innovation types. In addition, the theoretical application of a three-step behavioural change approach revealed that out of nine dominant behavioural change interventions three, namely "education", "persuasion", and "modelling", have been found to be most applicable to overcome barriers towards the purchase of "re"products. Finally, several theoretical implications for existing and future research could be grounded in the fields of circular economy, innovation development, as well as behavioural economics.

Key empirical findings show that barriers including "*lack of cultural change*", "*lack of trust and company image*", "*lack of infrastructure*", "*lack of knowledge and information*", and "*lack of perceived advantage*" are recognized by companies independently of the circular innovation type while "*lack of ownership*" is mainly relevant for PaaS models and provider of refurbished products are especially challenged by "*lack of perceived quality*" or "*uncertainty about quality*", "*lack of status*", and "*lack of technical compatibility*". Dominant interventions to overcome these barriers are "*education*", "*persuasion*", and "*incentivisation*" whereby the company's maturity and brand reputation, as well as the circular innovation type, have recognised as the main variables influencing the relevance of barriers as well as the choice of interventions. Additionally, design thinking and lean start-up have been identified as the most dominant approaches to integrate the customer perspective into the development process of circular innovation while barriers are mainly identified using typical market research methods. In combination with theoretical findings, a systematic approach to identify and overcome customer barriers towards circular innovation has been proposed which next to other aspects provides a prospect for further research. Lastly, a set of managerial implications could be defined. These insights provide valuable recommendations for European consumer electronics companies that want to develop and implement circular innovation.

Wendlandt, Lea. Klientų barjerų žiedinėms inovacijoms įveikimas: Europos buitinės elektronikos įmonių atvejis. Magistro studiju baigiamasis projektas / vadovė doc. dr. Jolita Čeičytė-Pranskūnė, Kauno technologijos universitetas, Ekonomikos ir verslo fakultetas.

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Raktiniai žodžiai: žiedinės inovacijos, žiedinė ekonomika, klientų barjerai, intervencijos, elgsenos pokyčiai, inovacijų diegimas, dizainu grįstas mąstymas, buitinė elektronika.

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Santrauka

Pasaulio ekonominės sistemos, paremtos linijiniu modeliu, trūkumai lemia kompleksines aplinkosaugos problemas, tokias kaip visuotinis atšilimas ir didėjantis planetos biologinio pajėgumo viršijimas, taip pat – ekonomines problemas, tokias kaip išteklių trūkumas. Todėl didėja naujos ekonominės sistemos poreikis. Labiausiai aptariamas ir gerai žinomas sprendimas - sistemos perėjimas prie žiedinės ekonomikos, už kurį jau pasisakoma keliose žiedinės ekonomikos politikos ir reguliavimo iniciatyvose. Tačiau, nors naudos žinomos, o varomosios jėgos ir politiniai reglamentai egzistuoja, ši koncepcija vis dar nėra plačiai naudojama. Viena iš pagrindinių priežasčių yra egzistuojantys klientų barjerai žiedinėms inovacijoms, todėl fiksuojamas žemas žiedinių inovacijų priėmimo rodiklis.. Nors įmonės susiduria su didelėmis problemomis kuriant vartotojams priimtinas žiedines inovacijas, žiedinių inovacijų tyrimų, o ypač iš klientų perspektyvos, šiame kontekste yra labai nedaug. Siekiant padėti įmonėms sėkmingiau diegti žiedines inovacijas ir efektyviau pereiti prie žiedinės ekonomikos, būtina geriau suprasti vartotojų barjerus žiedinėms inovacijoms nagrinėjant būdus kaip įtraukti vartotojų perspektyvą kuriant žiedines inovacijas, kaip taikyti sisteminius metodus šiems barjerams identifikuoti ir taikyti intervencines priemones joms įveikti.

Pagrindinis **tyrimo tikslas** - pagrįsti intervencijas, skirtas klientų kliūtims žiedinėms inovacijoms įveikti, Europos buitinės elektronikos įmonių atveju. Šiam tikslui pasiekti keliami šie **pagrindiniai tyrimo** uždaviniai:

1. Išanalizuoti probleminę žiedinės ekonomikos ir žiedinių inovacijų diegimo situaciją verslo ir akademiniame kontekste, ypatingą dėmesį skiriant klientų perspektyvai.
2. Atlikti literatūros analizę, siekiant:
   a) apibrėžti teorinius žiedinės ekonomikos, žiedinių inovacijų, taip pat elgsenos pokyčių ir inovacijų diegimo teorijų pagrindus.
   b) apibrėžti ir sukategorizuoti klientų barjerus žiedinių inovacijų atžvilgiu.
   c) išanalizuoti esamus teorinius požiūrius, kad būtų galima sistemingai nustatyti ir įveikti klientų barjerus žiedinėms inovacijoms.
3. Pagrįsti tyrimo metodiką, skirtą ištirti klientų barjerus žiedinėms inovacijoms, jų nustatymo metodus ir intervencijas, skirtas joms įveikti praktiniame Europos buitinės elektronikos įmonių kontekste.
4. Empiriškai ištirti ir patvirtinti metodus, skirtus klientų barjerams žiedinėms inovacijoms nustatyti, ir intervencijas joms įveikti Europos buitinės elektronikos įmonių atveju.
5. Pagrįsti intervencijas ir atitinkamus veiksmus, kuriais siekiama įveikti klientų barjerus, trukdančias diegti žiedines inovacijas.

Pagrindiniai tyrimo metodai apima išsamią literatūros analizę, kuria pagrindžiami empirinio tyrimo indikatoriai. Siekiant juos ištirti praktiškai, pasirinktas kokybinis tyrimo dizainas, apimantis ekspertų interviu ir atrinktų Europos buitinės elektronikos įmonių daugybinių atvejų analizę. Remiantis tikslingos atrankos metodu, buvo atrinkta dešimt interviu dalyvių, įskaitant keturis ekspertus ir šešis praktikus iš keturių įmonių. Buvo atliekami pusiau struktūruoti interviu vadovaujantis iš anksto parengtu interviu gidu. Be to, siekiant išskirti svarbiausią informaciją, naudojant MAXQDA programinę įrangą, buvo atlikta kokybinė turinio analizė.

Pagrindinės teorinės išvados apima aiškų žiedinės ekonomikos apibrėžimą ir koncepcijos atskyrimą nuo tvarumo, taip pat pagrindinius jos principus. Be to, pateikiamas aiškus žiedinės inovacijos apibrėžimas ir atskyrimas nuo kitų susijusių sąvokų, tokių kaip aplinkosauginės, tvariosios ir taupiosios inovacijos. Remiantis žiedinės elgsenos ir inovacijų diegimo teorijų analize, nustatyta dvylika bendrųjų klientų barjerų, trukdančių diegti žiedines inovacijas, kurios toliau suskirstomos į psichologinius ir funkcinius barjerus, o taip pat ir pagal jų reikšmę skirtingoms žiedinių inovacijų rūšims. Teoriškai pritaikius trijų žingsnių elgsenos pokyčių metodą, nustatyta, kad iš devynių dominuojančių elgsenos pokyčių intervencijų trys jų, t. y. "švietimas", "įtikinėjimas" ir "modeliavimas", labiausiai tinka įveikti barjerams, susijusiems su "pakartotinių" produktų pirkimu. Galiausiai, pagrįsta teorinė reikšmė ir suformuluotos tolimesnės tyrimų kryptys žiedinės ekonomikos, inovacijų plėtros, taip pat elgsenos ekonomikos srityse.

Pagrindinės empirinio tyrimo išvados rodo, kad tokias kliūtis, kaip "kultūrinių pokyčių stoka", "pasitikėjimo ir įmonės įvaizdžio stoka", "infrastruktūros stoka", "žinių ir informacijos stoka" ir "suvokiamo pranašumo stoka", įmonės pripažįsta nepriklausomai nuo žiedinių inovacijų tipo, o "nuosavybės stoka" labiausiai aktuali prekių ir paslaugų modeliams. Atnaujintų produktų teikėjams ypač daug iššūkių kelia "suvokiamos kokybės stoka" arba "netikrumas dėl kokybės", "statuso stoka" ir "techninio suderinamumo stoka". Dominuojančios intervencijos šiems barjerams įveikti yra "švietimas", "įtikinėjimas" ir "skatinimas", o įmonės brandumas ir prekės ženklo reputacija bei žiedinės inovacijos tipas pripažinti pagrindiniais kintamaisiais, darančiais įtaką barjerų svarbai ir intervencijų pasirinkimui. Be to, dizainu grįstas mąstymas ir taupieji startuoliai buvo pripažinti dominuojančiais metodais, kuriais siekiama integruoti kliento perspektyvą į žiedinių inovacijų kūrimo procesą, o barjerai dažniausiai nustatomi taikant tipinius rinkos tyrimų metodus. Kartu su teorinėmis išvadomis buvo pasiūlytas sisteminis požiūris, kaip nustatyti ir įveikti barjerus, kylančius iš klientų perspektyvos, kuriant žiedines inovacijas, kas, greta kitų aspektų, suteikia perspektyvą tolesniems tyrimams. Galiausiai, apibrėžtos vadybinės implikacijos. Šios įžvalgos suteikia vertingų rekomendacijų Europos buitinės elektronikos įmonėms, norinčioms kurti ir diegti žiedines inovacijas.

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List of Abbreviations and Terms

Abbreviations

BM – Business Model
BCW – Behavioural Change Wheel
C2C – Cradle-to-Cradle
CBM – Circular Business Model
CBMI – Circular Business Model Innovation
CE – Circular Economy
CEAP – Circular Economy Action Plan
CD – Circular Design
CI – Circular Innovation
COM-B – Acronym for Capability, Opportunities, Motivation, and Behaviour
CPI – Circular Product Innovation
CSI – Circular Service Innovation
EI – Eco Innovation
EMF – Ellen McArthur Foundation
EOD – Earth Overshoot Day
EU – European Union
EC – European Commission
FI – Frugal Innovation
G20 – Association of 20 most important industrialised and emerging countries and the EU (since 1999)
GACERE – Global Alliance on Circular Economy and Resource Efficiency
GHG – Greenhouse Gas
IPCC – International panel on climate change
k.o. – knock out
LE – Linear Economy
LI – Linear Innovation
Miele – Miele & Cie. KG
MVP – Minimum Viable Product
NPD – New Product Development
NPV – Net Present Value
PaaS – Product as a Service
Philips DA – Philips Domestic Appliances
PSS – Product Service System
PLC – Product Life Cycle
SC – Supply Chain
SDG – UN Sustainability Development Goals
SI – Sustainable Innovation
TB – Target Behaviour
TDF – Theoretical Domains Framework
TCO – Total Cost of Ownership
UCD – User-centered design
WTP – Willingness to pay
XaaS – Anything as a Service

Terms

"Re"products – CI type which includes all products that were cycled back already (repaired, reused, remanufactured, refurbished, recycled products)

Introduction

Relevance. The world's prevailing economic system is mainly based on a linear system, meaning the take, make, and waste of natural resources (EMF, 2021a, p. 3). This system bears several limitations and ultimately leads to increased environmental problems, for instance, the ongoing overshoot of the plant's biocapacity caused by extensive overconsumption of limited natural resources (Global Footprint Network, 2021) or the global warming caused by a rising amount of greenhouse gas (GHG) emissions (ipcc, 2021, p. 8). In this context, the circular economy (CE) concept has been promoted as a promising approach to replacing the linear system (EMF, 2020, p. 4). As a result, the transition to CE is already supported by several European Union (EU) governmental policies and initiatives such as the 2030 Sustainability Agenda, including the United Nations (UN) 17 Sustainable Development Goals (SDG), the Paris Agreement, the Green Deal, the EU Circular Economy Action Plan, as well as the Global Alliance on Circular Economy and Resource Efficiency (GACEPR). Considering a specific example from the Netherlands, the Ministry of Infrastructure and the Environment and the Ministry of Economic Affairs initiated a government-wide program to develop a CE in the Netherlands by 2050. Thereby, an interim objective of a 50% reduction in the use of primary raw materials (minerals, fossils, and metals) by 2030 has been defined (Dijksma & Kamp, 2016, p. 5). Besides, regulations, other aspects also drive the transition towards CE. Those aspects include economic risks such as resource scarcity and volatile material prices but also new enabling technologies. Consequently, companies are increasingly required to implement CE and develop new products, services, and business models, namely "circular innovations" (CI), in order to enable a transition towards CE (Jesus et al., 2021, p. 17).

Problem and Research Gap. Even though policy regulations, benefits, and drivers exist, the concept of CE is not widely in use (De Angelis, 2018; Elzinga et al., 2020, p. 1; Kirchherr, Hekkert, et al., 2017, p. 4; Parajuly et al., 2020, p. 6; Planing, 2015, p. 7). Until today, only 8.6% of the global economy is circular (van Veldhoven et al., 2021, 12). Reasons for that are several barriers that hinder companies from transitioning towards CE. These barriers are diverse, including economic, organisational, institutional, technological, supply chain, and social aspects. Social barriers describe the emphasis area of the following thesis. In recent years several CIs have been developed and offered to the market. Nevertheless, until today, those CIs are often rather less successful in replacing existing linear alternatives (Rexfelt & Selvefors, 2021, p. 1). As a consequence, companies struggle with unclarity about market demand for CI, which researchers and practitioners frequently mention as a significant social barrier for companies to move on to CE on a large scale (Guldmann & Huulgaard, 2020, p. 6; Planing, 2015, p. 7; Rizos et al., 2016, p. 10). The reason for this uncertainty is the lack of customer adoption caused by several barriers and issues which customers face regarding CI (Wastling et al., 2018, p. 4). Although companies have significant problems in developing user accepted CI, there is only a little research on CI (Horbach & Rammer, 2020, p. 617), and cross-fertilisation between the fields of innovation and CE is primarily absent (Jesus et al., 2021, pp. 2–3). Moreover, even though the customer role and customer barriers towards CI are significant for the success of a CE transition, much literature and practice still focuses on a production and business perspective within CE and fails to consider the customer perspective (Camacho-Otero et al., 2017, p. 1; Centobelli et al., 2020, p. 1746; Rexfelt & Selvefors, 2021, p. 1; Selvefors et al., 2018, p. 2047). In fact, only 19% of published CE definitions acknowledge the customer role (Kirchherr, Reike, & Hekkert, 2017, p. 228). Thereby, especially the customers' acceptance and attitude towards CI (Camacho-Otero et al., 2020; Elzinga et al., 2020, p. 1) as well as issues and barriers in the context of using CIs are underexposed (Camacho-Otero et al., 2018, p. 1; Selvefors et al., 2018, p. 2047).

Additionally, studies on the development and design of CIs rarely involve the customer perspective (Camacho-Otero et al., 2018, p. 15). While products are mainly designed for circular (re-)production flows, customer barriers towards those products are rarely considered (Rexfelt & Selvefors, 2021, p. 1). This lack of consideration of the customer perspective is problematic as the empathy for the demand-side and users of innovation is essential for new products, services, and business models to be successful (Hippel, 2005, p. 108). Consequently, the lack of customer consideration within the development of CI limits the possibility to develop CIs which are commercially profitable and attractive to the users (Selvefors et al., 2018, p. 2047). Furthermore, "as long as products and services are designed in a way that makes people prefer linear options over circular ones, the transition will not gain momentum" (Rexfelt & Selvefors, 2021, p. 1). In order to help companies to develop CIs which customers are likely to adopt successfully, exploration of customer barriers towards CI is required (Almefelt & Rexfelt, 2017, p. 11). More specifically, research on how to foster the consideration of the customer perspective within the development of CIs is needed as well as approaches to identify customer barriers and interventions to overcome these (Camacho-Otero et al., 2018, p. 17). Based on this problem the **research aim** is to ground interventions to overcome customer barriers towards CI in the case of consumer electronics companies. To achieve this research aim, the following **research objectives** were defined:

1. to analyse the problematic situation of CE and CI implementation in business and academia context with a special focus on the customer perspective.
2. to perform a literature analysis in order to:
    a) lay the theoretical foundations including foundations of CE, CI, as well as behavioural change and innovation adoption theories.
    b) define and categorise customer barriers towards CIs based on literature.
    c) analyse existing theoretical approaches to systematically identify and overcome customer barriers towards CI.
3. to ground a research methodology to explore approaches to identify and interventions to overcome such in the practical context of European consumer electronics companies.
4. to empirically explore and validate approaches to identify and interventions to overcome customer barriers towards CI in the case of European consumer electronics companies.
5. to ground interventions and corresponding actions to overcome customer barriers towards CI.

Methodology. The research design of the following study is illustrated in Fig. 1. In the first part of the thesis, the relevance of CE and CI, as well as a more detailed analysis of the underlying research problem, are elaborated. In the second part, theoretical solutions will be discussed. Five main research areas are introduced based on an extensive literature analysis. The areas include foundations of CE and CI, theories on circular behaviour, behavioural change, and CI adoption, main customer barriers towards CI as well as existing theoretical approaches to identify and overcome customer barriers towards CI. In order to explore and validate approaches to identify and interventions to overcome customer barriers towards CI in practice, the research scope has been limited to the case of European consumer electronics companies. This limitation was chosen as the consumer electronics industry is one of the most environmentally harmful industry sectors. At the same time, the regulative pressure towards a circular transition is especially high in the EU. Due to the unexposed character of the research context a qualitative research method is pursued based on the combination of semi-structured expert interviews and case study analysis. Thereby, the interview guideline was developed based on previously defined research indicators which are part of the innovation barrier categorisation by Ram & Sheth (1989) as well as the behavioural change interventions (BCW) by Michie et al. (2014). Based

on purposeful sampling, ten interviews have been conducted in total, four with experts of different relevant fields and six with practitioners of four selected case companies. To analyse the data, a qualitative content analysis was performed using MAXQDA, which led to the grounding of approaches to identify and interventions to overcome customer barriers towards CI. The results are presented and discussed in the final part of the thesis, followed by limitations, recommended prospects for further research, and the main conclusions on overcoming customer barriers towards CI in the case of customer electronics companies.

This research is a complementary work to the research project „Circular Design – TOOLS for product integrity" at Kaunas University of Technology.

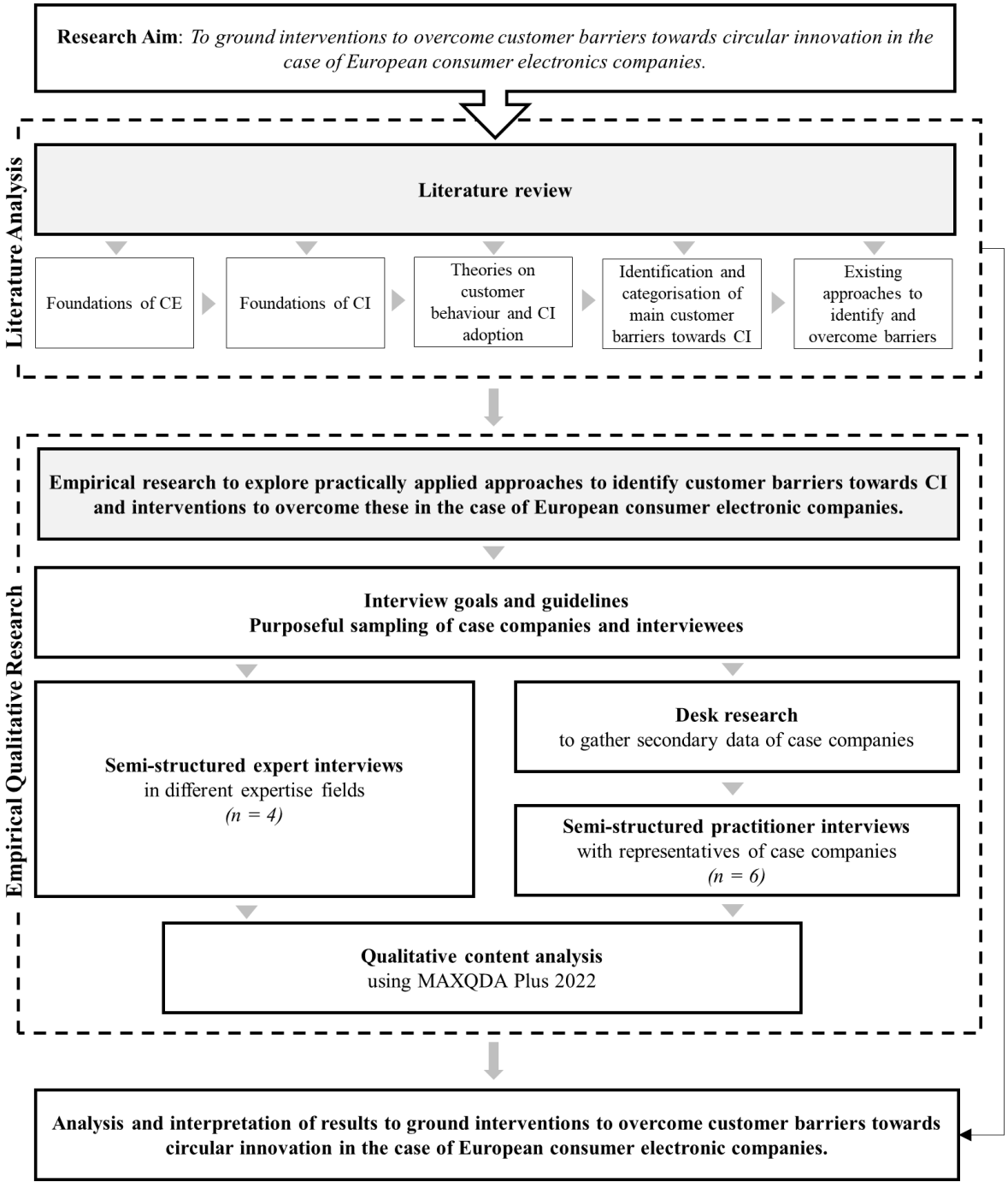

Fig. 1. Research design (own illustration)

1. Problem Analysis of Customer Barriers Towards Circular Innovation

This part of the thesis provides a more detailed problem analysis and is divided into four sub-chapters.

1.1. Limitations and Problems of Linear Economy Leading to a Circular Economy Need

The world's prevailing economic system is based on a so-called linear economy (LE)which is defined as "an economy in which finite resources are extracted to make products that are used - generally not to their full potential - and then thrown away ('take-make-waste')" (EMF, 2021a, p. 3). Often LE is associated with waste, pollution, climate change, significant energy use, biodiversity loss, and the degradation of natural systems (De Angelis, 2018; EMF, 2020), which describe frequently criticised ecological limitations of LE. In addition, economic problems are caused by the LE. These include the inefficient use of resources which leads to decrease in profitability, the risk of fluctuating raw material prices, and supply security due to resource scarcity. Table 1 summarises the main LE limitations.

Table 1. Limitations of the linear economy for corporate businesses (own review)

Dimension	Limitations of Linear Economy	Authors
Economic	Inefficient resource usage causes lower profitability and financial efficiency	(Prieto-Sandoval et al., 2018, p. 612)
	Risk of fluctuating raw material prices	(EMF, 2015a, p. 28)
	Risk of supply security and safety due to resource scarcity	(EMF, 2015a, p. 29)
Ecologic	Contributory negligence into natural degradation, climate change, biodiversity loss, and pollution caused by extensive extraction of natural resources, water and energy, emissions of toxic substances, and extensive waste production	(Aloini et al., 2020) (De Angelis, 2018) (EMF, 2015a, p. 29)
	Assumption of unlimited access to limited resources and energy	(De Angelis, 2018) (EMF, 2015a, p. 19)

As a result of the ecological limitations of the prevailing LE, several environmental problems occurred and worsened over the past decades. This development led to increased environmental pressure, which can be understood as "the activities and factors that cause environmental change", for instance, extensive land, water, and energy usage, wasteful resource consumption as well as emission of greenhouse gas (Writer, 2020). In the following, two examples of environmental problems are presented, which make the term environmental pressure more tangible.

In the current world, humanity is living beyond the limits of the planet earth (van Veldhoven et al., 2021, p. 12). The *increasing consumption* can be represented by the "Earth Overshoot Day" (EOD). This day indicates the date when the global population consumed more resources than the planet can regenerate within one year. Since 1970 the global population has been causing an almost constantly increasing world's ecological deficit, which means that the annual demand for resources overshoots the planet's biocapacity with a rising trend. As the overshoot day 2021 was on July 29th, symbolically, the global population demanded resources of 1.7 Earths to be in balance with the regeneration of natural resources (Global Footprint Network, 2021). Next *global warming* has been increased successively since 1850 (ipcc, 2021, p. 6). The climate change is not only caused by natural factors but mainly by humans. According to OECD, without any urgent action, the average global temperature could rise by 3 to 6°C by 2100 (OECD, 2021b). A dangerous development as weather and climate extremes happen today are predicted to become more frequent and extreme as climate change accelerates (EMF, 2021b; ipcc, 2021, p. 11).

Based on the limitations of the LE and the problems that it causes, several scientists and experts worldwide agree on the need for switching towards a new economic model which includes fundamental changes within and rethinking of the prevailing operating system (EMF, 2015a, p. 19, 2015a, p. 3; European Commission, 2020). Therefore, the creation of public demand to operate within the boundaries of our planet is required and ecological limits must be central to economic decision-making (Global Footprint Network, 2021). In this context, the CE concept has proven to address mentioned LE limitations (EMF, 2020, p. 4). Thereby, CE can be understood as

> *"an economic system in which resource input and waste, emission, and energy leakages are minimised by cycling, extending, intensifying, and dematerializing material and energy loops"* (Geissdoerfer et al., 2020, p. 3).

Within the broad context of sustainability, CE has become a highly discussed topic in practice as well as in natural science and management literature (Alhawari et al., 2021, p. 1; Aloini et al., 2020, p. 9). The following two chapters will dig deeper into policy and practitioner attempts to implement CE.

1.2. European Policy Initiatives for Circular Economy

Next to scientific researchers, policymakers realised the increasing environmental pressure and urgency of action. The G20 countries account for about 75% of global material use and 80% of global GHG emissions and therefore play an essential role in the transition towards and implementation of a CE (OECD, 2021a, p. 5). As the need for a new economic model is fostered by the limitations of the prevailing linear model, policymakers worldwide started to develop initiatives in order to reduce environmental pressure. The following chapter provides exemplary ongoing policy initiatives which are closely connected to CE.

In September 2015, the UN established the "*2030 Agenda for Sustainability"*. The core of the agenda are "*17 UN Sustainability Development Goals"* (SGD) which represent "an urgent call for action by all countries - developed and developing - in a global partnership." The SDGs aim to "improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests" (United Nations, 2021b). Thereby, the Agenda for Sustainability serves to "ensure that all nations and all people everywhere are reached and included in achieving the SDGs" (UNHCR, 2021). One SDG specifically relevant for CE is SDG 12 „Responsible Consumption and Production." This goal includes for instance the target to sustainably manage and use natural resources, substantially reduce waste generation, and remove market distortions that encourage wasteful consumption (United Nations, 2021a). However, CE also contributes to other SDGs, for instance SDG 2 "End Hunger" by sustainable food production, SDG 6 "Clean Water", SDG 7 "Affordable and Clean Energy", SDG 13 "Climate Action", and SDG 15 "Life on Land" (Triodos Research, 2017).

In December 2015, the European Commission (EC) established the first-ever legally binding global climate change agreement, the "*Paris Agreement*". This agreement is "a global framework to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C". Furthermore, countries impacted by climate change or active in fighting against climate change are getting support based on this agreement (European Commission, 2021c). In December 2019, the EC passed the "*European Green Deal*" which is "an ambitious package of measures ranging from ambitiously cutting GHG emissions, to investing in cutting-edge research and innovation, to preserving Europe's natural environment" (European Commission, 2021b). The deal aims to foster the implementation of the Paris Agreement by committing to remake Europe's economy for climate neutrality by 2050. "The Green Deal covers areas such as energy, construction, agriculture and

transport, and further develops both the concept of 'circular economy', as well as the EU's biodiversity strategy" (Buth, 2020).
In March 2020, the EC published the new „*Circular Economy Action Plan*" (CEAP), a fundamental component of the European Green Deal. By announcing CE initiatives along the entire product life cycle, the CEAP 2020 aims to promote the EU transition towards CE and, hereby to reduce environmental pressure. The CEAP 2020 "targets how products are designed, promotes circular economy processes, encourages sustainable consumption, and aims to ensure that waste is prevented, and the resources used are kept in the EU economy for as long as possible" (European Commission, 2020). As part of the CEAP the EC proposed to establish a "*Global Alliance on Circular Economy and Resource Efficiency"* (GACERE). This alliance aims "to provide a global impetus for initiatives related to the circular economy transition, resource efficiency, and sustainable consumption and production, building on efforts being deployed internationally." Furthermore, GACERE members are supposed to work together in multilateral fora like the UN General or Environment Assembly (European Commission, 2021a).

1.3. Relevance of Circular Economy and Circular Innovation for Companies

Next to policymakers, also companies deal with the implementation of the CE concept. Practitioners even state that it is not a matter of whether but of when to get to CE, especially when considering that start-ups keen to scale are threatening to those established companies that pursue a "wait-and-see" approach in the context of a CE transition (Kirchherr, Hekkert, et al., 2017, p. 10, 2017, p. 11). In fact, CE offers several benefits which drive companies to initiate CE. According to the Ellen McArthur Foundation (EMF), CE not only tackles the negative impacts of LE but also enables a systemic shift based on long-term resilience and provides economic opportunities and environmental and societal benefits (EMF, 2020, p. 4). The following represents exemplary drivers and benefits of different nature, including the categories of economy, ecology, society, organisation, institution, and regulation as well as technology and supply chain (Aloini et al., 2020). A tabular overview is provided in Appendix 1a (see page 112).

From an **economic perspective**, companies are driven by the risk of economic inability to act as resource scarcity is increasing (European Parliament, 2015). This global resource shortage leads to an increase and volatility in raw material prices which next to increasing competitive pressure and global sustainability awareness and investment is another CE driver for corporates (EMF, 2015b, p. 6; Planing, 2015, p. 2). Furthermore, CE offers companies the possibility to improve their cost efficiency, profitability, revenue streams, as well as competitiveness based on new business development and innovation opportunities (Aloini et al., 2020, p. 5; Liao & Tsai, 2019, p. 324; van Dam et al., 2020, p. 13). For instance, by a transition from LE to CE, the cost of remanufacturing smartphones can be decreased by about 50% per device (EMF, 2015b, p. 8). Furthermore, the EMF has estimated that in medium-lived complex products industries, CE has the potential of saving up to $630 billion in material costs annually at an EU level for an 'advanced' scenario. Even more is assumed in a fast-moving consumer goods industry with up to $700 billion in material savings annually (EMF, 2015a, pp. 23–24). Furthermore, especially CBM provides firms with new ways of value creation as well as stronger and longer-lasting customer relationships (De Angelis, 2018, pp. 23–24; EMF, 2015b, p. 11). To give an example, Signify and Regency, both established lighting companies, started to sell "light as a service". With this so-called product-service system (PSS), they offer, fund, and install more energy-efficient lighting options for the business customers (Early, 2020).

From an **ecological perspective**, companies are driven by the increasing environmental problems, including climate change, global warming, as well as resource overconsumption and scarcity (Aloini et al., 2020, p. 5). According to EMF Denmark's producing and hospital sector (covering 25% of the Danish economy) show a potential to reduce the carbon footprint by 3–7% as well as the consumption of raw materials by 5-50% for selected materials by 2035 (EMF, 2015b, p. 11). Thereby, CE provides the benefit to reduce negative environmental impact for instance by increasing resource efficiency or reducing GHG emissions.

From a **social perspective**, companies are driven by the increasing global awareness and need for sustainability and can benefit from new employment opportunities (Aloini et al., 2020, p. 5). Here, EMF states that CE in Denmark has the potential to create 7,000-13,000 job equivalents by 2035 (EMF, 2015a, p. 13). Even if those estimations rely on several assumptions and involve a certain level of uncertainty, they illustrate the generally positive impact of CE.

From an **organisational perspective**, companies are driven by the risk of losing their brand reputation and CSR ranking in case they are not transitioning towards CE or a more sustainable way of making business (McCulloch, 2021). Additionally, the companies can benefit from CE by developing future relevant new skills and capabilities for CE (Aloini et al., 2020, p. 5).

From a **regulatory perspective**, companies are driven by established regulations and standard requirements, for example, those mentioned in chapter 1.2. Additionally, the Extended Producer Responsibility (EPR) Directive "is a policy approach under which producers are given a significant responsibility – financial and/or physical – for the treatment or disposal of post-consumer products" (OECD, 2021c). For example, in the UK, producers of electrical devices are forced to recycle at least 65% of the average weight of e-waste placed on the market (Early, 2020). Furthermore, companies can benefit from supportive regulatory funds, taxations, and subsidies (Aloini et al., 2020, p. 5).

From a **technological perspective**, companies are driven by technological advancements such as online platforms, the internet of things (IoT), blockchain, or 3D printing technologies, which substantially reduce waste in manufacturing (EMF, 2015a, p. 31; Nascimento et al., 2019, p. 18; Sipka & Hedberg, p. 21). Those technologies can be used as an enabler for CBM which is necessary for the transition towards CE.

Lastly, from a **supply chain perspective**, companies are driven by the risk of resource scarcity which was previously mentioned in the economic perspective. With the transition to CE, firms can benefit from the potential of reducing supply chain dependence and the possibility of multi-disciplinary, increased availability of resources and capability (Tura et al., 2019, p. 92). Furthermore, CE offers new opportunities for joint maintenance optimisation of supply chain actors as well as increased supply chain efficiency (Estarrona et al., 2019, p. 109).

While the previous section illustrated the relevance of CE for corporate business. Constructively, the following puts a particular emphasis on the relevance of CI.

The occurrence of environmental problems and the increasing awareness of the urgency of action transformed the competitive landscape and forced corporates to change how they think about products, technologies, processes, and business models (Nidumolu et al., 2009). In a corporate context, this change is often associated with innovation (Horbach & Rammer, 2020, p. 616) as they enable companies to rethink their current business and spark creative solutions (EMF, 2015a, pp. 23–24). CIs empower companies to establish economically viable ways to implement CE principles (Bocken et al., 2016, p. 308; Circular Economy Transition, 2021, p. 15). Consequently, form a

corporate business perspective, CI represents an enabler to embrace the necessary change to transit towards CE and can be considered as highly relevant for companies (Eisenreich et al., 2021, p. 9).

Even though policy regulations, benefits, and drivers exist, the concept of CE is still not widely in use (De Angelis, 2018; Elzinga et al., 2020, p. 1; Kirchherr, Hekkert, et al., 2017, p. 4; Parajuly et al., 2020, p. 6; Planing, 2015, p. 7) (Bocken et al., 2019, p. 1). According to the Circularity Gap Report 2021 the world economy's circularity, measured by the relation of cycled materials and material input of the global economy, shows a low value of only 8.6% leading to a massive circularity gap (van Veldhoven et al., 2021, 12). Furthermore, although CIs have the potential to enable companies from transit towards CE, recent developments of CIs show relatively low market success compared to linear alternatives (Rexfelt & Selvefors, 2021, p. 1). The reasons for this problem are several barriers that hinder companies from transit towards CE or hinder customers from adapting CIs (Araujo Galvão et al., 2018, p. 79; McCrea, 2020). The following chapter will first briefly introduce the main barriers companies face when implementing the concept of CE before going more into detail in the context of customer barriers towards CI.

1.4. Circular Economy Barriers and Customer Barriers Towards Circular Innovation

To introduce the main barriers that companies face when implementing CE, the categories, including barriers in the context of economy, regulation, organisation, technology, supply chain, as well as society are presented in the following.

From an **economic perspective**, CE requires high upfront investments, that seem unprofitable from a short-term perspective. Also, the lack of financial capabilities is hindering as well as the lack of tools and methods to measure long-term economic benefits of CE projects (Tura et al., 2019, p. 92).

From a **regulatory perspective**, companies face complex, overlapping, and sometimes incoherent regulations, including a lack of supportive regulatory frameworks such as tax relief or subsidies. Also, prevailing subsidies, financial aid, and uncosted externalities of the LE are hindering as well as the lack of CE knowledge of policy decision-makers. (Tura et al., 2019, p. 92; Urbinati et al., 2019, p. 10)

From an **organisational perspective**, companies face the incompatibility of CE projects with existing (linear) operations and development targets as a challenge. Also, the lack of long-term and system-based thinking is hindering as well as conflicts with existing business culture, heavy organisational hierarchy, and lack of management support (Urbinati et al., 2019, p. 10). Additionally, organisational lack of knowledge and skills hinders the CE implementation (Tura et al., 2019, p. 92).

From a **technological perspective**, companies can lack information and knowledge about enabling technologies as well as access to technologies and technological skills themselves (Urbinati et al., 2019, p. 10).

From a **supply chain perspective**, companies are challenged by the lack of supply network support caused by a strong industrial focus on linear models as well as hindered by the lack of sustainable (circular) material alternatives (Melati et al., 2021; Tura et al., 2019, p. 92).

Lastly, the **social perspective** includes this thesis's focus area, especially meaning customer barriers towards CI. Thereby, companies are confronted with uncertainty about the customer acceptance and demand towards CI (Araujo Galvão et al., 2018, p. 82; Kirchherr, Hekkert, et al., 2017, p. 7). Studies have found that existing concepts to implement CE, such as product-service systems or circular business models, show relatively low adoption rates (Camacho-Otero et al., 2017; Guldmann & Huulgaard, 2020, p. 10). Furthermore, in a case study analysis of 30 sampled SMEs dealing with CE, 54% of the respondents highlighted the lack of support from the demand network as their main barrier

in the transition towards CE (Rizos et al., 2016, p. 10). Also, the Copernicus Institute of Sustainable Development, Utrecht University, the Netherlands, and Deloitte have jointly carried out research on CE barriers in the EU, including a survey with 153 businesses, 55 government officials, and expert interviews with 47 CE leaders. The research revealed cultural barriers including the lack of customer interest and awareness as one of two main and most suppressing CE barriers. The research revealed cultural barriers including the lack of customer interest and awareness as one of two leading and most suppressing CE barriers (Kirchherr, Hekkert, et al., 2017, p. 3, 2017, p. 8). Lastly, in a cross-case study Guldmann and Huulaard (2020) show that seven out of twelve case companies mention unclarity about market demand as a main CE barrier (Guldmann & Huulgaard, 2020, p. 7). These examples illustrate a significant problem in dealing with customer barriers towards CI within a practical environment. To address customer barriers companies have already started implementing initiatives such as customer education and behaviour-change programs. For instance, Coca-Cola launched a community legacy program called "Zero Waste Cities," to accelerate behavioural change (Clarke, 2021). However, no approach exists that enables companies to systematically identify and then overcome customer barriers towards CI within the development process of CI. Therefore, methods and guidelines need to be developed as such approaches are rare (Selvefors et al., 2018, p. 2055).

To summarise, the world's economic system is based on a linear model, which has limitations leading to serious environmental problems such as global warming and increasing overshoot of the plant's biocapacity. Therefore, the need for a new economic system is rising. In practice as well as in academia, the most discussed and well-known solution is a system transition towards a CE. Policymakers are aware of the possibilities of this concept and advocate the transition towards a CE by developing several CE policies and initiatives, including the 2030 Sustainability Agenda with the UN 17 SDGs, the Paris Agreement, the Green Deal, the EUCEAP as well as the GACERE. Moreover, several drivers and benefits motivate corporates to transit towards CE. However, even if benefits, drivers, and policy regulations exist, the concept is still not widely used. Reasons for that are several barriers which companies face. This emphasises social barriers, more specifically customer barriers towards CI, as recent developments of CIs show rather low adoption rates. This is a significant and frequently mentioned social barrier for companies as the adoption of CIs is understood as an enabler for companies to establish economically viable ways to implement CE principles which is critical to make the switch to CE. Therefore, the following provides the theoretical foundation for identifying and overcoming customer barriers towards CI.

2. Theoretical Solutions to Overcome Customer Barriers Towards Circular Innovation

This chapter introduces the main theoretical foundations and solutions that help to identify and overcome customer barriers towards CI.

2.1. Theoretical Foundation of Circular Economy

This first part focuses on the theoretical foundations of CE by introducing the definition and differentiation of CE compared to sustainability, as well as providing key activities, principles, and frameworks of CE.

2.1.1. Definition and Differentiation of Circular Economy Compared to Sustainability

The term circular economy is in widespread use. Over 100 CE definitions exist as the concept and its application have almost exclusively been developed and executed by practitioners of different expertise and interest fields (Corvellec et al., 2021, p. 2). Therefore, many researchers claim the need for more clarity and convergence within the CE terminology (De Angelis, 2018, p. 67). Based on an extensive and widely recognised literature review by Kirchherr (Kirchherr, Reike, & Hekkert, 2017), including the analysis of 114 CE definitions, Geissdoerfer identified several shortcomings and revisited those 114 CE definitions, coming up with a more recent understanding of CE as

> "[…] *an economic system in which resource input and waste, emission, and energy leakages are minimised by cycling, extending, intensifying, and dematerializing material and energy loops. This can be achieved through digitalisation, servitisation, sharing solutions, long-lasting product design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling*" (Geissdoerfer et al., 2020, p. 3).

Next to CE, the term "sustainability" increasingly receives attention. However, both terms are often blurred, confused, and wrongly interchanged (Corvellec et al., 2021, p. 5; Geissdoerfer et al., 2017, p. 757). Therefore, the differences and similarities between the terms remain ambiguous. The following section aims to provide more clarity about the differences and similarities as well as the relationship between CE and sustainability. The main differences between CE and sustainability are shown in Table 2. The comparison shown in this table is mainly based on an extensive literature review conducted by Geißdoerfer (Geissdoerfer et al., 2017). This research has shown that sustainability is understood in a broader more holistic way than CE in many categories. The most apparent difference between the two terms is that only sustainability is strongly connected to the triple-bottom-line concept established by Elkington in 1994. Based on this concept, the main goal of sustainability is to reach long-term profitability based on three dimensions: environment, economy, and society, also known as "planet, profit, and people" (3P) (Elkington, 1994). Contrary, CE focuses on the establishment of a new economic system which in the first place aims to close resource loops and therefore leads to economic and environmental benefits. CE advocates as the EMF state that CE also provides social benefits, for example, by establishing new employment options (EMF, 2020, p. 4). However, critics especially point out that CE lacks a clear social dimension (Corvellec et al., 2021). Furthermore, the origins of sustainability can be traced back to the environmental movements caused by the industrial revolution as well as the ecological crisis. In contrast, CE's origins are closer connected to the economic risk of resource scarcity and increasing raw material prices. From a scientific perspective, CE has origins in different complementary schools of thought including for instance, cradle-to-cradle (C2C) design, functional service economy (performance economy),

biomimicry, industrial ecology, natural capitalism, or the blue economy system approach (EMF et al., 2015, p. 46; Lewandowski, 2016).

Table 2. Differences between sustainability and CE (own analysis)

	Sustainability	**Circular Economy**
Definition	„The human ability to ensure that the current development meets the needs of the present without compromising the ability of future generations to meet their own needs“ (Brundtland, 1987).	“An economic system in which resource input and waste, emission, and energy leakages are minimised by cycling, extending, intensifying, and dematerializing material and energy loops” (Geissdoerfer et al., 2020, p. 3).
Origins	Origin in environmental movements caused by the industrial revolution and ecological crisis (Du Pisani, 2006, p. 83) The first widely spread definition: Brundtland Report 1987 (Brundtland, 1987)	Origin in economic risk of resource scarcity and increasing resource prices (Coste-Maniere et al., 2019, p. 132) Mentioning of a “closed” also called “spaceman” economy by Boulding in 1966 (Boulding, 1966) Connection between CE and a material balance principle by Knees 1970 (Kneese et al., 1970) Fist conceptualization of a circular economic model by Pearce & Turner in 1990 (Pearce & Turner, 1990)
Main Goal	Open-ended and dependent on considered agents and their interests. Long term profitability based on ecological responsibility, social sustainability, and economic sustainability (Elkington, 1994).	Closing the loop: eliminate all resource inputs as well as waste and emission leakages of a system
Motivation	Generally diffused and divers / often embrace reflexivity and adaptivity to different contexts Corporate Sustainability is the outcome of a triple optimisation called Triple-Bottom-Line (3P) (Elkington, 1994)	The consumption of limited resources in a linear system threatens the long-term base for economic prosperity There is an extensive interdependence between the economy and the environment (Pearce & Turner, 1990)
Focus Dimensions	Horizontal system: environment, economy, and society on an equal level (Elkington, 1994)	Hierarchical system: focus on economy resulting in possible benefits for the environment and indirect benefits for society (Geissdoerfer et al., 2017, p. 765)

Next to differences, there are several similarities which might be one reason for the mistaken interchangeable use of CE and sustainability (Geissdoerfer et al., 2017). First, both terms consider *environmental hazards* as each is connected to intra- and intergenerational commitments motivated by environmental risks. Second, both terms include a g*lobal perspective* as each considers problems on a global level. Third, both terms include *interdisciplinarity* as each makes use of interdisciplinary approaches in order to integrate non-economic (environmental) aspects into new developments. In both cases, this causes the need for innovation, system change and thinking as well as stakeholder cooperation. Fourth, both consider *regulations* and incentives as key tools for their implementation. And lastly, *business model innovation* (BMI) as both concepts consider BMI as an opportunity to cope with incremental technological capabilities.

To conclude, CE and sustainability have clear differences in their general definition, origins, main goals, and motivation. The most significant difference lies within the dimensions they aim to contribute to. For CE, those dimensions are mainly economy and environment, while for sustainability, the underlying triple-bottom-line approach also includes a social dimension. Nevertheless, CE and sustainability show similarities regarding their consideration of environmental

hazards, their global and interdisciplinary perspective, as well as the consideration of regulations, incentives, and BMI as an enabler. Furthermore, even if some CE critics describe the relationship between CE and sustainability as a trade-off, their mentioned similarities cause an instead conditional or beneficial relationship. In the context of this thesis, the result of the comparative analysis indicates that the following research most probably will also have implications for companies aiming to reach sustainability goals. Furthermore, due to the closeness of both terms in specific aspects, literature on sustainability will probably provide valuable input for further research.

2.1.2. Key Principles of Circular Economy

According to EMF (2015), CE is based on three key principles (EMF, 2015a, p. 22). *Principle 1* means to preserve and enhance natural capital, e.g., usage of renewable energy. *Principle 2* means to optimise resource yields by circulating products, components, and materials at the highest utility, e.g., sharing or looping products and extending product lifetimes. *Principle 3* means to foster system effectiveness by revealing and designing out negative externalities, e.g., water, air, soil, and noise pollution; climate change; toxins; congestion; and negative health effects related to resource use.

Furthermore, several approaches exist which try to cluster CE key activities. As this thesis is focusing on rather technical resource cycles the "butterfly diagram" published by EMF (see Appendix 1b, page 113), which divides the whole economic system into a biological and a technological cycle, can be used to illustrate the main CE activities relevant for the following research. The activities included in this technological cycle consider the customer as a user of technical non-consumed materials such as metals, plastics, or wood. In this technosphere, different loops understood as key activities exist aiming to return technical material back into the economic system after they were used including sharing, maintaining and prolonging, reusing, and redistributing, refurbishing, remanufacturing, as well as recycling. Thereby, EMF emphasises the power of the "inner circle", which means the tighter the loops the larger the positive environmental and economic impact (EMF, 2013).

To understand which aspects are especially relevant to corporates in the field of CE and impact the development of CI, the "ReSOLVE Framework" is introduced in the following. This framework translates the three CE core principles defined by EMF into six business action: regeneration, sharing, optimisation, looping, virtualisation, and exchange. Each action represents a circular business opportunity and correlates positively with the other actions which means that one action can foster and accelerate the performance of another (EMF, 2015a, p. 22). Both the CE resource loops as well as the ReSOLVE actions are described in more detail in Appendix 1c (see page 114).

Lastly, next to the ReSOLVE framework, researchers have developed so-called "R-Frameworks" representing mechanisms to enable and implement CE. As R-Frameworks describe the "how-to" of CE, researchers describe them as a core principle of CE (Kirchherr, Reike, & Hekkert, 2017, p. 223). In this context, the 3R-Framework is the most recognised one (Yang et al., 2014, p. 217). This framework states that CE is based *reducing, reusing, and recycling.* Corresponding to these activities, there are three fundamental approaches to CE resource flows (Bocken et al., 2016, p. 309). *Reducing resource flows (reduce)* targets to achieve resource efficiency and narrow resource flows by using fewer resources per product. *Slowing resource loops (reuse)* targets to extend and/or intensify the product's utilisation period by designing long-life goods and product-life extension. *Closing resource loops (recycle)* targets to achieve a circular flow of resources by practising recycling activities that close the loop between post-use and production. Next to the 3R-Framework there are also 4R, 6R, and even 9R-Frameworks which a more nuanced.

To conclude, CE is based on the three principles of preserving and enhancing natural capital, optimising resource yields, as well as fostering system effectiveness. Those principles can be translated into six main business actions (regenerate, share, optimise, loop, virtualise, and exchange), which already include the main resource loops of the technological circular cycle (share, maintain, reuse, redistribute, refurbish, remanufacture, and recycle). Lastly, CE is based on three main resource flow approaches: reducing, slowing, and closing resource flows.

As mentioned in the problem analysis, CI represents an enabler to embrace the required change to transit towards a CE system from a corporate business perspective. Therefore, the following chapter introduces the theoretical foundations of CI.

2.2. Theoretical Foundations of Circular Innovation

This chapter provides the necessary theoretical foundations to understand the context of CI.

2.2.1. Definition and Types of Circular Innovation

The literature review on CI revealed that the term CI is rarely used as a keyword in scientific literature. For instance, the database SCOPUS includes only six papers with the keyword "circular innovation". The same is true for similar synonyms such as CE innovation or circular-oriented innovation. However, only one paper was found which provides a more precise and concrete definition of circular-orientated innovation (COI). This thesis understands CI as a synonym for COI, which allows referring to the definition of COI in order to understand CI. Brown et al. (2019) defined COI as

> "*the coordinated activities that integrate CE goals, principles, and recovery strategies into technical and market-based innovations, such that the circular products and services that are brought to market purposively maintain product integrity and value capture potential across the full life-cycle*" (Brown et al., 2019, p. 3).

Thereby, the OECD (2018) defines business innovation itself as

> *"a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm" (OECD/Eurostat, 2018, p. 70).*

Based on these definitions, as well as relevant aspects of CI, which were introduced earlier and a further literature review on papers in the context of CI, Table 3 shows a comparison of conventional, linear innovations (LI) and CI. The comparison shows that both LI and CI include common **innovation features** that were introduced as part of the innovation definition (Baregheh et al., 2009, p. 1334; OECD/Eurostat, 2018, p. 70). Considering the **main goal**, LIs mainly aim to increase competitiveness, differentiation, and economic positioning within the market. In contract, CIs aim to improve economic performance and reduce negative environmental impact by enabling CE and closing the loop as well as maximising the value of component materials (Hannon et al., 2016; Schmitt, pp. 5–6; Vorobiova, 2020). Furthermore, LIs are based on an open-loop **approach,** "take-make-waste", where **economic success** is attached to physical material as the BM focuses on products and revenue streams based on the purchase of physical material. Contrary, CIs are based on a closed-loop approach, "reduce-reuse-recycle", where economic success is detached from physical material as the BM focuses on services and revenue streams based on servitisation (Estarrona et al., 2019, p. 110). Considering the **product design**, LIs include products which are designed for a short lifetime and often planned obsolescence (Dalul, 2020). Contrary, CIs are designed based on circular principles and design strategies, including design for durability, repairability, modularity, or upgradeability

(Horbach & Rammer, 2020, p. 616). When developing LI, practitioners usually take in a short-term **perspective** combined with a linear way of thinking as (if even) only a single Product Life Cycle (PLC) is considered. Also, LI often means a non-feedback-based perspective as the intensity of cooperation within and beyond the focal **value chain** is rather low. Contrary, when developing CI, practitioners have to take in a long-term perspective combined with system thinking as multiple PLCs have to be considered (Centobelli et al., 2020, p. 1744; Kirchherr, Reike, & Hekkert, 2017, p. 227). Additionally, the **value creation** of LI is attached to material ownership which is perceived as a status. Consequently, customers represent an owner who is not involved in feedback loops as owned products are discarded after usage. Contrary, the value creation of CI is detached from material ownership. Here, the **customer represents** a user and is highly involved in feedback loops such as repairing, maintaining, returning, and recycling. This involvement requires environmental consciousness and awareness as well as circular behaviour (Camacho-Otero et al., 2018, p. 15).

Table 3. Comparison of linear and circular innovation (own analysis)

	Linear Innovation	**Circular Innovation**
Innovation features	• New or improved character • Significant differentiation from previous products/services • Multi-stage process of transforming ideas into products/services/BMs etc.	
Main Goal	• Increasing competitiveness, differentiation, and economic positioning within the market	• Improving economic performance while decreasing negative environmental impact by enabling CE and closing the loop as well as maximising the value of component materials
Approach	• Open loop: "take-make-waste"	• Closed loop: "reduce-reuse-recycle"
Economic Success	• Attached to physical material	• Detached from physical material
Business model	• Product focus • Revenue by selling as many products as possible	• Service focus • Revenue by alternative streams and servitisation
Product Design	• Short life and planned obsolescence	• Based on circular principles and design strategies, e.g., durability, repairability, modularity, upgradeability etc.
Perspective	• Short term • Single PLC (purchase to sales) • Linear thinking • Non-feedback based	• Long term • Multiple PLC • System thinking • Feedback based
Value Chain	• Lower intensity of cooperation within and beyond the focal value chain	• Higher intensity of cooperation within and beyond the focal value chain
Value creation	• Value creation is attached to material ownership which is perceived as a status	• Value creation is detached from material ownership
Customer role and behaviour	• Ownership based usage • Tendency to over consumption • No involvement in feedback loops: discard after use • No need for environmental conscious and awareness	• Access-based usage (collaborative consumption) • Tendency to more conscious usage • High involvement in feedback loops: repair, maintain, return, recycle etc. after use • Need for environmental conscious and awareness

A more specific introduction in the customer perspective on CE and circular behaviour, in general, is provided in chapter 2.3.1. Lastly, as CI can be understood as an enabler to CE, it contributes to

sustainability and sustainable development in the same way as CE. This means that the main contribution of CI is based on the dimensions of economy and environment, while indirect social contributions are possible as well (Horbach & Rammer, 2020, p. 615). Considering the main goal of LI, the main focus lies in the dimension of economy, while a direct contribution to sustainability could not be found. **Examples** for LI could be the iPhone X, plastic straws when they were new, the first curved lighting system, or a Porsche 911 GT3. Contrary, examples for CIs could be the Fairphone 4, reusable glass straws, light-as-a-service business models, or sharing services for electric vehicles.

As the OECD definition of innovation has shown, innovation can refer to products, services, as well as business models. For a better understanding of CI, the following provides more details on the terms of circular products, circular services, as well as circular business models and circular business model innovations as contrary to the first three terms, the latter one is an already frequently used and defined term within academic literature. Based on the definition of CE, **circular products** can be understood as *products developed based on CE principles in order to reduce negative environmental impact and increase economic efficiency* (own definition based on insights from chapter 2.1). Examples of circular products could be fully compostable and biodegradable napkins as well as all kinds of "re"products including reused, repaired, remanufactured, refurbished, and recycled products which the customer purchases. In the same way, **circular services** can be understood as *services that are developed based on CE principles in order to reduce negative environmental impact and increase economic efficiency* (own definition based on insights from chapter 2.1). Examples of circular services are all kinds of services that aim to prolong the product life cycle for the customer incl. repairing, upgrading, or maintenance as well as a take-back and recirculate service (Selvefors et al., 2018, p. 2053). Other than circular products and services, the terms **CBM** and **CBMI** are more common and, therefor,e already defined. According to Nußholz (2017) a CBM describes

> "*how a company creates, captures, and delivers value with the value creation logic designed to improve resource efficiency through contributing to extending useful life of products and parts (e.g., through long-life design, repair and remanufacturing) and closing material loop*s" (Nußholz, 2017, p. 12).

Examples of CBM could be sharing or leasing business models, as well as the most common type of CBM, which are Product Service Systems (PSS). According to Goedkoop (1999) a product-service system (PSS) is *"a marketable set of products and services, jointly capable of fulfilling a client's need*" (Goedkoop et al., 1999). The term Product as a Service (PaaS) describes a synonym for the same definition. However, in academia, the term PSS is more commonly used and will be focused on in the following (Rombouts, 2010). As a PSS enables companies to decouple economic success from material consumption, it provides the opportunity to reduce environmental impacts of economic activities (Gopalakrishnan & Matthews, 2018, p. 1). The aim of a PSS as a special type of servitisation is to: close materials cycles, decrease consumption and material through alternative types of product use, e.g., collaborative consumption system, increase resource productivity and dematerialisation, including the decoupling of economic success from physical material, as well as increase customer value as an output and provide access to product benefits without ownership (Akbar et al., 2016, p. 1). Thereby, asset performance and utilisation are valued higher than ownership. Based on those characteristics, a PSS can be understood as an enabler of CE (Baines et al., 2007, p. 1545). An example for PSS could be home appliances-as-a-service which fosters reuse, repair, and extended lifecycles.

Continuing, CBMI can be understood as an enabler of CE principles throughout the PLC (De Angelis, 2018; Gillabel et al., 2021). Brocken et al. (2019) define the process of CBMI as

> "*innovating the business model (i.e., updating the elements of an existing business model, or establishing a new organisation and associated business model) to embed, implement and capitalize on circular economy practices"* (Bocken et al., 2019, p. 3).

Thereby, CBMI requires an iterative process of several phases resulting in different stages of innovation for example a single new activity added to a business model or a comprehensive change in various business model elements. Additionally, CBMI supports companies to rethink the way how they create, deliver, and capture value which can be a holistic approach to align the value creation logic of a company with circular principles (Bocken et al., 2019, p. 3). While linear BMs lose the value associated with a product or service after its usage CBMs are designed to preserve the embedded environmental and economic value within the system (Centobelli et al., 2020, p. 1740).

2.2.2. Circular Innovation in Comparison to Related Concepts

Several terms have been developed in order to link environmental concerns with innovation. However, their distinction and interrelation are not always clear (Jesus et al., 2021, p. 2). Therefore, the following will consider and distinguish terms that are closely related to CI: sustainable innovation (SI), eco-/ environmental innovation (EI), as well as frugal innovation (FI). Table 4 shows an overview of the comparison of CI related concepts.

Table 4. Comparison of CI and related concepts (own analysis)

	Eco- / Environmental Innovation	**Sustainable Innovation**	**Frugal Innovation**
Main Goal	Avoid or reduce environmental damage and increase environmental benefits compared to alternatives.	Serve sustainable development by increasing economic, environmental, and social benefits.	Achieve affordable green excellence to meet basic needs of un(der) served markets.
Similarity to CI	Achievement to contribute to environmental benefits.	Achievement to contribute to environmental and economic benefits by following a system approach.	Contribution to the fair management of limited natural resource.
Difference to CI	No pure linkage to CE and description of how to reach environmental and economic benefits. No clear intention to increase economic benefits.	Integration of social benefits as part of the triple-bottom-line approach, which is not a primary focus of CI.	Overall goal is that macroeconomic growth becomes more inclusive. No primary aim to increase environmental benefits.
Relationships	CI/EI: CI is a more economic-orientated understanding of EI. EI/SI: Together with social innovation EI is an essential part of SI.	CI/SI: CI is one part of SI and can contribute to the development of SI FI/SI: Frugality and the principles of Jugaad philosophy can support SI but does not necessarily mean sustainability.	FI/CI: FI can enable CE and therefore foster CI. However, this is not the primary aim. FI/EI: FI can lead to EI. However, this is not the primary aim.

Sustainable Innovation (SI): the term sustainable innovation is most frequently used to describe innovations that simultaneously address ecological, economic, and social concerns and therefore contribute to the triple bottom line of sustainable development (Jesus et al., 2018, p. 3001; Le Bas,

2016, p. 6). Therefore SI can be understood as the combination of social and environmental innovation (Le Bas, 2016, p. 6). In comparison to CI, similarities and differences for SI can be identified (see Table 4). While both concepts have the same goal of reducing negative environmental impact, SI is a broader approach that takes the dimension of society more into account, which CIs do not directly address.

Environmental Innovation (EI): the term environmental innovation, also known as eco-innovation, is defined as "*new or modified processes, techniques, systems, and products to avoid or reduce environmental damage*" (Kemp et al., 2001). EI aims to create environmental benefits compared to possible alternatives. Those benefits can occur within the development and production of the EI or during its usage (Le Bas, 2016, p. 6). EI is an acknowledged possibility to increase competitiveness without negative environmental impacts or burdens as well as to contribute to environmentally specified sustainability targets (Le Bas, 2018, p. 7). Therefore, EI is an essential condition towards sustainable development and can be understood as a part of SI (Jesus et al., 2018, p. 3001). The main dimensions are design dimensions, including component addition, sub-system change, and system change, user dimensions, including development and acceptance, product service dimensions, including change in product service or value chain process and relations, as well as a governance dimension (Carrillo-Hermosilla et al., 2009, p. 23). The environmental focus of EI shows a clear linkage to CE and, therefore, CI. Furthermore, EI has been recognised as a key element in fostering transition towards CE, including a circular system of production and consumption. Some authors mention that EI serves to close resource loops, including resource use efficiency, CE activities such as reusing, recycling, and BM innovation, as well as value creation and capturing (Kiefer et al., 2019, p. 339). Therefore, the relationship between transformative EI and CE is also described "to be a fulcrum for realising the potential of a new clean and coherent techno-economic paradigm" (Jesus et al., 2018, p. 3001). However, while the main goal to avoid or reduce environmental damage or even increase environmental benefit is the core of both EI as well as CI, not all EI necessarily have to be linked to a CE or contribute to CE (Jesus et al., 2018, p. 3000; Kiefer et al., 2019, p. 339). For example, innovations in material science enable a product design with less hazardous materials. Those EIs are able to promote CIs but are not automatically CIs perse. In addition, although EI is understood as an enabler for sustainable economic performance. The concept does show a clear intention or motivation for economic benefits, even if EI can serve to reach those. Furthermore, EI focuses rather on the description of "what" needs to be done in order to achieve environmental goals. At the same time, the term CI is more precise and additionally describes the "how" to achieve those goals by directly referring to CE principles.

Frugal Innovation (FI): the term frugal innovation is defined as

"*a resource scarce solution (i.e., product, service, process, or business model) that is designed and implemented despite financial, technological, material or other resource constraints, whereby the final outcome is significantly cheaper than competitive offerings (if available) and is good enough to meet the basic needs of customers who would otherwise remain un(der)served*" (Hossain et al., 2016, p. 133).

This un(der)served, lower end of the mass market is also known as the "bottom of the pyramid." According to Herstatt and Tiwari (2020) FI is based on three main criteria: substantial cost reduction, concentration on core functionalities, and optimised performance level. Based on these criteria, the aim is to reach "affordable green excellence" and make macroeconomic growth more inclusive (Herstatt & Tiwari, 2020, p. 21; Le Bas, 2016, p. 6). In comparison to CI, researchers describe FI as

a new technological paradigm that does not have the primary aim to increase environmental benefits as CI does. For example, the mini-truck Tata Acer targeting the Indian market was developed in order to meet local needs rather than environmental goals (Le Bas, 2018, p. 8). However, FI contributes to fair management of limited resources and exhibits three main environmental properties: "the ability to repair in case of failure, the possible recovery of end of life components, and recycling" (Le Bas, 2016, p. 8). Furthermore, on a high level, a frugal lifestyle is compatible with the CE concept as it includes the notion of anti-consumption (Herstatt & Tiwari, 2020, p. 14).

To conclude, this comparative analysis of related concepts indicates that next to the pure focus on CI other more established concepts can partly be used in order to source more information as the term CI itself is not well established. For this, it is recommendable to focus on the concept of EI as it is most similar to the defined understanding of CI. Considering Frugal or sustainable innovation, only elements that are similar to CI should be considered in further elaborations.

As mentioned in the problem analysis, there is a significant gap in considering the customer perspective during the development of CIs within practice as well as academia. This leads to the critical problem of low customer acceptance of CI. Therefore, the following chapter introduces more specifically the customer perspective within CE as well as circular behaviour, behavioural change, and innovation adoption theories.

2.3. Frameworks for Circular Behaviour and Customer Adoption of Circular Innovation

This chapter introduces the main frameworks and theories which help to better understand the customer role and perspective within CE.

2.3.1. The Customer within Circular Economy: Characteristics of Circular Behaviour

To use existing behavioural models to explain circular behaviour it is important to understand the specifications and characteristics of circular behaviour first. Furthermore, the understanding of circular behaviour is necessary as the user of CIs plays a crucial role in CE. Additionally, the success of CIs is highly dependent on the willingness of customers to accept new forms of ownership, to change familiar behaviour and habits or to ultimately hand in or dispose discarded products in the right way (Poppelaars & Vlugter, 2020). As mentioned earlier, circular behaviour includes the customer as a user who is highly involved in feedback loops such as repairing, maintaining, returning, recycling (Camacho-Otero et al., 2018, p. 15). Circular behaviour can be fostered by an environmental consciousness and awareness (Parajuly et al., 2020, p. 2). Researchers state that consumption in the CE can be understood as a form of sustainable consumption which requires the customer to perform a series of behaviours that enable circular usage (Camacho-Otero et al., 2018, p. 4; Rexfelt & Selvefors, 2021, p. 2). Thereby, Baker (1994) defined sustainable consumption as

> *"the use of goods and services that respond to basic needs and bring a better quality of life, while minimising the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardise the needs of future generations"* (S. Baker, 1996, p. 94).

Furthermore, circular behaviour also can be linked to existing research on green customer and so-called "curtailment" behaviour which includes "water and energy conservation, car use reduction, and to some extent recycling and responsible waste disposal" (Jansson et al., 2010, p. 359). Additionally, curtailment behaviour is characterised by the involvement of frequent efforts, discomfort, and the requirement of changing habits (Jansson et al., 2010, p. 359).

To support the exploration of circular behaviour and Rexfelt & Sevefors et al. (2020) developed a circular consumption cycle that highlights many circular paths of consumption as alternatives to the traditional linear consumption process (see Fig. 2) (Rexfelt & Selvefors, 2021, p. 3).

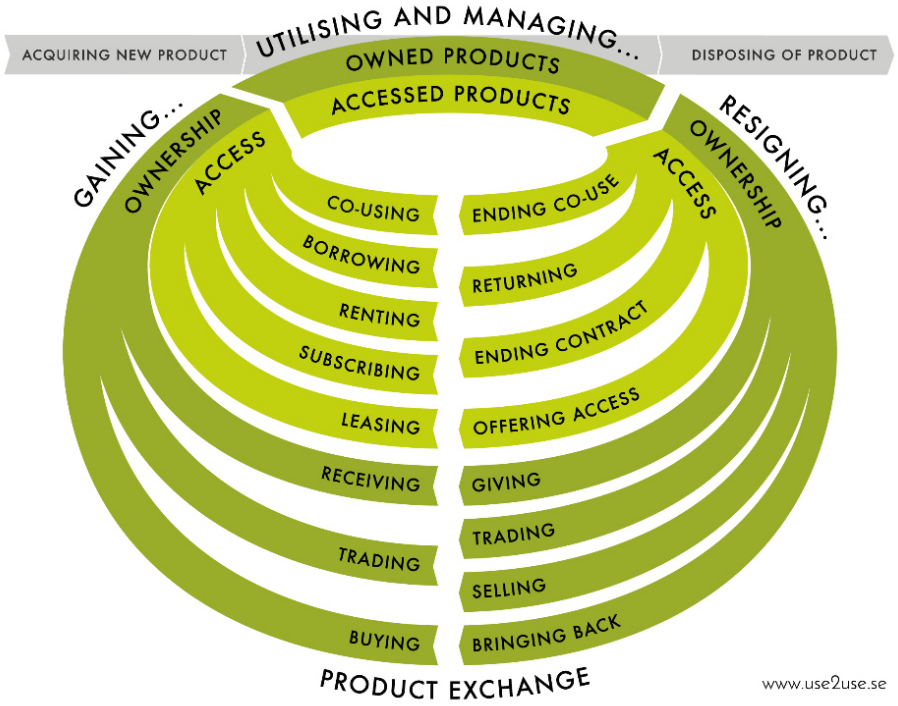

Fig. 2. Circular consumption cycle (according to Rexfelt& Selvefors, 2021)

The activities illustrated in this consumption cycle aim to remind product and service designers of alternative modes of consumption within the CE. These activities "provide the potential to explore new opportunities for supporting circulation of products by taking a user perspective on product circularity" (Selvefors et al., 2018, p. 2050). According to Fig. 2, circular consumption can be understood as a three-part process, including the main phases of obtainment, use, and clearance (Rexfelt & Selvefors, 2021, p. 2). Often those processes involve producers, providers, and other players, which can facilitate or enable the exchange of products between users. For instance, exchange agents can provide channels through which people can connect and carry out the exchange, or agents temporarily take over ownership and ensure the product is in good condition before it is reused by other users (Selvefors et al., 2018, p. 2052). Furthermore, activities within the circular consumption cycle are divided into either access- or ownership-related activities (Selvefors et al., 2018, p. 2050).

Next to the mentioned specifications of circular consumption, there are four main aspects that distinguish circular behaviour from a traditional linear one (Camacho-Otero et al., 2018, p. 15):

- **Anonymity**: as customers do not own but use products, consumption becomes anonymous.
- **Connected consumption**: as sharing and servitisation becomes prevailing, new relationships between customers and companies establish, resulting in deeper forms of engagement and involvement.
- **Multiplicity of values**: as circular solutions cannot only rely on their utility value, consumption in CE needs to address several values at the same time, which can be fostered by frugality and well-being.
- **Political consumerism**: customers perceive CIs as a form of rebellion against mainstream consumption, and engaging with them is expected to reflect a certain political stance. While

material consumption in linear systems is perceived as status, CE requires the dematerialisation of innovation.

- **Uncertainty**: CE products only move temporary from producers to customer and return to continue the journey to other customers which might arise issues of trust, risk, and loss of control.

Based on the understanding of circular behaviour and consumption, the following subchapter will introduce one of the most well-known behavioural theories, the Theory of Planned Behaviour.

2.3.2. Theory of Planned Behaviour

In 1991, the Theory of Planned Behaviour (TPB) was introduced as an extension of the Theory of Reasoned Action (TRA) (Ajzen, 1991, p. 181). As the TPB has been frequently applied in the context of environmental behavioural studies for instance travel mode choice, household recycling, waste composting, the purchase of energy-saving light bulbs, or general pro-environmental behaviour it seems to be an appropriate theory in the context of this thesis (Camacho-Otero et al., 2018, p. 14; Elzinga et al., 2020, p. 3; Lang & Joyner Armstrong, 2018, p. 8; Parajuly et al., 2020, p. 3; Rexfelt & Hiort af Ornäs, 2009, p. 684; Steg & Vlek, 2009, p. 311). According to the TPB, behaviour is directly influenced by intention which is again directly influenced by three main independent determinants (see Fig. 3).

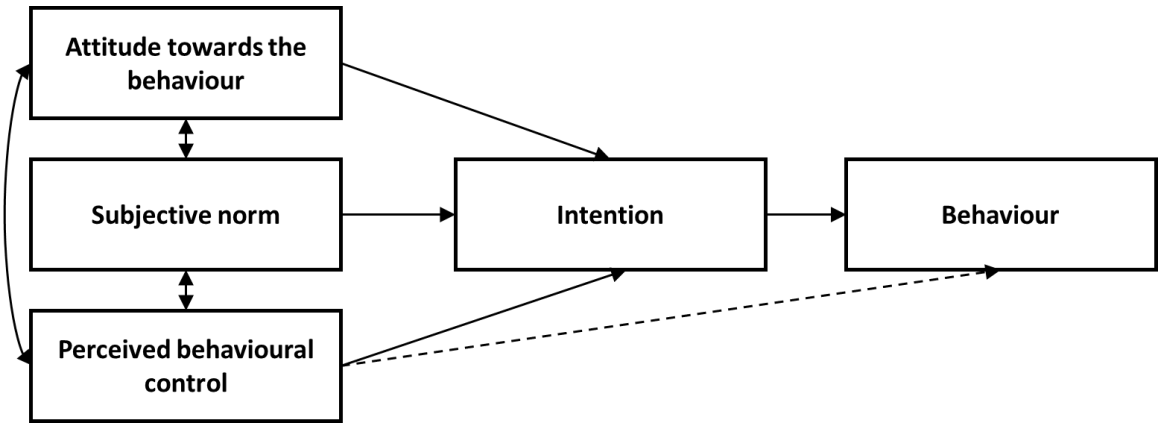

Fig. 3. Theory of planned behaviour (TPB) (according to Ajzen, 1991)

Thereby, *subjective norm* describes "the perceived social pressure to perform or not to perform the behaviour". *Attitude towards a behaviour* means "the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question". And *perceived behavioural control* is "the perceived ease or difficulty of performing the behaviour and it is assumed to reflect experience as well as anticipated impediments and obstacles". (Ajzen, 1991, p. 188) In general, the greater those three determinants are, the stronger should be an individual's intention to perform the considered behaviour. However, the relative importance of each determinant depends on the behaviours as well as situations considered. (Ajzen, 1991, p. 188)

As mentioned before, the transformation towards CE required the customer to develop and persuade circular behaviour. According to Ajzen the probability that a customer behaves circularly depends on their intention influenced by the three independent determinants: attitude, subjective norm, as well as perceived behavioural control. Therefore, the TPB implies that customer barriers towards CI could be caused by the lack of one of those three determinants.

However, behavioural studies on consumers' engagement in CE have shown that customers are generally willing to engage in CE practices such as repairing, renting, leasing, buying used products

etc., but lack of actual engagement (European Commission, 2018, p. 3; Parajuly et al., 2020, p. 3). For example, in one study, 25% of European respondents stated they would lease selected e-products, while only 1% did. Or, 75% of European respondents claim they sort their e-waste while only 35% of e-waste is collected in Europe (Parajuly et al., 2020, p. 2). Furthermore, the TPB faced criticism in terms of its lack of insights into moral, affective, and habitual processes, as well as the absence of context within explanations (Camacho-Otero et al., 2019, p. 931). Based on these limitations and the missing explanation of the mentioned intention-action gap, as well as the required behavioural change towards a circular behaviour further models and frameworks are needed. In this context, the highly recognised COM-B Model on behavioural change by Michie et al. (2011) will be introduce in the following.

2.3.3. COM-B Model of Behavioural Change

The implementation of CE and the adoption of CI require a significant level of behavioural change within the society. Michie et al. (2011) present three factors, including capability, opportunity, and motivation as well as behaviour change interventions and policies as fundamental elements in the context of behavioural change. Based on this understanding, they developed a behavioural change framework, including the so-called COM-B model and the Behavioural Change Wheel (BCW) (Michie et al., 2011, p. 2). The research on the BCW is mainly focused on the effective practice of clinical medicine and public health. However, model has been in the broad CE context before. For instance, researchers mention the importance of intervention strategies of pro-environmental behaviour (Steg & Vlek, 2009, p. 313) or have already applied the BCW in the context of recycling behaviour (Gainforth et al., 2016, p. 5). Also, the BCW inventor herself suggested using the model for other social challenges, including the climate emergency (West & Michie, 2020, p. 1). And finally, based on the literature analysis conducted for this thesis one frequently cited study by Wastling et al. (2018) was found, which already applied the COM-B model in the context of design for circular behaviour (Wastling et al., 2018, p. 7). For these reasons, the COM-B model seems to be applicable in the context of this thesis, meaning behavioural change towards the adoption of CI. The following will provide a brief description of the most important terms within Michie's framework. The COM-B model aims to provide a framework for behavioural change useful for those who design interventions and plan policy (Michie et al., 2011, p. 3). The model includes three main factors which interact over time (see Fig. 4). **Capability** means the "individual's psychological and physical capacity to engage in the activity concerned. It includes having the necessary knowledge and skills" (Michie et al., 2011, p. 5). Thereby, capabilities are distinguished between *physical* capabilities "that involve a person's physique, and musculoskeletal functioning (e.g., balance and dexterity)" and *psychological* capabilities "that involve a person's mental functioning (e.g., understanding and memory)" (West & Michie, 2020, p. 2). **Opportunity** means "all the factors that lie outside the individual that make the behaviour possible or prompt it" (Michie et al., 2011, p. 5). With this factor, the model naturally incorporates context as opportunity represents the context in which relation the behaviour can be understood (Michie et al., 2011, p. 9). Opportunities are distinguished between *physical* opportunity "that involves inanimate parts of the environmental system and time (e.g., financial and material resources)" and *social* opportunity "that involves other people and organisations (e.g., culture and social norms)" (West & Michie, 2020, p. 2). **Motivation** means "all those brain processes that energise and direct behaviour, not just goals and consciously decision-making. It includes habitual processes, emotional responding, as well as analytical decision-making" (Michie et al., 2011, p. 5). Motivations are distinguished between *reflective motivation,* which

involves conscious through processes (e.g., plans and evaluations), and *automatic motivation* that involves habitual, instinctive, driven-related, and affective processes (e.g., desires and habits) (West & Michie, 2020, p. 2).

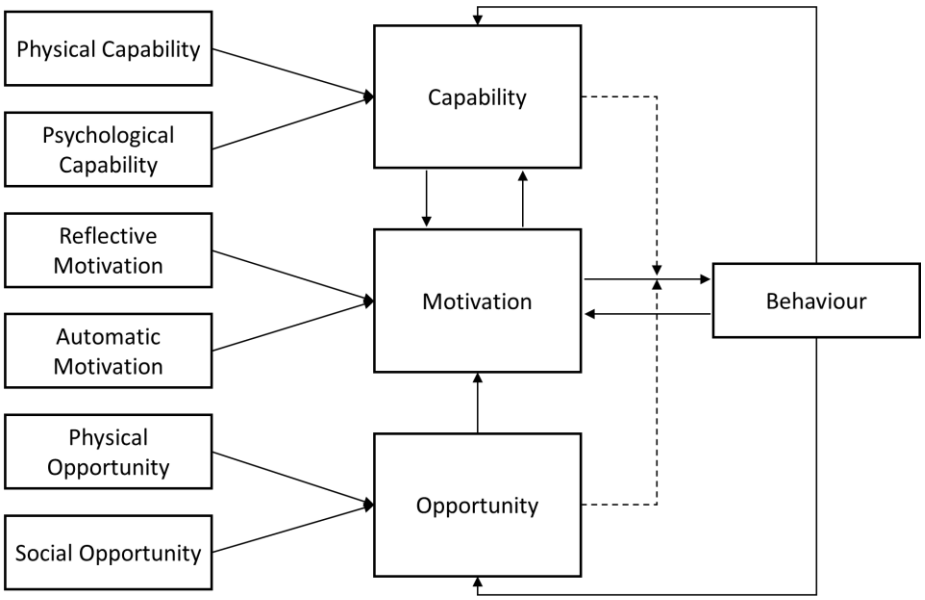

Fig. 4. COM-B model (according to West & Michie, 2020)

Next to these three main factors, two more layers of behavioural change, including nine interventions and seven policies which were developed based on 19 reviewed frameworks for behavioural change are part of the model (Michie et al., 2011, p. 2). All three layers are combined within the behavioural change wheel (BCW) (see Fig. 5).

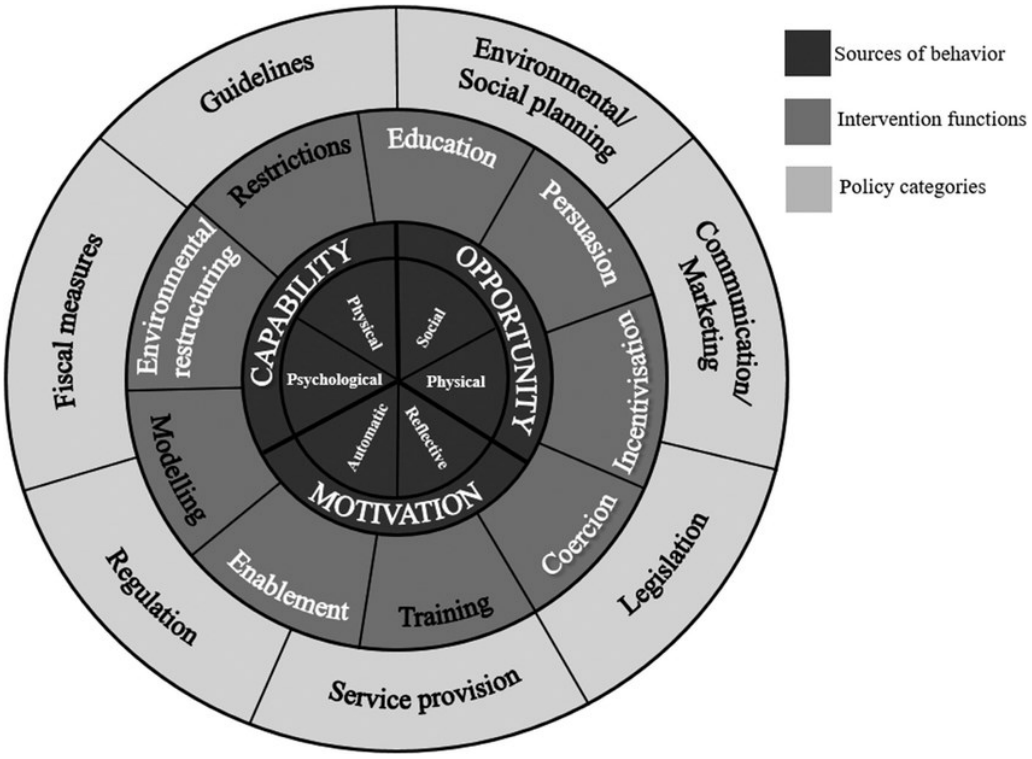

Fig. 5. Behavioural change wheel (BCW) (according to Michie et al., 2011)

Thereby, **interventions** describe "activities aimed at changing behaviour", while **policies** include "actions on the part of responsible authorities that enable or support interventions" (Michie et al.,

2011, p. 7). An overview of the definitions of interventions included in the BCW can be found in Appendix 2a (see page 115). The structure of the BCW illustrates that all three layers interact. For instance, the behaviour COM-B system interacts with the intervention layer and the intervention layer with the policy layer (Michie et al., 2011, p. 7).

In practice, the BCW can be applied in three steps (see Fig. 6). The following description of this process is based on Michie et al. (2016). **First**, the behaviour must be understood. This step includes the *definition of the problem* in behavioural terms, which consists of a specification of the target individual or group involved in the behaviour, the context in which the behaviour occurs, and the behaviour itself.

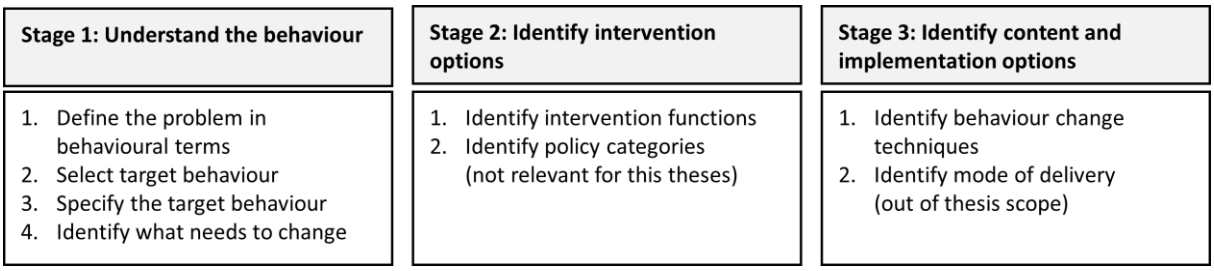

Fig. 6. COM-B and BCW application process (according to Michie et al., 2016)

In the second part of this step, a *target behaviour must be selected*. Thereby it is recommended to create a long list of potential behaviours that may be relevant to the problem identified. Those are later prioritised based on four criteria, including the impact of the changed behaviour, the likelihood of change, the potential of spillover effects, and the ease of measurement. In the third part, the *target behaviour must be specified*. Lastly, it must be *identified what needs to change*. In this part, the six sub-factors of the COM-B model need to be investigated in order to identify issues, limitations, and barriers that hinder customers to adapt CI. Based on this investigation, COM-B components that need to be adjusted in order to support the behavioural change can be identified. For this, a behavioural analysis can be conducted based on focus groups, questionnaires, observations, or documentary analysis. **Secondly**, suitable investigations and policies must be selected to overcome identified barriers towards behaviour change. For this, the BCW provides a comprehensive approach to consider several different interventions and policies. The BCW can be combined with the Theoretical Domains Framework (TDF), which provides 14 domains as a synthesis of 33 theories of behaviour and behavioural change. Those domains can be allocated to the six components of the COM-B model (see Appendix 2b, page 116). As not all interventions are the same relevant for a specific TDF domain or COM-B component a link between COM-B factors, TDF domains, and interventions is provided by Michie et al. (2014) (Michie et al., 2014, p. 114). Furthermore, the authors recommend using so-called APEASE criteria in order to select and shape the most appropriate interventions. These criteria include affordability, practicability, effectiveness, cost-effectiveness, acceptability, side-effects/safety, and equity. A more detailed description of the criteria can be found in the Appendix 2c (see page 117). In the second part of this step, policies need to be selected. However, as this thesis is supposed to provide methods to overcome customer barriers which companies and companies of CI can apply, policies which are made by authorities can be defined as out of scope. **Third**, behavioural change techniques (BCT) must be selected and implementation options must be defined. Thereby, a BCT is "an active component of an intervention". For this, the BCT Taxonomy developed by Michie et al. (2013) can be used (Michie et al., 2013). Furthermore, the resource *The Behaviour Change Wheel – A Guide to Designing Interventions* (Michie et al., 2014) provides further guidance

on linking BCT with interventions. Even if the three-step process seems to be linear, it is important to mention that it may involve cycling back and forth between steps if necessary. (Michie et al., 2016)

As the thesis focuses on CIs, the next chapter focuses more specifically on the adoption and inhabitation of innovations and provides the foundation to categorise barriers in further research.

2.3.4. Theory on Innovation Adoption and Innovation Barriers

Adoption theories explain the adoption behaviour of an individual customer. The adopter's utilisation decision depends on complex uncertainty-reducing information processing procedures, which should already be considered in the early phases of an innovation process and positively influenced when the invention is introduced (Schuh & Klappert, 2011, p. 53). The probably best-known model of innovation adoption is the one of Rogers (1995). As several researchers already used and confirmed Rogers model for studies in the context of customer adoption of PSS it is briefly introduced in the following (Rexfelt & Hiort af Ornäs, 2009, p. 684). According to Rogers, innovation adoption is structured in five steps: knowledge, persuasion, decision, implementation, and confirmation which are influenced by several factors. Thereby Rogers lists five product-related factors which are highly influential on the adoption and diffusion of innovation (Rogers, 1995):

- *Perceived relative advantage* = innovation's perceived added value and serious positive difference compared to previously used solutions
- *Compatibility* = innovation can be easily integrated into existing processes and is consistent with existing values, norms, trends, and needs
- *Low complexity* = innovation is comprehensible and understandable
- *Testability* = innovation's performance and value can be tested without taking major risks
- *Observability* = innovation's performance results are visible

Complementary to these positive influencing factors of adoption there are also negative factors which can be defined. According to Ram & Sheth (1989) so-called innovation inhibitors are divided into two areas, psychological and functional barriers towards innovation (see. Table 5).

Table 5. Innovation barriers (according to Ram & Sheth, 1989)

Psychological Barriers	**Explanation**
Tradition Barrier	Cultural change which requires a customer to deviate from established traditions. The greater the deviation to prevailing attitudes, the greater the resistance.
Image Barrier	Perceptual problem leading to unfavourable association with the innovation due to stereotyped thinking.
Functional Barriers	**Explanation**
Usage Barriers	Incompatibility of innovation with existing workflows, practices, or habits leading to required changes in customer's routine.
Value Barriers	Lack of incentive as innovation does not offer a strong performance-to-price value compared to substitutes
Risk Barriers	Uncertainty including not anticipatable side effects lead the customer to postpone the adoption until less risk has to be taken. Four main risk types • Physical risk: harm to person or property • Economic risk: High monetary costs • Functional risk: performance uncertainty • Social risk: peer ridicule and ostracism

Psychological barriers are caused by two factors customers' traditions and norms as well as the perceived product image. Those factors rather occur through conflicts with prior customers' beliefs. Furthermore, functional barriers are caused by three different factors, including product usage patterns, product value, and risk associated with product usage. Those factors rather occur if customers perceive significant changes from the innovation adoption. (Ram & Sheth, 1989, p. 7)

2.4. Identification of Main Customer Barriers Towards Circular Innovation

In this chapter, the main customer barriers towards CI will be identified and structured based on previously introduced frameworks. For this, an extensive literature review was conducted, including four priority clusters of different research focus as well as corresponding keywords. Appendix 3a (see page 118) provides a more detailed overview of the strategy used to conduct the literature review based on the database SCOPUS. In total, 37 papers were selected for a first screening considering suitability for the research context, the number of citations (rather more than less), as well as publishing year (rather new than old). After an initial screening, 23 of those papers were acknowledged as suitable for further investigations.

Furthermore, throughout the process, additional sources were used in order to better describe and understand the specific barriers identified. The tabular result of the literature review is shown in Appendix 3b-e (see pages 119-122). Based on the information gathered within the review, in total twelve main customer barriers towards CI could be identified. Considering identified barriers according to Ram & Sheth's (1989) model of innovation barriers, a categorisation can be performed according to the two barrier categories, psychological and functional barriers, as well as corresponding barrier types (see Table 6). For this categorisation each identified customer barrier is allocated to the primary and most suitable barrier type even if, in some cases, an allocation to more than one barrier type would be possible.

Table 6. Categorisation of identified customer barriers (own analysis according to Ram & Sheth, 1989)

Category	Type	Customer Barrier
Psychological Barriers	Tradition	**B1** - Lack of cultural change **B2** - Lack of ownership **B3** - Lack of emotional attachment
	Image	**B4** - Lack of status **B5** - Lower perceived quality **B6** - Lack of trust and company image
Functional Barriers	Usage	**B7** - Lack of convenience **B8** - Lack of infrastructure **B9** - Lack of technical compatibility
	Value	**B10** - Lack of knowledge and information **B11** - Lack of perceived advantage
	Physical Risk	Not mentioned.
	Economic Risk	No primarily allocation.
	Functional Risk	**B12** - Uncertainty about quality
	Social Risk	No primarily allocation.

The following chapters will provide a more detailed explanation of identified customer barriers towards CI. Thereby, the order was selected based on the categorisation according to Ram & Sheth.

2.4.1. Identified Psychological Barriers

Psychological barriers occur based on conflicts with customers' prior beliefs. In the context of CE and CI, those prior beliefs are based on a mostly linear mindset and attitude. As described in chapter 2.2.1 (see Table 3), these include, for example, the understanding of consumption as take-make-dispose as well as the association of value creation and status with the ownership of physical products. Based on the literature review, three sub barriers were identified for the barrier type of tradition and another three for image barriers. All six barriers will be explained in the following.

Identified Tradition Barriers: tradition barriers describe the cultural change which requires the customer to deviate from established traditions and attitudes. The barriers of "lack of cultural change", "lack of ownership", and "emotional attachment" were identified as traditional barriers.

B1 - Lack of cultural change: several authors mention that customers are not always rational, objective, and utility-maximising. Instead, customers often base their decisions on subjective beliefs about a new product or service. This is because most customers are traditionalists, unwilling to change established beliefs or learned behaviour (Planing, 2015, p. 7). For example, most people repeatedly buy the same 150 items which fulfil 85% of their needs (Kirchherr, Hekkert, et al., 2017, p. 10). Consequently, customers lack the willingness to change their *linear mindset*. One reason for this is the lack of customers' *environmental interest and awareness* (Kirchherr, Hekkert, et al., 2017, p. 10; Urbinati et al., 2019). For example, some customers do not care about returning used products (Bhatia & Srivastava, 2018, p. 81). However, researchers also state that even if customers are aware, intent, and show an attitude to behave more environmentally friendly, they do not act as they intended. This intention-action gap reveals a significant barrier towards CI and implies that companies cannot only rely on a pro-environmental attitude of customers (Armstrong et al., 2015, p. 32). Furthermore, many customers struggle with the required shift to a more long-term perspective, as their purchase decisions and behaviour is mostly based on a *rather short-term perspective*. Another prevailing attitude, customers in a linear system have, is the one of "*one-time consumption*" which hinders them from participate in circular services and transactions like offering or buying "re"products (Bhatia & Srivastava, 2018, p. 81). Lastly, Baines et al. (2007) mention the necessary cultural shift as the main barrier to PSS adoption. More specifically, the author highlights the hindering belief of customers that *value is created by owing a product* rather than by having a need met, as it is the case of PSS (Baines et al., 2007, p. 1549). This barrier will be described in more detail in the next barrier, which shows that identified barriers are not exclusive but rather strongly interlinked and dependent.

B2 - Lack of ownership: one more specific belief that hinders customers from adopting CIs and specifically sharing BM is that a product can only satisfy needs when the customer owns it (Baines et al., 2007, p. 1549). This belief is especially prominent if the product is associated with a high level of emotions, self-expression, symbolism, or memory (Armstrong et al., 2015, p. 32; Park & Armstrong, 2017, p. 15). Also, customers with a high desire for control and materialism are especially affected by this barrier (Akbar et al., 2016, p. 1). Those customers are not enthusiastic about ownerless consumption and are not motivated to search for access rather than ownership possibilities (Baines et al., 2007, p. 1549; Mont, 2002a, p. 244). Furthermore, the authors mention customers' fear of getting penalised for damaging products they do not own as well as the issue of losing control over the end result and identification issues with non-owned products (Armstrong et al., 2015, p. 32; Catulli et al., 2021, p. 5; Enckell & Isgran, 2017, p. 14). However, a more recent study on the adoption of CBM, including take-back management, product lease, and pay-per-use has shown that the

characteristic of ownership loss has only a marginal influence on a customers' adoption of CI. This new empirical finding could indicate the start of the required cultural change.

B3 - Lack of emotional attachment: lack of emotional attachment is especially critical when considering that CIs aim to extend the possible product life cycle. If customers lack emotional attachment to their products, their motivation to continue the product usage decreases, and the need for new products dominates (Wu et al., 2021, p. 1). Therefore, the lack of emotional attachment is hindering a circular behaviour that includes proper treatment or maintenance. Also, customers are likely to discard products earlier than needed if an emotional attachment is missing (Jensen et al., 2021, p. 7). While product attributes such as a high level of emotions, self-expression, symbolism, or memory were hindering in the context of the previous barrier "lack of ownership", they are rather supportive overcoming the barrier of lack of emotional attachment. Emotional attachment rather supports usage-based ownership while it might be rather hindering in terms of access-based usage. Therefore, companies should evaluate whether the emotional attachment is rather hindering or supportive for the considered CI due to this paradox relation.

Identified Image Barriers: image barriers describe the perceptual problem leading to unfavourable associations with the innovation due to stereotyped thinking. The barriers of "lack of status", "lower perceived quality" as well as "lack of trust and company image" were identified as image barriers.

B4 - Lack of status: this barrier is closely linked to the lack of ownership. As a consequence of lost ownership, customers struggle to identify with the products they use or vice versa have difficulties to express one's identity with the product (Armstrong et al., 2015, p. 37; Camacho-Otero et al., 2018, p. 14; Enckell & Isgran, 2017, p. 14). As many customers associate status with their consumption of products, they will rather choose owned products. Furthermore, "re"products, for example, remanufactured mobile phones, are often stereotyped as less prestigious, which hinders especially upper-middle-class customers to adopt CIs such as "re"products as they perceive a loss in the products' status (Schotman & Ludden, 2014, p. 194; Wahjudi et al., 2020, p. 10). Lastly, "re"products are often also associated with losing comfort and enjoyment (M. Baker et al., 2014, p. 92; Camacho-Otero et al., 2018, p. 13).

B5 - Lower perceived quality: closely linked to and interrelated with the lack of status is the barrier of lower perceived quality (Bhatia & Srivastava, 2018, p. 81; Guldmann & Huulgaard, 2020, p. 10). Often especially "re"products are undervalued in relation to new products as customers evaluate them based on stereotyped thinking and lack of differentiation (Almefelt & Rexfelt, 2017, p. 17; Camacho-Otero et al., 2018, p. 13). Thereby, the quality perception of different "re"product types depends on the knowledge and information the customers have access to. For example, some people might not understand the differentiation of remanufactured and refurbished products, even if there is a significant difference in the provided quality level as refurbished products do not necessarily provide the original quality while remanufactures ones usually do or even provide higher quality than before. Furthermore, customers are concerned about poor quality, hygiene, security, performance, low reliability, and the fact that "re"products soon become outdated which leads to a general low attitude towards this type of CI (Almefelt & Rexfelt, 2017; Camacho-Otero et al., 2018, p. 13; Catulli et al., 2021, p. 5). Ultimately, this negative attitude and low perceived quality reduces customers' willingness to pay (WTP). For instance, the WTP for remanufactured consumer products is 15% lower than for new products (Wahjudi et al., 2020, pp. 4–5).

B6 - Lack of trust and company image: generally, as customers are more used to buy brand-new products rather than "re"products, it is especially important for CI providers to actively build trust towards the customers (Mont, 2002b, p. 7). In the context of CIs and especially PSS, trust refers to "the ability to be confident that the (PSS) provider is offering a quality solution, and that in case of damage, they will solve any problem" (Camacho-Otero et al., 2018, p. 13). For example, customers have to trust the provider that the claimed remanufactured product is not only a used product (Wahjudi et al., 2020, p. 7). Furthermore, studies revealed scepticism of customers towards the motives and sustainability claims of CI offering companies such as PSS providers (Armstrong et al., 2015, p. 32). Also, these trust issues include concerns about the continuation of the business or guarantees (Armstrong et al., 2015, p. 38). Moreover, PSS imply a strong and usually long-term customer-provider relationship that requires a certain commitment and new roles and obligations which not all customers are willing to enter (Armstrong et al., 2015, p. 38; Rexfelt & Hiort af Ornäs, 2009, p. 677). Additionally, CIs and especially PSSs and sharing BMs require not only trust in the provider but also other customers who will use the same product (Camacho-Otero et al., 2018, p. 15). Customers can be afraid of sharing sensitive data, which is required to enable PSS and sharing BM. Considering the second part of this barrier, the previously identified image barriers can be even more amplified by the lack of trust in the CI provider and their image, which are closely interrelated. The CI provider's image, understood as the impression of the provider's company significantly affects the customers in acquiring the offered CI. This is true for all companies not only CI providers. However, especially for new, unknown products, which tend to require a drastic cultural shift as CIs do, the importance of the provider's image is even higher (Almefelt & Rexfelt, 2017, p. 17). Furthermore, some companies are reluctant to get associated with "re"products as they fear losing their company image, which confirms the customers in their stereotyped thinking (Mont, 2002b, p. 98).

2.4.2. Identified Functional Barriers

Functional barriers occur based on perceived significant changes from adopting the CI. Those significant changes can include habit and behavioural changes (usage barriers), additional risk occurring with the CI adoption (risk barriers), or the lack of incentives to invest in the CI (value barriers). The following chapter will introduce main barriers in all three functional barrier types.

Identified Usage Barriers: usage barriers describe the incompatibility of CIs with existing workflows, practices, or habits leading to required change in customers' routine and behaviour. In the context of CI, those habits are most likely to be based on a linear system and mentality, meaning the understanding of a take-make-waste, as well as single-use consumption. The barriers of "lack of convenience", "lack of infrastructure", "lack of technical compatibility", as well as "lack of emotional attachment" were identified as usage barriers.

B7 - Lack of convenience: this barrier refers to the need for behavioural and habitual change. The implementation of access-based PSS in the customers' real life often requires a rather radical change in their behaviour which significantly reduces the convenience and practicability of the questioned CI (Almefelt & Rexfelt, 2017, p. 15). For instance, the shift to circular consumption often requires more time, effort, and planning than established consumption patterns (Selvefors et al., 2019, p. 3). The stronger habits are already established and the less compatible they are to the new required behaviour, the higher the risk that people won't change their behaviour and consequently will not adopt the CI. According to Jesus & Mendonca (2018), one reason why customer habits change very slow is the inadequate awareness and information regarding the CE concept as well as a lack of

possible choices (Jesus & Mendonça, 2018, p. 83). Often the required behavioural change is still underestimated by companies who develop and offer CIs (Schotman & Ludden, 2014, p. 195). However, an incompatible design for habits and a lack of consideration of the impact of CIs in the customers' everyday life can increase the lack of convenience (Camacho-Otero et al., 2018, p. 13). To name some examples for lack of convenience, the take-back management of "re"products often requires additional effort for the customer (Elzinga et al., 2020, p. 6, 2020, p. 1) (Rexfelt & Hiort af Ornäs, 2009, pp. 687–688). For instance, if replacement often is more convenient than repairing (European Commission, 2018, p. 3). Also, the adoption of PSS often confronts customers with altered payment structures e.g., recurring costs of leasing and pay-per-use models which many customers are rather sceptical and resistant about (Armstrong et al., 2015, p. 38). Convenience is also negatively affected if the introduction of PSS requires additional time, e.g., searching for an appropriate PSS provider for sharing possibilities (Akbar et al., 2016, p. 4216) or if the PSS raises concerns such as perceived product scarcity risk or whether the customer would need to specify their need for a service in advance (Rexfelt & Hiort af Ornäs, 2009, pp. 687–688).

B8 - Lack of infrastructure: closely connected to the previous barrier is the barrier of lack of infrastructure as this barrier negatively impacts the convenience of CI. Lack of infrastructure means a lack of channels to pursue circular behaviour. For example, lack of channels to collect used products (Bhatia & Srivastava, 2018, p. 81). This leads to the issue, that customers are not even able to behave in a circular way. Thinking about PSS and sharing BM, lack of infrastructure could mean the lack of available sharing options which leads to a lack of flexibility and customers' consideration of rather choosing owned product offerings than shared ones (Rexfelt & Hiort af Ornäs, 2009, p. 677).

B9 - Lack of technical compatibility: this barrier is especially relevant for "re"products as for example remanufactured products may be of an older version which do not receive the same support or technological compatibility as new products (Almefelt & Rexfelt, 2017). Considering fast-changing fashion and technological trends, customers are afraid that "re"products, for example, remanufactured mobile phones become obsolete very quickly which would not be valuable to invest in (Guldmann & Huulgaard, 2020, p. 10; Wahjudi et al., 2020, p. 7). For the same reason, customer are resistant to the option of repairing products and rather buy new ones (European Commission, 2018, p. 3).

Identified Value Barriers: value barriers describe the lack of incentives as the innovation does not offer a strong performance-to-price value compared to substitutes. In the context of CI, environmental products and services are often perceived as more expensive but simultaneously as less qualitative, which leads to a lower performance-to-price value. The barriers of "lack of knowledge and information" and "lack of perceived advantage" were identified as value barriers.

B10 - Lack of knowledge and information: one reason for the mentioned lower quality perception of CIs is a significant lack of customer knowledge and customer access to relevant information necessary to make a well-informed purchase decision. As mentioned before customers might not know the difference between different "re"product types. For example, they might not know that the purpose of remanufacturing is to assure product quality on a high level. The lack of knowledge about the CE concept and its benefits as well as insufficient available information especially about the durability (lifetime) and reliability of "re"products during the purchase situation lead to the issue that it is difficult for many customers to inspect their performance, quality, and condition and causes erroneous perceptions regarding those attributes. (Almefelt & Rexfelt, 2017, p. 19; Jensen et al., 2021,

p. 6). Furthermore, customers require more information about the environmental impact of their purchases (Armstrong et al., 2015, p. 32). In short, the customer lacks specific product knowledge and information, which enables them to assess the potential benefits or associated risks of the CIs (Camacho-Otero et al., 2018, p. 13; Rexfelt & Hiort af Ornäs, 2009, p. 689). Consequently, customers tend to adopt innovations based on well-known buying arguments, e.g., purchase price at the point of sale, brand, and aesthetics, rather than circular arguments such as durability, reparability, upgradeability, or total cost of ownership (TCO). While classical economic theory argues that a homo oeconomicus would rather invest in a more expensive but durable product, many customers do not act based on this economic logic and ignore TCO and net present value (NPV) (Planing, 2015, p. 7). The reason is that they lack knowledge and information about TCO, NPV as well as new payment and cost structures (Enckell & Isgran, 2017, p. 14; Mont, 2002b, p. 94). Furthermore, another aspect is the lack of knowledge in terms of missing cognitive, technical, and motoric skills to repair products by oneself, even if using one's hand to make and manipulate things is a natural human ability that improves in time with practice (European Commission, 2018, p. 3; Nazlı, 2021, p. 6). Lastly, often customers are not even aware of circular alternatives to traditional linear ones. For example, "re"products or sharing options often does not reach the "critical mass" and peer or influencer referrals are missing which leads to lower visibility and practicability of acquiring CIs (Jensen et al., 2021, p. 7).

11 - Lack of perceived advantage: this barrier seems to be the consequence which summarised all barriers introduced in this chapter. For example, customers do not understand or trust the benefits of a remanufacturing process or only focus on the short-term effects of their purchase decision which in the case of CIs might not be beneficial compared to alternative offerings (M. Baker et al., 2014, p. 91). Research has shown that the price-quality ratio is the most important driver and simultaneously a barrier to customer engagement in CE. While customers were willing to pay more for products with better durability and reparability, lower prices of non-circular offerings can disregard CI credentials (European Commission, 2018, p. 3). Customers do not repair their products as they expect repairs to be too expensive (European Commission, 2018, p. 3). Additionally, research revealed that customers do not understand the value proposition of PSS compared to other options and face uncertainties in predicting need congruence as it might be hard to envision how a PSS solution works in practice (Rexfelt & Hiort af Ornäs, 2009, p. 689). Also, studies show customers struggle with a lack of transparency about the real advantage of the CI in light of their historical consumption habits (Armstrong et al., 2015, p. 37). As customers are used to the producers' aim of profit maximisation the alleged win-win situation of PSS might be difficult to grasp (Rexfelt & Hiort af Ornäs, 2009, p. 689).

Identified Risk Barriers: risk barriers describe the uncertainty, including not anticipatable side effects which lead the customer to postpone the adoption until less risk must be taken. Those risk barriers are divided into four main groups, physical, economical, functional, and social risks. Based on the literature review CIs especially face functional risks, while physical risks were not identified and economic and social risks could be derived from already mentioned barriers.

B12 - Uncertainty about quality: customers, who consider to adopt CIs, face a high perceived uncertainty about the innovation's quality and residual value especially for "re"products (Guldmann & Huulgaard, 2020, p. 10). This is the case because quality standards as well as information, support, and trust in quality guarantees for "re"products are missing (Bhatia & Srivastava, 2018, p. 80; Wahjudi et al., 2020, p. 9). The described issue is especially critical for "re"products as their variation

of quality and performance is usually larger than for new products (Almefelt & Rexfelt, 2017, p. 16). As a consequence, the lack of knowledge and information as well as the missing trust in especially "re"products' reliability, lifetime, and safety, leads to high uncertainty and the inability of value assessment (Chakraborty et al., 2019; Cole et al., 2019, p. 8; Schmidt et al., 2015, p. 287).

To conclude, the review on customer barriers towards CI revealed twelve main barriers. Thereby, it is important to mention that even though each barrier was introduced individually, several barriers are interrelated and impact each other. Consequently, some aspects can be part of more than one barrier. Furthermore, a categorisation based on Ram & Sheth's (1989) model on innovation barriers was possible. This categorisation revealed that the most barriers towards CI are part of the barrier types of tradition, image, usage, and value while only one barrier was primarily allocated within the barrier type of risks, more specifically functional risks. No barriers were primarily allocated to the barrier types, physical, economic, and social risk. In this regard, it is important to mention that the identified barriers were allocated to the primary and best suitable barrier type, which means that some aspects might also be allocatable to other barrier types. Nevertheless, to provide a clearer and better to follow categorisation, only the primary allocation was introduced. Lastly, it is important to mention that the presented literature review is supposed to provide a more general overview on of CI barriers. As soon as a more concrete case or context is selected there might be additional variables which influence the adoption of CIs as well as the relevance of identified barriers. This might be especially the case as soon as a more specific case and context is selected. For example, a study by Camacho-Otero et al. (2019) on user acceptance and adoption of circular offerings in the fashion sector considered demographical factors such as age, gender, level of education, and geographical location (Camacho-Otero et al., 2019). Furthermore, not all barriers have the same relevance when considering different types of CI. For example, the barrier of low perceived quality [B5] might be more relevant for "re"products rather than for sharing services (Schmidt et al., 2015, p. 289). Therefore, the following table (see Table 7) shows which barriers are especially relevant for which type of CI.

Table 7. Relevance of identified barriers for different CI types (own analysis)

<table>
<tr><th colspan="2">CI Types</th><th>Specific Barriers</th><th>General Barriers</th></tr>
<tr><td rowspan="2">Circular Product Innovation</td><td>All "re"products[1]</td><td>B5 - Lower perceived quality
B12 - Uncertainty about quality</td><td rowspan="4">B1 - Lack of cultural change
B4 - Lack of status
B6 - Lack of trust and company image
B7 - Lack of convenience
B10 - Lack of knowledge and information
B11 - Lack of perceived advantage</td></tr>
<tr><td>"Re" products excl. recycling[2]</td><td>B9 - Lack of technical compatibility</td></tr>
<tr><td>Circular Service Innovation</td><td>Prolonging, take-back, and recirculate services[3]</td><td>B5 - Lower perceived quality
B8 - Lack of Infrastructure
B9 - Lack of technical compatibility
B3 - Lack of emotional attachment
B12 - Uncertainty about quality</td></tr>
<tr><td>Circular Business Model Innovation</td><td>Product Service Systems[4]</td><td>B2 - Lack of ownership
B8 - Lack of Infrastructure</td></tr>
</table>

[1]incl. reused, repaired, remanufactured, refurbished, and recycled products / [2]incl. reused, repaired, remanufactured, and refurbished products / [3]e.g., services for reusing, repairing, maintaining, redistributing, refurbishing, remanufacturing, or recycling / [4] e.g., X as a Service incl. leasing or renting

Moreover, the relevance of barriers might also vary depending on additional variables, including cultural and system attributes such as prevailing sustainability awareness, level of prevailing access-based consumption, knowledge about sustainability and CE within the culture, as well as the

development level of required system infrastructure. For example, PSSs have been accepted faster in communal cultures such as Scandinavia, the Netherlands, or Switzerland (Baines et al., 2007, p. 1549; Cole et al., 2019, p. 8). In addition to cultural attributes, company attributes such as visibility and sustainability image as well as CI attributes themselves, including the BM's payment structure, or the product's usage intensity, intimacy, status associating, quality importance, average product lifetime etc. can influence the relevance of barriers. Consequently, to develop a methodology that is applicable for a wide range of companies in different industries, offering different types of CI, the to be developed methodology should also enable companies to identify and analyse barriers in the considered context.

2.5. Approaches to Identify and Overcome Customer Barriers Towards Circular Innovation

This chapter will introduce existing relevant approaches to identify and overcome customer barriers towards CI.

2.5.1. User-Centered Design

To encompass human aspects of consumption and enable a design for behavioural change, product design must go beyond the physical characteristics of innovation (Parajuly et al., 2020, p. 6) (Wastling et al., 2018, pp. 12–13). Thereby the focal point of user-centered design (UCD) is that the design of a product, service or BM is based on an understanding of the users, their needs, priorities, and experience. This user perspective provides the opportunity to design commercially profitable innovations that are attractive to people in their everyday lives (Selvefors et al., 2019, p. 2). A major condition for acceptance of CIs is that a circular consumption is preferable, and that the customer perceives an advantage relative to alternatives. In order to achieve this, companies must understand the targeted customer group as well as the consequences CIs might have for their everyday life, including the obtaining, using, managing, and circulating of products (Camacho-Otero et al., 2018, p. 15; Rexfelt & Hiort af Ornäs, 2009, p. 689; Selvefors et al., 2019, p. 3). This understanding should be developed within the very early stage of the design and development process of innovations. In this regard, ompanies should study customer habits, beliefs, and routines in order to identify the roots of possible conflicts with the innovation to be developed. As those psychological attributes are highly individual, it is crucial for companies to clearly define a specific target group rather than trying to develop a one-fits-all solution (Rexfelt & Hiort af Ornäs, 2009, p. 690). Considering the UCD process, there is no valid general definition. However, in the simplest terms this process includes exploration, ideation, and evaluation phases. Thereby, *exploration* means the understanding of the users and their context to identify needs and requirements. While *ideation* describes the process of generating ideas and concepts which in the last step will be *evaluated*. Within these phases, a new innovation can be designed and refined iteratively with the continuous involvement of the user itself (Rexfelt & Selvefors, 2021, p. 7). One well-known approach which is widely used in practice is the design thinking which the Stanford University developed in the 1970th to 80th (Hoffmann et al., 2016, p. 243). Even if UCD and the design thinking approach are not completely the same, both include the same elements of empathy, problem-solving, iteration, and collaboration (Browne, 2021). Design thinking can be understood as a meta-methodology that provides a set of principles, tools, and methods as part of an iterative and interdisciplinary problem-solving process that aims to develop human-centric innovations (Meinel et al., 2011, p. xiv). Typically, the design thinking process is based on five phases including, understanding, defining, ideating, building, and testing (Meinel et al., 2011, p. xiv). Furthermore, also participatory design and co-creation can be approaches to enable and

foster user-centered design and increase user adoption rates, especially in the case of PSS development (Armstrong et al., 2015, p. 39; Baines et al., 2007, p. 1549; Camacho-Otero et al., 2018, p. 16; Rönnberg Sjödin et al., 2017, p. 1).

2.5.2. Identification of BCW Interventions and Methods to Overcome CI Barriers

As mentioned earlier, CIs require a change in the customers' behaviour. Therefore, companies should be able to identify and design behavioural interventions. In this context, interventions are most effective when they are systematically planned (Steg & Vlek, 2009, p. 314). The previously introduced model of behavioural change by Michie et al. (2011) provides a more encompassing and structured method to identify potential interventions (Wastling et al., 2018, p. 8). This chapter will test the appropriability of the COM-B model and BCW based on an exemplary application in the context of CI. This chapter is structured based on the first five sub-steps of the three-stage iteration process for intervention design. Thereby, single steps of the method which are only applicable for a concrete case are not fully applied.

Stage 1 - understanding the behaviour: This stage is structured in four sub-steps, including the definition of the problem in behavioural terms, the selection of a target behaviour, the specification of the target behaviour (TB), and the identification of what needs to change. In a more generalised context, the problem which is intended to be solved is the lack of customer adoption of CI, including the unwillingness to purchase CIs as well as the lack of circular behaviour while using the CI. In behavioural terms and according to the circular consumption cycle by Rexfelt & Selvefors (2021) this problem can be defined by a set of target behaviours (see Appendix 4a, page 123). A more detailed specification of location and individuals performing the behaviour as a second step is not provided, as this is only possible in a more concrete context. As a third sub-step, a target behaviour must be selected. For this, the target behaviour "*Unwillingness to receive products previously owned by other users*", is selected in order to provide an exemplary application of the process. Continuing in the process, changes which are required to promote the selected targe behaviour have to be identified. For this, thaae COM-B model combined with TDF domains are used to first define preconditions for the target behaviour and then identify what needs to change. The analysis with a detailed overview of preconditions of the targeted behaviour as well as allocated barriers can be found in Appendix 4b (see page 124), while the aggregated result is shown in Fig. 7. For example, based on barriers identified previously no change is required in the COM-B component of physical capability as no specific physical skills are required. However, change is needed in the TDF domain of knowledge as part of psychological capability. Here, the barriers [B5] "lower perceived quality" and [B10] "lack of knowledge and information" provide insights into the main issues leading to the needed change.

		Identified Customer Barriers Towards CI *TARGET BEHAVIOUR (TB): Willingness to purchase previously owned "re"products*											
COM-B Factor	**TDF Domain**	**Lack of cultural change**	**Lack of ownership**	**Lack of emotional attachment**	**Lack of status**	**Lower perceived quality**	**Lack of trust and company image**	**Lack of convenience**	**Lack of infrastructure**	**Lack of technical compatibility**	**Lack of knowledge and information**	**Lack of perceived advantage**	**Uncertainty about quality**
Physical Capability	**Physical skills**		Not relevant for considered TB	Not relevant for considered TB					Not relevant for considered TB				
Psychological Capability	**Knowledge**					+					+		
	Cognitive and interpersonal skills										+		
	Memory, attention, and decision	+					+				+	+	
	Behavioural regulation	+											
Social Opportunity	**Social Influence**				+						+		
Physical Opportunity	**Environmental context**							+					
Reflective Motivation	**Social/prof. role and behaviour**				+	+							
	Belief about capabilities	+						+					
	Optimism						+						+
	Intentions	+				+		+					+
	Goals												
	Beliefs about consequences					+	+			+	+	+	+
Automatic Motivation	**Reinforcement**	+						+					
	Emotions											+	

green (+) = affected TDF domain and COM-B factor suggested by Michie et al. (2014)

Fig. 7. Overview of barriers affecting COM-B factors and corresponding TDF domains (own analysis)

Stage 2 and 3– Identification of intervention options: Intervention options can be identified based on barriers identified earlier and translated into needed change as part of stage 1. In the second and third stage, interventions and policies as supposed to be defined. However, as this thesis focuses on providing methods to overcome customer barriers that companies can apply, policies that are developed by authorities are out of scope. To define interventions, a matching matrix which links TDF domains to the most appropriate intervention options by Michie et al. (2014) can be used (see Fig. 8) (Michie et al., 2014, pp. 113–115). The following introduces each intervention option and demonstrates how the interventions can support companies to overcome corresponding barriers toward CI, as well as which possible BCT suggested by Michi et al. (2014) or additional methods identified can be used to implement the considered intervention (Michie et al., 2014, 259-283).

	Identified Customer Barriers Towards CI *TARGET BEHAVIOUR (TB): Willingness to purchase previously owned "re"products*											
Recommended Interventions	**Lack of cultural change**	**Lack of ownership**	**Lack of emotional attachment**	**Lack of status**	**Lower perceived quality**	**Lack of trust and company image**	**Lack of convenience**	**Lack of infrastructure**	**Lack of technical compatibility**	**Lack of knowledge and information**	**Lack of perceived advantage**	**Uncertainty about quality**
Education	+	Not relevant for considered TB	Not relevant for considered TB	+	+	+	-	Not relevant for considered TB	-	+	+	+
Persuasion	+			+	+	+	-		-	-	+	-
Incentivisation	+				+	-	+				+	-
Coercion	-				-		-				-	
Training	-					-	-			+	-	
Restriction												
Environmental restructuring	-			-		-	+			+	-	
Modelling	+			+	+	+				+	+	+
Enablement	-			-	-	-	-			-	-	+

yellow (-) = suggested intervention by Michie et al. (2014) but not found to be relevant / green (+) = intervention found to be relevant

Fig. 8. Matching of interventions and barriers (own analysis according to Michie et al., 2014)

Education is defined as the action of "increasing knowledge or understanding". This refers to knowledge and understanding about the purchase of "re"products in the considered context. Research has shown that the transition to CE depends on creating and communicating the right information that urges customers to change how they purchase and use products and services (Iacovidou et al., 2021, p. 24799). Education and transparency play a central role in CI adoption (Jesus & Mendonça, 2018, p. 83). As part of education, informational strategies aim at "changing perceptions, motivations, knowledge, and norms, without actually changing the external context in which choices are made" (Steg & Vlek, 2009, p. 313). This intervention is relevant for several identified barriers as the increase of knowledge can help to change cultural norms, attitudes and beliefs as well as increase environmental awareness [B1] (Iacovidou et al., 2021, p. 24799), enables the customer to understand and differentiate quality conditions of "re"products [B5], increases trust in the product provider [B6], reduces uncertainty in general [B12], obviously reduces lack of knowledge and information [B10], and enables customers to perceive the real advantage of CI [B11]. Education can be implemented in several ways including, marketing and communications via different media channels such as social media, product labelling, printed ads, in-store activities, websites, or blogs. Some researchers even understand customer communication as one key element in order to facilitate circular consumption (Camacho-Otero et al., 2020, pp. 6–9). To implement education, different BCT can be applied, including "information about social and environmental benefits", as well as "feedback on outcome(s) of behaviour" including benefits the customer can reach when purchasing "re"products compared to new linear ones such as reduction of CO2 footprint. The information transmitted should include "prompts and cues" including product labelling with information specific for "re"products for instance, product lifespan, guarantees, technical compatibility (Parajuly et al., 2020, p. 5), or advertisement which educates customers about how and where to access "re"products. Furthermore, sceptics about sustainability claims can be reduced by transparency in production and reprocessing processes of "re"products (Armstrong et al., 2015, p. 32). Lastly, information strategies are most effective if pro-environmental behaviour, in this case, the choice of "re"products over linear new products, is relatively convenient in terms of money, time, effort, and social disapproval (Steg & Vlek, 2009, p. 313).

Persuasion is defined as the action of "using communication to induce positive or negative feelings or stimulate action" (Michie et al., 2014, p. 111). In this context, persuasion would be initiated to induce positive feelings towards and stimulate purchasing of "re"products. Furthermore, persuasion can be applied in order to "influencing actors' attitudes, strengthening their altruistic and ecological values, and/or strengthening their commitment to act pro-environmentally" (Steg & Vlek, 2009, p. 313). This phenomenon is also described in Roger's innovation-decision process, which considers persuasion as the most crucial part of the innovation-decision process. As mentioned earlier (see chapter 2.3.4), according to Roger, a positive attitude towards an innovation will most likely occur if a relative advantage is perceived, the innovation is compatible with current beliefs and practices, the innovation's complexity is rather low, and it is easy to test and observe. Moreover, if persuasion is combined with education, it can support the positive perception of transmitted information, which can be an effective alternative to traditional pure information campaigns (Parajuly et al., 2020, p. 4). This is highly relevant when considering that environmental awareness and positive attitudes towards environmentally favourable practices as buying "re"products are key determinants of sustainable customer choice (European Commission, 2018, p. 4). Persuasion is relevant for several identified barriers as the induction of positive feelings and stimulation of action can influence customers' attitudes and values which can help to overcome the lack of cultural change and lack of environmental

awareness and interest [B1] or lack of status [B4]. Also, persuasion can increase customers' willingness to pay for "re"products as a result of a higher perceived quality [B5], increase the trust in the "re"product provider [B6], resulting in a higher perceived advantage [B11]. Similar to education, persuasion is part of marketing and communication. Thereby, it can be understood as a type of choice influence to shape the customers' mindset and encourage them to choose "re"products rather than new product alternatives (Rafinejad, 2020). According to Cialdini (2005), persuasion is typically implemented based on six techniques including reciprocity, scarcity, authority, commitment, and consistency, liking as well as consensus (Cialdini, 2005, p. 294). Also, nudging as an emerging behavioural change approach can be used to persuade customers. It is understood as "any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives" (Wee et al., 2021, p. 5) and can be used in the field of persuasion. In this context, nudging has been frequently used to promote pro-environmental behaviour change (Wee et al., 2021, p. 6). However, due to its manipulative character nudging has also been criticised for being unethical and unfit for tackling global problems such as climate change (Parajuly et al., 2020, p. 5). The following will describe the six persuasion techniques by Cialdini (2005) and, if applicable, give examples of how they can be used in order to induce positive feelings towards the purchase of "re"products. The first technique is **reciprocity**, meaning the phenomenon that people usually give back to others the form of behaviour they have received first. Second is **scarcity**, which means that people usually desire more of those things they can have less. In this case, companies can offer limited editions of "re"products and promote the unique character as products have a usage history. Third is **authority**, meaning that people usually follow the lead of credible and knowledgeable others. Companies can take advantage of testimonials like influencers or use sustainability and quality certificates provided by acknowledged issuers for this technique. Fourth is **commitment and consistency**, meaning that people usually prefer to be consistent with the things they are used to think or belief in. In general, the majority of people would confirm a generally positive attitude towards pro-environmental behaviour (Parajuly et al., 2020, p. 2). Companies can confront customers with this commitment in the moment of purchase decision. Commitment strategies already appeared to be successful in previous studies on pro-environmental behaviour (Steg & Vlek, 2009, p. 313). Fifth is **liking**, which means that people usually prefer to say yes to those that they like. And finally, **consensus**, meaning that people search for social proof by observing others' behaviour especially when they are uncertain. Furthermore, a BCT by Michi et al. (2014), which can be used, is the "use of credible sources" for example, by collaborating with companies which have a positive reputation in the field of "re"products or by reaching quality certifications. Additionally, "information about social and environmental benefits", "information about the consequences of consumption of new linear products" such as environmental problems including climate change or waste problems, and "feedback on outcome(s) of behaviour", including benefits the customer can reach when purchasing "re"products compared to new linear ones such as reduction of CO2 footprint, can be applied as BCT.

While **incentivisation** is defined as the action of "creating an expectation of reward", **coercion** is inversely defined as the action of "creating an expectation of punishment of cost" (Michie et al., 2014, p. 111). Both interventions are also known as structural strategies (Steg & Vlek, 2009, p. 314). Thereby, research has shown that in the context of pro-environmental actions rewards and incentives are more effective than sanctions and coercions (Steg & Vlek, 2009, p. 314). This intervention is especially relevant in order to help customer change their habits [B1] [B7] (Iacovidou et al., 2021, p. 24799). Furthermore, incentivisation could also contribute to solving the issue of lower willingness

of customers to pay for "re"products [B5] [B12]. To implement incentivisation, companies can apply the BCT "feedback on outcome(s) of behaviour" including the presentation of benefits the customer can reach when purchasing "re"products compared to new linear ones such as reduction of CO2 footprint. Also, companies can provide customers with tools to analyse and track their contribution to the environment by using "re"products which is part of the BCT "self-monitoring of outcome(s) of behaviour" (Michie et al., 2014, 259-283). It is important to mention that companies have to ensure that customers do not attribute their behaviour to the rewards of their personal convictions. In this case, incentives would only have a short-term effect as the incentive is not linked to a personal belief and changed habit (Steg & Vlek, 2009, p. 314).

Training is defined as the "imparting of skills" (Michie et al., 2014, p. 111). This intervention is only relevant if companies are in the position of training customers and customers are willing to get trained by the provider. This might be more likely the case in a B2C relationship rather than a C2C. The identified skills needed for the targeted behaviour are the comparing of product attributes at a more complex level as relevant attributes for "re"products are not as familiar to the customer as the ones for new products. In this context, barrier [B10] "lack of knowledge and information" was identified as hindering as insufficient and unstandardised information about product attributes makes this comparison even more difficult for the customer. Therefore, additionally to previously introduced interventions, companies could apply the BCT "instruction on how to perform the behaviour" (Michie et al., 2014, p. 153) by providing the customers with training material on how to compare attributes of "re"products with the ones of new products. This can be done by content marketing via social media, blogs, or websites.

Restriction is defined as "using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours)" (Michie et al., 2014, p. 111). As companies are usually not in the position to define rules for their customer, this intervention is less or even not relevant in the context of overcoming customer barriers towards CE.

Environmental restructuring is defined as "changing the physical-social context" (Michie et al., 2014, p. 111). This intervention is especially relevant for barrier [B10] "lack of knowledge and information" as environmental restructuring can increase the awareness for "re"products as well as barrier [B7] "lack of convenience" as the convenience can be increased by providing the needed infrastructure to access "re"products. In order to implement environmental restructuring, companies can apply the BCT of "restructuring the physical environment" for instance, by collaborating with more retailers in order to make access to "re"products easier. To increase accessibility, awareness about existence, as well as convenience, companies could also establish or integrate "re"products in online shops or existing platforms which decrease the required time of searching. Also, as part of the BCT "prompts/cues" nudging in the form of sizing can be used meaning the "changing of size or the quantity of the object to influence people's behaviour" (Hollands et al., 2013). Companies offering "re"products could, for example, provide larger instore booths in order to attract customers' attention and inform them about the possibility of obtaining "re"products.

Modelling defines the action of "providing an example for people to aspire to or imitate". In the context of pro-environmental behavioural change, modelling and the information about the behaviour of others have already been found to be successful (Steg & Vlek, 2009, p. 313). Thereby, social support and role models provide the possibility of strengthening social norms and informing

customers about the perceptions, efficacy, and behaviour of others. Therefore, this intervention is especially relevant to overcome [B1] as well as [B4] as stereotyping can be reduced, [B5] as quality perception can be positively influenced, [B6] as the perception of the company as well as trust towards the company can be positively influenced. Additionally, [B10] as additional information and knowledge can be provided, [B11] as people can perceive the advantage based on a realistic example, and [B12] as people can receive insights about the quality perception of other people. In order to implement modelling in the context of CI, early adopters of "re"products can be very useful communicators and role models in spreading their experience with their decision to adopt the CPI (Jansson et al., 2010, p. 366). Therefore, companies should identify those early adopters, in best case influencers of the targeted customer group, and make sure that they can share their experience and show their adoption of "re"products", e.g., via social media or other forms of communication.

Enablement is defined as the action of "increasing means/reducing barriers to increase capability (beyond education and training) or opportunity (beyond environmental restructuring)". In this case, companies could offer options of testing "re"products, e.g., by extended money-back guarantees (Rexfelt & Hiort af Ornäs, 2009, p. 690). This intervention can be especially relevant for barrier [B12] as it has the potential to reduce uncertainty in general, by lowering or even avoiding the risk customers expect to take when buying a "re"product. In the considered context, no additional enablement intervention options or corresponding BCT could be identified to be supportive.

To conclude, applying the three-stage process of the theory of behavioural change by Michie et al. (2014) has shown that previously identified barriers towards CI are rooted in all three different components of behavioural change including lack of capabilities, opportunities, and motivation. Thereby, the exemplary application of the process for the target behaviour "willingness to purchase previously owned "re"products" revealed interventions and BCT that can be used in order to overcome identified barriers towards CI. Especially the interventions of education, persuasion, and modelling could be identified to be effective as they target the highest variety of customer barriers towards CI, followed by incentivisation, training, environmental restructuring, and enablement, while restriction and coercion were considered as not supportive. This is the case as companies are rather not in the position to initiate restrictions or coercions towards their customers. As the analysis was conducted without a concrete context, the identified effectiveness of interventions provides a suggestion and inspiration for companies in which area of interventions their most properly find techniques and methods to overcome barriers. However, several variables influence the effectiveness of interventions, including the target group, the specific CI to be analysed, as well as other influencing aspects such as economic, psychological, cultural, demographical, and socio-material factors (Camacho-Otero et al., 2019, p. 934). Studies have shown that is it difficult to develop CI especially PSSs for a broad spectrum of customers (Rexfelt & Hiort af Ornäs, 2009, p. 677). In order to target attitudinal factors such as values, beliefs, norms, or habits, and develop effective interventions which are tailored to individual needs, wants, and perceived barriers, companies should segment their markets and investigate the specific characteristics of their target customer groups (Steg & Vlek, 2009, p. 313). Lastly, a combination of interventions is recommendable in regard to behavioural change as not only one but the combination of several barriers can hinder to adapt CI (Steg & Vlek, 2009, p. 314). By applying the introduced approach, companies should be able to identify and overcome behavioural barriers towards a considered CI. However, there is a need to empirically explore the field of intervention design in the context of barriers towards CI.

3. Research Methodology for the Exploration of Approaches to Overcome Customer Barriers

3.1. Research Design

As mentioned in the introduction, there is a significant gap in research on approaches to identify and interventions to overcome customer barriers towards CI. In order to contribute to this gap, a primary literature analysis has been conducted in five main research areas. To further explore the research context in practice, empirical research is needed. The following grounds the initially introduced research design (see Fig. 1).

The context of CE and especially CI is rather complex. Today literature on CE is partly ambiguous and empirical research is rather rare (Alhawari et al., 2021, p. 1). The same is true for research on CI (Horbach & Rammer, 2020, p. 617), and even less theoretical and empirical research is published on interventions to overcome customer barriers towards CI. Due to the immature, unknown, and underexposed characteristics of the underlying research context an *exploratory, qualitative research approach* seems to be most suitable. This can be confirmed by those few studies which already exist in the context of identifying and overcoming customer barriers towards CI, mainly resulting from research on behavioural change in the context of CE, as all of them are based on qualitative research (Chamberlin & Boks, 2018; Daae et al., 2018; Parajuly et al., 2020; Wastling et al., 2018). Thereby, **qualitative research** claims to describe the lifeworld from the perspective of those who participate and with this contributes to a better understanding of social realities and draws attention to processes, meaning patterns, and structural features (Flick et al., 2004, p. 3). Furthermore, the **exploratory nature** of the research provides the possibility of adapting to changes throughout the research process which is beneficial in case of a relatively unexplored research context (Saunders et al., 2007, p. 134). For qualitative research both, a deductive and an inductive research logic is possible (De Angelis, 2018, p. 66). In the case of this thesis the **research logic is primarily deductive** as the research aims first to lay the theoretical foundation and present possible approaches to overcome customer barriers towards CI in theory before analysing those theoretical elements within an empirical context (Hyde, 2000, p. 83). This deductive qualitative and exploratory research approach has been promoted by Hyde (2000) and proven to be effective by Casula et al. (2020) (Casula et al., 2020, p. 18; Hyde, 2000, p. 85). In order to apply an exploratory, qualitative research approach, a **multiple case study analysis** is conducted based on semi-structured company and expert interviews. **Case studies** are a well-known form of deductive as well as inductive qualitative inquiries and in-depth studies of a particular instance (Hyde, 2000, p. 85, 2000, p. 83; Welch et al., 2013). Furthermore, case study analysis is a "suitable research method in order to investigate contemporary phenomenon in real-life context and is suitable for exploratory work" where the research context is immature and primarily "why" and "how" questions are supposed to be answered (Yin, 2014, p. 14). Thereby, a **multiple** analysis form is chosen to increase the probability of reaching saturation as well as a more compelling, vigorous, and robust perspective on the research context (Yin, 2018, 54; 61). In order to apply a case study analysis and ensure triangulation, secondary data based on desk research as well as primary data based on semi-structured interviews were gathered (Yin, 2018, p. 15). Thereby, secondary data was gathered in advance of the corresponding interview, which ensured sufficient preparation and clarified of more specific questions. This included the analysis of publicly available data of selected case companies, for instance, newspaper articles, annual reports, or website information. Moreover, **primary data** was generated based on **semi-structured interviews** with representatives (practitioners) of the selected case companies to further explore practically applied approaches to

overcoming customer barriers towards CI. Lastly, next to practitioner interviews, **expert interviews** were conducted as an additional information source of high-level knowledge which is of great importance for research practice (Bogner et al., 2014b, p. 1) and increases saturation and triangulation. Both kinds of semi-structured interviews were prepared following suggestions by Brinkmann and Kvale (2018) and Bogner et al. (2014) and are based on an interview guide including an outline of themes as well as prepared questions to be covered (Bogner et al., 2014c; Brinkmann & Kvale, 2018b). This interview guide considers the previously defined fourth research objective:

> *To empirically explore and validate effective approaches to identify and interventions to overcome customer barriers towards CI in the case of European consumer electronics companies.*

Primarily the interview guideline aims to identify recognised customer barriers of the considered CI and explore approaches to identify and interventions to overcome these barriers. Secondary, it aims to explore how companies try to integrate the customer perspective within the CI development process as well as to identify practical requirements towards a possible systematic approach of identifying and overcoming customer barriers towards CI. Next to these aims, the guideline has been developed under consideration of theoretical findings of the literature review. Thereby, the guidelines for case companies (see Appendix 5a, page 125) and experts (see Appendix 5b, page 126) slightly vary. However, the main categories remain the same, including "*introduction*", "*interviewee (and company) introduction*", "*customer integration*", "*customer barriers*", "*approaches to identify barriers*", "*interventions to overcome barriers*", "*practical requirements*", and "*closure*".

3.2. Case and Interviewee Sampling

In order to narrow the scope and explore approaches on how to overcome customer barriers towards CI, a specific industry and geographical context were selected. This narrowing is specially motivated by the assumption that the occurrence, as well as relevance of customer barriers, is highly dependent on the considered product or service as well as the prevailing regional culture impacting customers decision-making (Camacho-Otero et al., 2019). Thereby, the European consumer electronics industry was chosen as an emphasis area for the empirical research. Regarding geographical limitation, Europe and preferably Germany and the Netherlands, were selected as Europe, especially Germany and the Netherlands are leading regions in terms of the transition towards CE (EMF et al., 2015, p. 6; Isles, 2021; Mazur-Wierzbicka, 2021, p. 1). This has been argued in the introduction based on several CE promoting EU policy initiatives (see chapter 1.2). Furthermore, the regional scope was chosen due to the author's familiarity with the European and especially German market and the possibility of conducting interviews in the native language without important content-related insight being lost or not recognised caused by language barriers. As of industry limitation, the electronic consumer good, also called customer electronics industry was selected because electronics are one the key value chains in the CE transition (Froger, 2021). This is the case since the electronics sectors are suffering from huge and rising levels of waste, especially highly hazardous and a fast-growing amount of e-waste, for instance, caused by premature obsolescence. The latest global e-waste monitor shows that the world generated 53.6 Mt of e-waste which equals an average of 7.3 kg per capita (Europe ranked first with 16.2 kg per capita) in 2019, which is even projected to grow in the future. The e-waste generation is mainly fuelled by the higher consumption rates of electrical and electronic equipment (EEE), short life cycles, and few repair options (Forti et al., 2020, p. 13). As previously identified, customer barriers refer to the end customer of CIs, the B2C industry has been selected as an emphasis

area. Therefore, the consumer electronics industry has been chosen as an industrial limitation of the research. The consumer electronics industry can be understood as a sector of the economy in which companies are engaged designing, manufacturing, and marketing of electrical equipment and appliances for the domestic end user. That equipment and appliances can include so-called brown goods (small electronic goods mainly in the entertainment sector such as TV, smartphones, notebooks, and sound systems) as well as white goods (small and large electronic goods mainly used as household and kitchen appliances such as washing machines, laundry dryer, fridges, dishwasher, stoves, coffee machines, blender etc.). Both types will be considered in the following research. In order to generate empirical insights, practitioners of selected case companies as well as experts were sampled. The sampling process is described in the following and illustrated in Fig. 9 (for practitioners) and Fig. 10 (for experts).

Sampling of case companies and practitioner interviewees: case companies were identified via LinkedIn. Thereby, a purposeful sampling technique (Johnson et al., 2019, pp. 7–13) was applied by assessing the companies' case suitability based on previously defined sampling criteria and publicly available data. Table 8 provides an overview of the must, should, and could criteria considered in order to select suitable case companies.

Table 8. Case company sampling criteria

Must[1] sampling criteria	Should[2] sampling criteria	Could[3] sampling criteria
• Company is a provider of any kind of CI in the consumer goods industry • Company has an existing customer base for the considered CI in Europe	• Company is focused on electronics and electrical equipment • Company is focused on reused, remanufactured, or product as a service offerings • There is relevant secondary data publicly available	• Company has an established innovation management • Company has the strategic gool to transit towards CE or operated based on CE principles • Company is recommended by an interview partner

[1]k.o. criteria / [2]Optional criteria of higher relevance / [3]Optional criteria of lower relevance

At a minimum, companies had to fulfil the listed must criteria. Thereby, companies that could fulfil additional should or could criteria were prioritised and contacted first. Both, incumbent as well as young companies or start-ups were taken under consideration. Potential case companies were found and screened via the European Circular Economy Stakeholder Platform (European Union, 2022), academic literature for instance, Bressanelli et al. (2020) (Bressanelli et al., 2020), as well as a case collection of the 5-year research project "Circular X" funded by the European Research Council (Circular X, 2022). In total 18 cases were screened to be suitable. Eleven most suitable companies were contacted successively via LinkedIn profiles of possible company representatives and suitable interview partners. To find suitable contact persons for the companies which could also be suitable for the interview, additional sampling criteria were predefined (see Table 9).

Table 9. Practitioner interviewee sampling criteria

Must[1] sampling criteria	Should[2] sampling criteria	Could[3] sampling criteria
• Interviewee is a representative employee of the case company • Interviewee is knowledgeable in the customer perspective of the considered CI	• Interviewee is knowledgeable in CE	• Interviewee is directly involved in CI development activities • Interviewee is directly involved in customer experience or customer journey design of the considered CI

[1]k.o. criteria / [2]optional criteria of higher relevance / [3]optional criteria of lower relevance

At a minimum, potential interviewees had to fulfil the listed must criteria. While contacting selected company representatives, a prewritten standard interview request including information about the research context and the interview setting was adjusted to specific company aspects. In case of uncertainty about the suitability of the interview partner sampling criteria were shared within the request to get referred to the most suitable employee. In one case, even a short pre-interview call was executed to clarify required interviewee characteristics and get directed to the most suitable interview partner. Out of eleven contacted companies, four companies could be recruited for one or more interviews, five contacted companies denied participation in the research mainly out of time capacity issues and two did not reply to the request. The sampling process for the case company and practitioner interviewees is illustrated in Fig. 9.

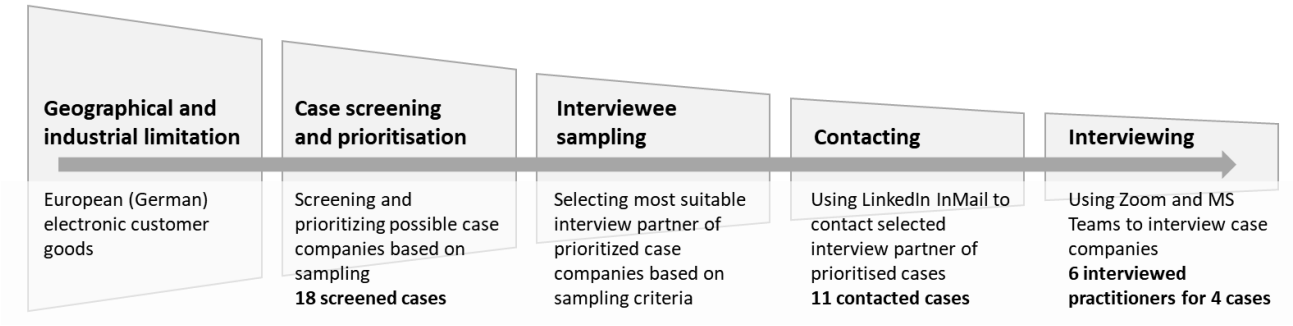

Fig. 9. Sampling funnel for case companies and practitioner interviewees

Sampling of expert interviewees: in addition to cases and practitioner interviewees, experts of different relevant expertise fields were requested for an interview. For this, the same approach was applied. First, sampling criteria were predefined (see Table 10).

Table 10. Expert interview sampling criteria

Must[1] sampling criteria	Could[2] sampling criteria
• Interviewee is highly knowledgeable in one of the selected expertise fields (CE, CI, behavioural psychology, circular design of CI) • Interviewee reaches an expert status by being active in the field for several years, having a relevant academic degree, or a unique combination of relevant skills • Interviewee is knowledgeable in the customer perspective	• Interviewee has own experience in CI development

[1]k.o. criteria / [2]optional criteria of lower relevance

In order to screen possible interview partners, LinkedIn search was used by filtering for specific skills, experiences, or positions considering listed sampling criteria. In total, eleven suitable interview partners were screen and ten of them were contacted while five could be recruited for an interview. The others did not reply to the request.

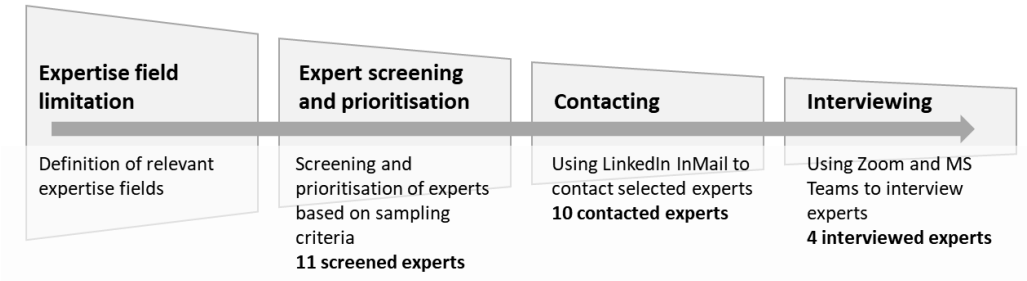

Fig. 10. Sampling funnel for expert interviewees

Even though the research design does not directly involve customers in the empirical research due to the limited scope and time for the master thesis, a customer-orientated approach could be guaranteed by considering sampling criteria that prefer interviewees with sufficient knowledge about the customers' perspective. This approach takes advantage of the aggregated knowledge and experience of the interviewees with several customers and, therefore, seemed to be more efficient and doable within the master thesis scope.

3.3. Data Collection and Analysis

Based on the sampling in total, ten interviews were conducted, six with practitioners of case companies and four with selected experts. Interviews were conducted via Zoom or MS Teams, while the language, English or German, was selected based on the interviewee's preference. Therefore, five interviews were conducted in German and five others in English. All interviews were scheduled for 45-60min except of interview four, which was scheduled for 30min due to the limited time capacity of the interviewee. The interviews were conducted within the time period of 7 March to 8 April 2022.

In advance of the interview, the interview guideline was reviewed based on previous desk research considering specific aspects of the company or expertise fields of the corresponding interview partner. If valuable the interview guideline was adjusted accordingly. This procedure is also recommended by (Bogner et al., 2014e, p. 30).

Additionally, guidelines were iteratively adjusted, throughout the research period, if considered to be useful based on newly gained insights. According to the interview guide, "must" categories and corresponding questions were defined and covered in all interviews. The predefined sequence of questions was usually followed but adapted to the flow of conversation if necessary. Lower prioritised categories and questions were covered if there was enough time, if the categories were already touched throughout the conversation of the interviewee could provide valuable insights due to the according knowledge or experience.

The content analysis process is orientated on the recommendations of Kim & Kuljis (2010), who structure the process into nine main analysis steps including "theory and rational", "conceptualisations", "operationalisation", "coding system", "sampling", "training", "coding", "final reliability", as well as "analysing". Furthermore, the interview study steps by Brinkmann & Kvale (2018) has been used as an inspiration (Brinkmann & Kvale, 2018a). Thereby, interviews were audio-recorded for documentation purposes as recommended by Bogner et al. (2014) and later transcribed (ad verbatim) using the transcription software "trint" (Bogner et al., 2014e, p. 40). This transcription resulted into 93 pages of interview documentation which became the basis for the analysis. The qualitative text data was then coded and analysed using the software MAXQAD 2022 Plus which is one of the most popular and reliable tools for qualitative content analysis (Bogner et al., 2014a, p. 85). Based on the theoretical analysis, research indicators for empirical analysis have been defined and used as a foundation of a primary coding system. Concerning customer barriers, the categorisation of "psychological" and "functional barriers", as well as further sub-categories is based on Ram & Sheth (1989). Furthermore, each of the identified 12 barriers is used as an indicator. Those barriers are based on the extensive literature review performed previously. Concerning interventions to overcome these barriers, the concept of the BWC by Michie et al. (2011) has been used, including the interventions of "education", "persuasion", "incentivisation", "coercion", "restriction", "training", "modelling", "environmental restructuring", as well as "enablement" (Michie et al., 2014, p. 116). The primarily

coding system has then been refined based on repeatedly mentioned aspects. In order to avoid over-documentation, interviews were transcribed in the original language (Bogner et al., 2014e, p. 39). However, in order to stay consistent, the coding was done in English only, as deductive codes were previously defined in English.

3.4. Research Quality and Ethics

Several quality criteria have been considered during the data collection and analysis process to ensure high quality research. First, **rigor** has been increased by being very exact and careful (Cypress, 2017, p. 254) during the data collection and analysis, including detailed documentation based on an ad verbatim transcript (Cypress, 2017, p. 254) as well as the clear argumentation of the research design and methods in chapter 3.1 (Cypress, 2017, p. 254). Additionally, the use of a state of the are QDA software (Bogner et al., 2014a, p. 83) as well as the provided transparency over the applied coding structure increases *reliability* of the research. Furthermore, rigor could be increased by considering quality criteria for interviews recommended by Brinkmann & Kvale (2018) as well as the CASET-evaluation template for case study analysis in innovation management by Goffin et al. (2019) (Brinkmann & Kvale, 2018c, p. 4; Goffin et al., 2019, p. 594). *Validity* could be increased by choosing a purposeful sampling process (Johnson et al., 2019, pp. 7–13).

Moreover, as mentioned before, **triangulation** has been applied by collecting data from different sources, including primary sources through semi-structured interviews of practitioners and experts, as well as secondary data publicly available through annual reports or press articles of selected case companies (Bressanelli et al., 2020, p. 6; Johnson et al., 2019, pp. 7–13). Lastly, saturation has been reached by conducting as many interviews as necessary to no longer receive completely new insights.

Even if **saturation** is difficult to reach in an emerging research context, as in this research's case (Johnson et al., 2019, pp. 7–13), saturation was considered in the number of interviews that are conducted in order to make sure that no significant new information is emerging from the data collection process. Based on this approach, in total, ten interviews with the sample of practitioners and experts have been conducted.

Concerning research **ethics**, several initiatives have been applied in order to fulfil ethical conducts for qualitative research. Approximately one week in advance to the interview, a pre-read document was sent to the interview partners in order to explain the research purpose as well as to provide information about the interview setting, including the procedure of formal anonymisation as well as a consent form of voluntary participation (see Appendix 5c, page 127) (Bogner et al., 2014d, pp. 89–90; Johnson et al., 2019, pp. 7–13). Additionally, audio recording has only been started upon the interviewee's agreement and consciousness. Furthermore, to ensure that no sensitive or confidential data is included within the research, transcripts have been anonymised and sent to the corresponding interviewee for a final recheck. Therefore, all information analysed within the research is in consent of the interviewees.

4. Empirical Findings on Interventions to Overcome Customer Barriers Towards CI

The following chapters will present empirical findings. Thereby, expert interviews are analysed first in order to provide an overview of different expertise fields before going into practical details of selected case firms. Thereby, several tables, including interviewees' exemplary quotations are provided n the appendix and referred to in the following analysis.

4.1. Overview of Expert Interviews

Expert interviews have been conducted in order to take advantage of high knowledge in different expertise fields and explore the research context from different angles. An overview of interviewed experts and their corresponding expertise field is listed below (see Table 11). Corresponding interview transcripts are provided in a separate document.

Table 11. Overview of expert interviewees

Position / profession	Expertise field	Duration
Behavioural scientist at Open Now[1] Environmental psychologist at University of Amsterdam	• Behavioural science for environmental psychology	55min
Professor and senior researcher at Maastricht University	• Sustainable business with interdisciplinary experience in design, engineering, and sustainability science. • Circular economy and circular business models.	26min
Head of design at Red Paddle Co.	• Circular design and engineering worked with EMF • Design thinking and new product development	51min
Project Manager for circular economy in the automobile industry	• Circular economy • Stakeholder collaboration and data transfer for the use case circular economy	56min

4.2. Comparative Analysis and Interpretation of Expert Interviews

In order to increase literacy and reduce interpretation effort for the reader all four expert interviews are analysed and interpreted in a comparative way.

4.2.1. Approaches of Customer Integration and Barrier Identification

According to experts, different *approaches of customer integration* are applied by companies to integrate the customer perspective (see Appendix 6a, Table 27). These include design thinking, lean start-up, an integrated product design including a customer-centered design, as well as elements of behavioural economics. In terms of the latter, the psychologist recommends that companies either should develop their own behavioural economics skills or hire external agencies that are specialised in behavioural science.

Considering *approaches to identify customer barriers,* typical customer research approaches have been mentioned by the psychologist and professor including customer surveys, interviews, focus groups, customer workshops, as well as netnography[2] and scientific research (see Appendix 6b, Table 28). Thereby, a more concrete and sophisticated process of identifying customer barriers towards CI has been suggested by the psychologist, including several steps (Psychologist, Pos. 11-45; 317-330;

[1] Open Now is an Amsterdam located communications agency which works for companies but also the Dutch government to promote behavioural change based on behavioural science.

[2] Netnography is a specific type of qualitative research based on publicly available data within social media Kozinets (2011)

420-432). First, an initial clear definition of a target group as well as the target behaviour and corresponding preconditions that are required in terms of ability, motivation, and opportunity. In the next step, barriers and motives towards these preconditions are identified based on customer research methods, including small surveys on a website, and customer interviews to describe customer attitudes and behaviours, focus groups and customer workshops. Additionally, netnography has been mentioned meaning the analysis of social media and online reviews, but also the consideration of scientific resources such as literature reviews and meta-analysis have been stated to be useful in identifying customer barriers. Lastly, the most influenceable and effective barriers and motives are selected to create a behavioural strategy including interventions on how to overcome these barriers which can be based for instance on models such as the BCW but also other concepts.

4.2.2. Identified Barriers and Interventions to Overcome

The following analyses recognised *customer barriers* (see Table 12) and *interventions* to overcome these. An overview of quotes that show how experts connect barriers with possible interventions can be found in Appendix 6d (see page 135), while a more detailed elaboration on interventions is provided in chapter 4.6.

Starting with "*lack of cultural change*", all experts confirmed a required cultural shift. In this context, companies are struggling with the issue that an ownership mindset is difficult to overcome, especially for older generations. Interventions recommended by experts include collaboration with influencers as well as communication to motivate people for change and to create awareness. Next to communication, experts highlight the importance of "well-educated" customers for a circular transition which can be supported by education in the form of demonstrating the value of a CI. Moreover, experts referred to the factor of time and assume that cultural change is driven by new generations. Lastly, in one case, restriction is considered to in a way that too environmental harmful product configuration is restricted which is applicable if customers can configure products.

Considering the barrier of "*lack of ownership*", it has been mentioned that the mindset of materialism is promoted by today's marketing that manipulates customers to think, for example, that everyone needs a car although it is not used most of the time. In the case of PaaS models, companies can try to overcome ownership issues by trying to increase the customers' decision impact on the selection of accessed products. Based on the psychologist's experience, people don't need to have much influence on a decision but rather have to have the feeling that they have an influence on a decision which makes them feel more ownership. Contrary to that, the automobile project manager questions whether the barrier is still an issue as, for instance, 70-80% of the company's vehicles are owned by fleet operators and only accessed by the end customer, which indicates that the barrier of ownership must be considered with respect to the corresponding industry characteristics.

In terms of "*lack of emotional attachment*", the psychologist mentions that the barrier strongly depends on the individual's emotional attachment to products which is also influenced by the product's price and quality. Only the designer suggests how to overcome the barrier which indicates that this barrier might be intangible. Out of design perspective a product presents a vehicle for memories and emotions which then defines whether a person is emotionally attached or not. However, a concrete action to increase emotional attachment has not been provided.

Going further, "*lack of status*" in the case of "re"products is especially perceived by premium brands where customers do not want to use reused products as they have a negative attitude towards those products. One expert mentions an example of a premium brand that purposefully does not

communicate its circularity actions in order to not lose its high-premium image. A suggested intervention is to communicate "sustainability as a status", which is accelerated because sustainability starts to become a social argument.

Table 12. Exemplary quotes of experts on recognised customer barriers towards CI

Category	Type	Barrier	Exemplary quotes
Psychological	**Tradition**	**Lack of cultural change**	*"[Ownership thinking] which is really hard to overcome, and that's probably a bigger cultural change."* (**Psychologist**, Pos. 239-240)
			"I think it needs a totally different set of perception of goods and that we own and buy or access." (**Professor**, Pos. 98-99)
			"The cultural shift is definitely required. And in order to shift culture, that's a big topic." (**Designer**, Pos. 137-138)
			"The standard customer is in another generation where cultural change is still needed." (**Project manager**, Pos. 231-234)
		Lack of ownership	*"I think it [ownership] really is like a norm and the value in our society."* (**Psychologist**, Pos. 235-237)
			"Is it really a problem? 70-80% of our products are owned by fleet operators." (**Project manager**, Pos. 256-261)
		Lack of emotional attachment	*"Definitely there's a point there and probably depends on differences in people how emotionally attached they get with products."* (**Psychologist**, Pos. 262-264)
	Image	**Lack of status**	*"When luxury goods, maybe fancy cosmetics brands might do a lot within factories to close, slow, and narrow the loop, but then they won't communicate to the customer because their brand is about luxury and feel-good factor."* (**Professor**, Pos. 84-89)
			"People have a negative attitude against remanufactured products." (**Project manager**, Pos. 318-319)
		Lack of perceived quality	*"We have observed a couple of the barriers, so people might perceive the quality to be less, so especially with a highly premium goods."* (**Professor**, Pos. 78-80)
		Lack of trust and company image	*"Lack of trust and company image, that might count for many, many of the different type of examples."* (**Professor**, Pos. 113-114)
			"That would help mitigate any trust issues." (**Designer**, Pos. 217)
			"The lack of trust and company image is really a topic." (**Project manager**, Pos. 327-328)
Functional Barriers	**Usage**	**Lack of convenience**	*"Inertia and convenience are really big factors."* (**Psychologist**, Pos. 231)
			"Lack of convenience in the service model, people don't want to have all kind of contract." (**Professor**, Pos. 118-119)
		Lack of infrastructure	*"Infrastructure is really a topic. On the one hand the digital infrastructure, on the other hand the physical. The German recycling industry is not well advanced for vehicles. That also leads to problems at the customer's side, so where do they return the car."* (**Project manager**, Pos. 379-385)
		Lack of technical compatibility	*"I guess that is also scepticism, but it's also true with like iPhone chargers or these kinds of things."* (**Psychologist**, Pos. 217)
	Value	**Lack of knowledge and information**	*"And what I find important and needs more research is the total cost of ownership. Like for instance, if I buy a Patagonia sweater that is maybe 100 Euros than 20 Euros from H&M, I need to understand why I am paying 100 Euros rather than 20 Euros."* (**Professor**, Pos. 92-94)
			"Lack of knowledge on the return infrastructure." (**Project manager**, Pos. 139)
		Lack of perceived advantage	*"Perceived advantage. Yeah, and it's also typical."* (**Professor**, Pos. 127)
			"As of right now customers have a very limited willingness to pay more for sustainability." (**Project manager**, Pos. 181-182)
	Functional risk	**Uncertainty about quality**	*"This trade-off [thinking] between quality and environmental friendliness. It's just very big."* (**Psychologist**, Pos. 120-122)
			"For example, if we have recycled material, we do not reach the requirements of a primary material." (**Project manager**, Pos. 407-412)

In terms of "*lack of perceived quality*" and "*uncertainty about quality*", usually only one of both barriers have been mentioned as interviewees did not recognise a significant difference between both barriers. Uncertainty about quality is especially recognised for "re"products as people are scared that these break faster or need more maintenance. Also, a typical trade-off thinking between quality and environmental friendliness is an issue that is partly justified as some circular products, such as those that include recycled material, cannot reach the quality level of non-circular products yet. In the context of scepticism, three experts recommend that companies should offer "guarantees" or product testing options such as "try before buy". Furthermore, the intervention of "reduce prices" is applied to lever the problem.

Considering "*lack of trust and company image*", this barrier has been considered to be relevant as customers require information transparency. In this regard, several interventions are mentioned, including the transparent presentation of measurable circular company initiatives as well as the use of credible sources such as certified information, the involvement of independent parties, and the collaboration with journalist and experts to enabler a science-based communication. Furthermore, delivering promises is effective, which can be supported by a philosophy that is based on "under promising", meaning to only promise what definitely can be achieved. Lastly, branding has been mentioned in connection to authenticity as customers do not buy what you do, they buy why you do it. Thereby, the project manager highlights that authenticity can be achieved by not only focusing on the development of CIs but also aligning the company's organisation with a circular purpose, meaning that there are dedicated responsibilities and internal circularity related goals that need to be achieved by the leadership. Lastly, experts recognise that customer trust requires time.

In terms of "*lack of convenience*", customers' inertia is an issue from a psychological perspective. For instance, in terms of service models, people don't want to have all kind of contracts. The psychologist distinguishes two aspects. On the one hand, inconvenience can be a psychological barrier as the customers anticipate it, which is part of scepticism. On the other hand, inconvenience can be a real pain and not only anticipated such as additional time effort. Thereby, to overcome the barrier, the first step always should be to try to make it more convenient and easier for people and then target the psychological barrier, for instance, with instructions on websites on how to make it easier or modelling by working with identifiable peer groups. Lastly, companies can also try to identify a specific first target group that tolerates a certain amount of inconvenience in order to get into the market.

In terms of "*lack of technical compatibility*", the same two aspects of scepticism and actual pain can be differentiated. Concerning the actual pain, product standardisation can be used to overcome this issue which is further promoted by policy initiatives. Furthermore, design for upgradeability is applied in order to unlock upgradable software functionalities and digitally extend the lifetime.

Additionally, the barrier "*lack of knowledge and information*" is recognised by experts as there is a lack of knowledge about the return infrastructure as well as transparency in general. In this context, communication is used, as well as customer-product interaction in order to provide product-specific data, for instance, based on a digital product pass. Moreover, instructions for using the CI and information on individual consumption behaviour are used. Lastly, the professor mentions that customers lack knowledge regarding the total cost of ownership. However, no explicit intervention has been mentioned for this issue.

Finally, "*lack of perceived advantage*" is recognised as a "typical" barrier. Experts recognise that customers have very limited willingness to pay more for sustainability. In this regard, experts are

referring to the interventions of branding, cost reduction, especially for refurbished products, as well as providing customers with sufficient information so that they can make the best possible decision. Furthermore, addressing motives in order to promote advantages for different customer groups has been suggested. Thereby, not all circular strategies might be relevant and attractive for all customer groups. The professor mentioned that people might want to have a service model as they prefer to have new phones all the time while in order cases refurbishment could also be good if someone just wants to have a new battery.

To sum it up, the analysis of expert interviews shows that in the non-psychological expertise field the customer perspective is mainly integrated into the CI development process based on a design thinking, lean start-up, as well as an integrated product design approach. Next to this, the psychologist refers to aspects of behavioural economics and suggests a sophisticated multi-stage process in order to integrate customers and identify customer barriers towards CI. Typical customer research methods, including customer surveys, interviews, workshops, and focus groups are suggested next to netnography and scientific research. According to barriers and interventions to overcome these, experts of all four fields recognise all twelve barriers with one exception which is "*lack of emotional attachment*". In terms of "*lack of ownership*" experts provided contrary insights as some confirmed the barrier while the product manager questioned whether this barrier is evident. Furthermore, from a psychological perspective, some barriers such as "*lack of technological compatibility*" or "*lack of convenience*" should be considered out from two angles meaning a barrier can be rooted in scepticism or actual pain. Thereby, companies should try to first overcome the actual pain before trying to intervene in the psychological dimension.

4.3. Overview of Cases

Next to expert interviews, a case study analysis has been conducted. This chapter briefly describes selected case companies with a special focus on their activities in the field of CE and CI. An overview of all cases is provided in Table 13.

Table 13. Overview of case companies and practitioner interviewees

Case	Company	Focused CI type	Interviewee's position	Interview duration
A	Miele & Cie. KG	Refurbished and circular designed washing machines	Leading Function in Central R&D	55min
		Rented domestic appliances (PaaS)	Project Manager @ Digital Innovation Lab	44min
		Shared laundry machines (PaaS)	Co-Founder @ Miele Operations & Payment Solutions	54min
B	HOMIE	Rented (paid-per-use) household appliances (PaaS)	Co-Founder	56min
C	Anonymised[3]	Refurbished consumer electronics	CEO	51min
D	Philips Domestic Appliances	Refurbished consumer electronics	Customer Sustainability Lead	42min

Case A (Miele & Cie. KG)

Miele & Cie. KG is a German manufacturer and leading provider of premium domestic appliances, including cooking, baking, and steam-cooking appliances, refrigeration products, coffee makers,

[3] The company of case C will be mentioned as "circular marketplace"

dishwashers, and laundry and floor care products. Founded in 1899, the family-run company is represented in about 100 countries, employees almost 21,000 people, and generated a turnover of 4.5 billion Euro based on the Miele Group in 2020 (Miele & Co. KG, 2021, p. 6). As part the international two-degree climate target commitment, Miele aims to be carbon-neutral by 2050 (Miele & Cie. KG, 2019). To reach this aim, the company's sustainability strategy includes several initiatives to promote a transition towards CE (Miele & Co. KG, 2021, p. 45). As those initiatives resulted in various different types of CI it was possible to conduct three interviews with different business areas including the central R&D department, the Smart-Home division, as well as a Miele Operations & Payment Solutions start-up powered by Miele. As the latter two are more separated from the actual company structure, they are shortly introduced in the following.

As part of the company's digital transformation, Miele started to establish a new business division called "Smart Home" (SH) in 2016 (Kaiser & Stummer, 2020, p. 29). With a focus on connected home appliances, this division is designed to unite the company's product development activities with digital features, business models, and services including the early identification of trends and disruptive technologies, understanding customer needs as well as the cooperation with research institutions, start-ups and platforms (Kaiser & Stummer, 2020, p. 30; Rathgeber, 2022). Functioning as an innovation engine, the SH division includes several subunits, for instance, "Future Business Design", "AI & Data", "Scouting & Technology", as well as the "Digital Innovation Lab". One of the current projects within the Digital Innovation Lab is the "Miele Upgreat" program which offers a renting model for Miele appliances and is the emphasis area of the corresponding interview.

Miele Operations & Payment Solutions is a fully Miele owned subsidiary founded in 2019. The start-up developed the so-called "appWash" concepts for shared use of Miele sharing machines and tumble dryers, including online reservations and cashless payment (Miele & Co. KG, 2021, p. 29).

Case B (Homie Pay-Per-Use)

Homie is a Dutch company that offers domestic appliances based on a service model. The company was founded based on academic research by one of the co-founders in 2018 and initially aimed to encourage sustainable use of home appliances. Thereby the service originally focused on a paid-per-use model only for washing and drying machines with a monthly usage minimum and expanded to a service of other domestic appliances based on an all-in monthly price (Homie, 2022b). Today, the company "operates at the forefront of the circular economy" in several Dutch regions (Homie, 2022a). To do so, the company moves from ownership to access, including the offering of energy-efficient, repairable, and longer-lasting appliances through repairs and maintenance. Furthermore, the company tries to stimulate sustainable consumption behaviour by nudging customers to use their appliances more efficiently thought the product's lifecycle as well as by offering shared use of white goods (Homie, 2022b). Lastly, Homie refurbishes and reuses young appliances (Homie, 2022d) and collaborates with "we cycle" in order to recycle parts, old Homie appliances, and non-Homie appliances that are no longer usable (Homie, 2022b).

Case C (Circular Marketplace)

Case C is the only company that requested to anonymise its data. Therefore, only a general overview of the business is provided based on data gathered within the conducted interview. Therefore, the primary information source is the interview transcript. Case C is an online marketplace for renewed, more specifically refurbished, consumer electronics, including smartphones, notebooks, tablets, as well as kitchen and domestic appliances (Pos. 13-18). The business is based on the vision of becoming

the one-stop shop for sustainable consumption (Pos. 26-27). Thereby, the company does not refurbish products by its own but operates as a platform between end customers and professional refurbishing companies (Pos. 38-42). With this concept, the company offers about 40% cheaper products and simultaneously contributes towards CE by reducing 70% CO2 emissions compared to new products.

Case D (Philips Domestic Appliances)

Philips Domestic Appliances (Philips DA) used to be a business area within one of three business propositions of the Dutch multinational and multi-industry "Koninklijke Philips N.V." also known as Royal Philips (Koninklijke Philips N.V., 2022). With the mission of "helping people to turn their houses into homes", Philips DA manufactures consumer electronics in the segments kitchen appliances from entry-level to premium, coffee, garment care, floor care and air (Philips DA, 2022a, 2022c). In September 2021, the division was divested by Royal Philips and sold to Hillhouse Investment, a global investment company located in Hongkong (Koninklijke Philips N.V., 2021b). As part of Royal Philips, Philips DA was founded in 1891 and is headquartered in Amsterdam, Netherlands. The company is represented in over 100 countries worldwide, employs around 7,000 people, and generated a revenue of 2.2 billion € in 2020 (Koninklijke Philips N.V., 2021c; Philips DA, 2022a). Since an independent annual or sustainable report for Philips DA is not available yet, most of the following information is derived from previous reports when Philips DA was still part of Royal Philips. Within these reports, and the Philips DA website, the company commits itself to the transition towards CE as one of their sustainability elements (Koninklijke Philips N.V., 2021a, pp. 48–49; Philips DA, 2022b). Philips DA's ambitions is "to provide environmentally conscious customers a more sustainable alterative" by targeting to design 100% of their products based on eco-design requirements including "energy efficiency, packaging, hazardous substances, weight, materials, lifetime reliability and circularity" by 2025 (Philips DA, 2022b). At the end of 2020, the company reached its aim to generate 15% of revenues from circular products and services and to send zero waste to landfill (Koninklijke Philips N.V., 2021a, pp. 48–49). Those circular products are products that meet specific CE requirements, including performance and access-based business models, refurbished, reconditioned, and remanufactured products, systems, and components but also upgrades or refurbishment on-site or remote, as well as products with a certain recycled plastics content (Koninklijke Philips N.V., 2021a, p. 234).

4.4. Single Analysis and Interpretation of Cases

In this chapter, all four cases will be analysed based on primary data gathered within semi-structured interviews with practitioners as well as secondary data, if available and reasonable.

4.4.1. Case A (Miele)

For Case A, Miele & Cie. KG, three interviews were conducted, including a representative of the central R&D who is responsible the promotion of CE out of R&D perspective and mainly provided insights on refurbished Miele products, a project manager of Miele's Digital Innovation Lab who provided insights on the Miele renting program called "Miele Upgreat", and a co-founder of the Miele start-up "Miele Operations & Payment Solutions" who provided information on Miele's sharing service. The following comparatively analyses and interprets the three interviews.

Considering *approaches of customer integration* (see Appendix 6a, Table 27) Miele mainly applies different design thinking methods and elements of lean start-up in the form of prototyping and MVP testing. In this regard, Miele has its own test studio, which is used to perform usability tests with a

representative selection of consumers who have the opportunity to extensively test new domestic appliances (Miele & Co. KG, 2021, p. 24). Additionally, from R&D perspective, CIs should be based on an integrative design approach, including digital platforms for efficient product lifecycle management and systems engineering. Based on this, customers' requirements are consciously recorded, catalogued, categorised, and channelled. In terms of behavioural economics, no explicit psychologists are involved. However, basic knowledge on behavioural economics is integrated into the CI development process. Additionally,

Considering *approaches to identify barriers,* mainly typical customer research methods are applied, including customer surveys, customer interviews, customer experiments, and customer workshops (see Appendix 6b, Table 28). Within these interviews, customers have been asked about pains and gains along the usage process of shared washing using processual story cards. In addition to that, Miele's customer service is strongly involved as an indirect source for customer insights. Lastly, in 2020 founded its global Digital Hub, "Miele X" located in Amsterdam. Miele X aims "to understand customers to the fullest and to ensure a superior online experience and purchase journey" (Miele & Cie. KG, 2020). In collaboration with professional institutions such as the GfK, Miele conducts typical market research based on customer and satisfaction surveys over the past 30 years, which provides insights about market perception, purchase decisions, and user behaviour of more than 250,000 customer opinions each year (Miele & Co. KG, 2021, p. 34).

Coming to *customer barriers* as well as *interventions* to overcome these, several barriers could be confirmed while others have been denied (see Table 14). An overview of quotes that show how Miele connects barriers with possible interventions can be found in Appendix 6d (see page 135). A more detailed elaboration on interventions is provided in chapter 4.6.

Considering the barrier of "*lack of cultural change*", all three interviews confirmed this issue. The co-founder mentioned that renting models are new for people which requires a change in their mindset. While the sustainability report provides insights on customer information campaigns or e-waste initiatives that are pursued in order to raise customers' awareness of environmentally responsible recycling or old appliances (Miele & Co. KG, 2021, p. 48, 2021, p. 48), interviewees state that Miele is not actively pursuing an intervention to overcome cultural change and rather refer to the factor of "time" meaning that society is in a turnaround regarding mindset and that the acceptance of CIs will change in the mind of people over time.

Going further, "*lack of ownership*" is perceived by Miele's service models, including the "Upgreat" program and sharing service. While the interviewees notice that lacking ownership is especially an issue for older generations, it is recognised that the barrier is less problematic in industries such as car sharing. In this context, the company is active in the sense that it tries to promote advantage of an access-based instead of ownership-based consumption, such as a "full-service offering", including time savings and comfort. The company mentions that a full-service is necessary to lead people into an access-based market. Furthermore, interviews are again referring to the factor of "time".

Coming to the barrier "*lack of status*", this issue is especially recognised for reused products. As Miele is a premium brand, the status of "premium" and "used" clashes. However, the project manager rated Miele product's general association with status as rather low. Miele tries to overcome the status barrier by clear customer segmentation. Further, the company strengthens its sharing service ambitions within the Miele profession (B2B) market as Miele's professional customers rather focus on the products function then its status which is why it is less relevant for those customers whether it

is new or used. Additionally, the factor of time has been mentioned again as a generation will come which does not care about things that are used by others before.

Table 14. Exemplary quotes of Miele interviewees on recognised customer barriers towards CI

Category	Type	Barrier	Exemplary quotes
Psychological	**Tradition**	**Lack of cultural change**	*"Our society thinks like that."* (**R&D Manager Miele,** Pos. 350)
			"A renting model is new for people, and it requires a change in their mindset." (**Project Manager Miele Upgreat,** Pos. 310-311)
			"Germany is in an old economy thinking of selling, selling, selling, better buy than rent." (**Co-Founder Miele Sharing,** Pos. 383-386)
		Lack of ownership	*"The customer returns something very durable after a relative short amount of time, that could be in the mind of some people."* (**Project Manager Miele Upgreat,** Pos. 128-133)
			"In other industries it's not a problem and seems to be completely normal." (**Project Manager Miele Upgreat,** Pos. 463-465)
			"This is especially relevant for earlier generations who value to have OWN stuff." (**Co-Founder Miele Sharing,** Pos. 306-308; 455-456)
	Image	**Lack of status**	*"Products that are status oriented (like I-Phones), there it could be an issue, but I have not recognised this for our products."* (**Project Manager Miele Upgreat,** Pos. 150-153)
			"Premium and used clashes somehow." (**Co-Founder Miele Sharing,** Pos. 360)
		Lack of trust and company image	*"Customers buy a reused Miele product because they trust the brand."* (**R&D Manager Miele,** Pos. 285)
			"That is definitely a point." (**Co-Founder Miele Sharing,** Pos. 246)
Functional Barriers	**Usage**	**Lack of convenience**	*"Many points are rather the opposite; the factor convenience should be higher in our case."* (**Project Manager Miele Upgreat,** Pos. 133-137)
			"As soon as there is any stress, or own effort for the customer, it will fail." (**Co-Founder Miele Sharing,** Pos. 424-426)
		Lack of infrastructure	*"There are countries where a take back infrastructure is well established (as in Germany), but there are also other markets."* (**R&D Manager Miele,** Pos. 303-305)
		Lack of technical compatibility	*"If you buy a 15-year-old refurbished product it will have another standard concerning ECO label or water consumption than a new one."* (**R&D Manager Miele,** Pos. 137-139) *"Nobody wants to stick to old standards."* (**R&D Manager Miele,** Pos. 223)
			"With a shared or leasing service the customer always goes with the technological trend." (**Co-Founder Miele Sharing,** Pos. 438-441)
	Value	**Lack of knowledge and information**	*"The customer does not know that Miele takes back old appliances."* (**R&D Manager Miele,** Pos. 303)
			"Customers have questions they never had before when buying a product, for instance how is product responsibility treated." (**Project Manager Miele Upgreat,** Pos. 205-211)
			"They do not know that it exists." (**Co-Founder Miele Sharing,** Pos. 263-265)
		Lack of perceived advantage	*"The customer choses the cheaper product even if the more expensive one is of higher quality and circularity."* (**R&D Manager Miele,** Pos. 346-350) *"You can develop a way more circular and sustainable product but then nobody buys it as it is too expensive."* (**R&D Manager Miele,** Pos. 340-342)
			"For the people the sharing concept makes sense, they know they live in a student dorm only for 3 years." (**Co-Founder Miele Sharing,** Pos. 210-211)
			"Renting is more expensive compared to buying if you consider long durations such as 20 years." (**Project Manager Miele Upgreat,** Pos. 330-332)
	Functional risk	**Uncertainty about quality**	*"Miele products are known for durability."* (**R&D Manager Miele,** Pos. 120-122; 275)
			"The quality of our renting products is the same." (**Project Manager Miele Upgreat,** Pos. 124-125)
			"For sure there are customers that have doubts regarding the functionality of reused products whether it might be rusty inside for example." (**Co-Founder Miele Sharing,** Pos. 473-475)

In terms of "*lack of trust and company image*", Miele recognises the importance of trust. Interviewees mention that customers buy reused Miele products because they trust the brand. Miele is mainly

tackling this barrier with branding, which is aligned with the company's product design for durability. Furthermore, Miele relies on a strong reputation as the customer knows from hearsays that Miele products last long and everyone in Germany knows the high quality of Miele. This is also supported by the customer survey "Green Brands of the Year 2020", which revealed that customers continue to see Miele's sustainability performance as very good (Miele & Co. KG, 2021, p. 12). Additionally, Miele conducts brand positioning surveys several times a year in order to analysed customers' perception of the company's commitment to sustainability (Miele & Co. KG, 2021, p. 23)

Considering "*lack of convenience*", both PaaS interviews reject the barrier. The convenience factor should be higher the in case of Miele's renting and sharing model as the company is offering a full-service to its customer. However, the company recognised that as soon as there is any stress or effort for the customer the service will fail as it would not provide sufficient added value compared to ownership-based models. Therefore, a full-service offering has been identified as one intervention Miele pursues next to design for circularity making products easier to repair for the customer. Lastly, the company also tries to overcome the barrier by addressing motives such as environmental impact as there are also people who accept a certain amount of extra effort in favour to the environment.

The "*lack of infrastructure*" barrier seems to be only an issue for Miele's refurbished products as the establishment of a take back infrastructure is not equally sophisticated in different markets Miele serves. The company overcomes this issue by collaborating with partners meaning certified Miele partners that take back products.

Concerning the barrier of "*lack of technical compatibility*", the R&D manager is referring to Miele's refurbished products as components of new generations do not fit those of older ones, which makes reusing more difficult. Furthermore, it is recognised that customers do not want to stick to old standards. Contrary, Miele's PaaS models are not struggling with this issue as customers of a shared or leasing service always go with the technological trend. In order to overcome the barrier, especially for refurbished products, Miele pursues systematic spare part management which guarantees services parts for an assumed lifetime of 20 years (Miele & Co. KG, 2021, p. 40). However, this is rather cost-intensive as storages have to be maintained. Furthermore, design for circularity, more specifically design for upgradeability, is another intervention which is realised by detaching electronics from the rest of the product. This intervention is supported by the corporate sustainability report that highlights a universal design of its products including a timeless design, repairability and the ability to update control software (Miele & Co. KG, 2021, p. 40).

Contrary, the "*lack of knowledge and information*" is present for all considered Miele CI types. For instance, customers do not know that Miele takes back old appliances, customers have questions they never had before in terms of renting household appliances, or they do not know that a sharing service for Miele products exist. The barrier is tackled by customer communication, meaning educating and informing customers. This is done via corporate communication and the company's website (Miele & Co. KG, 2021, p. 42), including a specific FAQ section and online contact forms that allow to directly contact the company in case of any questions. Additionally, marketing and awareness events are considered to inform customers about the existence of the CI.

Moreover, "*lack of perceived advantage*" has been recognised by the R&D manager as customers do not buy more sustainable products as they are too expensive. Furthermore, the project manager mentions that for long-term durations renting is usually more expensive. In order to overcome this barrier Miele relies on branding and the fact that a premium brand has more possibilities in terms of higher costs. Additionally, customer segmentation plays a role as customers that are willing to pay

more for circularity are targeted first. Considering the PaaS models, Miele tries to address motives such as cost savings or environmental aspects. Furthermore, also for this barrier the full-service offering has been mentioned as an effective intervention.

Coming to the last barrier, "*uncertainty about quality*", all three interviews rejected this barrier due to the high-quality perception of Miele products. Although, they confirm that other companies struggle with barriers, especially for reused products. Therefore, uncertainty about quality is mainly overcome by Miele's brand reputation.

To conclude, Miele applies different approaches to integrate the customer perspective into the development process of its CI. Those are mainly based on design thinking and partly lean start-up, integrated product design, as well as behavioural economics. In order to identify customer barriers, the company pursues typical customer research methods, including customer surveys, interviews, experiments, and workshops. Additionally, customer service has been mentioned as a significant information source for customer barriers. Considering customer barriers and interventions to overcome these, the interviews provided different insights considering their corresponding CI type. While Miele mainly struggles with "*lack of infrastructure*", "*lack of technical compatibility*", as well as "*lack of knowledge*" in terms of their refurbished products, the company's service models face barriers such as "*lack of cultural change*" and "*lack of ownership*". Thereby, Miele takes advantage of its well-established brand and strong reputation in terms of quality and durability enabling the company to overcome the barriers of quality concerns and "*lack of trust*". Furthermore, a full-service offering has been highlighted as key to overcome customer barriers regarding "*lack of convenience*" especially in terms of PaaS models. Lastly, the company relies on a cultural and mindset shift based on new generations, considering the barriers of "*lack of cultural change*" and "*lack of ownership*".

4.4.2. Case B (Homie)

In the second case, an interview has been conducted with one of Homie's co-founders. As Homie offers household appliances based on a renting model, the interview focussed on the CI type of product (household appliances) as a service. Currently, the company installed close to 4.000 machines at customers' sites (Co-Founder Homie, Pos. 5).

In terms of *customer integration,* the company mainly developed its CI based on a lean start-up approach, meaning they tried to be quick and experimented a lot regarding pricing, the delivery and repairing process, as well as how to attach and retain customers (see Appendix 6a, Table 27). Those experiments were based on typical marketing practices such as split testing. Furthermore, in order to *identify customer barriers* typical customer research methods have been applied such as customer surveys, customer interviews, and focus groups which an external agency did (see Appendix 6b, Table 28). Additionally, academic research integrates relevant scientific findings on customer barriers within the CI development. Moreover, Homie tries to maintain a close and recurring customer contact which was highlighted to be essential for a PaaS model and is pursued by rather long binding contracts (Co-Founder Homie, Pos. 178-180), a top service offering and service promise (Co-Founder Homie, Pos. 169-170; 172-173), and the establishment of an eco-system. The latter one means that it is the company's vision to provide customers a renting service for a fully furnitured housing (Co-Founder Homie, Pos. 185-190).

In terms of *customer barriers* as well as *interventions* to overcome these, several barriers are faced but also overcome by Homie (see Table 15). An overview of quotes that show how Homie connects

barriers with possible interventions can be found in Appendix 6d (see page 135). A more detailed elaboration on interventions is provided in chapter 4.6.

Starting with "*lack of cultural change*", the company recognised the issue that a paid-per-use model for household appliances is not yet in the mindset of people. In this regard, the company relies on the factor of time and argues that PaaS models are already established and accepted within the B2B market and slowly but surely trickling into the B2C market as well. Furthermore, the company noticed differences within national cultures as, for instance, the PaaS model is more common in Sweden than the Homie's current market, the Netherlands.

Continuing with "*lack of ownership*", Homie identified that it is difficult to get people from owning a washing machine to the mindset of just using it. Interventions that are applied in this context are the addressing of motives by highlighting the advantages of a PaaS model whenever possible. Furthermore, the company actively tries to avoid comparison. It is not position itself in the market of buying but rather delivers on the promise of PaaS by ensuring a high-quality machine independent of its brand. Lastly, similar to the previous barrier, the company refers to the factor of time considering the already established PaaS marketing in the B2B sector.

Further, in terms of "*lack of emotional attachment*" the interviewee mentioned that any white good usually is not an emotional purchase like a car, which is why this barrier does not seem to be relevant for Homie.

Also, the barrier of "*lack of status*" has not been recognised as a barrier. However, the company applies the intervention of social comparison by showing customers' own consumption information compared to those of other users. With this, Homie aims to promote more sustainable consumption and pushes customers to become an example for other uses.

Table 15. Exemplary quotes of Homie on recognised customer barriers towards CI

Category	Type	Barrier	Exemplary quotes
Psychological	**Tradition**	**Lack of cultural change**	*"It is not yet in the mindset of people that pay per use."* (Pos. 210)
		Lack of ownership	*"It's hard to get people from this mindset of owning a washing machine to just using it."* (Pos. 366-367)
		Lack of emotional attachment	*"A washing machine or any white good is not an emotional purchase like a car, which has to be cool."* (Pos. 238-240)
	Image	**Lack of perceived quality**	*"We're not worried about that at all."* (Pos. 253-255)
		Lack of trust and company image	*"In Germany, data and privacy are always, always question number one."* (Pos. 268-269)
Functional Barriers	**Usage**	**Lack of convenience**	*"It is super convenient. So, there is no lack of convenience."* (Pos. 308-309)
		Lack of infrastructure	*"That was a big, big, big deal in the beginning, because we are not shipping something that I could just put in an envelope."* (Pos. 291-293)
		Lack of technical compatibility	*"It's a standalone product, so that's not a big deal."* (Pos. 307-308)
	Value	**Lack of knowledge and information**	*"No doubt, there are a lot of people, who don't know that this exists."* (Pos. 99-101)
		Lack of perceived advantage	*"People compare buying versus renting versus pay per use."* (Pos.199-202)
	Functional risk	**Uncertainty about quality**	*"We never had questions whether or not wash will actually get cleaner in one machine or another."* (Pos. 362-362)

In addition, the barriers of "*lack of perceived quality*" and "*uncertainty about quality*" have been mentioned in the same context. However, the interviewee does not recognise any significant quality issues within Homie's customer base, which can be explained by the intervention of delivering a service promise. Based on this service agreement, Homie guarantees its customers that the company will immediately replace a non-functioning machine. Therefore, the full-service offering combined with delivering a promise is used to intervene.

In terms of the "*lack of trust and company image*", the company struggles with the fact that it is not a well-known brand. The interviewee further mentions the possible problem of data privacy especially within the German market which might become an issue as soon as the company expands regionally. In order to increase trust, the company relies on its service agreement and uses credible sources within the communication, such as the customer review platform "Trustpilot" where Homie scores 4.9 out of 5, which shows that it is a trustworthy company and that customers are satisfied with the service (Homie, 2022f). Furthermore, the company tries to increase data security by managing its data architecture and server regulations.

Moreover, the "*lack of convenience*" barrier has not been recognised as an issue. Contrary the interviewee states that the service is rather highly convenient as the company offers a full-service including a fast delivery, repairing and maintenance, and transportation service in case the customer moves. Furthermore, the manufacturing of an own machine based on design for circularity principles enable an easier and more convenient repairing process.

In terms of "*lack of infrastructure*", the company had significant issues initially as there was no infrastructure established for the shipment of the appliances. To intervene, the company started to collaborate with external partners but quickly switched back to establishing its own infrastructure to avoid losing direct customer contact. Today, the established infrastructure is one of the company's selling points and is even used by other companies.

As the appliances are usually sold as "stand-alone products", the interviewee did not recognise any issues concerning "*lack of technical compatibility*".

However, in terms of "*lack of knowledge and information*", Homie struggles with the fact many people don't know that Homie's service exists. In this context, the company refers to typical marketing and communication approaches but mentions that it increases the cost per order. The company offers a typical FAQ section, including instruction videos on how the service works (Homie, 2022c). Additionally, once the customer is within the contract, the company provides information based on a mobile app that educates the customer about more circular behaviour and informs them about user-specific behavioural information. Lastly, the company provides instructions on what customers can do to increase the products lifetime.

Lastly, coming to "*lack of perceived advantage*", Homie struggles with the fact that customers directly compare buying, renting, and paid-per-use. Thereby, this barrier has been an issue, especially in the beginning of the CI offering when the company was still identifying its target customer and positioning itself within the market. Therefore, the interviewee refers to the importance of a clear target group definition which enables a more precise addressing of motives. Those motives are based on advantages of a full-service, including speed of service, the environmental impact, as well as less risk as any risk is with the company. Thereby Homie explicitly promotes the value of free delivery, replacement, connection and their app with consumption insights on their website (Homie, 2022g).

Regarding the targe group, the co-founder refers to so-called “tree huggers” who care less about costs if the product is more sustainable. In addition, Homie is actively targeting the customer group of expats and actively addressing their motives and pains on the corporate website (Homie, 2022e, 2022e). Also, the mentioned avoidance of comparison is used in this context, as well as the offering of a calculation tool that helps potential customers to evaluate whether the service is worth it.

To sum it up, Homie developed its service based on a lean start-up approach, including several customer research methods such as interviews, focus groups, and experiments. The company is struggling with several barriers, mainly in the area of lack of knowledge and information, trust, infrastructure, and cultural change. Other barriers are either not relevant to the company or overcome by diverse interventions. The main interventions applied by the company are the focus on a full-service offering, clear target group segmentation, as well as the providing of behavioural consumption data, and the avoidance of comparison to buying alternatives.

4.4.3. Case C (Circular Marketplace)

The interview of Case C was conducted with the CEO of the online marketplace for refurbished customer electronics.

In terms of *customer integration* and *approaches to identify barriers* the company has been established based on a minimum viable product (MVP) approach. This included a close customer integration based on direct customer interviews, customer surveys, A-B website tests, as well as the customer service which is developing statistics on customer questions, complains and feedback. Additionally, the company is doing independent market research with agencies to explore brand awareness and discover why customers do not buy refurbished products. (See Appendix 6a, Table 27 and Appendix 6b, Table 28).

Concerning *customer barriers* as well as *interventions* to overcome these, the CEO provided several insights (see Table 16). An overview of quotes that show how Homie connects barriers with possible interventions can be found in Appendix 6d (see page 135). A more detailed elaboration on interventions is provided in chapter 4.6.

Starting with the first barrier of “*lack of cultural change*”, the CEO recognises the trend towards sustainability, especially in western Europe due to Fridays for Future. As not only the young generation but also the parents’ generation is affected by this mindset switch, the CEO sees a potential in the intervention of emotional triggering meaning the use of persuasion and nudging.

Considering “*lack of status*”, the company struggles with the fact that people sometimes buy “fake” refurbished products which causes a bad experience that often transfers to the whole category of refurbished products, meaning stereotyping is an issue. This barrier is caused by the fact that there is no legally protected definition of the condition status “refurbished” (CEO Circular Marketplace, Pos. 161-165). Therefore, policy initiatives could primarily help to overcome this barrier. Additionally, the term “used” is rather negatively associated in the context of electronics. To overcome this issue, the company works with influencers, who demonstrate that refurbished is nothing bad, especially when targeting younger generations. In addition to that, the company pursues branding campaigns and offers its customers the possibility of a 30-days test phase. Lastly, the company takes advantage of the status issue in the sense that other companies use the online marketplace to separate their refurbished product portfolio from the virgin product one, so that the brand’s original target group is not negatively affected by the refurbished products.

Considering "*lack of perceived quality*" and "*uncertainty about quality*", the company faces the issue that people think refurbished products are broken or do not work. The CEO mentions that this concern is only partly justified as refurbished products have almost the same failure rate as new products. However, if a refurbished product fails, customers feel confirmed in their previous concerns. Interventions in this context are a significantly reduced price as the company sells its refurbished products for up to 40% less compared to new ones but also education about the difference between used and refurbished as well as the mentioned test-phase are applied. Furthermore, the company defined specific and transparently communicated quality criteria that business partner that want to sell their refurbished products via the marketplace have to fulfil.

Table 16. Exemplary quotes of Case C (Circular Marketplace) on recognised customer barriers towards CI

Category	Type	Barrier	Exemplary quotes
Psychological	**Tradition**	**Lack of cultural change**	*"There is a trend towards sustainability, especially in western Europe due to Fridays for Future."* (Pos. 339-342)
	Image	**Lack of status**	*"The term 'used' in the field of electronic is still very negatively associated."* (Pos. 150-151) "It happens that people buy fake refurbished products and have bad experience which they transfer to the whole category of refurbished products." (Pos.167-170)
		Lack of perceived quality	*"Compared to a new product refurbished products have a little higher failure rate which is still pretty low."* (Pos. 172-178)
		Lack of trust and company image	*"Trust is one of the biggest barriers."* (Pos. 156-157) *"Trust that has to be built as people do not know it [refurbished products]."* (Pos. 159-160)
Functional Barriers	**Usage**	**Lack of technical compatibility**	*"Not really as we sell products which are currently also still be sold as new products."* (Pos. 260-261)
	Value	**Lack of knowledge and information**	*"People do not know refurbishment as a condition category."* (Pos. 147-148)
		Lack of perceived advantage	*"That's often the case that circular innovation is more expensive than alternatives."* (Pos. 440)
	Functional risk	**Uncertainty about quality**	*"People think it is broken, or it does not work."* (Pos. 153)

Continuing with "*lack of trust and company image*", the CEO mentions this barrier as one of the most significant ones. Trust has to be built, especially because people do not know about refurbished products. In this regard, delivering a promise is used as one intervention that is an advantage for refurbished product providers. Customers usually have lower expectations towards a refurbished product than a new one which makes it easier to fulfil or exceed customers' expectations. Furthermore, reputation and branding play a role in the sense that 50% of the company's customers are based on referrals. Also, the company tries to present its brand in a trustful and high qualitative way by using credible sources meaning journalists that are writing recommending articles about the company as well as a reputable and trustworthy design for the company's website. Additionally, a free-of-charge 0800 hotline is provided on the website to offer a personal touchpoint for the customers and differentiate the company from other non-trustful marketplaces. Moreover, the company tries to increase trust by transparency, for instance, it formulates its product condition criteria very transparent so that the customer knows what to expect.

Considering "*lack of convenien*ce", the company is not explicitly struggling with this issue. However, the circular marketplace relies on a customer advantage compared to manufacturing companies that offer their products on their own website. As Case C is a marketplace, the customer finds a wide

variety of products from different brands and in different condition categories in one place, that significantly reduces the searching effort for customers.

Furthermore, the company is not facing the barrier of "*lack of technical compatibility*", is usually only sells products that are still available within the virgin product market.

Contrary to that, "*lack of knowledge and information*" is a significant issue as people do not know refurbishment as a condition category. Interventions, in this case, are marketing and communication via google shopping, Google Ads, performance marketing, as well as social media including Facebook, Instagram, YouTube, TikTok, Snapchat, etc. The circular marketplace even promotes its business through television and press. Additionally, the company tries to educate the customers about the difference between refurbished and used products and answers any customer questions during the pre- and post-purchase phases based on its customer service via hotline, online chat, and email. Lastly, the company is present at sustainability exhibitions where customers can test products in person.

Coming to the last barrier, "*lack of perceived advantage*", the company relies on a lower price point for refurbished products. Therefore, the typical barrier that CIs are more expensive than linear alternatives is not an issue for the circular marketplace. Therefore, a reduced price is the main intervention in this case.

To sum it up, Case C established its business based on an iterative MVP approach and improved its marketplace based on direct customer insights via market research, including customer interviews, surveys, and experiments. The main barriers are "*lack of trust*", "*lack of status*", as well as *quality* concerns mainly cause by the fact that customers "*lack of knowledge and information*". Therefore, the company actively tries to provide needed information on the website to create transparency and invests in marketing campaigns in order to increase awareness about the existence and advantages of the condition category refurbishment.

4.4.4. Case D (Philips Domestic Appliances)

Coming to the last case, an interview has been conducted with the customer sustainability lead of Philips DA. Thereby, the interview focuses on the company's refurbished products, even though there are several other CE initiatives within the company.

In terms of *customer integration* and *approaches to identify barriers,* the company applies different customer research activities, such as moderated interviews by external agencies or customer experiments in order to pilot different messaging. Recently in Q4 2020, the company conducted a comprehensive customer research in some of its key markets, including Europe. In this research, the company gathered insights about the customers' perception of the brand as well as the industry, how they think about the company and sustainability and sustainability initiatives such as refurbishment. Furthermore, the company defined the key benefits of their refurbished products and tried to understand the main customer barriers as well as drivers towards purchasing refurbished products. As a result of this approach, the company defines a key challenge that needs to be tackled and collaborates with external agencies in order to develop a communication strategy to overcome this challenge. (See Appendix 6a, Table 27 and Appendix 6b, Table 28).

Considering *customer barriers* as well as *interventions* to overcome these insights are provided in the following (see Table 17). An overview of quotes that show how Philips DA connects barriers with possible interventions can be found in Appendix 6d (see page 135). A more detailed elaboration on interventions is provided in chapter 4.6.

Starting with "*lack of cultural change*", the only explicit insight that was provided is that the company selected Nordic markets for their customer research as there is a great openness to the idea of sustainability.

Additionally, the barrier of "*lack of emotional attachment*", were identified as evident as the emotional attachment to refurbished products should be rather high compared to virgin products in case the customer makes the conscious choice of buying something better for the environment.

Continuing, "*lack of status*" is also a barrier Philips DA faces as they are struggling with the wording of "refurbished" product as this term is usually not known by the customers. However, alternatives such as "used" are not accurate enough and negatively associated. Furthermore, status is usually associated with buying something new. Therefore, an intervention that the company uses is to try to promote and communicate "sustainability as a status" by finding a way to turn the situation upside down and instead of saying that status is only busing new, promoting that status is being mindful and aware of sustainability.

Table 17. Exemplary quotes of Philips DA on recognised customer barriers towards CI

Category	Type	Barrier	Exemplary quotes
Psychological	**Tradition**	**Lack of cultural change**	*"It was the Nordic markets because there is such an openness to the idea of sustainability, you know, to markets." (Pos. 117-118)*
		Lack of emotional attachment	*"If I look at the lack of emotional attachment, this one we have not identified as a factor."* (Pos.300-302) *"You made a choice buying something that is better for the environment. So, the emotional connection or attachment should actually be then doubled because there are two choices made understood." (Pos.307-310)*
	Image	**Lack of status**	*"So, we are struggling a bit with the wording on how we call it refurbished product?"* (Pos.89-90) *"Status is only buying new." (Pos. 293)*
Functional Barriers	**Value**	**Lack of knowledge and information**	*"A lot of customers actually are not even familiar with the term refurbished product. They don't know what it is, and they don't know what it means."* (Pos.82-84)
	Functional risk	**Uncertainty about quality**	*"You have the technical barrier. So, is this product now really working as it should? Or is it actually, you know, less good than a new product when it breaks down, you know, after a few years?"* (Pos.105-108) "*Another barrier is the psychological barrier. So, is this really a hygienic product? I mean, it has been used before or has it been used before? Can I trust this product*?" (Pos.100-102)

In the context of "*lack of perceived quality*" the interviewee mentioned that the issue is closely connected to "*uncertainty about quality*" and mention aspects for the latter one which include that the company notice a technical barrier that customers are concerned whether the product really works. Additionally, this barrier also includes a psychological component as customers are afraid that refurbished products are not hygienic. The company applies three different interventions to overcome quality concerns. First, they offer product guarantees that promises a product condition "as good as new". Second, they use communication to educate the customer about the differences between used and refurbished as well as different refurbished quality conditions. And third, as the products are refurbished by the company itself, they established internal quality requirements that are aligned with the ones of new products to make sure the required quality is also reached for refurbished products.

Next, "*lack of trust and company image*" has not been mentioned as a barrier. However, several interventions are pursued by the company in order to increase trust. Those are mainly in the field of branding, including that the company decided to refurbish products by themselves and not outsource this process as customer studies have shown that customers trust Philips DA more than they would

trust a third party because they know the brand (Customer Sustainability Lead Philips DA, Pos. 240-241). Additionally, by owning the refurbishment process, the company has higher control over quality requirements and avoids customers having disappointing experiences with Philips branded products (Customer Sustainability Lead Philips DA, Pos. 235-238).

In terms of "*lack of knowledge and information*", Philips DA struggles with the fact that "a lot of customers are not familiar with the term "refurbished product". Therefore, they do not know what it is and what it means. To overcome this lack, the company pursues education in the form of simplified explanations. Furthermore, marketing and communication will play a role in the future. As soon as the current customer research project resulted in a strong message around refurbishment the company will execute marketing campaigns. Lastly, the company applies nudging in the sense that they provide customers a note in their online shop for new products, which says, *"Did you know that this product is also available as refurbished?"* to nudge customers into buying a refurbished product instead of new ones.

Finally, in terms of "*lack of perceived advantage*", the company applies price reduction.

Based on their customer research approach, Philips DA summaries identified customer barriers in a concrete challenge statement: "*How to convince customers that buying a refurbished product is a good a more environmentally friendly option, knowing that some of our customers do not even know what the refurbished product is, and other customers feel insecure about the quality of the refurbished electronic household product*." (Customer Sustainability Lead Philips DA, Pos. 418-421).

In summary, Philips DA is actively identifying customer barriers towards its refurbished product portfolio. This is mainly done in cooperation with external agencies and moderated customer interviews. Based on this research the company identified three main barriers including the "*lack of knowledge*", the "*uncertainty about quality*" in a technical and hygienical manner, as well as the "*lack of status*". In order to overcome these barriers, Philips DA focusses on communication, including branding and education, but also made strategic decisions such as insourcing the refurbishing process in order to have better control over quality requirements.

4.5. Cross-Case Analysis and Interpretation

Next to the single case analysis, this chapter briefly compares the most insightful similarities and differences between the cases.

4.5.1. Approaches of Customer Integration and Barrier Identification

In terms of approaches to integrate the customer perspective two dominant approaches that companies apply are design thinking as well as lean start-up. In two cases, the need for an integrated product design as well as the partial use of behavioural economic elements were mentioned. Considering approaches to identify customer barriers, companies rely on typical customer research methods. Those methods include customer surveys, interviews, experiments, workshops, as well as focus groups and the use of customer service as a secondary customer insight source. Additionally, the relevance of trend research was mentioned by the R&D manager of Miele, as well as the use of academic research by the co-founder of Homie. The latter can be explained by Homie being established based on a scientific research project. Lastly, independent of the size and maturity of the company, almost all cases collaborate with professional customer research agencies. (See Appendix 6a, Table 27 and Appendix 6b, Table 28).

4.5.2. Identified Barriers and Interventions to Overcome

Concerning recognised barriers and pursued interventions to overcome these, similarities but also differences could be analysed between the four cases. Next to the already provided single result tables a comparative table of insights from all cases is provided in Appendix 6c (see Table 29 - Table 32).

In terms of "*lack of cultural change*" independent of the considered CI type all case companies confirmed that there is a need for cultural change towards a circular mindset in order to facilitate the adoption of CI. Additionally, companies recognise that the lack of cultural change is highly dependent on the prevailing regional culture. Most companies thereby rely on the factor of time and pursue a rather passive role which means that they assume a mindset shift towards a more circular consumption will be promoted by future generations. However, in case of the circular marketplace, nudging in form of emotional triggering was mentioned as a possible intervention. In the case of Homie, penalty fees are executed in order to force customers to a more circular behaviour.

Considering "*lack of ownership*", the case analysis shows that only companies that offer PaaS models recognise this barrier, such as the Miele sharing and renting models or Homie. At the same time, it is not evident in case of refurbished products such as the circular marketplace of Philips DA. In the cases of Miele renting and sharing as well as Homie the active promotive of a full-service offering as a significant advantage compared to an ownership-based purchase is pursued as an intervention. However, in this case Miele and Homie rely on the factor of time and a generation-dependent mindset shift. Lastly, Homie, as a no-name company, tries to avoid the barrier of ownership by actively avoiding the comparison to ownership alternatives but rather focusing on delivering on the promise of PaaS.

Next, in terms of "*lack of emotional attachment*", most companies did not mention any aspect in the context of this issue or denied that it is a problem. In the case of Homie, washing machines are not classified as an emotional purchase. The lack of insights could either be caused by the fact that analysed companies do not recognise the barrier, or the barrier is rather difficult to understand. Consequently, no insights were provided by companies in order to overcome customer barriers.

In the context of "*lack of status*", several issues are recognised. Those issues include stereotyping and negative associations with refurbished products in the case of the circular marketplace and Philips DA. Next to this, especially for premium brands such as Miele the reuse of products based on a PaaS model clashes with the customers' premium claim. Nevertheless, it was mentioned that the status associated with household products is relatively low compared to other products such as smartphones which is why this barrier is recognised by case firms but in a rather low intensity. Several interventions were mentioned to overcome the lack of status. While the co-founder of Miele's sharing model relies on the factor of time, Philips DA and the circular marketplace try to actively intervene by collaborating with social media influencers, executing branding campaigns, offering a 30-days test phase, promoting sustainability as a status, or pursuing typical marketing and communication activities. Furthermore, customer segmentation has been mentioned to be useful. In the case of the Miele sharing model, an additional offering of the service for a segmented B2B market is considered in which the status issue is perceived as less dominant.

Going forward, the barriers of "*lack of perceived quality*" as well as "*uncertainty about quality*" have frequently been used synonymously. While concerns about quality and hygiene are a dominant barrier for refurbished products in the case of Philips DA and the circular marketplace, this issue is not recognised by Miele's service models or Homie. In most cases, quality concerns are either overcome by branding, especially in the case of incumbent firms such as Miele or guarantees and promises

which are also applied in the field of PaaS as part of the service agreement. Furthermore, marketing and communication is applied as well as test phases. In the case of Philips DA, strict quality criteria are used to either ensure the quality of the own refurbishing process or to control the processes of suppliers, such as in the case of the circular marketplace.

Concerning "*lack of trust and company image*", it became evident that rather emerging cases are struggling with this barrier. At the same time, incumbents such as Miele and Philips DA refer to company image and trust as a significant driver of the CI adoption. Additionally, also lack of trust in data security has been mentioned in the case of renting model Homie. In this sense, two dominant interventions are branding, especially for incumbent companies, and the use of credible sources, especially for emerging companies.

In terms of "*lack of convenience*", the barrier has been rejected by PaaS cases by the argument that the convenience of service or renting models has to be significantly higher compared to ownership-based offerings in order to be attractive to the customer. Therefore, all analysed PaaS cases, including Miele sharing, renting as well as Homie, invest a lot in order to offer a full service. Independent of the CI type, companies use design for circularity to reduce reparability efforts. In the case of the circular marketplace, convenience is increased based on the platform concept and the wide variety of products that are accessible to the customer in one place.

Next to this, "lack of infrastructure" is only perceived by Miele's R&D manager as well as Homie's co-founder. Thereby, infrastructure seems to be a critical aspect for both types of CIs, PaaS as well as "re"products. In both cases, the take-back infrastructure for products at the EOL is a challenge that is overcome by collaborating with partners.

Considering "*lack of technical compatibility*", two case groups can be differentiated. The first are refurbish cases where the barrier has been recognised, while for the second group of PaaS models, the barrier has been rejected as customers usually "flow" with the technological trend by using servitised product offerings. Therefore, only two interventions have been mentioned which are the systematic spare part management as well as circular design to enable upgradeability in the case of Miele R&D.

Contrary, "*lack of knowledge and information*" is a barrier all case companies recognise independent of the considered CI type. Thereby, customers primarily lack knowledge about the existence of the CI, are not familiar with new terms such as "refurbishment" or miss information on specific aspects that are required to make a proper investment decision. As this barrier is a barrier in all cases, several interventions have been identified. Dominant interventions are marketing and communication activities as well as the education of customers via the corporate website, followed by information transparency via product-customer interactions, awareness events, or nudging.

Lastly, "*lack of perceived advantage*" has been recognised by both CI types. Regarding PaaS models, Miele renting and Homie face the issue that customers are directly comparing access-based recurring payments vs. ownership-based on time purchases which is often more expensive for customers in the long run. This is perceived as a lack of advantage as customers do not consider non-monetary aspects such as the additional services. In terms of refurbished products, customers are usually not willing to pay the same price as for new products. Therefore, companies reduce prices up to 40%. In terms of PaaS, case companies focus on promoting the advantages of an access-based model such as the full-service offering. Additionally, for both CI types, companies generally try to address specific customer motives that differ depending on the customer group as well as CI type.

To sum it up, a significant difference in the relevance of barriers according to the corresponding CI type could be identified. While some barriers such as "*lack of cultural change*", "*lack of trust and company image*", "*lack of infrastructure*", "*lack of knowledge and information*", and "*lack of perceived advantage*" are recognised independently of the CI type others such as "*lack of ownership*" is mainly relevant for PaaS models while provider of refurbished products are especially challenged by "*lack of perceived quality*" or "*uncertainty about quality*", "*lack of status*", and "*lack of technical compatibility*". In terms of "*lack of emotional attachment*", no evidence could be found by analysing case companies. In contrast, the presence of a high degree of "*convenience"* is significant for the adoption of PaaS models. Additionally, a difference between incumbent and emerging businesses could be identified. While established companies such as Miele or Philips leverage their well-established brand reputation, for instance, by deciding to in-house the refurbishing process, no-namers such as Homie actively try to avoid comparison with brand names and try to deliver value-based on functionality and service rather than branding. Furthermore, while emerging companies such as Homie or the circular marketplace have to invest in trust-building interventions, incumbent cases rely on their already established brand image. Additionally, incumbent companies suffer less from infrastructural barriers as they rely on already established infrastructures and partnerships to enable a functioning take-back system for "re"products. Contrary, this barrier has been significant for an emerging business such as Homie and turns out to be a circular success factor for the CI. Lastly, Miele's interventions, such as the systematic spare part management, are probably not economically viable for small emerging business.

4.6. Grounding Interventions to Overcome Customer Barriers Towards CI

As main barriers and interventions were analysed in previous chapters, this chapter categorises those interventions and analyses them in more detail.

Education. Education is one of the two most prominent applied interventions considering analysed case companies and experts.

Why. The main goal of analysed case companies and experts in applying education is to increase transparency and thereby overcome *lack of knowledge and information* but also to promote a *cultural change* towards a more circular mindset. Furthermore, companies also try to increase *trust*, reduce *scientism about quality*, and even increase *convenience* based on education.

How. Several different actions to execute education could be explored, that partly confirm theoretically elaborated ones but also provide new insights (see Table 18).

In most cases, education is based on typical "*marketing and communication*" activities, including performance marketing but also Google shopping, Google Ads, as well as social media campaigns. Next to this, companies use "*awareness events*" in order to make circularity more tangible. Furthermore, a "*customer-product interaction*" helps in order to set prompts and provide information about behavioural outcomes such as CO2 emissions. Also, companies strongly rely on their "*customer service*" in order to educate and overcome scepticism due to unanswered questions. Lastly, the "*corporate website*" is typically used as the main vehicle to share customer-relevant information, which is explained in the following.

What. Content-wise education is used in order to provide information on different aspects, mainly with the goal to provide the customer with correctly prepared information so that he can make the best possible decision. First, information to educate the customer about the existence of CIs and create awareness. Second, customers are educated about the positive environmental impact of the CI as well as the general value of the product or service provided to the customer, such as what is included in a

renting or sharing model. Third, especially for "re"products, customers get educated about different product condition categories as well as quality criteria. Third, customers receive information about the price as well as the reasons for a positive or negative price variation compared to other non-circular alternatives. And lastly, customers get educated about the general process of how to acquire, use, and, if applicable, how to return a product. As soon as the customer has acquired the CI, at least in the case of PaaS models, companies also try to provide individual consumption data to help customers to pursue a more sustainable consumption.

Table 18. Empirical insights on the intervention of education

Category	Type	Exemplary quotes
Education	Marketing and communications	*"You might have to increase customer education and inform the customer."* (**R&D Manager Miele,** Pos. 305-308)
		"Customers find us online, primarily via performance marketing." (**Project Manager Miele Upgreat,** Pos. 48-51)
		"That is something you have to teach to your customer with ads." (**Co-Founder Miele Sharing,** Pos. 375-376)
		"We do google shopping, Google Ads, performance marketing so all on social media, Facebook, Instagram, YouTube, TikTok, Snapchat. Also, via TV and press." (**CEO Circular Marketplace,** Pos. 45-51)
		"From a marketing point of view, we try to figure out, how can we talk about refurbished product in a way that actually explain to consumers what they really are." (**Customer Sustainability Lead Philips DA,** Pos. 94-98)
		"Also, typical marketing mechanisms." (**Professor**, Pos. 144-145)
		"It's about education, ultimately communication. Because if you can show an added value in this way, then that's going to shift over time." (**Designer**, Pos. 142-143)
		"The cultural change is in my eyes a communication task." (**Project manager**, Pos. 242.-243)
	Awareness events	*"Making circularity tangible and touchable. You have to create awareness. We have a brand academy where our customer is guided through and educated."* (**Product Manager**, Pos. 94-104; 135; 432-434)
		"For example, the city of Gütersloh initiates a digital day to show why digitalisation is good." (**Co-Founder Miele Sharing,** Pos. 496-498)
		"We have also been at sustainability exhibitions where customer could test our products in person." (**CEO Circular Marketplace,** Pos. 283-286)
	Customer-product interaction	*"That's built into our software. I think it's [reminder for circular behaviour] three times a year."* (**Co-Founder Homie**, Pos. 429)
		"You have to communicate to your customer directly via your product, e.g., when the customer has to do the next maintenance check-up etc." (**Project Manager**, Pos. 396-397) *"A digital product pass can provide information about how much CO2 has been emitted in the production and the usage phase."* (**Project Manager**, Pos. 85-88)
	Customer service	*"We maintain a close customer contact and try to answer every question e.g., via telephone, or a contact form"* (**Project Manager Miele Upgreat,** Pos. 194-197; 217-218)
		"Education is key because at the minute I educate our customer service team, which propagates that through to customers." (**Designer**, Pos. 292-293)
		"Since the beginning we offered a free of charge 0800 hotline to be available to our customers in person." (**CEO Circular Marketplace,** Pos. 222-226)
	Corporate website	*"We have formulated our condition criteria very transparent on our webwide so that the customer knows what to expect."* (**CEO Circular Marketplace,** Pos. 198-205)
		"We try to collect typical customer questions in FAQs and answer them for further customers." (**Project Manager Miele Upgreat,** Pos. 214-217)
		"Education that is our website." (**Co-Founder Homie**, Pos. 409-410)
		"We provide education based on FAQs." (**Project Manager Miele Upgreat,** Pos. 193-194)
		"On our website we provide information on the different product condition categories and the steps of the refurbishing process." (**CEO Circular Marketplace,** Pos. 198-205)
		"Giving tips on the website. Giving advise on how to overcome it [inconvenience]." (**Psychologist**, Pos. 175-177)

Finally, it is important to mention that even if education might be the most obvious intervention to apply in order to overcome customer barriers such as "*lack of knowledge and information*", behavioural change will not be achieved by education alone. However, education is an essential precondition for other interventions to be effective. This is also seen in other cases as education is understood as persuasion in the sense that Homie tries to convince its potential customers to join.

Therefore, the following will provide further information on other interventions that are applied by companies and suggested by experts.

Persuasion. Continuing, persuasion is the second most prominent intervention considering analysed case company and expert interviews.

Why. In general, persuasion is used to overcome several barriers, including "*lack of trust"* as well as "*lack of perceived advantage*" and the "*uncertainty about quality"*. Furthermore, in some cases persuasion is used to promote a "*pro-circular mindset"*. This means to initiate cultural change, to overcome a "*lack of ownership"* caused by a materialism mindset as well as a negative associated "*status"* especially for "re"products and finally to tackle "*lack of convenience"* as well as to reduce "*lack of knowledge and information"* by creating awareness.

How. Thereby, several different actions are used in order to realise persuasion. An overview is provided in Table 19. Next to typical "*marketing and communication*" actions some cases explicitly mentioned the use of "*nudging"*. For instance, by emotional triggering in case the target group believes in the need for an environmental change but also by simply prompting customers to also consider refurbished products at the place where they are purchasing virgin products. However, even if nudging is applied in one case, ethical concerns were highlighted that need to be considered as customers could be manipulated subconsciously. Furthermore, companies try to communicate status in a converted way. From the initial association of status with virgin products, Philips DA, for instance, tries to connotate status with mindful and sustainable consumption. Homie provides customers with consumption data in order to promote a more sustainable behaviour as soon as the customer is using the service. Furthermore, companies use "*branding*" in order to persuade customers, which aims to create a positive association with the considered CI independent which type of CI. Thereby, especially incumbent bands such as Miele or Philips DA rely on their advantage of an already well-established, positive connotated, and trustworthy brand name. The contrary case could be discovered for no-name companies such as Homie, which actively try to avoid comparison to buying prices and therefore do not brand their products. In addition, companies collaborate with influencers or very identifiable peers to apply persuasion in form or liking. Lastly, authority is used as a persuasion technique by using "*credible sources*" such as certificates (energy labels, REACH certificates) or collaborating with journalist, or researchers in order to enable science-based communication. However, even if companies own certificates such as eco-labels, REACH, or C2C, they are not always purposefully used to persuade customers (Co-Founder Homie, Pos. 452-454). Next to those concrete techniques, companies use "*guarantees*" and service or product "*promises*" in order to overcome scepticism. Finally, in the case of PaaS, the communication of advantages of a "*full-service offering*" compared to ownership is actively applied in order to lead customers in a servitised market.

What. To persuade customers, companies usually try to address target group's specific motives. Those are identified within typical customer research and lead from environmental motives, over monetary motives, up to service advantages such as risk carry over flexibility, or technological upgradeability. This indicates that benefits need to be defined according to the corresponding CI as well as target group's motives. Even if CIs target to promote a pro-environmental consumption, arguments do not always have to be environmental (Psychologist, Pos. 129).

Table 19. Empirical insights on the intervention of persuasion

Category	Type	Exemplary quotes
Persuasion	Marketing and communication	*"We send out surveys to ask our customer about their motives."* (**Project Manager Miele Upgreat,** Pos. 172-175)
		"Miele is 95% recyclable and also advertises this in a positive manner." (**Co-Founder Miele Sharing,** Pos. 340-342)
		"We do that by demonstrating the advantages of the service." (**Co-Founder Homie**, Pos. 413)
		"And that's also another aspect that we need to tackle in communication because this is another key barrier for our consumers." (**Customer Sustainability Lead Philips DA,** Pos.108-109)
		"What of these motives are most influenceable and effective for the target behaviour that we want to reach." (**Psychologist**, Pos.31-34)
		"We have a Circularity ad in the TV where we use pictures to attach emotions to the topic of circularity." (**Project Manager**, Pos. 437-440)
	Branding	*"Customers buy a refurbished Miele product because they trust the brand."* (**R&D Manager Miele,** Pos. 285)
		"Powered by Miele, that's what customers trust in." (**Co-Founder Miele Sharing,** Pos. 101-102)
		"Everyone in Germany knows the high quality of Miele." (**Project Manager Miele Upgreat,** Pos. 123)
		"What we also do is branding campaigns." (**CEO Circular Marketplace,** Pos. 236) *"We have a really high referral rate."* (**CEO Circular Marketplace,** Pos.182)
		"People don't buy what you do. They buy why you do it." (**Designer**, Pos. 170)
		"We have a brand academy where our customer is guided through." (**Project Manager**, Pos. 432-434)
	Credible sources	*"The Trustpilot […] shows that we are a trustworthy company."* (**Co-Founder Homie**, Pos. 454) *"The energy label, that is very important people look at that."* (**Co-Founder Homie**, Pos. 461-463)
		"If a journalist writes a good article about us that is more trustworthy than a Facebook ad." (**CEO Circular Marketplace,** Pos. 213-216)
		"You need to have certification or accreditation to do that because too many people are profiting on misinformation. With regards to our chemical management in the EU there is something called REACH compliance." (**Designer**, Pos. 204-211)
		"We have different forms for example with journalists or researchers to communicate our topics science based." (**Project Manager**, Pos. 236-241, 430) *"What is very important for us is to involve independent expertise which can assess and attest the efficacy of our measures."* (**Project Manager**, Pos. 153-157)
	Sustainability as a status	*"We see that sustainability becomes a new status symbol."* (**Project Manager**, Pos. 185-187)
		"Instead of saying that status is only buying new, status is being mindful and being, aware about sustainability in the world." (**Customer Sustainability Lead Philips DA,** Pos.291-29
		"We also had social comparison and also individual information, so we did a lot of the behavioural economics." (**Professor**, Pos. 221-222)
	Nudging	*"Here I see the connection to emotional triggering."* (**CEO Circular Marketplace,** Pos. 247)
		"We try to give them the information at the page where we are selling the new products actually to nudge customers into buying a refurbished product." (**Customer Sustainability Lead Philips DA,** Pos.279-281)
		"We have done nudges." (**Professor**, Pos. 220)
	Influencer (liking)	*"You can get a very identifiable peer, that persuades with you by their own story."* (**Psychologist**, Pos. 173-175)
	Feedback on behaviour (commitment)	*"They get updates on their usage we balance to how other customers do it."* (**Co-Founder Homie**, Pos. 410-412)
		"We also had social comparison and also individual information, so we did a lot of the behavioural economics." (**Professor**, Pos. 221-222)
	Guarantees and promises	*"If I promise you, it works, and I will fix it if it doesn't that should be fine."* (**Co-Founder Homie**, Pos. 252-253)
		"With full guarantees, so they are as good as new." (**Customer Sustainability Lead Philips DA,** Pos.54)
		"Which is more effective for like scepticism and concerns, it's like giving guarantees. So, saying things like within the next two years, we will repair everything, or you can always switch it, if it doesn't work anymore." (**Psychologist**, Pos. 115-117)
		"You can have all kind of promises, product promises, and return." (**Professor**, Pos. 143-144)
		"Remanufactured engines get the same quality certification and guarantee as new ones, so you get the security." (**Project Manager**, Pos. 312-314)
	Full-service offering	*"It is the full-service, that offers time savings and comfort."* (**Project Manager Miele Upgreat,** Pos. 335-345)
		"You have to offer a full-service to lead people in this market." (**Co-Founder Miele Sharing,** Pos. 426)
		"What we try and do is to make sure that we have an outstanding service." (**Co-Founder Homie**, Pos. 202-203)

Incentivisation. In terms of incentivisation companies are rather restrained.
Why. Incentivisation is mainly used as an intervention to overcome "*lack of perceived advantage", "lack of cultural change",* as well as "*lack of quality"*.
How. The main action in this field is to provide monetary incentives, including "*price reduction*" especially in the case of "re"products to leverage lower perceived quality but also in terms of product configuration where customers receive a price reduction in case of a configuration that emits less CO2. Even if this intervention is not applied and might not be economically viable for the company yet, it could be a possible intervention for the future. Furthermore, "*pledges*" are applied to incentivise customers to return end-of-life products in case of "re"products. Considering PaaS models, companies mention that a renting or paid-per-use model makes a more expensive product "*financially viable*" as a possible incentivisation. Considering "*rewards*", this action is especially relevant in the field of promoting circular behaviour as soon as the customer is already using a CI, such as price incentives for lower temperature washes or a gentler use of products that slow down maintenance cycles. Lastly, non-monetary incentivisation in the form of positive "environmental impacts" is used. However, this is only applicable if customers appreciate pro environmental actions. (See Table 20)

Table 20. Empirical insights on the interventions of incentivisation, coercion, and restriction

Category	Type	Exemplary quotes
Incentivisation	Reduced price	*"We sell our products 40% reduced compared to new products."* (**CEO Circular Marketplace,** Pos. 83-88)
		"They are then offered to consumer as at a lower price." (**Customer Sustainability Lead Philips DA,** Pos. 53.54)
		"You have a price advantage and that leverages the problematic." (**Project Manager**, Pos. 316-317) *"In the future maybe, you even get your car cheaper if you configure it with less CO2 emissions."* (**Project Manager**, Pos.442-443)
	Pledge	*"You can sell us your old devices."* (**CEO Circular Marketplace,** Pos. 357)
		"We could provide bonus if you return products for recycling." (**Project Manager**, Pos. 90-91)
	Financial viability	*"We incentivise to the extent that we try and make it financially viable option."* (**Co-Founder Homie**, Pos. 415-416)
	Rewards	*"Price incentives, a lower temperature was being cheaper than a higher temperature wash."* (**Professor**, Pos. 221-222)
		"We could provide certificates for gentle product usage where customers get rewards for." (**Project Manager**, Pos. 88-89) *"The digital product pass will show you that maintenance cycles got sorter as you drove gentler, and you saved 100 Euro gas, so it is a win-win."* (**Project Manager**, Pos. 510-514)
	Environmental impact	*"Second incentive is via indicators such as CO2 emission savings, if it is a status symbol for the customer."* (**Project Manager**, Pos. 322-325)
		"For each sold product we plant a tree to make our customer's purchase CO2 positive which can be an incentive for people who appreciate environment." (**CEO Circular Marketplace,** Pos. 364-367)
Coercion	Cancellation fees	*"Coercion is only once you are in. So, that's what I mentioned about minimum term contracts."* (**Co-Founder Homie**, Pos. 417-418)
	Penalty fees	*"It's [circular behaviour] good for the machine and if you don't do it, we will charge you."* (**Co-Founder Homie**, Pos. 431-433)
Restriction	Product configuration	*"It is a topic that we restrict certain product configurations that have a too high CO2 amount."* (**Project Manager**, Pos. 462-466)

Coercion. Considering coercion, this intervention has been rejected to be effective to overcome customer barriers towards CI in almost all interview cases. In the case of Miele, a negative connotated communication towards the customer is not applied (Project Manager Miele Upgreat, Pos. 293-294). From psychological perspective, interventions in the context of CI adoption should rather be framed positively connotated (Psychologist, Pos. 337-339; Philips DA, Pos. 331), such as providing

incentives. Other experts argue that "for effective long term behavioural change, education and empowerment is always better than coercion and restriction" (Designer, Pos. 276).
Why. Nevertheless, in one case, a possible application for coercion has been mentioned, however, not explicitly to overcome one of the considered barriers.
How. Homie uses minimum term contracts in order to keep customers using their CI once they are in. Furthermore, customers are charged a penalty fee in case they do not execute required actions to prolong the lifetime of the appliances. (See Table 20)

Restriction. Similar insights to the once for coercion can be analysed in the case of restriction. Restriction is rather seen as something in the responsibility of policymaking than company interventions (Psychologist, Pos. 358; Project Manager, Pos. 466-468).
Why. Nevertheless, also for this intervention, in one case, a possible application for coercion has been mentioned, however, not explicitly to overcome one of the considered barriers.
How. A possible action could be to restrict product configurations that record CO2 emissions higher than a certain threshold. Nevertheless, this is only possible if customers can configure the product. Furthermore, the according expert highlighted that restriction is rather the responsibility of legislation and policy than of companies. (See Table 20)

Training. Continuing with training, practitioners, as well as experts, did not mention specific physical skills that are required in order to adopt the considered CI. Therefore, no action in the field of training has been explored. However, training might be applicable as soon as companies try to promote a more sustainable behaviour during the usage phase of a product. (See Table 21)

Environmental restructuring. The intervention of environmental restructuring has been the one that was least self-explanatory to interviewees. However, several actions have been mentioned which can be categorised under this intervention.
Why. Thereby, environmental restructuring is mainly used to overcome "*lack of technical compatibility"* as well as "*lack of perceived quality"* through changes within the product design. Additionally, "*lack of infrastructure"* is overcome by collaborating with partner companies while "*lack of convenience" is tackled by adjusting business models, such as in the case of the circular marketplace*.
How. "*Design for circularity"* is applied by companies in the sense of design for durability, repairability and upgradeability and product design standardisation. However, applying those product design principles only impacts the customer if they are simultaneously communicated and promoted properly. Furthermore, external "*partner collaboration"* helps companies to build a sufficient infrastructure, especially in the case of delivery and take-back system for renting services or end-of-life products for refurbishment. Furthermore, Miele established spare part management in order to secure the repairability of the product even years after the corresponding product line was stopped being produced. This is probably only possible for rather large and established companies, while smaller ones need to collaborate with partners as the storing of spare parts is rather expensive for the company. Lastly, considering the circular marketplace (Case C), the concept of an online marketplace restructures the business model of selling refurbished products in a way that significantly lowers the search effort for the customer and therefore increases convenience. (See Table 21)

Modelling. For the intervention of modelling, three different actions has been explored.
Why. Modelling is mainly used to overcome "*lack of cultural change"*, as well as "*lack of status"* and "*lack of convenience"*.

How. In order to apply modelling, companies cooperate with influencer, which can provide instructions on how to increase convenience but also demonstrate that CIs are nothing bad such as in the case of "re"products. Additionally, social comparison of consumption data is used (See Table 21).

Table 21. Empirical insights on training, environmental restructuring, modelling, enablement

Category	Type	Exemplary quotes
Training	Sustainable behaviour	*"Maybe someday there will be a training for ecological driving."* (**Project Manager**, Pos. 459-460)
Environmental restructuring	Partner collaboration	*"Clarifying how resource cycles are closed within the specific country and how the customer service can be integrated in that."* (**R&D Manager Miele,** Pos. 320-321) *"We are even required to take back old appliances, what we do in collaboration with our local Miele certified dealer."* (**R&D Manager Miele,** Pos. 313-315)
		"So, they now pay us to do that because we have a call center, a warehouse, drivers so that infrastructure is now actually one of our selling points." (**Co-Founder Homie**, Pos. 301-305)
	Spare part management	*"Building storages for spart parts, but this is extremely expensive."* (**R&D Manager Miele,** Pos. 218)
	Design for circularity	*"Designing the product in a way that it is easy to repair without much effort."* (**R&D Manager Miele,** Pos. 72-74) "Miele appliances are designed and tested in a way that they last every long." (**R&D Manager Miele,** Pos. 120-128)
		"We are actually having our own machine developed in China. It's [..] much easier to fix." (**Co-Founder Homie**, Pos. 108-110)
		"I think now there is an EU policy that says that you can't change your charger anymore." (**Psychologist**, Pos. 211-222)
		"We have projects that aim to unlock upgradable software functionalities in the vehicle in order to extend the lifetime in a digital manner." (**Project Manager**, Pos. 37-40)
	Market place concept	*"We do not stand in cannibalism with our own products and can offer a wide variety of selection with the most attractive offerings."* (**CEO Circular Marketplace,** Pos.88-90)
Modelling	Influencer	*"That is strongly steered by social media, influencer maybe."* (**Co-Founder Miele Sharing,** Pos. 506-508)
		"We work with influencer especially for the younger generation which demonstrate that refurbished is nothing bad." (**CEO Circular Marketplace,** Pos.236-241)
		"I think then you can get like a very identifiable peer, that persuades with you by their own story." (**Psychologist**, Pos. 173-175) *"I think influencer is a good, really good, idea. I think social media is so powerful so that should really be used."* (**Psychologist**, Pos. 184-185) *"Another thing is to use modelling. So, if you're thinking about a video or someone who shows how you can make something easier for yourself like someone if you can identify with and that you feel like it's part of your peer group."* (**Psychologist**, Pos. 168-172)
		"Sure, social media presence and influencer is what we do too." (**Project Manager**, Pos. 485)
	Social comparison	*"You become an example [for other users]."* (**Co-Founder Homie**, Pos. 437-439)
		"We also had social comparison and individual information." (**Professor**, Pos. 221-222)
Enablement	Product configuration	*"Where we enable the customer is to make decisions in the usage phase or the product configuration."* (**Project Manager**, Pos. 502-508)
		"You can personalise products, that customers feel they take part in certain decisions, so maybe can decide which kind of washing machine for instance they get to share." (**Psychologist**, 242-244)
	Calculation tool	*"So, we have this little tool on the side where you can select how many washes you should do, and it will calculate [the costs]."* (**Co-Founder Homie**, Pos. 475-477)
	Testability	*"We have a 30-days test phase, so we reduce risks."* (**CEO Circular Marketplace,** Pos. 233-236)
		"Try before you buy and things like that." (**Professor**, Pos. 144)

Enablement. Coming to the last intervention, companies also try to enable customers.

Why. Enablement is mainly used in order to overcome "*lack of ownership"*, "*lack of status",* as well as "*lack of perceived advantage",* and "*quality"* (see Fig. 11).

How. Thereby three main activities could be explored. Companies use "*testability*" in order to enable customers to try before they purchase or invest in a CI. Furthermore, some kind of "*product configuration*" is applied in order to enable customer to make certain decisions and have an influence on the product they are using, especially in a PaaS model and therefore feel a certain amount of ownership. Next, in one case, customers are provided with a calculation tool to estimate the costs of a renting service over time dependent, on customer-specific preferences. (see Table 21)

Others. Next to actions within those nine interventions one aspect has frequently been mentioned which is the factor of "*time"*. Companies referred to this aspect in the context of lack of "*cultural change", "ownership"*, "*status", "trust"*, and "*perceived advantage".* Thereby, companies rely on the belief that cultural change as well as change within the mindset of people, including the issues of ownership, status, as well as perceived advantage, are overcome with the mindset change of new generations. This rather passive approach implies that especially incumbent brands, such as Miele and Philips, are less dependent on a cultural shift than emerging companies such as Homie which are purely focused on a circular business model and only target a rather small market yet. Additionally, the passive approach can also indicate that cultural change might be primarily the task of higher instances such as policy. Additionally, one case mentioned that especially trust is only built and reinforced over time. Based on the categorisation and previous mapping of barriers with intervention actions a matrix has been created which provides an overview and summary of main empirical findings (see Fig. 11). The numbers are shown in the figure visualise how often the corresponding intervention action was mentioned by different practitioners or experts in relation to the linked barrier. Thereby the illustration does not have the purpose to quantifying empirical research but rather gives an indication of the focus companies and experts lay regarding the use and application of interventions and corresponding actions, as well as provide a summarised overview of which interventions are pursued to overcome what barrier.

To sum it up, several actions are executed by companies in order to overcome customer barriers towards CI. The visualisation of empirical results shows that the main actions to overcome customer barriers towards CI are based on the interventions of education, persuasion, and incentivisation. The next prominent interventions are environmental restructuring as well as modelling. Interventions that are rather less applied are training and enablement, while interventions which are mainly rejected are coercion and restriction. Considering the lack of cultural change and ownership, companies primarily refer to the natural mindset shift by generations and time. In terms of emotional attachment, no interventions have been identified since most cases did not recognise this barrier. Lack of status is tackled by several actions which are manly part of persuasion and modelling, including the promotion of sustainability as a status, the collaboration with influencer, or branding and marketing and communications, whereby none of them is dominant. Contrary, considering lack of trust, persuasion in the form of branding is the most dominant action to intervene, followed by the use of credible sources. Lack of convenience is overcome by persuasion including the promotion of a full-service offering, while lack of infrastructure is tackled by environmental restructuring, including partner collaboration. Next, lack of technological compatibility is also primarily overcome by environmental restructuring, meaning design for circularity. Lack of knowledge and information is dominantly overcome by education, including marketing and communications, awareness events, as well as the

providing of information via the corporate website, and customer-product interaction. Lastly, lack of perceived advantage and lack of quality are overcome by persuasion. Thereby lack of perceived advantage is mainly overcome by addressing customer motives while lack of quality is overcome by guarantees, branding, and price reduction as part of incentivisation.

Furthermore, as analysed in previous chapters, the way how companies pursue those interventions mainly depends on the companies' individual resources and capabilities.

		Customer barriers towards circular innvation										
		Psychological					**Functional**					
		Lack of circular mindset	Lack of ownership	Lack of emotional attachment	Lack of status	Lack of trust	Lack of convenience	Lack of infrastructure	Lack of technical compatibility	Lack of knowledge and information	Lack of perceived advantage	Lack of quality
Education	Marketing and communication	2								7		2
	Awareness events	1								2		
	Customer-product interaction									2		
	Customer service					2				1		
	Corporate Website					1				2		
Persuasion	Marketing and communication	2			1							
	Branding				1	7					2	3
	Credible sources					4						
	Sustainability as a status				2							
	Nuding	1								1		
	Influencer	1			1		1					
	Feedback on behaviour									2		
	Guarantees and promises					2						6
	Addressing motives		1				2				6	
	Full-service offering		2				4				3	1
Incentivisation	Price reduction										2	3
	Pledge										2	
	Financial viability										1	
	Rewards	2										
	Environmantal impact										2	
Coercion	Cancellation fees	No evident allocation identified										
	Penalty fees	No evident allocation identified										
Restriction	Product configuration	No evident allocation identified										
Training	Sustainable behaviour									1		
Environmental restructuring	Partner collaboration							2				
	Spare part management								1			
	Design for circularity					1	2		3			1
	Marketplace concept						1					
Modelling	Influencer	1			1		1					
	Social comparison				2							
Enablement	Product configuration		1									
	Calculation tool										1	
	Testability				1							2
Others	Factor of time (generation shift)	4	3		1	1					1	

Fig. 11. Final result of grounding interventions according to customer barriers (own analysis)

5. Discussion

This chapter provides a brief discussion of the most insightful empirical results as well as their comparison with theoretical aspects. Concerning approaches to integrating the customer perspective, most cases refer to the design thinking approach by Stanford University and the lean start-up methodology by Ries (2020). Thereby, companies integrate several different approaches to identify customer barriers which are mainly part of typical customer research, and support a user-centered design, as suggested by (Selvefors et al., 2019, p. 2). In the case of the environmental psychologist, a multiple-step approach was suggested, which is similar to the thee-step behavioural change process by Michie et al. (2011). Furthermore, from a sustainable business perspective, it is important to consider that desirability testing in the form of identifying and overcoming customer barriers is highly important and usually the first dimension to test. However, companies should not forget about testing economic viability, technological feasibility, as well as the final circularity of the developed CI.

Considering recognised customer barriers towards CI, all theoretically defined barriers except of "lck of emotional attachment" could be confirmed within empirical research. Nevertheless, the need for a small revision of the barrier categorisation based on Ram & Sheth (1989) was identified based on interviewee's feedback (see Table 22). The revision concerns the barriers "*lack of cultural change*", "*lack of perceived quality*", *uncertainty about quality*", as well as "*lack of trust and company image*". As the first two barriers were addressed simultaneously in the majority of interviews, it seems to be reasonable to merch those barriers by focussing on the general "*lack of quality*" as part of a functional risk barrier. Aspects that used to be part of the barrier "*lack of perceived quality*" should then be considered within the barrier "*lack of status*" as those two barriers seem to be very closely linked. Furthermore, it turned out that company image is already one of the most significant interventions used in the field of branding. Therefore, the barrier itself should be limited to the context of "*lack of trust*" without already referring to an intervention. Lastly, as many interviewees did not directly understand what specifically is meant by the barrier "*lack of cultural change*", a more precise title has been chosen which is "*lack of circular mindset*".

Table 22. Revision of barrier categorisation and labelling

Category	Type	Theoretical categorisation	Empirically revised categorisation
Psychological	**Tradition**	**Lack of cultural change**	**Lack of circular mindset**
		Lack of ownership	**Lack of ownership**
		Lack of emotional attachment	**Lack of emotional attachment**
	Image	**Lack of status**	**Lack of status**
		Lack of perceived quality	**-**
		Lack of trust	**Lack of trust**
Functional Barriers	**Usage**	**Lack of convenience**	**Lack of convenience**
		Lack of infrastructure	**Lack of infrastructure**
		Lack of technical compatibility	**Lack of technical compatibility**
	Value	**Lack of knowledge and information**	**Lack of knowledge and information**
		Lack of perceived advantage	**Lack of perceived advantage**
	Functional Risk	**Uncertainty about quality**	**Lack of quality**

Furthermore, the theoretically derived allocation of barriers to CI types (see chapter 2.4, Table 7) could mainly be confirmed for the cases of refurbished products, renting, and sharing services. Thereby, only three barriers need to be allocated differently. The barrier of "*status*" was primarily allocated to be relevant for all CI types but has been dominant only for refurbished CI providers. Secondly, the barrier of "infrastructure" has been assumed to be mainly relevant for PaaS models, whereby it has also been recognised to be hindering in the case of tack-back systems for refurbished products. Additionally, the presence of a high degree of "*convenience"* has been found to be especially significant for the adoption of PaaS models. In terms of "*lack of emotional attachment*", no evidence could be found by analysing case companies.

Additionally, other variables that influence the relevance of barriers have been identified throughout the empirical research. These variables include cultural attributes such as the prevailing national culture, sustainability awareness, and knowledge, or the maturity of access-based consumption within the region. Moreover, system attributes are relevant, including prevailing regulatory initiatives and promotions of CIs, such as the maturity of take-back infrastructures or legislative awareness and education campaigns. Furthermore, company attributes were mentioned, such as brand awareness and perception as well as reputation, has been analysis within the interviews but also product- and service-related attributes, such as the product's status and emotional association, quality, and price. And lastly, target group-specific attributes such as individual motives and pains, purchase power, or social environment.

Coming to interventions pursued almost all executed actions of case companies in order to overcome customer barriers towards CI could be categorised based on the BCW interventions by Michie et al. (2011). In terms of persuasion, the six different persuasion techniques by Cialdini (2005), including reciprocity, scarcity, authority, commitment, liking, and consensus, case companies and experts mainly refer to three of them, including liking, authority, and commitment. A dominant activity especially used by incumbent firms is branding which addresses four different barriers. This insight confirms the phenomenon of the incumbent's "unfair advantage" compared to emerging businesses, especially in the field of trust and reputation, which has been coined by Nesheim (2005).

Even though companies apply behavioural change interventions, their selection and establishment are not grounded on a structured behavioural change approach. Therefore, the next chapter proposes a systematic approach to identify and overcome customer barriers towards CI, which combines insights from literature as well as gathered empirical insights on approaches companies and experts already apply in practice.

5.1. Proposal of a Systematic Approach to Overcome Customer Barriers Towards CI

Based on theoretical and empirical findings within the European consumer electronics industry, this chapter provides the proposal of an approach to systematically identify and overcome customer barriers towards CI (see Fig. 12). Thereby the fundamental steps of the proposed approach are based on those of the design thinking approach by Brown (2008). The proposed approach is grounded based on the empirical insight that several companies already used this approach within the context of CI. Therefore, an orientation on design thinking makes it easier for companies to apply the approach. For each step the following provides insights on the aim as well as supporting methods and materials that can be used in order to reach this aim.

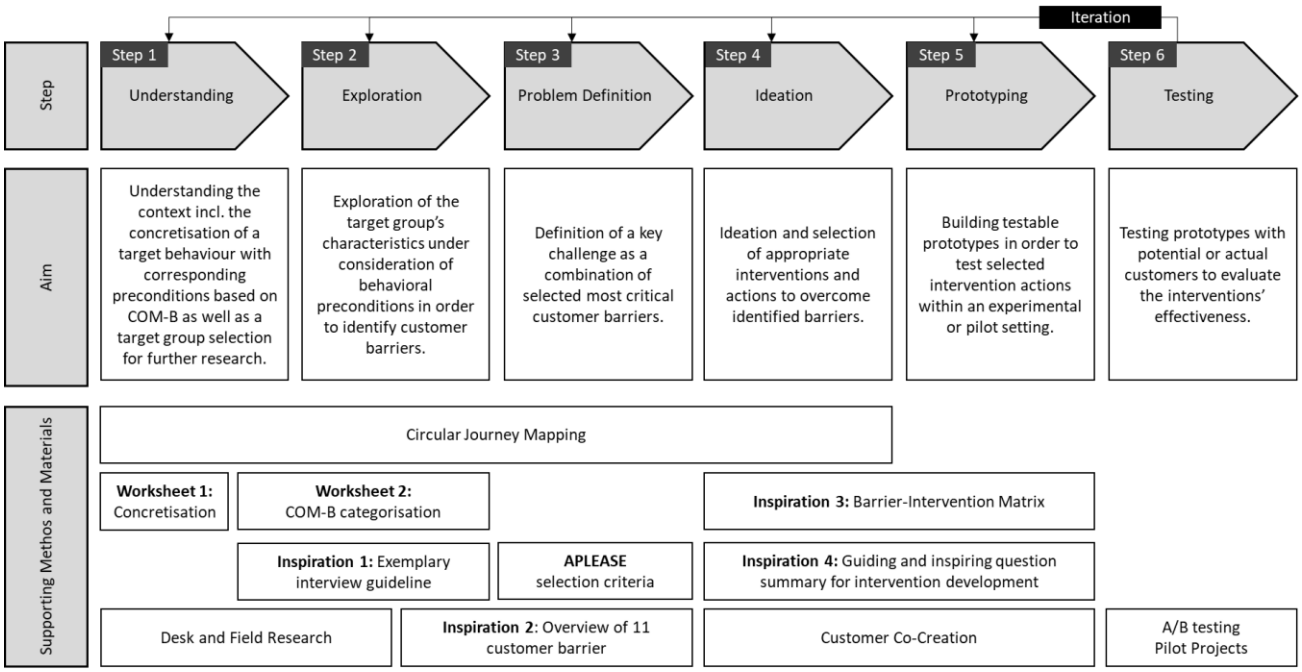

Fig. 12. Proposal of a systematic approach to overcome customer barriers towards CI

Step 1 – Understanding

As mentioned in the theoretical analysis, as well as noticed by practitioners and experts, the relevance of barriers towards CI is highly dependent on several different variables (Armstrong et al., 2015, p. 9). Therefore, it is important first to understand and define the considered context in which customer barriers towards CI are supposed to be identified and overcome. For this, a specification sheet can be used which includes five central questions on the culture, the system, the company, the CI itself, as well as the target group (see Table 23). Those questions are grounded based on analysed empirical findings. The understanding built within this step primarily aims to bring every person included in the CI development process on one page and lay the foundation for further exploration. Furthermore, companies should be aware of different innovation adoption groups considering the target group definition. Those adoption groups are defined in the theory of innovation diffusion by Roger (1995) and include innovators, early adopters, early majority, late majority, and laggers (Rogers, 1995). Within conducted empirical interviews, several practitioners and experts mentioned the approach of first trying to target so-called "early adopter" or "lead user" (Project Manager Miele Upgreat, Pos. 296-299; Psychologist, Pos. 196-198; Professor, Pos. 192-195). Thereby the lead user concept has been developed by Hippel (2005) and describes a small group of people that are more advanced in terms of perceiving their problems compared to the majority as well as intrinsically motivated to overcome faced challenges (Hippel, 2005, p. 4). Within the context of CI "circular lead user" could be identified be characteristics such as the willingness to accept a certain degree of inconvenience in favour to a positive environmental impact (Psychologist, Pos. 196-199), an advanced knowledge in sustainability which is primarily the case of Generation Z and millennials (Customer Sustainability Lead Philips DA, Pos. 86-88), an already rather circular consumption behaviour for instance the purchase or second-hand products (Professor, Pos. 107), but also customer who just like to try new things (Co-Founder Homie, Pos. 342-345) or who have a significant advantage by purchasing the CI, such as expats or students in the case of renting and paid-per use models (Co-Founder Homie, Pos. 318-320; Co-Founder Miele Sharing, Pos. 268-269).

Table 23. Worksheet 1 – Context specification sheet

Attribute Type	Guiding specification question	Explanation
Cultural	What are characteristics of the (regional) culture in which the CI is supposed to be implemented?	Analysing the culture (norms, beliefs, mindset)
System	What are supporting and hindering regulations and infrastructures in the targeted regional market?	Analysing the system (regulations, infrastructure, partnerships)
Company	What are characteristics of the company offering the considered CI?	Analysing company characteristics relevant for the customer (reputation, image, and visibility)
Innovation	What are characteristics of the considered CI?	BM structure, service, or product attributes (price, quality, status association)
Customer	What are characteristics of the target group?	Defining a rough user persona (attitudes, beliefs, and habits)

Gained knowledge and insights regarding the target group can be documented within a user persona (R&D Manager Miele, Pos. 420) representing an abstraction of real customer groups who share common characteristics and needs (Miaskiewicz & Kozar, 2011, pp. 418–419). This method helps to vividly represent the target customer group in mind throughout the whole innovation process. Furthermore, as part of this first step, the targeted customer behaviours that are required for the CI adoption should be defined. Those behaviours can refer to the three main phases of the circular customer journey (see chapter 2.3.1, Fig. 2), including the behaviour of obtaining, using or clearing the considered CI within the previously specified context. After this, target behaviours can be specified using the COM-B model and defining preconditions that need to be fulfilled in order to promote the targeted behaviour (Psychologist, Pos. 374-375). As a tool, the worksheet shown in Table 24 can be used, which is based on Michie et al. (2011) but simplified to make it easier to apply.

Table 24. Worksheet 2 – Specification of target behaviours and barriers based on COM-B

TARGETED BEHAVIOUR: obtaining/using/clearing XY		
COM-B Component	**Preconditions for targeted behaviour**	**List of identified barriers**
Physical Capability (Physical skills)		
Psychological Capability (Knowledge, cognitive and interpersonal skills, memory attention and decision process, behavioural regulation)		
Social Opportunity (Social influence though norms, taste, meanings, opinion leaders, institutions, networks, and relationships)	Step 2	Step 3
Physical Opportunity (Environmental context and resources incl. Infrastructure, objects, time, and schedules)		
Reflective Motivation (Cost/benefits, beliefs, attitudes, goals, intentions)		
Automatic Motivation (Emotions, habit, reinforcement)		

Step 2 – Exploration

As a second step, companies further explore the target group's characteristics under consideration of previously defined preconditions of the targeted behaviour. Thereby typical customer research methods should be applied, including customer interviews, questionaries, direct observation, netnography, or focus groups. Based on this research, barriers towards previously defined behavioural preconditions can be identified. For this identification, the previous research provides several options of guidance. First, the revised categorisation of identified and empirically confirmed customer barriers can be used as guidance on what to focus on (see Table 22). Secondly, following questions can guide and inspire the exploration of barriers.

According to Ram & Sheth (1989) companies should discuss about the following:

- What are possible **traditional barriers** towards the CI, meaning necessary cultural change.
- What are possible **image barriers** towards the considered CI, meaning perceptual problems leading to unfavourable associations with the innovation due to stereotyped thinking.
- What are possible **usage barriers** towards the considered CI, meaning incompatibility with existing workflows, practices, or habits leading to required changes in the customers' routine.
- What are possible **value barriers** towards the considered CI, meaning lack of incentives and performance-to-price value compared to substitutes.
- What are possible **risk barriers** towards the considered CI, meaning uncertainties about harm to person or property, high monetary costs, performance uncertainties, and peer ridicule and ostracism.

According to Michie et al. (2011) companies should additionally discuss possible behavioural change barriers, including the following:

- What **physical capabilities** might the customer lack to perform the required behaviour?
- What **psychological capabilities** might the customer lack to perform the required behaviour?
- Which part of **reflective motivation** might the customer lack to perform the required behaviour?
- Which part of **automatic motivation** might the customer lack to perform the required behaviour?
- Which **physical opportunity** might the customer lack to perform the required behaviour?
- Which **social opportunity** might the customer lack to perform the required behaviour?

As mentioned before, a direct customer integration into the CI design process is crucial to define user-centered interventions. In the case of customer interviews, the following guideline (see Table 25) can be used as an inspiration. The exemplary interview guideline has been developed based on theoretical constructs of the BCW by Michie et al. (2011) as well as empirical insights. However, the questions should be specified according to previously defined behavioural preconditions. For instance, if the customer needs to know the benefits of remanufactured products, a question could be: "What do you know about benefits of remanufactured products?" In order to dig deeper into the roots of a barrier, companies can further apply the so-called 5-Why technique, which is an effective approach to problem-solving (Serrat, 2017, p. 308). Gathered insights and identified barriers can be documented within Worksheet 2 (see Table 24).

Table 25. Exemplary interview guideline to identify barriers

COM-B Component	**Behavioural preconditions:** what needs to happen for the targeted behaviour to occur?
Physical Capability	• Are you physically able to obtain/use/clear the considered CI?
Psychological Capability	• What do you know about the obtainment/use/clearance of the considered CI? • Is it difficult for you to understand and compare the attributes of the considered CI and alternative options? • How do you usually decide on consuming offerings similar to the considered CI? • To what extent do you monitor your consumption behaviour?
Social Opportunity	• To what extent would your social environment (family/friends) help you to obtain/use/clear the considered CI? • Do you know people who did already use the considered CI?
Physical Opportunity	• Which infrastructural aspects might hinder you in the adoption the considered CI? • Do you have access to equipment you need to adopt the considered CI? (e.g., access to the internet) • Do you have the required time and money obtain/use/clear the considered CI?
Reflective Motivation	• To what extent would the adoption of the considered CI be accepted by your social environment? • How difficult would it be for you to obtain/use/clear the considered CI? • To what extent are you confident that any barriers that might occur during the obtaining/using/clearing of the considered CI can be solved? • To what extent do you intend to adopt the considered CI? • What do you think are the consequences of obtaining/using/clearing the considered CI?
Automatic Motivation	• Are there any incentives for you to obtain/use/clear the considered CI? • Would you feel happy about the obtainment/use/clearance of the considered CI?
Others	• Do you have any other thoughts on what could hinder you in obtaining/using/clearing the considered CI?

Step 3 – Problem definition

As probably several barriers will be identified, companies should define criteria that are used to select the most relevant or hindering barriers. Those criteria could be oriented on the APLEASE criteria by Michie et al. (2011) (see Appendix 2c, page 117) or include, for instance, estimated effort, costs, and duration to overcome the barriers (CEO Circular Marketplace, Pos. 425-428). Another possible criterion is the degree of influenceability as in some cases barriers might be not influenceable by the company such as in case or required changes within legislations (Psychologist, Pos. 32-34; CEO Circular Marketplace, Pos. 421-423). As a final task of this step, companies should formulate a concrete challenge, including the problem they want to focus on. Philips DA, for instance, the company defined this challenge as: "How to convince customers that buy a refurbished product is a good and more environmentally friendly option, knowing that some of our customers do not even know what the refurbished product is and other customers feel insecure about the quality of the refurbished electronic household product" (Customer Sustainability Lead Philips DA, Pos. 416-419).

Step 4 – Ideation

Lastly, an ideation session on how to overcome identified barriers should be conducted. For this session, companies can use the developed barrier-intervention matrix in order to get inspired by which actions can be pursued in order to overcome what barrier (see Fig. 11). Furthermore, a summary of guiding questions has been developed based on empirical findings which should help companies within the ideation and development of appropriate interventions (see Appendix 7, page 143). However, inspirations must be adjusted towards the previously defined context. In the case of ideation

workshops, customers could be invited to involve their insights directly as part of customer co-creation. Furthermore, in order to increase the probability of the interventions' effectiveness, companies that do not have access to internal behavioural economics competences should consider collaborating with external agencies that are specialised in behavioural change and communication (Psychologist, Pos. 85-87; Philips DA, Pos. 122-124). Lastly, companies can also search for analogies in other industries in order to get inspired (R&D Manager Miele, Pos. 119-121) or actively try to collaborate with other companies in order to profit from each other's insights and reduce effort. In this context, in one case of the empirical interviews, the possibility of an open-source experimentation platform has been mentioned (Co-Founder Homie, Pos. 527-528).

Step 5 & 6 – Prototyping and Testing

In the last two steps, companies are supposed to build and test their intervention actions. This can be done in several different types of prototyping dependent on the intervention to be tested. In this context, direct customer integration is required again, which can be done based on customer experiments. Most companies within empirical research used a typical A/B testing to evaluate the effectiveness of their interventions (Co-Founder Homie, Pos. 150; CEO Circular Marketplace, Pos. 330), which is especially effective in applying the interventions including education, persuasion, incentivisation, modelling, and enablement. Considering those activities belonging to environmental restructuring, pilot projects are rather recommendable as they are rather strategic.

The proposed five-step approach offers companies the possibility to integrate relevant behavioural change elements into an already established design thinking process.

5.2. Theoretical Implications

The thesis contributes to several open research prospects as it discusses a context in the interface of CE, innovation development, as well as behavioural economics. First of all, the research contributes to the required need for *cross-fertilisation between innovation and CE* (Jesus et al., 2021, pp. 2–3). In this context, the conducted literature review supports a better understanding of the relationship between CE and sustainability as well as related innovation concepts, including the differentiation between circular, environmental, sustainable, and frugal innovation as requested by previous researchers (De Angelis, 2018, p. 67; Geissdoerfer et al., 2017, p. 767).

Additionally, with the explicit focus on customer barriers, the study targets the missing *consideration of the customer perspective within CE research* (Camacho-Otero et al., 2017, p. 1; Centobelli et al., 2020, p. 1746; Rexfelt & Selvefors, 2021, p. 1; Selvefors et al., 2018, p. 2047). In this context, empirical insights on how considered case companies try to integrate the customer perspective within the development of CI and identify customer barriers are especially relevant.

Next, theoretical as well as empirical insights contribute to the need for *exploration of customer barriers towards CI* (Almefelt & Rexfelt, 2017, p. 11). Based on a literature review, a broad overview of customer barriers towards CI has been provided. These were further categorised based on CI types and innovation barrier types by Ram & Sheth (1989) as well as validated by empirical findings. To the researcher's knowledge, this overview is unique in its holistic consideration of different CI types which provides a foundation for further qualitative as well as quantitative research purposes. Thereby, several insights have been gathered that indicate relationships and interdependence between identified barriers, while two dominant angles to consider barriers were found to be dominant. First, psychological barriers rooted in scepticism and second, actual barriers rooted in real pain.

Moreover, the execution of empirical research, in general, contributes to *the lack of empirical research studies* in the context of CE and CI (Alhawari et al., 2021, p. 1). Considering the final research on interventions to overcome customer barriers towards CI, to the researcher's knowledge it is the *first time that the BCW model by Michie et al. (2011) has been applied in the context of customer barriers towards CI* in the European consumer electronics industry. While the possibility of applying the three-step behavioural change approach by Michie et al. (2011) was demonstrated based on a theoretical example first, insights on how companies apply the nine BCW interventions have been gathered based on case studies and expert interviews. Thereby, actions that are practically applied to execute BCW interventions could be grounded.

In general, by choosing the BCW as an underlying theoretical construct, the research *provokes discussion on behavioural change interventions and behavioural economics in the context of CI*, which is a still rather underexposed research field. Next to mentioned contributions, the research provides valuable theoretical insights which can be used to imply further research prospects. Those insights include the finding that companies use *partner collaboration* as one part of the environmental restructuring, this insight supports the request for more research on "how companies' partnerships influence the creation of value in a circular business model" (Centobelli et al., 2020, p. 1745). Additional, findings on *circular design strategies,* such as design for repairability or upgradeability, contribute to the call for further research on case studies to examine how design practices are used as interventions to foster CE projects (van Dam et al., 2020, p. 13). Furthermore, existing *research controversies* regarding the barrier of "lack of ownership" could be confirmed as empirical findings indicate that the barrier of ownership must be considered with respect to the corresponding industry as well as generational characteristics and might be less relevant than a few years ago. This touches on two other valuable findings. First is the *relevance of time* within the process of overcoming customer barriers. Several companies, especially in the case of cultural change and ownership, rely on the mindset switch based on the generational change as well as the typical innovation diffusion curve which implies that in the consumer electronic industry CIs are currently rather in a phase of targeting early adopters. Second is that the relevance of barriers depends on several *variable attributes*, as also suggested by Camacho-Otero et al. (2019). Lastly, the research provides an empirical example of *"unfair advantage" phenomenon* of incumbent companies compared to emerging ones (Nesheim, 2014). As established brands such as Miele or Philips DA have access to a well-known and reputed brand name, it is easier for them to overcome trust or quality concerns.

5.3. Managerial Implications

Besides contributing to existing theoretical research gaps, the study provides managerial implications for companies aiming to develop and implement CIs within the European consumer electronics industry. The empirical results show that companies, independent of size and maturity, actively pursue interventions to overcome customer barriers towards CI.

Implications for management in general

- *Importance of behavioural economic capabilities*: even if a certain amount of behavioural economics competencies is key in order to increase the effectiveness of intervention design, only a few companies have access to their own professional behavioural change competencies, including knowledge about psychological and behavioural constructs. Therefore, managers should ensure access to behavioural economics capabilities, which can either be done by developing their own capabilities or by hiring external agencies or experts to support the process, which might be rather affordable for established, larger companies.

- *Importance of intervention combination*: theoretical and empirical research findings show that companies should apply several behavioural interventions in combination in order to overcome complex barrier constructs. However, in this context, companies must be aware of possible negative spill-over effects, e.g., high price reductions causing quality concerns. Therefore, managers should carefully assess the compatibility of selected interventions.
- *Application of a systematic approach*: to support companies to integrate behavioural change aspects within already established innovation development processes, an approach orientated on the dominant design thinking phases has been proposed, including several guiding materials. This approach could help companies to systematically identify and overcome customer barriers towards CI within the innovation development process, which enables them to significantly reduce market uncertainty and increase their CIs adoption rate.
- *Importance of policy support*: in addition to corporate interventions, managers should ensure that relevant policies are initiated to support those initiatives. For instance, the need for an official definition of condition criteria for refurbished products, the initiation of mandate laws around greenwashing, or product standardisation regulations were mentioned.
- *Importance of matching circular strategies and CI types with target customer groups*: empirical findings highlight the importance of customer segmentation. Thereby, not all CI types are the same attractive to different customer groups. Therefore, companies need to make strategic decisions on which circular strategy and CI type they want to focus on in order to attract targeted customer groups.
- *Importance of ethics*: companies applying behavioural economics in order to promote behavioural change in their target customers should consider ethical conduct.

Furthermore, there are additional implications that depend on the maturity as well as the CI type of the corresponding company.

Implications for emerging companies

- *Relevance of collaboration*: partner collaborations are especially important in order to guarantee access to the required infrastructure.
- *Relevance of credible sources*: to cope with unfair advantage of established brand names and incumbent companies, emerging companies should rely on the use of credible sources such as journalists, scientists, or certifications and guarantees to overcome trust and quality issues.

Implications for incumbent companies

- *Leveraging unfair advantages*: an established brand can be a significant "*unfair advantage*" in overcoming customer barriers such as lack of trust or quality concerns.
- *Aligning brand and design*: considering identified interventions, findings show that companies need to combine branding and communication activities with the product and infrastructural design in order to overcome barriers
- *Coping strategies for cannibalism*: there are two strategies to cope with possible cannibalism of the linear product portfolio. In the case of the circular marketplace, companies use the platform to offer their refurbished products separately of their core business which can be understood as a rather passive way of CE transition. On the other hand, Philips DA actively tries to nudge customers on its own website to purchase refurbished instead of new products.
- *Organisational foundation of CI development*: to increase authenticity, managers of established companies should make sure that the development of CI is aligned with the corporate purpose and structure including roles, responsibility, and leadership goals.

5.4. Limitations and Further Research

As especially the empirical research has been conducted with a limited scope, results are primarily valid for CIs including refurbished products, as well as PaaS model, including renting and sharing models within the European consumer electronics industry. As the research has shown that barriers highly depend on several attributes, a generalisation beyond the limitations of this research cannot be guaranteed and therefore should be analysed within further research. While the selection of four cases fulfils the requirements of a multiple case study (Yin, 2018, p. 58), a consideration of more cases or interviews could have provided insights on additional interventions applied or further details on those already identified. Nevertheless, the fulfilment of triangulation criteria by partly integrating secondary data resources helped to mitigate this limitation. Thereby, the criticism of too few subjects analysed is a typical limitation for qualitative research accompanied by subjectivity as coding and interpretation have only made by one researcher (Brinkmann & Kvale, 2018c, p. 8). Considering the integration of the customer perspective within the research, a purposeful sampling (Johnson et al., 2019, pp. 7–13) has been pursued to guarantee that interviewees can provide an aggregated customer perspective. However, further research could focus on direct customer integration to explore the actual effectiveness of identified interventions (Steg & Vlek, 2009, p. 313) under consideration of different influencing variables such as customer characteristics, culture, or brand perception. This could be done using focus groups or customer experiments. Furthermore, as mentioned in the problem analysis part of the research, customer barriers towards CI are only one out of several reasons why companies fail to transit towards CE. To successfully transit towards CE, a holistic system approach needs to be established that aggregates findings of this research with results of research focusing on other barriers towards CE. Mentioned further research prospects are summarised in Table 26.

Table 26. Further research prospects

	Further research prospects
Qualitative prospects	• Validation and concretisation of the proposed systematic approach to identify and overcome customer barriered • Exploration on possibilities to overcome customer barriers towards CI based on integrated product design using systems engineering methods • Exploration on possibilities to apply the lead user method within the context of CI • Exploration of circular lead user characteristics
Quantitative prospects	• Investigation of the effectiveness of different intervention actions under consideration of different variable attributes (system, culture, company, innovation, target group attributes) (Camacho-Otero et al., 2019) • Investigation of the relationship and spill over effects between identified customer barriers towards CI (e.g., by using DEMANTEL methodology (Bhatia & Srivastava, 2018, p. 86)) • Investigation of the relationship between a company's maturity and the relevance of perceived customer barriers towards CI • Investigation of the relationship between CI types and the relevance of perceived customer barriers towards CI • Investigation of the relationship between the effectiveness of intervention actions and different customer adoption groups (incl. companies, early adopters, etc.)

6. Conclusion

1. **A systematic approach to identify and overcome customer barriers towards CI can help companies to successfully transit towards a CE which is key to tackle threatening limitations of the prevailing linear economic system.**

The world's economic system is based on a linear model, which has limitations leading to serious environmental problems such as global warming and increasing overshoot of the planet's biocapacity, as well as economic problems such as resource scarcity. Therefore, the need for a new economic system is rising. The most discussed and well-known solution is a system transition towards a CE, which is already advocated by several CE policies and regulatory initiatives. However, even if benefits, drivers, and policy regulations exist, the concept is still not widely used. One reason for this are customer barriers towards CI, as recent developments of CIs show rather low adoption rates. Although companies have significant problems in developing user-accepted CIs, there is only a little research on CI and even less on the customer perspective within this context. In order to help companies to implement CIs as part of their transition towards CE successfully, exploration of customer barriers towards CI is required, followed by research on how to foster the consideration of the customers' perspective within the development of CIs as well as systematic approaches to identify and interventions to overcome customer barriers.

2. **Based on theoretical foundations of CE and CI, frameworks for circular behaviour and customer adoption of CIs led to the theoretical identification of twelve customer barriers towards CI. These include "lack of cultural change", "lack of ownership", "lack of emotional attachment", "lack of status", "lack of perceived quality", "lack of trust", "lack of convenience", "lack of infrastructure", "lack of technical compatibility", "lack of knowledge and information", "lack of perceived advantage", and "uncertainty about quality". Additionally, nine interventions based on the behavioural change wheel by Michie et al (2011) were suggested to help companies overcoming these barriers including "education", "persuasion", incentivisation", "coercion", "restriction", "training", "environmental restructuring", "modelling", and "enablement".**

In this thesis, CE is understood as an economic system in which resource input, waste, emission, and energy flows are minimised. While CE and sustainability are often confused due to similarities regarding their consideration of environmental hazards, their global and interdisciplinary perspective, as well as the consideration of regulations, incentives, and business model innovation as an enabler, there are clear differences in terms of their general definition, origins, main goals, and motivation. For instance, while CE is mainly based on the dimensions of economy and environment, the underlying dimensions of sustainability are combined in a triple-bottom-line approach that includes a social dimension. CE is based on the three principles of preserving and enhancing natural capital, optimising resource yields, as well as fostering system effectiveness. Those principles can be translated into six main business actions (regenerate, share, optimise, loop, virtualise, and exchange), which already include the main resource loops of the technological circular cycle (sharing, maintaining, reusing, redistributing, refurbishing, remanufacturing, and recycling). Lastly, CE is based on three main resource flow approaches: reduce, slow, and close resource flows. As part of CE, CIs stand in contrast to rather common linear innovations and can be understood as those innovations that integrate CE goals, principles, and recovery strategies. Different types of CIs can be differentiated, including circular products, such as refurbished, reused, remanufactured, or recycled products, circular services, such as repairing or upgrading services, as well as circular business

models, which are primarily PaaS models such as sharing or renting. Comparing CIs with other related concepts such as environmental, sustainable, and frugal innovations, most similarities could be identified between CIs and environmental innovations. Existing frameworks for circular behaviour propose a circular consumption cycle including the three main phases of gaining, utilising and managing, as well as resigning. Thereby, circular behaviour itself is characterised by anonymity, connected consumption, a multiplicity of values, political consumerism, and uncertainty. Building on the theory of planned behaviour, the COM-B and BCW model of behavioural change by Michie et al. (2011) provides a systematic three-step approach to create behavioural change interventions. These steps include the understanding of the behaviour, the identification of intervention options, as well as the implementation of those. Thereby, the BCW proposes nine primary interventions, including education, persuasion, incentivisation, coercion, training, enablement, modelling, environmental restructuring, and restriction which can be pursued to overcome lack of behavioural change that is caused by capability, opportunity, or motivation issues. While the model has been applied primarily within the health care context, a suitability to apply the model in the context of CE could be identified based on previous research.

Considering innovation adoption theories, according to Roger (1995), positive influencing factors are perceived relative advantage, compatibility, low complexity, testability, and observability. According to Ram & Sheth (1989), five main innovation inhibitors can be differentiated into psychological barriers such as tradition and image barriers and functional barriers such as usage, value, and risk barriers. Based on those existing theoretical constructs, an extensive literature review, including 37 papers, has been conducted, leading to the identification of twelve dominant customer barriers. Those barriers could be categorised based on the mentioned model by Ram & Sheth (1989), as well as their assumed relevance for different types of CI. Finally, as part of the theoretical solutions, approaches to identify and overcome customer barriers were introduced, which are the user-centered design, including the design thinking approach, as well as a theoretical application of the behavioural change approach by Michie et al. (2014). This application has shown that previously identified barriers towards CI are rooted in all three different components of behavioural change, including lack of capabilities, opportunities, and motivation. Thereby, the exemplary application for the target behaviour "*willingness to purchase previously owned "re"products*" revealed several methods and, more specifically, interventions that can be used in order to overcome identified barriers towards CI. The most dominant interventions identified are education, persuasion, and modelling as they target the highest variety of customer barriers towards CI. Furthermore, incentivisation, training, environmental restructuring, and enablement were identified to be supportive, while restriction and coercion were perceived as not useful.

3. **The grounded empirical research design includes a qualitative approach based on semi-structured expert interviews and a multiple case study analysis. Thereby, the barrier categorisation by Ram & Sheth (1989) and the nine interventions by Michie et al. (2011), were used as research indicators to explore how companies recognise customer barriers towards CI and pursue interventions to overcome these in the case of European consumer electronics companies.**

Due to the underexposed research context, a qualitative, exploratory research design was chosen, which was applied based on a multiple case study analysis combined with expert interviews. In both cases, semi-structured interviews were conducted based on a previously developed interview guideline, including defined research indicators. Thereby the regional and industrial research scope was chosen to be European consumer electronics companies as the relevance of CIs is especially high

in this industry and the European market is rather far developed considering already existing CE policies. Companies and interviewees were sampled based on a purposeful sampling technique, which led to, in total, ten conducted interviews. All interviews were recorded, documented, and analysed while specific measures were considered to fulfil research ethics and quality requirements, including rigor, triangulation, and saturation.

4. **Based on empirical research findings, eleven out of twelve theoretically identified barriers were found to be evident in practice. Thereby, dominant approaches to integrate the customer perspective and to identify customer barriers were evolved while actions on how companies pursue BCW interventions to overcome these barriers were explored.**

Empirical results show that companies are primarily using design thinking and lean start-up elements to integrate the customer perspective into the development process of CI. Thereby, barriers are usually identified based on typical market research methods such as customer interviews, surveys, experiments, or workshops also in collaboration with professional market research agencies but also by netnography or scientific research findings. Considering customer barriers towards CI, all barriers were found to be evident in practice except of "*lack of emotional attachment*". While some barriers such as "*lack of cultural change*", "*lack of trust and company image*", "*lack of infrastructure*", "*lack of knowledge and information*", and "*lack of perceived advantage*" are recognised independently of the CI type, "*lack of ownership*" is mainly relevant for PaaS models, while providers of refurbished products are especially challenged by "*lack of perceived quality*" or "*uncertainty about quality*", "*lack of status*", and "*lack of technical compatibility*". Considering identified interventions that companies pursue, several actions are executed to overcome customer barriers towards CI. Thereby, the main actions to overcome customer barriers towards CI are based on the interventions of education, persuasion, and incentivisation. The next prominent interventions are environmental restructuring and modelling. Interventions which are rather less applied are training and enablement, while interventions that are even mainly rejected are coercion as well as restriction. Additionally, a matching of barriers and interventions pursued could be provided based on empirical insights. Considering the *lack of cultural change* and *ownership*, companies primarily refer to the natural mindset shift by generations and time. In terms of *emotional attachment*, no interventions have been identified as most cases did not recognise this barrier. Lack of *status* is tackled by several actions which are mainly part of persuasion and modelling, including the promotion of sustainability as a status, the collaboration with influencers, or branding and marketing and communications, whereby none of them is dominant. Contrary, considering *lack of trust*, persuasion in the form of branding is the most dominant action to intervene, followed by the use of credible sources. *Lack of convenience* is primarily overcome by persuasion, including the promotion of a full-service offering while *lack of infrastructure* is tackled by environmental restructuring, including partner collaboration. Next, *lack of technological compatibility* is also primarily coped with by environmental restructuring, meaning design for circularity. *Lack of knowledge and information* is dominantly overcome by education including marketing and communications, awareness events, as well as the providing of information via the corporate website, and customer-product interaction. Lastly, *lack of perceived advantage* and *lack of quality* are overcome by persuasion. Thereby lack of perceived advantage is mainly overcome by the addressing of customer motives, while lack of quality is overcome by guarantees, branding, and price reduction as part of incentivisation.

5. **Most empirical findings confirm theoretical constructs. Thereby, a systematic approach to overcome customer barriers towards CI could be proposed by presenting a five-step approach based on design thinking and behavioural change elements.**

In consideration of theoretical and empirical findings, minor adjustments to the labelling and categorisation of the barriers were made. Furthermore, the theoretically assumed relevance of barriers dependent on the CI types could mainly be confirmed. The barrier of "status" was primarily allocated to be relevant for all CI type but is only dominant for refurbished CI providers. Secondly, the barrier of "infrastructure" has been assumed to be mainly relevant for PaaS models, whereby it was also recognised to be hindered in the case of tack-back systems for refurbished products. Additionally, the presence of a high degree of "convenience" has been found to be especially significant for the adoption of PaaS models. In terms of "lack of emotional attachment", no evident relevance could be found by analysing case companies. Furthermore, additional attributes that influence the relevance of barriers were identified, including system-, culture-, company-, innovation-, as well as target group-related attributes.

Lastly, a systematic approach to overcoming customer barriers towards CI has been proposed, including the five steps of understanding, exploration, problem definition, ideation, prototyping, and testing. Thereby, worksheets and guiding materials have been provided based on theoretical and empirical findings. These include a concretisation worksheet with questions to define the context within the understanding phase, and a worksheet to specify the targeted behaviour and barriers based on COM-B. Additionally, an exemplary interview guideline to support the exploration phase has been developed, followed by an overview of identified and revised barriers as an inspiration for the problem definition. Finally, a matrix showing which interventions were found to be used for what barriers has been created, accompanied by a summary of guiding questions. These materials should support companies in the ideation and prototyping phase by inspiring ideas for possible intervention actions. Consequently, the research's theoretical and empirical findings provide highly valuable implications for companies trying to transition towards CE by developing CIs.

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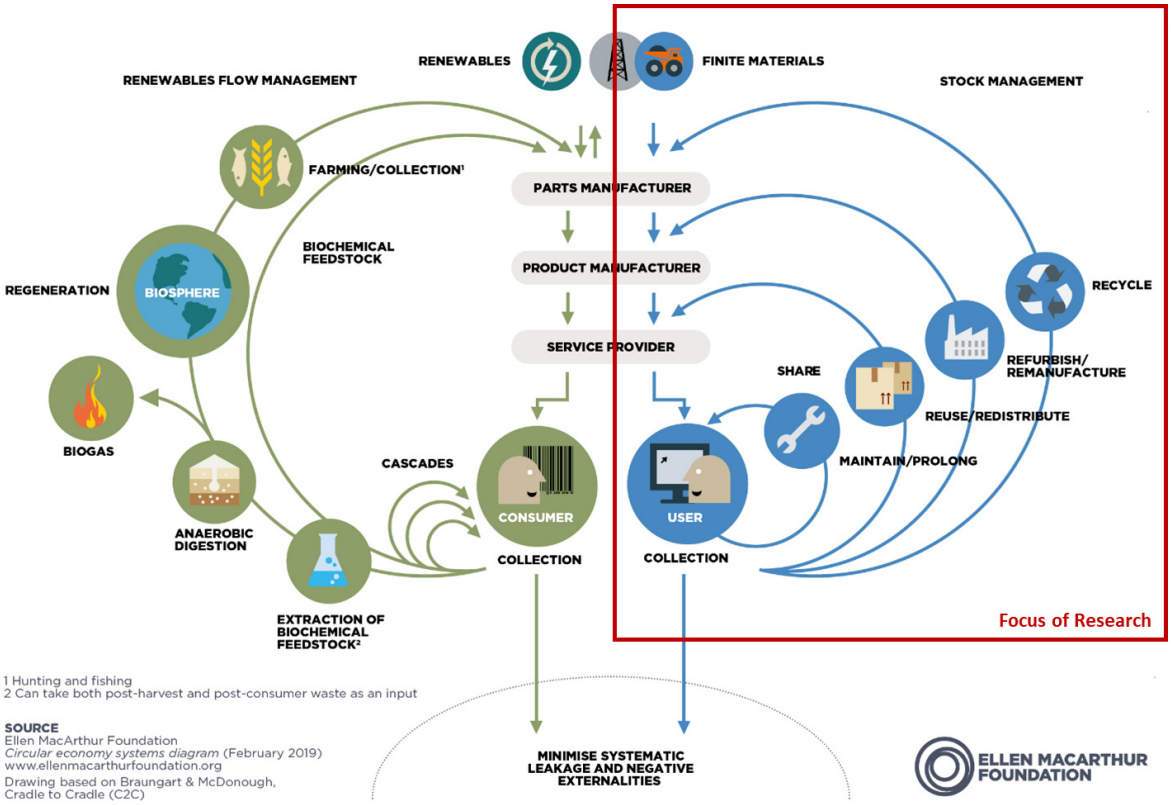
Appendices

Appendix 1. Additional Information about Circular Economy Foundations

Appendix 1a. Tabular overview of CE drivers and benefits based on Aloni et al. (2020) and Tura et al. (2019)

Dimension	Drivers	Benefits
Economic	• Risk of economic inability to act due to resource scarcity • Increasing and volatile raw material prices • Increasing competitive pressure • Increasing global sustainability awareness and investment	• Improving cost efficiency, profitability, revenue streams, and competitiveness • New business development and innovation • Strengthening customer relationships
Ecologic	• Environmental problems: climate change, global warming, resource overconsumption and scarcity	• Reducing negative environmental impact by increasing resource efficiency
Social	• Global awareness of sustainability needs	• New employment opportunities
Organisational	• Risk of losing brand reputation and CSR	• Development of skills and capabilities for CE
Institutional / Regulatory	• Directing regulations and standard requirements • Extended Producer Responsibility Directive	• Supportive funds, taxation, and subsidy policies
Technological / Informational	• New technologies as enablers for the transition towards CE	• Increase of information sharing through enhanced information management technologies
Supply Chain	• Risk of resource scarcity	• Potential for reducing supply dependence • Multi-disciplinary, increased availability of resources and capabilities • Joint maintenance and supply chain optimisation

Appendix 1b. Circular economy butterfly diagram according to EMF (2013)



Appendix 1c. ReSOLVE actions and CE Loops adapted from EMF (2015a) and (2021a)

ReSOLVE	CE Loops	Description
Regenerate	X	Shifting to renewable energy and materials to reclaim, retain, and regenerate the ecosystem's health.
Share		"The use of a product by multiple users. It is a practice that retains the highest value of a product by extending its use period."
Optimize	X	Increase product performance and efficiency to remove production and supply chain waste along the whole PLC by leveraging new technologies such as big data, or automation.
Loop	**Maintain**	"Keep a product in its existing state of quality, functionally and/or cosmetically, to guard against failure or decline. It is a practice that retains the highest value of a product by extending its use period."
	Reuse	"The repeated use of a product or component for its intended purpose without significant modification."
	Redistribute	"Divert a product from its intended market to another customer so it is used at high value instead of becoming waste."
	Refurbish	"Return a product to good working order. This can include repairing or replacing components, updating specifications, and improving cosmetic appearance."
	Remanufacture	"Re-engineer products and components to as-new condition with the same, or improved, level of performance as a newly manufactured one."
	Recycle	"Transform a product or component into its basic materials or substances and reprocess them into new materials."
Virtualize	X	Deliver a product virtually to dematerialise and avoid the need for physical material consumption or create new value.
Exchange	X	Replace old materials with advanced materials by applying and integrating new technologies.

Appendix 2. Additional Information about the Application of the Behavioural Change Wheel

Appendix 2a. Overview of BCW invention definitions (Michie et al., 2011, p. 8)

Interventions	Definition	Examples
Education	Increasing knowledge or understanding	Providing information to promote healthy eating
Persuasion	Using communication to induce positive or negative feelings or stimulate action	Using imagery to motivate increases in physical activity
Incentivisation	Creating expectation of reward	Using prize draws to induce attempts to stop smoking
Coercion	Creating expectation of punishment or cost	Raising the financial cost to reduce excessive alcohol consumption
Training	Imparting skills	Advanced driver training to increase safe driving
Restriction	Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours)	Prohibiting sales of solvents to people under 18 to reduce use for intoxication
Environmental restructuring	Changing the physical or social context	Providing on-screen prompts for GPs to ask about smoking behaviour
Modelling	Providing an example for people to aspire to or imitate	Using TV drama scenes involving safe-sex practices to increase condom use
Enablement	Increasing means/reducing barriers to increase capability or opportunity[1]	Behavioural support for smoking cessation, medication for cognitive deficits, surgery to reduce obesity, prostheses to promote physical activity

Appendix 2b. COM-B components and TDF domains (Michie et al., 2014, pp. 88–90, 2014, pp. 113–115)

COM-B Component	TDF Domain	What needs to happen for the targeted behaviour to occur?
Physical Capability	Physical skills	Physical ability to perform the considered behaviour
Psychological Capability	Knowledge	An awareness of the existence of something
	Cognitive and interpersonal skills	An ability or proficiency acquired through practice
	Memory, attention, and decision processes	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives
	Behavioural regulation	Anything aimed at managing or changing objectively observed or measured actions
Social Opportunity	Social Influence	Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours
Physical Opportunity	Environmental context and resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour
Reflective Motivation (cost/benefits, beliefs, attitudes)	Social role and behaviour	A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting
	Belief about capabilities	Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use
	Optimism	The confidence that things will happen for the best or that desired goals will be attained
	Goals	Mental representations of outcomes or end states that an individual wants to achieve
	Intentions	A conscious decision to perform a behaviour or a resolve to act in a certain way
	Beliefs about consequences	Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation)
Automatic Motivation (Emotions, habit)	Reinforcement	Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus
	Emotions	A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or even

Appendix 2c. APEASE evaluation criteria for interventions (Michie et al., 2014, pp. 23–24)

Criterion	Description
Affordability	Interventions often have an implicit or explicit budget. It does not matter how effective, or even cost-effective it may be if it cannot be afforded. An intervention is affordable if within an acceptable budget it can be delivered to, or accessed by, all those for whom it would be relevant or of benefit.
Practicability	An intervention is practicable to the extent that it can be delivered as designed through the means intended to the target population. For example, an intervention may be effective when delivered by highly selected and trained staff and extensive resources but in routine clinical practice this may not be achievable.
Effectiveness and cost-effectiveness	Effectiveness refers to the effect size of the intervention in relation to the desired objectives in a real world context. It is distinct from efficacy which refers to the effect size of the intervention when delivered under optimal conditions in comparative evaluations. Cost-effectiveness refers to the ratio of effect (in a way that has to be defined, and taking account of differences in timescale between intervention delivery and intervention effect) to cost. If two interventions are equally effective then clearly the most cost-effective should be chosen. If one is more effective but less cost-effective than another, other issues such as affordability, come to the forefront of the decision making process.
Acceptability	Acceptability refers to the extent to which an intervention is judged to be appropriate by relevant stakeholders (public, professional and political). Acceptability may differ for different stakeholders. For example, the general public may favour an intervention that restricts marketing of alcohol or tobacco but politicians considering legislation on this may take a different view. Interventions that appear to limit agency on the part of the target group are often only considered acceptable for more serious problems (Nuffield Council on Bioethics, 2007).
Side-effects/safety	An intervention may be effective and practicable but have unwanted side-effects or unintended consequences. These need to be considered when deciding whether or not to proceed.
Equity	An important consideration is the extent to which an intervention may reduce or increase the disparities in standard of living, wellbeing, or health between different sectors of society.

Appendix 3. Additional Information about the Literature Review on Customer Barriers Towards CI

Appendix 3a. Literature review strategy (own development)

	Research Focus	**Key Words**
Priority 1	Investigating customer barriers for CE and CI	Customer / user barrier(s) + circular economy / circular innovation
Priority 2	Investigating customer barriers for the most common CBM types	Customer / user barrier(s) + PSS / product service systems [PaaS / product as a service]
Priority 3	Investigating customer barriers for different CE circles and product types	Customer / user barrier(s) + share(d products) / sharing / repair(ed products) / repairing / reuse(d products) / redistribute(d products) / remanufacture(d products) / refurbish(ed products) / recycle(d products) / take back (system)
Priority 4	Investigating customer barriers towards circular or environmental behaviour and attitude	Customer / user barrier(s) + [circular attitude / circular behaviour] / environmental attitude / environmental behaviour

(in backets [x] = keywords that did not provide any paper)

Appendix 3b. Result of literature review on customer barriers towards CI (1/4) (based on own literature review)

	#	Barrier	Description & Sub Issues	Authors
Tradition Barrier	**B1**	Lack of cultural change	Customers resist to develop circular behaviour, attitude, and mindset as the need for cultural change in order to acquire and use CI conflicts with their prior beliefs which are rooted in the mindset of a linear system including the attitude of one-time consumption or low environmental awareness. Sub issues: • Customers base decisions on subjective believes instead of rationales • Unwillingness to change learned behaviour • Linear mindset: lack of environmental interest and awareness, short-term perspective, one-time consumption, and ownership attitude • Intention-action gap	(Almefelt & Rexfelt, 2017) (Baines et al., 2007, p. 1549) (M. Baker et al., 2014, p. 91) (Bhatia & Srivastava, 2018, p. 81) (Kirchherr, Hekkert, et al., 2017, p. 10) (Planing, 2015, p. 7) (Schotman & Ludden, 2014, p. 195) (Urbinati et al., 2019)
	B2	Lack of ownership	Customers have difficulties of detaching value from the ownership of physical products as it conflicts with their attitudes of materialism and emotional identification. • Ownership attitude and materialism • Product identification issues • Products associated with high level of emotions, self-expression, symbolic, and memory • Lost control over end result • Fear of penalties for non-owned product damage	(Baines et al., 2007, p. 1549) (Camacho-Otero et al., 2018, p. 14) (Catulli et al., 2021, p. 5) (Mont, 2002a, p. 244) Critic by (Elzinga et al., 2020, p. 1)
	B3	Lack of emotional attachment	Customers lack emotional attachment to products which leads to poor treatment and maintenance as well as an earlier discard. Sub issues: • Paradox relationship to lack of ownership	(Jensen et al., 2021, p. 7)

Appendix 3c. Result of literature review on customer barriers towards CI (2/4) (based on own literature review)

Image Barrier	**B4**	Lack of status	Customers have difficulties to identify themselves with access-based products which leads to the lack of status symbolic. Customers stereotype "re"products with a generally low prestige and value status. Sub issues: • Product identification issues • Association of ownership with status • Stereotyping of "re"-products as less qualitative and valuable	(M. Baker et al., 2014, p. 92) (Camacho-Otero et al., 2018, p. 14) (Enckell & Isgran, 2017, p. 14) (Schotman & Ludden, 2014, p. 194) (Wahjudi et al., 2020, p. 10)
	B5	Lower perceived quality	Customers stereotype CI such as "re"products with low value attributes such as quality, performance, reliability, or hygiene which leads to a negative attitude and undervalue of CI comparted to alternative products as well as a lower WTP. Sub issues: • Lack of knowledge and information • Concerns about quality, hygiene, security, performance, reliability, and technological obsolescence • Lower willingness to pay for "re" products	(Almefelt & Rexfelt, 2017) (Bhatia & Srivastava, 2018, p. 81) (Camacho-Otero et al., 2018, p. 13) (Catulli et al., 2021, p. 5) (Guldmann & Huulgaard, 2020, p. 10) (Wahjudi et al., 2020, pp. 4–5)
	B6	Lack of trust and company image	Customers are confronted with a high degree of required trust in the CI provider as well as other customers as products are only used temporary and then returned to CI provider or distributed to another user. Furthermore, customers are greatly affected by the perception of the provider's company image especially if the offering is unknown and performance indicators are uncertain especially in the case of "re"products. Sub issues: • Lack of trust in CI provider regarding sustainability claims, business continuation, guarantees • Lack of trust in other user in the collaborative consumption system • Concerns about sharing sensitive personal data • Unwillingness to enter commitments of a long-term customer-provider relationship • Lack of company reputation and visibility	(Almefelt & Rexfelt, 2017) (Elzinga et al., 2020, p. 9) (Schmidt et al., 2015, p. 287) (Wahjudi et al., 2020, p. 7) (Mont, 2002b, p. 7) (Camacho-Otero et al., 2018, p. 13) (Cotton, 2019) (Pecorari & Lima, 2021, p. 5) (Almefelt & Rexfelt, 2017) (Jensen et al., 2021, p. 7) (Mont, 2002b, p. 98)

Appendix 3d. Result of literature review on customer barriers towards CI (3/4) (based on own literature review)

	#	Barrier	Description	Authors
Usage Barrier	**B7**	Lack of convenience	Customers perceive CI as less convenient as their acquisition and usage usually require a change in habits and behaviour which leads to a negative attitude concerning the foreseen usage struggles as well as concerns about less comfort and enjoyment. Sub issues: • Unwillingness to change habits and learned behaviour • Inadequate awareness and information regarding CE concept • Incompatible product/service/BM design towards established habits • Necessity to get familiar with new payment structures • Cost of searching for PSS provider • Risk of product scarcity	(Almefelt & Rexfelt, 2017) (Elzinga et al., 2020, p. 6) (Camacho-Otero et al., 2018, p. 13) (Jesus & Mendonça, 2018, p. 83) (Schotman & Ludden, 2014, p. 195)
	B8	Lack of infrastructure	Customers lack infrastructure which enables them to behave in a circular way e.g., lack of channels to collect used products. Sub issues: • Lack of channels to pursue circular behaviour such as recycling or repairing • Lack of available sharing options	(Bhatia & Srivastava, 2018, p. 81)
	B9	Lack of tech. compatibility	Customers are concerned that CI such as "re"products may become obsolete quickly and do not offer needed support or compatibility to other new products. Sub issues: • Fast changing fashion trends • Technological development • Technological obsolescence of "re"products	(Almefelt & Rexfelt, 2017) (Guldmann & Huulgaard, 2020, p. 10) (Wahjudi et al., 2020, p. 7)

Appendix 3e. Result of literature review on customer barriers towards CI (4/4) (based on own literature review)

Value Barriers	**B10**	Lack of knowledge and information	Customers lack knowledge and information about CI characteristics and benefits which hinders them to make an informed purchase decision. Also visibility of CI as well as the knowledge and information about TOC and NPV, new payment and cost structures and product attributes such as quality, performance, durability, and reliability is lacking. Sub issues: • Missing knowledge about different of "re"products • Missing knowledge about benefits of CI • Insufficient available information about durability and reliability • Purchase decisions are based on well-known buying arguments • Missing knowledge and information about NPV, TCO, and new payment • Missing cognitive, technical, and motoring skills for self-repairing • Lack of visibility and awareness of CI (no peer or influencer recommendationon)	(Almefelt & Rexfelt, 2017) (Camacho-Otero et al., 2018, p. 13) (Enckell & Isgran, 2017, p. 14) (Elzinga et al., 2020, p. 9) (Jensen et al., 2021, p. 6) (Jesus & Mendonça, 2018, p. 83) (Mont, 2002a, p. 244) (Mont, 2002b, p. 7) (Pecorari & Lima, 2021, p. 2) (Planing, 2015, p. 7) (Wahjudi et al., 2020, p. 10)
	B11	Lack of perceived advantage	Customers do not see or understand the value of CI compared to alternative products which is the result of several other barriers and leads to the non-adoption of CI or lower WTP. Sub issues: • Consequence of all other barriers • Negative price-quality ratio perception of CI e.g., repairing options • Missing understanding of PSS value proposition • Lack of transparency about real value of CI	(Almefelt & Rexfelt, 2017) (M. Baker et al., 2014, p. 91) (Camacho-Otero et al., 2018, p. 13) (Elzinga et al., 2020, p. 9) (Mont, 2002b, p. 98) (Wahjudi et al., 2020, p. 5)
Risk Barrier	B12	Uncertainty about quality	Customers are uncertain about the residual value of circular products and doubt the quality assurance especially for "re"products which leads to concerns about reliability, product lifetime, need of costly repairing, and fear about safety as well as the perception of greater risk. Sub issues: • Uncertainty about quality and residual value of "re"products • Lack of quality standards and guarantees • Quality and performance variation of "re"products • Inability of value assessment	(Almefelt & Rexfelt, 2017) (Bhatia & Srivastava, 2018, p. 80) (Camacho-Otero et al., 2018, p. 13) (Chakraborty et al., 2019) (Cole et al., 2019, p. 8) (Guldmann & Huulgaard, 2020, p. 10) (Jensen et al., 2021, p. 7) (Wahjudi et al., 2020, p. 9)

Appendix 4. Additional Information about the Exemplary Application of the BCW Approach

Appendix 4a. Overview of target behaviours for problem of customer barriers towards CI

Willingness to obtain *circular products* instead of linear ones	**Willingness to use *circular services***	**Willingness to use *circular business models***
[TB1] Willingness to receive products previously owned by other users **[TB2]** Willingness to trade products previously owned by other users **[TB3]** Willingness to purchase previously owned products ("re"products) **[TB4]** Willingness to purchase new circular instead of linear designed ones	**[TB5]** Willingness to give products previously owned by oneself **[TB6]** Willingness to trade products previously owned by oneself **[TB7]** Willingness to sell products previously owned by oneself **[TB8]** Willingness to bring back products previously owned by oneself **[TB9]** Willingness to repair products owned **[TB10]** Willingness to maintain products owned	**[TB11]** Willingness to access instead of own products

Appendix 4b. Behavioural analysis to identify preconditions and barriers for target behaviour (own analysis based on Michie et al. (2014))

		TARGETED BEHAVIOUR: Willingness to purchase previously owned products ("re"products)	
COM-B	**Theoretical Domain**	**What needs to happen for the targeted behaviour?**	**What is missing based on analysed barriers?**
Physical Capability	**Physical skills**	-	-
Psychological Capability	**Knowledge**	**Knowledge/understanding about** • the difference between new and "re"products • the benefits of "re"products • how to access "re"products • the different "re"product types and their qualities/condition	**Lack of knowledge/understanding about** • the benefits of "re"products [B10] • how to access "re"products [B10] • the different "re"products types and their qualities/condition [B5] [B10]
	Cognitive and interpersonal skills	• Skills in analysing and comparing detailed and complex product attributes	• Insufficient and unstandardized information about product attributes of "re"products [B10]
	Memory, attention, and decision processes	• Awareness for "re"products • Consideration of circular attributes within the purchase decision	• Lack of environmental interest / awareness [B1] • Lack of awareness for "re"products [B10] • Lack of company image and reputation [B6]
	Behavioural regulation	• Customer reflects his consumption behaviour	• Customer is traditionalist and resistant to change established consumption behaviour [B1]
Social Opportunity	**Social Influence**	• Seeing people in social environment using "re"products • Receiving recommendations for "re"products	• Lack of status for „re"products [B4] • No recommendation of peers / influencer [B10]
Physical Opportunity	**Environmental context and resources**	• Customer spends time on searching for "re"products • Customer has convenient access to "re"products	• Lack convenient access to "re"products [B7]
Reflective Motivation	**Social/professional role and behaviour**	• Customer receives positive recognition from social environment for using "re"products	• Lack of status for „re"products [B4] • Lower perceived quality [B5]
	Belief about capabilities	• Customer is confident about his ability to transit towards a circular consumption	• Linear mindset (one-time consumption) [B1] • Lack of convenience [B7]
	Optimism	• Customer is confident to purchases "re"products	• Lack of trust in provider [B6] • Lack of image of "re"products provider [B6] • Uncertainty about quality [B12]
	Intentions	• Customer intents to choose "re"products over new products	• Linear mindset (one-time consumption) [B1] • Lack of environmental awareness / interest [B1] • Lower willingness to pay for "re" products [B5] • Lack of convenience [B7] • Uncertainty about quality [B12]
	Beliefs about consequences	• Customer believes buying a "re"product fulfils his desire regarding functional product attributes and sustainability • Customer believes to improve his environmental impact	• Lower perceived quality [B5] • Sceptics about motives and sustainability claims of provider [B6] • Concerns about product guarantees [B6] • Concerns about technical compatibility [B9] • Insufficient information about durability and reliability [B10] • Lack of perceived advantage compared to alternatives [B11] • Uncertainty about quality [B12]
Automatic Motivation	**Reinforcement**	• Customer recognises and accesses incentives for purchasing "re"products • Customer integrates "re"products in established purchase routines	• Customer is traditionalist and resistant to change established purchase behaviour [B1] • Lack of convenience [B7] • Habit incompatible product design [B6]
	Emotions	• Customer feels good about adapting circular behaviour • Customer reaches self-fulfilment by purchasing "re"products	• Lack of perceived advantage [B11]

Appendix 5. Additional Information about Empirical Analysis Preparation

Appendix 5a. Interview Guideline for Case Companies

Categories	***Question***	***Results***
Introduction	*The goal and the topic are presented for the interviewee.* *Short introduction of the term and concept of CI.*	Determine whether the interviewee is aware of the term CE and CI.
Interviewee and company introduction	1. **Primary**: WHAT is your position within company X and how is it related to the context of my research? 2. **Primary**: WHAT CI did your company already brought to market or is your company currently about to bring to the market? 3. **Primary**: HOW does the simplified customer journey of the CI look like?	To get to know the interviewee. To develop a general overview of the company's position in the context of CI development and identify the focused CI type for the further interview.
Customer integration	4. **Secondary:** HOW do you integrate the customer perspective within the development of your CI?	To reveal how the customer perspective towards CI is considered within the company's innovation activities.
Customer barriers	5. **Primary**: WHAT customer barriers do/did you notice towards the CI? **Secondary**: Showing interviewee an overview of 12 theoretically identified barriers to trigger further thoughts and insights.	To confirm identified barriers and reveal which barriers can be used for further exploration in the interview.
Approaches to identify barriers	6. **Secondary**: HOW did you identify those barriers? 7. **Secondary**: WHY did you choose to apply those and no other approaches? 8. **Secondary**: WHAT is most challenging in the context of identifying customer barriers?	To reveal approaches, companies use to identify customer barriers towards CI.
Interventions to overcome barriers	9. **Primary**: HOW do you overcome / deal with those barriers? **Secondary**: Showing interviewee an overview of 9 BCW interventions in order to trigger further thoughts and insights. 10. **Primary**: WHY did you choose to use those and no other approaches? 11. **Secondary**: WHAT is most challenging in the context of overcoming customer barriers?	To reveal interventions, companies use to overcome customer barriers towards CI.
Practical requirements	12. **Secondary**: WHAT helps or could help you to systematically identify and overcome customer barriers towards CI? 13. **Secondary**: HOW would a tool need to be implemented in the development process of CI?	To reveal requirements towards a to be developed systematic approach.
Closure	14. **Secondary**: Do you have anything else to mention in the whole context? Any comment, remark, idea, or concern? 15. **Secondary**: Can you recommend any other interview partners (experts or practitioners)? *The gratitude for a research participant is expressed. Also, the possibility for a follow-up is inquired.*	To gather additional thoughts and inform the interviewee about the further procedure.

Appendix 5b. Interview Guideline for Experts

Categories	***Question***	***Results***
Introduction	*The goal and the topic are presented for the interviewee.* *Short introduction of the term and concept of CI.*	Determine whether the expert is aware of the term CI.
Interviewee introduction	1. **Primary**: WHAT is your profession and your relation to and experience in the research context?	To develop a general overview of expert's background.
Customer integration	2. **Secondary**: HOW do/should companies integrate the customer perspective within the CI development?	To reveal how the customer perspective towards CI is considered within the company's innovation activities.
Customer barriers	3. **Primary**: WHAT customer barriers towards CI are most hindering for companies? **Secondary**: Showing interviewee an overview of 12 theoretically identified barriers to trigger further thoughts and insights.	To confirm identified barriers and reveal which barriers can be used for further exploration in the interview.
Approaches to identify barriers	4. **Secondary**: HOW do/should companies identify those barriers? 5. **Secondary**: WHY should companies apply those and no other approaches?	To reveal approaches, experts recommend using to identify customer barriers towards CI.
Interventions to overcome barriers	6. **Primary**: HOW do/should companies overcome / deal with these barriers? Secondary: Showing interviewee an overview of 9 BCW interventions in order to trigger further thoughts and insights. 7. **Secondary**: WHY do/should companies choose to use those and no other approaches?	To reveal interventions, experts recommend in order to overcome customer barriers towards CI.
Practical requirements	8. **Secondary**: WHAT helps or could help companies to systematically identify and overcome customer barriers towards CI? 9. **Secondary**: HOW would a tool need to be implemented in the development process of CI?	To reveal requirements towards a to be developed systematic approach out of an expert perspective.
Closure	10. **Secondary**: Do you have anything else to mention in the whole context? Any comment, remark, idea, or concern? 11. **Secondary**: Can you recommend any other interview partners (experts or practitioners)? *The gratitude for a research participant is expressed. Also, the possibility for a follow-up is inquired.*	To gather additional thoughts and inform the interviewee about the further procedure.

Appendix 5c. Pre-Read and Consent Form for Interviewees

PRE-READ INFORMATION

This information paper aims to provide some relevant information as a pre-read for the scheduled interview.

Research setting: The interview is part of the empirical research of my master thesis in the context of customer barriers towards circular innovation. The thesis is supervised by Dr. Jolita Čeičytė-Pranskūnė at Kaunas University of Technology and is the final project of the international double degree master "Global Technology & Innovation Management and Entrepreneurship" organized by Kaunas as well as Hamburg University of Technology.

Research relevance: The world's economic system is based on a linear model which has limitations leading to serious environmental problems such as global warming and increasing overshoot of the plant's biocapacity. Therefore, the need for a new economic system is rising. Circular innovations (CI) can be understood as coordinated activities that integrate circular economy (CE) goals, principles, and recovery strategies into innovations. Therefore, CI are enabler for the transition towards a CE which concept provides a number of benefits for companies and is already promoted by EU policies (including the 2030 Sustainability Agenda with the UN 17 SDGs, the Paris Agreement, the Green Deal, the EUCEAP as well as the GACERE). However, several barriers hinder companies from transitioning towards CE. One of those barriers are social barriers, which include customer barriers towards CI. Having a look at the circular economy model it becomes clear that next to other stakeholders, the customer plays a significant role to make the concept work. However, the customer perspective within CE is rather underexposed and most research still focuses on the production perspective within CE. Furthermore, there is little research done on CI in general. While some studies on customer barriers towards specific aspects of CI already exist on a quantitative level.

Nevertheless, even if practitioners have significant issues in developing customer-adopted CI research on tools and methods to identify and overcome customer barriers towards CI is almost completely missing.

Research aim: The research aims to explore methods and approaches (incl. behavioural interventions) which help companies and companies to overcome customer barriers towards circular innovation within the development process of those innovations.

Research design: As part of an extensive literature review, relevant theory in the field of CE, foundations of CI as well as customer behaviour within CE, behavioural change, and innovation adoption theories were analysed and 12 customer barriers towards circular innovation were identified. Furthermore, the behavioural change wheel by Michie et al. (2011) was used in order to identify possible interventions which could help companies to overcome identified customer barriers. In addition to this theoretical elaboration, the empirical study aims to generate and analyse practical, expert, and customer insights on how to overcome customer barriers towards circular innovation. To reach this aim, semi-structured interviews with industry practitioners of selected case companies, experts of selected specialization fields, as well as potential circular innovation customers are conducted. Based on those interviews gathered empirical insights will be combined and discussed under consideration of previously theoretical gathered insights.

Focus of empirical research: The scope of the empirical research is limited to the consumer goods industry, more specifically, circular innovation in the field of consumer electronics and white goods. Thereby, different types of circular innovations are supposed to be studied in order to generate a more holistic view and cover as many generic barriers as possible. Those circular innovations can be for instance remanufactured or reused products as well as shared offerings for products such as products appliances as a service business models.

CONSENT FORM: PARTICIPATION IN INTERVIEW

This form concerns your participation in an interview on customer barriers towards circular innovation and how to overcome these, to be conducted by me (Lea Wendlandt) as part of the research for my master's thesis.

1. Your **participation** in the interview **is voluntary**. You may withdraw and discontinue participation at any time or decline to answer any question. You will not receive any (financial) compensation for your participation in this research. However, the results of this study can be made available to you upon request.

2. The interview will typically last **approximately 45-60 minutes**. Notes will be taken during the interview, an **audio recording** of the interview will be made, and the audio recording of the interview will be **transcribed**.

3. To **protect your privacy**, your name will not be included in the recording. Other potentially identifying information will not be included in the transcription of the audio recordings when this information is irrelevant for research purposes.

4. It will be ensured that **you are not identifiable in publications** that follow from this interview, by changing your name and disguising or not disclosing any details that reveal your identity. Disguised extracts from the interview may be quoted in future publications.

5. In case of a **company interview**, you will be asked whether the name of the company you are representing is allowed to be shown within the research or not.

6. You are entitled to **access the information** you have provided at any time while it is in storage. You are also free to contact me to seek further clarification and information.

7. Your consent indicates that you are at **least 18 years of age**; you have read this consent form; your questions have been answered to your satisfaction and you voluntarily agree that you will participate in this research study.

Researcher
I – as a student enrolled in the master's program "Global Technology & Innovation Management and Entrepreneurship" at Kaunas University of Technology – commit to strictly adhering to all the points listed above.

Participant
At the beginning of the interview, you will be asked to indicate your consent by verbally agreeing on the content of this form.

Appendix 6. Additional Information about Empirical Findings

Appendix 6a. Comparative Quotes on Approaches to Integrate the Customer perspective (Experts and Cases)

Table 27. Exemplary quotes on approaches to integrate the customer perspective (experts and cases)

Approaches	Exemplary quotes
Design thinking	*"Basically, this project was developed on the basis of a design thinking approach."* (**Project Manager Miele Upgreat,** Pos. 373-374)
	"There is a design thinking process where we integrate the customer already today." (**R&D Manager Miele,** Pos. 66-69*)*
	"The project was very much design thinking. So, we really integrated the customer into the process and developed the product together." (**Co-Founder Miele Sharing,** Pos. 114-116) *"We tried different ideas based on design thinking."* (**Co-Founder Miele Sharing,** Pos. 48-49)
	"The companies I spoke with either used the combination of design thinking, so interviews, workshops, and focus groups, or lean start-up methods." (**Professor**, Pos. 34-36)
	"We use design thinking as the core of what we do." (Designer, Pos. 71-79)
Lean start-up (MVP testing)	*"In the last round we developed an MVP and had a functional system that has been tested by Miele students in the student dorm for ca. 4months in order to receive everyday feedback." (***Co-Founder Miele Sharing,** *Pos. 142-145)* *"We developed prototypes based on story telling cards."* (**Co-Founder Miele Sharing,** Pos. 125-127) *"We developed mock ups and click dummies to let customer test our features."* (**Co-Founder Miele Sharing,** Pos. 132-137)
	*"We use an MVP, a SaaS solution for our website to test our idea quickly and cheap." (***CEO Circular Marketplace,** *Pos. 118-126)*
	"We tried to be a lean start-up." (**Co-Founder Homie**, Pos. 504)
	"The companies I spoke with either used the combination of design thinking, so interviews, workshops, and focus groups, or lean start-up methods." (**Professor**, Pos. 34-36)
Integrated product design	*"There is more and more on digital platforms, i.e. the topic of PLM and systems engineering, where you consciously record all of the customer's requirements first and then then catalogue, categorise and channel them."* (**R&D Manager Miele,** Pos. 425-431)
	"We call it integrated product design. Integrated product design is making something that fulfils customer's problems or pains, gives them a gain, gives them advantages. And if you don't have this customer centered, user centered, human centered perspective I would say it is poor design." **(Designer, Pos.60-62)**
Behavioural economics	*"We do not have explicitly psychologist in our team. But my studies covered parts of it."* (**Project Manager Miele Upgreat,** Pos. 450-452)
	"Operating with outside agencies or like consultancies that are specialised in behavioural science." (**Psychologist**, Pos. 85-86) *"Building a small team, I guess there are a lot of behavioural insights units in companies."* (**Psychologist**, Pos. 87-88)
	"We did a lot of behavioural economics. But I think what comes in play is ethics." (**Professor**, Pos. 222-223)

Appendix 6b. Comparative Quotes on Approaches to Identify Customer Barriers (Experts and Cases)

Table 28. Exemplary quotes on approaches to identify customer barriers (experts and cases)

Approaches	Exemplary quotes
Customer surveys	*"On a regular basis we send out questionnaires to evaluate the motives of our customers and their perception of the brand and the offering."* (**Project Manager Miele Upgreat,** Pos. 172-175)
	"First we asked laundry room operators and dorm owners what they liked and what didn't based on a questionnaire." (**Co-Founder Miele Sharing,** Pos. 155-156)
	"We paid companies to do survey, customer interview, focus groups, all the kind of stuff." (**Co-Founder Homie**, Pos. 400)
	"We do independent market research with agencies where we ask about brand awareness, and why people would not buy a refurbished product." (**CEO Circular Marketplace,** Pos. 413-415)
	"We did actually in 2020 Q4, we did a big consumer research in some of the key markets in Europe." (**Customer Sustainability Lead Philips DA**, Pos. 116-117)
	"Small surveys on the website." (**Psychologist**, Pos. 99)
Customer interviews	*"We capture a lot in diverse customer interview."* (**Project Manager Miele Upgreat,** Pos. 79-80)
	"We travelled through 10 countries and asked and washed with people on camping sites and student dorms." (**Co-Founder Miele Sharing,** Pos. 40-41)
	"We paid companies to do survey, customer interview, focus groups, all the kind of stuff." (**Co-Founder Homie**, Pos. 400)
	"We called our customers the same day they did a purchase and asked how they found us, what we could improve, are they satisfied." (**CEO Circular Marketplace,** Pos. 126-129)
	"This was done with moderated interviews and by an external agency." (**Customer Sustainability Lead Philips DA,** Pos. 121-122)
	"The companies I spoke with either used the combination of design thinking, so interviews, workshops, and focus groups, or lean start-up methods." (**Professor**, Pos. 34-36)
	"Descriptive interview, so not making any assumptions, but really describing the customer attitudes and behaviour is really important." (**Psychologist**, Pos. 95-97)
Focus groups	*"We paid companies to do survey, customer interview, focus groups, all the kind of stuff."* (**Co-Founder Homie**, Pos. 400)
	"The companies I spoke with either used the combination of design thinking, so interviews, workshops, and focus groups, or lean start-up methods." (**Professor**, Pos. 34-36)
Customer experiments	*"You can test it and make experiments."* (**R&D Manager Miele,** Pos. 234-236)
	"And we have done a lot of experiments around pricing and strategy." (**Co-Founder Homie**, Pos. 63-64)
	"We invite customer into our office to do in-person tests of our website." (**CEO Circular Marketplace,** Pos. 135-135) *"We did a lot of A-B testing on our website to increase the conversion rate."* (**CEO Circular Marketplace,** Pos. 331-334)
Customer workshops	*"I have been in several workshops together with the target customer group where we developed ideas or solutions."* (**Project Manager Miele Upgreat,** Pos. 358-360)
	"We piloted a lot of different messaging." (**Customer Sustainability Lead Philips DA,** Pos. 428-432)
	"The companies I spoke with either used the combination of design thinking, so interviews, workshops, and focus groups, or lean start-up methods." (**Professor**, Pos. 34-36)
Customer service	*"Also, the customer service gets integrated as it captures very relevant customer insights."* (**R&D Manager Miele,** Pos. 85-86)
	"We show very clearly that there is an option to get in contact with us." (**Project Manager Miele Upgreat,** Pow. 168-170)
	"Our customer service maintains statistics about why customers called us and reasons why they did not buy." (**CEO Circular Marketplace,** Pos. 324-326)
Trend research	*"One of the most important approaches is design thinking and trend research."* (**R&D Manager Miele,** Pos. 417-418)
Netnography	*"Also looking at reviews online. Looking what people say on Twitter about it. Also analyse social media networks."* (**Psychologist**, Pos. 399-402)
Scientific research	*"To some extent we are the extension of academic research."* (**Co-Founder Homie**, Pos. 393-394)
	"Looking at reviews and meta-analysis of possible." (**Psychologist**, Pos. 391-394)

Appendix 6c. Comparative Quotes on Perceived Customer Barriers (Experts and Cases)

Table 29. Exemplary quotes on psychological barriers (1/2) (experts and cases)

Category	Type	Barrier	Exemplary quotes
Psychological	**Tradition**	**Lack of cultural change**	*"Our society thinks like that."* (**R&D Manager Miele,** Pos. 350)
			"A renting model is new for people, and it requires a change in their mindset." (**Project Manager Miele Upgreat,** Pos. 310-311)
			"Germany is in an old economy thinking of selling, selling, selling, better buy than rent." (**Co-Founder Miele Sharing,** Pos. 383-386)
			"It is not yet in the mindset of people that pay per use." (**Co-Founder Homie**, Pos. 210)
			"There is a trend towards sustainability, especially in western Europe due to Fridays for Future." (**CEO Circular Marketplace,** Pos. 339-342)
			"[Ownership thinking] which is really hard to overcome, and that's probably a bigger cultural change." (**Psychologist**, Pos. 239-240)
			"I think it needs a totally different set of perception of goods and that we own and buy or access." (**Professor**, Pos. 98-99)
			"The cultural shift is definitely required. And in order to shift culture, that's a big topic." (**Designer**, Pos. 137-138)
			"The standard customer is in another generation where cultural change is still needed." (**Project manager**, Pos. 231-234)
		Lack of ownership	*"The customer returns something very durable after a relative short amount of time, that could be in the mind of some people."* (**Project Manager Miele Upgreat,** Pos. 128-133)
			"In other industries it's not a problem and seems to be completely normal." (**Project Manager Miele Upgreat,** Pos. 463-465)
			"This is especially relevant for earlier generations who value to have OWN stuff." (**Co-Founder Miele Sharing,** Pos. 306-308; 455-456)
			"It's hard to get people from this mindset of owning a washing machine to just using it." (**Co-Founder Homie**, Pos. 366-367)
			"I think it [ownership] really is like a norm and the value in our society." (**Psychologist**, Pos. 235-237)
			"Is it really a problem? 70-80% of our products are owned by fleet operators." (**Project manager**, Pos. 256-261)
		Lack of emotional attachment	*"A washing machine or any white good is not an emotional purchase like a car, which has to be cool."* (**Co-Founder Homie**, Pos. 238-240)
			"If I look at the lack of emotional attachment, this one we have not identified as a factor." (**Customer Sustainability Lead Philips DA,** Pos.300-302)
			"Definitely there's a point there and probably depends on differences in people how emotionally attached they get with products." (**Psychologist**, Pos. 262-264)

Table 30. Exemplary quotes on psychological barriers (2/2) (experts and cases)

Category	Type	Barrier	Exemplary quotes
Psychological	**Image**	**Lack of status**	*"Products that are status oriented (like I-Phones), there it could be an issue, but I have not recognised this for our products."* (**Project Manager Miele Upgreat,** Pos. 150-153)
			"Premium and used clashes somehow." (**Co-Founder Miele Sharing,** Pos. 360)
			"The term 'used' in the field of electronic is still very negatively associated." (**CEO Circular Marketplace,** Pos. 150-151)
			"So, we are struggling a bit with the wording on how we call it refurbished product?" (**Customer Sustainability Lead Philips DA,** Pos.89-90)
			"When luxury goods, maybe fancy cosmetics brands might do a lot within factories to close, slow, and narrow the loop, but then they won't communicate to the customer because their brand is about luxury and feel-good factor." (**Professor**, Pos. 84-89)
			"People have a negative attitude against remanufactured products." (**Project Manager**, Pos. 318-319)
		Lack of perceived quality	*"We're not worried about that at all."* (**Co-Founder Homie**, Pos. 253-255)
			"Compared to a new product refurbished products have a little higher failure rate which is still pretty low." (**CEO Circular Marketplace,** Pos. 172-178)
			"We have observed a couple of the barriers, so people might perceive the quality to be less, so especially with a highly premium goods." (**Professor**, Pos. 78-80)
		Lack of trust and company image	*"Customers buy a reused Miele product because they trust the brand."* (**R&D Manager Miele,** Pos. 285)
			"That is definitely a point." (**Co-Founder Miele Sharing,** Pos. 246)
			"In Germany, data and privacy are always, always question number one." (**Co-Founder Homie**, Pos. 268-269)
			"Trust is one of the biggest barriers." (**CEO Circular Marketplace,** Pos. 156-157) *"Trust that has to be built as people do not know it [refurbished products]."* (**CEO Circular Marketplace,** Pos. 159-160)
			"Lack of trust and company image, that might count for many, many of the different type of examples." (**Professor**, Pos. 113-114)
			"That would help mitigate any trust issues." (**Designer**, Pos. 217)
			"The lack of trust and company image is really a topic." (**Project manager**, Pos. 327-328)

Table 31. Exemplary quotes on functional barriers (1/2) (experts and cases)

Category	Type	Barrier	Exemplary quotes
Functional Barriers	**Usage**	**Lack of convenience**	*"Many points are rather the opposite; the factor convenience should be higher in our case."* (**Project Manager Miele Upgreat,** Pos. 133-137)
			"As soon as there is any stress, or own effort for the customer, it will fail." (**Co-Founder Miele Sharing,** Pos. 424-426)
			"It is super convenient. So, there is no lack of convenience." (**Co-Founder Homie**, Pos. 308-309)
			"Inertia and convenience are really big factors." (**Psychologist**, Pos. 231)
			"Lack of convenience in the service model, people don't want to have all kind of contract." (**Professor**, Pos. 118-119)
		Lack of infrastructure	*"There are countries where a take back infrastructure is well established (as in Germany), but there are also other markets."* (**R&D Manager Miele,** Pos. 303-305)
			"That was a big, big, big deal in the beginning, because we are not shipping something that I could just put in an envelope." (**Co-Founder Homie**, Pos. 291-293)
			"Infrastructure is really a topic. On the one hand the digital infrastructure, on the other hand the physical. The German recycling industry is not well advanced for vehicles. That also leads to problems at the customer's side, so where do they return the car." (**Project manager**, Pos. 379-385)
		Lack of technical compatibility	*"If you buy a 15-year-old refurbished product it will have another standard concerning ECO label or water consumption than a new one."* (**R&D Manager Miele,** Pos. 137-139) *"Nobody wants to stick to old standards."* (**R&D Manager Miele,** Pos. 223)
			"With a shared or leasing service the customer always goes with the technological trend." (**Co-Founder Miele Sharing,** Pos. 438-441)
			"It's a standalone product, so that's not a big deal." (**Co-Founder Homie**, Pos. 307-308)
			"Not really as we sell products which are currently also still be sold as new products." (**CEO Circular Marketplace,** Pos. 260-261)
			"I guess that is also scepticism, but it's also true with like iPhone chargers or these kinds of things." (**Psychologist**, Pos. 217)

Table 32. Exemplary quotes on functional barriers (2/2) (experts and cases)

Category	Type	Barrier	Exemplary quotes
Functional Barriers	Value	Lack of knowledge and information	*"The customer does not know that Miele takes back old appliances."* (**R&D Manager Miele,** Pos. 303)
			"Customers have questions they never had before when buying a product, for instance how is product responsibility treated." (**Project Manager Miele Upgreat,** Pos. 205-211)
			"They do not know that it exists." (**Co-Founder Miele Sharing,** Pos. 263-265)
			"No doubt, there are a lot of people, who don't know that this exists." (**Co-Founder Homie**, Pos. 99-101)
			"People do not know refurbishment as a condition category." (**CEO Circular Marketplace,** Pos. 147-148)
			"A lot of customers actually are not even familiar with the term refurbished product. They don't know what it is, and they don't know what it means." (**Customer Sustainability Lead Philips DA,** Pos.82-84)
			"And what I find important and needs more research is the total cost of ownership. Like for instance, if I buy a Patagonia sweater that is maybe 100 Euros than 20 Euros from H&M, I need to understand why I am paying 100 Euros rather than 20 Euros." (**Professor**, Pos. 92-94)
			"There is a lack of knowledge about the return infrastructure." (**Project Manager**, Pos. 139)
		Lack of perceived advantage	*"The customer choses the cheaper product even if the more expensive one is of higher quality and circularity."* (**R&D Manager Miele,** Pos. 346-350) *"You can develop a way more circular and sustainable product but then nobody buys it as it is too expensive."* (**R&D Manager Miele,** Pos. 340-342)
			"For the people the sharing concept makes sense, they know they live in a student dorm only for 3 years." (**Co-Founder Miele Sharing,** Pos. 210-211)
			"Renting is more expensive compared to buying if you consider long durations such as 20 years." (**Project Manager Miele Upgreat,** Pos. 330-332)
			"People compare buying versus renting versus pay per use." (**Co-Founder Homie**, Pos.199-202) *"The perceived advantage that was a problem in the beginning when we were still trying to find out: where do we fit? Who is our customer?"* (**Co-Founder Homie**, Pos. 310-313)
			"That's often the case that circular innovation is more expensive than alternatives." (**CEO Circular Marketplace,** Pos. 440)
			"Perceived advantage. Yeah, and it's also typical." (**Professor**, Pos. 127)
			"As of right now customers have a very limited willingness to pay more for sustainability." (**Project Manager**, Pos. 181-182)
	Functional risk	Uncertainty about quality	*"Miele products are known for durability."* (**R&D Manager Miele,** Pos. 120-122; 275)
			"The quality of our renting products is the same." (**Project Manager Miele Upgreat,** Pos. 124-125)
			"For sure there are customers that have doubts regarding the functionality of reused products whether it might be rusty inside for example." (**Co-Founder Miele Sharing,** Pos. 473-475)
			"We never had questions whether or not wash will actually get cleaner in one machine or another." (**Co-Founder Homie**, Pos. 362-362)
			"People think it is broken, or it does not work." (**CEO Circular Marketplace,** Pos. 153)
			"And then of course, you have the technical barrier. So, OK, is this product now really working as it should? Or is it actually, you know, less good than a new product when it breaks down, you know, after a few years?" (**Customer Sustainability Lead Philips DA,** Pos.105-108)
			"This trade-off [thinking] between quality and environmental friendliness. It's just very big." (**Psychologist**, Pos. 120-122)
			"For example, if we have recycled material, we do not reach the requirements of a primary material." (**Project Manager**, Pos. 407-412)

Appendix 6d. Comparative Quotes on Interventions of Overcome Customer Barriers (Experts and Cases)

Table 33. Exemplary quotes on interventions to overcome lack of cultural change (experts and cases)

Barrier	Interventions	Exemplary quote
Lack of cultural change	**Time**	*"I think that is something that will change in the mind of people over time."* (**Project Manager Miele Renting**, Pos. 471-474)
		"We are in a turnaround regarding mindset and behaviour." (**Co-Founder Miele Sharing**, Pos. 299) *"Now it's flattening, and there is a trend of minimalism."* (**Co-Founder Miele Sharing**, Pos. 459-460)
		"In B2B product as a service has been around for a very long time. […] and it is slowly but surely trickling into the B2C market, too" (**Co-Founder Homie**, Pos. 215-218)
		"This is driven by generations." (**Project Manager**, Pos. 232-235)
	Marketing and communication	*"It's about education, ultimately communication. Because if you can show an added value in this way, then that's going to shift over time."* (**Designer**, Pos. 142-143) *"All these things will automatically start to ship the culture, well-educated customer."* (**Designer**, Pos. 265-268)
		"The cultural change is in my eyes a communication task." (**Project Manager**, Pos. 242.-243)
	Penalty fees	*"It's [circular behaviour] good for the machine and if you don't do it, we will charge you."* (**Co-Founder Homie,** Pos. 431-433)
	Influencer	*"Get like a very identifiable peer, that persuades with you by their own story and how this could be done."* (**Psychologist**, Pos. 174-175) *"Psychology and communications are second step and equally important, to really motivate people to change."* (**Psychologist**, Pos. 230-235)
	Rewards	*"Price incentives, a lower temperature was being cheaper than a higher temperature wash."* (**Professor**, Pos. 221-222)
		"We could provide certificates for gentle product usage where customers get rewards for." (**Project Manager**, Pos. 88-89) *"The digital product pass will show you that maintenance cycles got sorter as you drove gentler, and you saved 100 Euro gas, so it is a win-win."* (**Project Manager**, Pos. 510-514)
	Nudging	*"Here I see the connection to emotional triggering."* (**CEO Circular Marketplace,** Pos. 247)
	Awareness events	*"You have to create awareness."* (**Project Manager**, Pos. 235-236)

Table 34. Exemplary quotes on interventions to overcome lack of ownership (experts and cases)

Barrier	Interventions	Exemplary quote
Lack of ownership	**Full-service offering**	*"It is the full-service, that offers time savings and comfort, so making non-monetary aspects measurable."* (**Project Manager Miele Renting**, Pos. 335-345)
		"You have to offer a full service to lead people in this market." (**Co-Founder Miele Sharing**, Pos. 426)
	Time	*"I think that is something that will change in the mind of people over time."* (**Project Manager Miele Renting**, Pos. 471-474)
		"In B2B product as a service has been around for a very long time. […] and it is slowly but surely trickling into the B2C market, too" (**Co-Founder Homie**, Pos. 215-218)
	Addressing motives	*"We of course highlight wherever we can the advantage that we see of doing it product as a service."* (**Co-Founder Homie**, Pos. 373-375)
	Avoid comparison	*"We are not going to try and position ourselves in the market of buying. So, the way we do it is we try and deliver on the promise of product as a service."* (**Co-Founder Homie**, Pos. 374-378)
	Product configuration	*"You can personalise products, maybe that they feel like customers take part in certain decisions, so maybe can decide which kind of washing machine for instance they get to share."* (**Psychologist**, Pos. 242-244)

Table 35. Exemplary quotes on interventions to overcome lack of emot. attachment (experts and cases)

Barrier	Interventions	Exemplary quote
Lack of emotional attachment	**Quality**	*"One more thing that I would see as a variable with that example [buying bag] is like the quality of the bag."* (**Psychologist**, Pos. 263-264)
	Price	*"And if you paid for it or not."* (**Psychologist**, Pos. 265)
	Design for emotional attachment	*"If a product is well designed to fulfil a problem of pain or add a gain to a person's user journeys, they will use it more and will have experiences with it, and consequently they will attach emotion and memory to that product."* (**Designer**, Pos. 234-241) *"It's not the product. The product is the vehicle, the memory and the emotion that is what you treasure."* (**Designer**, Pos. 239-240)

Table 36. Exemplary quotes on interventions to overcome lack of status (experts and cases)

Barrier	Interventions	Exemplary quote
Lack of status	**Social comparison**	*"You become an example [for other users]."* (**Co-Founder Homie,** Pos. 437-439)
		"We also had social comparison and also individual information, so we did a lot of the behavioural economics." (**Professor**, Pos. 221-222)
	Customer segmentation	*"For Miele professional customers (B2B) the product just has to fulfil its function, there it is not relevant whether it is new or used."* (**Co-Founder Miele Sharing**, Pos. 351-358)
		"One of our manufacturers sells its refurbished goods via our platform so that the brands original target group is not negatively affected by the refurbished products." (**CEO Circular Marketplace**, Pos. 101-103)
	Influencer	*"We work with influencer especially for the younger generation who demonstrate that refurbished is nothing bad."* (**CEO Circular Marketplace**, Pos.236-241)
	Branding	*"What we also do is branding campaigns."* (**CEO Circular Marketplace**, Pos. 236)
	Testability	*"We have a 30-days test phase, so we reduce risks."* (**CEO Circular Marketplace**, Pos. 233-236)
	Sustainability as a status	*"What we are trying is to find a way around to actually turn it upside down that instead of saying that status is only busing new, status is being mindful and being aware about sustainability."* (**Customer Sustainability Lead Philips DA**, Pos.291-297)
		"Especially for our Chinese customer we see that sustainability becomes a new status symbol, the greener the care the better." (**Project manager**, Pos. 185-187) *"Sustainability becomes a social argument."* (**Project manager**, Pos. 295)
	Marketing and communication	*"We haven't really marked that yet in the sense of we haven't done a campaign or something strong around refurbishment, but that is, of course, what we are thinking about."* (**Customer Sustainability Lead Philips DA**, Pos.272-274) *"Once we have a strong message just to get information out there to consumers."* (**Customer Sustainability Lead Philips DA**, Pos.274-275)
	Time	*"The generation will come that does not care about things that are used by others before."* (**Co-Founder Miele Sharing**, Pos. 346-348)
	Policy initiative	*"One problem is that there is no official definition of refurbishment, no clear legal definition of a, b, c has to happen to name it refurbished."* (**CEO Circular Marketplace**, Pos. 161-165)

Table 37. Exemplary quotes on interventions to overcome quality concerns (experts and cases)

Barrier	Interventions	Exemplary quote
Lack perceived quality	**Branding**	*"Everyone in Germany knows the high quality of Miele."* (**Project Manager Miele Renting**, Pos. 123)
	Full-service offering	*"Fundamentally, it's out service that makes a difference not the sticker that is on the machine."* (**Co-Founder Homie**, Pos. 254-255)
Uncertainty about quality	**Branding**	*"Simultaneously, the branding is aligned with product design for durability."* (**R&D Manager Miele**, Pos. 281-288) *"Customers buy a refurbished Miele product because they trust the brand."* (**R&D Manager Miele**, Pos. 285)
		"Because the brand Miele creates trust as it is family owned and everyone knows about its quality." (**Co-Founder Miele Sharing**, Pos. 317-322)
		"German quality." (**Co-Founder Miele Sharing**, Pos. 476)
	Design for circularity	*"Miele products are tested for at least 20 years of durability."* (**R&D Manager Miele**, Pos. 275)
	Guarantees and promises	*"We promise you get a really good machine."* (**Co-Founder Homie**, Pos. 106-109) *"If I promise you, it works, and I will fix it if it doesn't that should be fine."* (**Co-Founder Homie**, Pos. 252-253)
		"With full guarantees, so they are as good as new." (**Customer Sustainability Lead Philips DA**, Pos.54)
		"Which is more effective for like skepticism and concerns, it's like giving guarantees. So, saying things like within the next two years, we will repair everything, or you can always switch it, if it doesn't work anymore." (**Psychologist**, Pos. 115-117) *"On the front end, you can already take away that skepticism very easily."* (**Psychologist**, Pos. 118-120)
		"You can have all kind of promises, product promises, and return." (**Professor**, Pos. 143-144) *"To say, like, this product, which is remanufactured, will be as good as new ore better."* (**Professor**, Pos.151-153)
		"Remanufactured engines get the same quality certification and guarantee as new ones, so you get the security." (**Project manager**, Pos. 312-314) *"The remanufactured engine will drive also it's 30.000 km for this we provide out guarantee."* (**Project manager**, Pos. 327)
	Marketing and communication	*"So, we education the customer the difference between used and refurbished."* (**CEO Circular Marketplace**, Pos. 154-156)
		"And that's also another aspect that we need to tackle in communication because this is another key barrier for our consumers." (**Customer Sustainability Lead Philips DA**, Pos.108-109)
	Testability	*"We have a 30-days test phase, so we reduce risks."* (**CEO Circular Marketplace**, Pos. 233-236)
		"Try before you buy and things like that." (**Professor**, Pos. 144)
	Quality requirements	*"Which is something that we have chosen to tackle by offering them the same quality and on the refurbished product that we offer on a new product."* (**Customer Sustainability Lead Philips DA**, Pos.185-187)

Table 38. Exemplary quotes on interventions to overcome lack of trust (experts and cases)

Barrier	Interventions	Exemplary quote
Lack of trust and company image	**Design for circularity**	*"Miele products are tested for at least 20 years of durability."* (**R&D Manager Miele**, Pos. 275; 287)
	Branding	*"Simultaneously, branding is aligned with durability promises."* (**R&D Manager Miele**, Pos. 281-288) *"The customer knows from hearsays that Miele product last long."* (**R&D Manager Miele**, Pos. 284)
		"We have a really high referral rate." (**CEO Circular Marketplace**, Pos.182) *"The topic branding is very important in the regard, so that we present our brand trustful and high qualitative."* (**CEO Circular Marketplace**, Pos. 216-218)
		"We as Philips, have decided actually as one of the first within our industry to do our own refurbishment, so we refurbish our own products." (**Customer Sustainability Lead Philips DA**, Pos. 223-226) *"Consumers clearly stated that they would prefer to buy a refurbished product from the owner of the brand than to buy it from a third party."* (**Customer Sustainability Lead Philips DA**, Pos.242-243) *"Because the quality which is something that the customers really connect to the Philips brand is there and that gave them a higher sense of trust."* (**Customer Sustainability Lead Philips DA**, Pos.244-246)
		"Everyone in Germany knows the high quality of Miele." (**Project Manager Miele Renting**, Pos. 123)
		"Because the brand Miele creates trust as it is family owned and everyone knows about its quality." (**Co-Founder Miele Sharing**, Pos. 317-322)
		*"People don't buy what you do. The buy why you do it." (***Designer**, Pos. 196-198) *"If you are not authentic, people will know and then they won't trust."* (**Designer**, Pos. 198)
		"If we say we want to establish sustainability in the DNA of our products it is important to establish an according organisation. In our resorts there are different departments responsible for sustainability, we have an own strategy part for CE, and our leadership is targeted to reach sustainability goals." (**Project manager**, Pos. 137-148) *"Not only at the customer site but also within the organisation sustainability has to be promoted by employees and leadership."* (**Project manager**, Pos. 444-447)
	Time	*"Trust is something that's earned. You can't just have it. And over time, that's reinforced."* (**Designer**, Pos. 224-225)
	Guarantees and promises	*"All we can do is deliver a great service and deliver on promise."* (**Co-Founder Homie**, Pos. 258-259)
		"One advantage is customers usually have a lower expectation compared to new products, so we easily excite customers" (**CEO Circular Marketplace**, Pos. 181-185)
		"Our philosophy is to under promise, and then over performing in order to reach trust." (**Project Manager**, Pos. 334-340)
	Data security	*"Our new platform is much more anonymised." (Co-Founder Homie, Pos.282)*
	Credible sources	*"We are not a B corporation. With cradle-to-cradle certification it's great, but I don't' think it persuades many customers to join."* (**Co-Founder Homie**, Pos. 452-454) *"The Trustpilot […] shows that we are a trustworthy company and that our customers are happy."* (**Co-Founder Homie**, Pos. 454-456)
		"If a journalist writes a good article about us that is more trustworthy than a Facebook ad." (**CEO Circular Marketplace**, Pos. 213-216)
		"Certification to say that but we don't advertise that fact we've got that. Maybe we should do." (**Designer**, Pos. 215-217)
		"Projects have to be transparent, certified, and reasonable." (**Project manager**, Pos. 119-121) *"What is very important for us is to involve independent expertise which can assess and attest the efficacy of our measures."* (**Project manager**, Pos. 153-157) *"We have different forms for example with journalists or researchers to communicate our topics science based."* (**Project Manager**, Pos. 236-241, 430)
	Customer segmentation	*"The generation that comes now probably appreciates used products as a positive image of the brand."* (**Co-Founder Miele Sharing**, Pos. 360-363)
	Corporate website	*"We have formulated our condition criteria very transparent so that the customer knows what to expect."* (**CEO Circular Marketplace**, Pos. 198-205) *"We tried to establish a reputable design of our website."* (**CEO Circular Marketplace**, Pos. 218-221)
	Customer service	*"Since the beginning we offered a free of charge 0800 hotline to be available to our customers in person."* (**CEO Circular Marketplace**, Pos. 222-226)
		"At the moment, because we […] demonstrate at the front line with our customer services, our customers do trust us." (**Designer**, Pos. 217-219)

Table 39. Exemplary quotes on interventions to overcome lack of convenience (experts and cases)

Barrier	Interventions	Exemplary quote
Lack of convenience	**Full-service offering**	*"We are even required to take back old appliances, what we do in collaboration with our local Miele certified dealer."* (**R&D Manager Miele**, Pos. 313-315)
		"It is the full-service, that offers time savings and comfort." (**Project Manager Miele Renting**, Pos. 335-345) *"The service includes logistic, maintenance, and repairing."* (**Project Manager Miele Renting**, Pos. 337-338)
		"You have to offer a full service to lead people in this market." (**Co-Founder Miele Sharing**, Pos. 426) *"Customers say, I better pay more over the years but do not have to struggle with maintenance etc."* (**Co-Founder Miele Sharing**, Pos. 411-415) *"It has to be easy immediately."* (**Co-Founder Miele Sharing**, Pos. 429)
	Design for circularity	*"Designing the product in a way that it is easy to repair without much effort."* (**R&D Manager Miele**, Pos. 72-74)
		"We are actually having our own machine developed in China. It's [..] much easier to fix." (**Co-Founder Homie,** Pos. 108-110)
	Marketplace concept	*"We can offer a wide variety of selection."* (**CEO Circular Marketplace**, Pos.88-90) *"We do not stand in cannibalism with our own products and can offer a wide variety of selection with the most attractive offerings."* (**CEO Circular Marketplace**, Pos.88-90)
	Addressing motives	*"There might be also the ecological thought that the customer has more effort but does in favour to the environment."* (**Co-Founder Miele Sharing**, Pos. 434-438)
	Target lead user	*"There's some part of the target group that is OK with little bit of inconvenience. So, finding that target group."* (**Psychologist**, Pos. 196-198)
	Influencer	*"Another thing is to use modelling. So, if you're thinking about a video or something like someone who shows how you can make something easier for yourself like someone if you can identify with and that you feel like it's part of your peer group."* (**Psychologist**, Pos. 168-172)

Table 40. Exemplary quotes on interventions to overcome lack of infrastructure (experts and cases)

Barrier	Interventions	Exemplary quote
Lack of infrastructure	**Partner collaboration**	*"We are even required to take back old appliances, what we do in collaboration with our local Miele certified dealer."* (**R&D Manager Miele**, Pos. 313-315)
		"We have moved from our own delivery to outsourcing back to in-house delivery." (**Co-Founder Homie**, Pos. 300-301) *"So, they [another brand] now pay us to do that because we have a call center, a warehouse, drivers so that infrastructure is now actually one of our selling points."* (**Co-Founder Homie**, Pos. 301-305)
	Policy initiatives	*"Structures must be much better promoted and expanded by politics. OEMs have to be obligated to set up the infrastructure to enable vehicle take backs and to interact with the customer at this point."* (**Project manager**, Pos. 400-405)

Table 41. Exemplary quotes on interventions to overcome lack of tech. compatibility (experts and cases)

Barrier	Interventions	Exemplary quote
Lack of technical compatibility	**Spare part management**	*"Building storages for spart parts, but this is extremely expensive."* (**R&D Manager Miele**, Pos. 218)
	Design for circularity	*"Detaching electronic from the rest of the product."* (**R&D Manager Miele**, Pos. 228-229)
		"I think now there is an EU policy that says that you can't change your charger anymore." (**Psychologist**, Pos. 211-222)
		"We have projects that aim to unlock upgradable software functionalities in the vehicle in order to extend the lifetime in a digital manner." (**Project Manager**, Pos. 37-40)

Table 42. Exemplary quotes on interventions to overcome lack of knowledge (experts and cases)

Barrier	Interventions	Exemplary quote
Lack of knowledge and information	**Marketing and communication**	*"There you might have to increase customer education and inform the customer."* (**R&D Manager Miele**, Pos. 305-308)
		"That is something you have to teach to your customer with ads or so." (**Co-Founder Miele Sharing**, Pos. 375-376) *"We hang up poster where our service is explained in 6 steps."* (**Co-Founder Miele Sharing**, Pos. 93-94)
		"It costs us an X amount of Euros per customer to attract them and get them to sign the contract. You know the cost per order." (**Co-Founder Homie**, Pos. 101-104)
		"We do google shopping, Google Ads, performance marketing so all on social media, Facebook, Instagram, YouTube, TikTok, Snapchat. Also, via TV and press." (**CEO Circular Marketplace**, Pos. 45-51) *"So, we education the customer the difference between used and refurbished."* (**CEO Circular Marketplace**, Pos. 154-156)
		"You first need to explain exactly what it is and to do that in a simple manner, because consumer doesn't have that much time; they need to get it served and understand it quick and quick and fast." (**Customer Sustainability Lead Philips DA**, Pos.261-264)
		"I was these swamps for cleaning jeans like if jeans have a stain and then you put it in the washing machine. But what you actually can do is just using the swamp to just clean the stain." (**Psychologist**, Pos. 343-345)
		"Then we are again at the topic of communication." (**Project Manager**, Pos. 139)
	Corporate Website	*"Information are very important to explain the customer what is included in the offering."* (**Project Manager Miele Renting**, Pos. 190-192) *"We provide education based on FAQs."* (**Project Manager Miele Renting**, Pos. 193-194) *"Customers can easily ask us questions via an online contact form."* (**Project Manager Miele Renting**, Pos. 217-218)
		"On our website we provide information on the different product condition categories and the steps of the refurbishing process." (**CEO Circular Marketplace**, Pos. 198-205)
		"Giving tips on the website, like just giving advice on how to make it easy for yourself." (**Psychologist**, Pos. 174-176) *"Giving advice on how to overcome it."* (**Psychologist**, Pos. 177)
	Customer-product interaction	*"That's built into our software. I think it's [reminder for circular behaviour] three times a year."* (**Co-Founder Homie,** Pos. 429)
		"A digital product pass can provide information about how much CO2 has been emitted in the production and the usage phase." (**Project Manager**, Pos. 85-88)
	Awareness events	*"For example, the city of Gütersloh initiates a digital day to show why digitalisation is good."* (**Co-Founder Miele Sharing,** Pos. 496-498) *"We have also been at sustainability exhibitions where customer could test our products in person."* (**CEO Circular Marketplace,** Pos. 283-286*)*
	Nudging	*"And there we always have a little note saying, 'Did you know that this product is also available as refurbished?'"* (**Customer Sustainability Lead Philips DA**, Pos.276-278) *"We try to give them the information at the page where we are selling the new products actually to nudge customers into buying a refurbished product instead of always buying a new one."* (**Customer Sustainability Lead Philips DA**, Pos.279-281)
	Feedback on behaviour	*"We also had social comparison and also individual information, so we did a lot of the behavioural economics."* (**Professor**, Pos. 221-222)
		"We provide you the transparency of usage information and how it impacts the environment." (**Project Manager**, Pos. 508-510)

Table 43. Exemplary quotes on interventions to overcome lack of perc. advantage (experts and cases)

Barrier	Interventions	Exemplary quote
Lack of perceived advantage	Customer segmentation	*"Targeting customers, who are willing to pay more for circularity."* **(R&D Manager Miele**, Pos. 390)
		"Customer segmentation is really important." (**Professor**, Pos. 186)
	Price reduction	*"We sell our products 40% reduced compared to new products."* (**CEO Circular Marketplace**, Pos. 83-88)
		"They are then offered to consumer as at a lower price." (**Customer Sustainability Lead Philips DA**, Pos. 53.54)
		"Y also aims to reduce costs. As you are more transparency, more efficient in disassembling for instance due to a digital twin." (**Project Manager**, Pos. 199-205) *"You have a price advantage and that leverages the problematic."* (**Project manager**, Pos. 316-317)
	Branding	*"Miele as a premium brand has more possibilities in terms of higher costs."* (**R&D Manager Miele**, Pos. 391)
		"We are a premium OEM and premium can differentiate itself by having sustainability in the products' genes. And that also in terms of the public image." (**Project Manager**, Pos. 82-85)
	Time	*"The mindset of the people the perception of the program will positively change over time."* (**Project Manager Miele Renting**, Pos. 317-318)
	Full-service offering	*"It is the full-service, that offers time savings and comfort, so making non-monetary aspects measurable."* (**Project Manager Miele Renting**, Pos. 335-345)
		"What we try and do is to make sure that we have an outstanding service." (**Co-Founder Homie**, Pos. 202-203)
	Avoid comparison	*"We have to move people away from doing this comparison of buy versus product as a service."* (**Co-Founder Homie**, Pos. 113-114) *"What we try and do is make sure we have […] an incomparable product. So, by having out own machine you will not be able to Google for the price somewhere else."* (**Co-Founder Homie**, Pos. 203-204)
	Calculation tool	*"So, we have this little tool on the side where you can select how many washes you should do, and it will calculate [the costs]."* (**Co-Founder Homie,** Pos. 475-477)
	Financial viability	*"We incentivize to the extent that we try and make it financially viable option."* (**Co-Founder Homie,** Pos. 415-416)
	Addressing motives	*"If you rent a Miele, you can save energy and water costs and protect your cloth from wear."* (**Project Manager Miele Renting**, Pos. 142-146)
		"For 20-years old people and younger an advantage is also the environmental aspect." (**Co-Founder Miele Sharing**, Pos. 469-470)
		"We of course highlight wherever we can the advantage that we see of doing it product as a service." (**Co-Founder Homie,** Pos. 373-375) *"The advantage should be round the service, […] the speed and sort of the sustainability side effect."* (**Co-Founder Homie**, Pos. 315-316) *"You do not have the capital outlay at the end of the contract."* (**Co-Founder Homie**, Pos. 213-214)
		"So, if you say like, you're going to save money, or this is a new technology you gonna take leadership by using his product." (**Psychologist**, Pos. 132-134)
		"In some cases, people might want to have like, for instance, a service model because they want to have new a phone all the time." (**Professor**, Pos. 181-182) *"Refurbishment could be good if someone just want a new battery."* (**Professor**, Pos. 182-183)
	Pledge	*"You can sell us your old devices."* (**CEO Circular Marketplace,** Pos. 357)
		"We could provide bonus if you return products for recycling." (**Project Manager**, Pos. 90-91)
	Targeting lead used	*"I always call them 'tree hugger', that were just in the world for sustainability. They didn't care the cost."* (**Co-Founder Homie**, Pos. 313-314)
		"So, you can learn a lot from your lead user or the first big user of your service, and then they can help you tweak it and make it better." (**Professor**, Pos. 194-196)
	Environmental impact	*"For each sold product we plant a tree to make our customer's purchase CO2 positive which can be an incentive for people who appreciate environment."* (**CEO Circular Marketplace,** Pos. 364-367)
		"Second incentive is via indicators such as CO2 emission savings, if it is a status symbol for the customer." (**Project Manager**, Pos. 322-325)
	Education	*"Provide the customer correctly prepared information so that he can make the best possible decision, for me that is enablement which is also possible for circular innovation."* (**Project Manager**, Pos. 515-518)

Appendix 7. Additional Information about the Proposed Systematic Approach to Overcome CI

Table 44. Guiding questions to develop recommended interventions (1/3)

Barrier	Intervention action	Guiding and inspiring questions
Lack of circular mindset	**Dominant interventions**	• How can we **educate**, **persuade**, or **incentivise** our customers to promote cultural change?
	Marketing and communications	• How can we use marketing and communication to promote cultural change?
	Awareness events	• How can we initiate awareness events to educate our customer about our CI?
	Influencer	• How can we collaborate with influencers to promote the needed cultural change?
	Nudging	• How can we emotionally trigger our customers to promote cultural change?
	Rewards	• How can we reward customers with a more circular mindset?
	Customer segmentation	• How can we target customer generations that promote the needed cultural change? • How can we target regional markets where a needed culture is already prevailing?
Lack of ownership	**Dominant intervention**	• How can we **persuade** or **enable** our customers to accept lack of ownership?
	Product configuration	• How can we make sure that customers feel they have influence on their decisions and feel more ownership for the product's they use based on an access model?
	Addressing motives	• How can we promote advantages (full-service) of an access-based usage model?
	Full-service offering	• How can we offer a full-service to our customers to increase the value of access-based products?
	Customer segmentation	• How can we target customer groups which are less driven by materialism?
Lack of emotional attachment	Circular Design	• How can we design products in a way they act as vehicles for memories and emotions?
Lack of status	**Dominant interventions**	• How can we **persuade** or **model** our customers to overcome lack of status?
	Marketing and communications	• How can we use marketing and communication to promote sustainability as a status?
	Sustainability as a status	• How can we communicate and promote sustainability as a status and social argument? • How can we connotate consumption as meaningful and sustainable?
	Influencer	• How can we collaborate with influencers that promote a positive association with CI?
	Branding	• How can we use branding on order to promote a positive status association with CI?
	Social comparison	• How can we use social comparison of consumption data to promote a positive status association with CI?
	Testability	• How can we allow our customers to test the CI to promote a positive status association with CI?
	Customer segmentation	• How can we target a B2B market in order to strengthen our PaaS portfolio?
	Policy initiative	• How can we promote policy initiatives that foster a clear definition of product condition criteria?

Table 45. Guiding questions to develop recommended interventions (2/3)

Barrier	Intervention action	Guiding and inspiring questions
Lack of trust	**Dominant interventions**	• How can we use **education, persuasion, or environmental restructuring** to increase customers' trust towards our company and the CI?
	Credible sources	• How can we use credible sources (journalists, scientists, institutions, consultancies etc.) to enable science-based communication and increase customers' trust? • How can we use credible sources for customer reviews?
	Branding	• How can we use or build a brand that is trusted by our customers? • How can we develop a circular company purpose and align our organisational structures (roles, responsibilities, leadership targets etc.) accordingly to increase our company's authenticity in terms of circular initiatives? • How can we align circular branding and circular product design?
	Corporate website	• How can we leverage our corporate website to increase customers' trust in our brand and the CI?
	Customer service	• How can we make sure that customers can contact us personally in case of any concerns?
	Guarantees and promises	• How can we ensure our customers that we deliver our promises?
	Data security	• How can we guarantee data security?
	Design for circularity	• How can we design and test our products in a way customers, for instance, trust in their durability?
Lack of convenience	**Dominant interventions**	• How can we use **persuasion, modelling, or environmental restructuring** to increase convenience of our CI?
	Influencer	• How can we collaborate with influencers that show customers how to increase convenience in the use of our CI?
	Addressing motives	• How can we encourage people to tolerate inconvenience by addressing motives such as environmental impact?
	Full-service offering	• How can we offer a full-service (incl. transportation, repairing etc.) to our customers that minimises required effort for customers?
	Increase convenience	• How can we make it easier for the customer to acquire and use our CI?
	Marketplace concept	• How can we take advantage of platform models in order to increase convenience in acquiring our CI?
	Design for circularity	• How can we increase the ease of repairing by product design?
	Customer segmentation	• How can we target early adopter groups that tolerate a certain amount of inconvenience?
Lack of infrastructure	**Dominant interventions**	• How can we use **environmental restructuring** to avoid infrastructural issues?
	Partner collaboration	• How can we use established tack-back infrastructure or collaborate with partners? • How can we leverage our capabilities by offering our established infrastructure to other market players?
	Policy initiatives	• How can we promote policy initiatives that strengthens the required infrastructure for CI?
Lack of technical compatibility	**Dominant interventions**	• How can we use **environmental restructuring** to avoid technical compatibility?
	Design for circularity	• How can we standardise our products? • How can we design our products for upgradability?
	Spare part management	• How can we establish spare part management to ensure long-term reusability of our products?

Table 46. Guiding questions to develop recommended interventions (3/3)

Barrier	Intervention action	Guiding and inspiring questions
Lack of knowledge and information	**Dominant interventions**	• How can we **educate, persuade**, or **train** our customer to overcome lack of knowledge and information?
	Marketing and communications	• How can we use communication to increase transparency, inform, and educate our customers?
	Awareness events	• How can we initiate or participate in awareness events?
	Customer-product interaction	• How can we educate our customers based on the product interface?
	Customer service	• How can we leverage our customer service to educate our customer?
	Corporate website	• How can we use our corporate website to provide required information and educate our customers?
	Nudging	• How can we use nudging to inform customers about the existence of our CI?
	Feedback on behaviour	• How can we provide customers feedback on their consumption behaviour?
	Sustainable behaviour	• How can we train customers for a more circular and sustainable behaviour while using our CI?
Lack of perceived advantage	**Dominant interventions**	• How can we **persuade**, **incentivise**, or **enable** our customer to overcome lack of perceived advantage?
	Branding	• How can we use branding to increase the positive perception of our CI?
	Addressing motives	• How can we address motives of our customer group in order to promote the most attractive circular strategy to the right target group?
	Full-service offering	• How can we offer a full-service to increase the perceived advantage or our CI?
	Price reduction	• How can we reduce our products prices?
	Pledge	• How can we offer customers pledges for returning EOL products?
	Financial viability	• How can we increase the financial viability of our CI?
	Environmental impact	• How can we incentivise customers with a positive environmental impact by using our CI?
	Calculation tool	• How can we help our customers to evaluate whether our CI is financially worth it?
	Customer segmentation	• How can we target customers that are willing to pay more for circularity?
Lack of quality	**Dominant interventions**	• How can we **use education, persuasion, incentivisation, environmental restructuring or enablement** to overcome quality concerns?
	Marketing and communications	• How can we educate our customers about different product condition criteria?
	Branding	• How can we build or use a brand that is associated with high quality products?
	Guarantees and promises	• How can we offer guarantees to our customer to overcome scepticism? • How can we offer our CI based on a service agreement?
	Full-service offering	• How can we offer a full-service to ensures continuous functionality of our CI?
	Price reduction	• How can we reduce prices in case of lower quality?
	Testability	• How can we offer test phases to our customer so that they can try out products before buying them?
	Design for circularity	• How can we design our products for durability?