Summary

The problem

The circular economy (CE) offers a promising approach for mitigating the negative impact of the production and consumption of electrical and electronic equipment (EEE) on the environment, the economy and human health. For a successful transition towards a CE, it is essential that products are returned at their end-of-use to be reused, refurbished, remanufactured and/or recycled. In other words, products should be looped back into the economy with a minimum loss of value and utility. However, in the case of mobile phones in the business-to-consumer (B2C) market, the transition is impeded by users who often store their devices in drawers after use or even throw them away. For instance, in the United Kingdom, more than half of replaced mobile phones were kept unused by their owners (Wilson et al., 2017), simply piling up after two to three years of average use (Manhart et al., 2016). These phones were kept twice as long in drawers than they were used in the first place (Wilson et al., 2017). In France, a total of 54 to 113 million phones are estimated to be left unused in their owners' homes (Rochat et al., 2019).

The main objective of this research

To ensure the minimum loss of value and utility, it is important that products come back into the system. From a company perspective, *collection* rates should be improved and the number of products kept by users should be reduced. From a user perspective, users should be stimulated to *return* their products timely in as good condition as possible. This dissertation focuses on closing the loop for mobile phones from a user perspective. The main objective of this research is to find potential solutions to increase the return of mobile phones after use so as to foster a transition towards a CE.

This research addresses two modes of consumption to achieve the return of mobile phones: (A) the contractual return at the end of the contract in access-based consumption, and (B) the voluntary return after use in ownership-based consumption. In access-based consumption, the user does not have legal ownership of the product and has to comply to the contract requirements of returning the device after use. In ownership-based consumption, the legal ownership of the product is transferred to the user, who then can control its destiny.

Research design

RQ1: What conceptual model could be used to understand the interaction between users, mobile phones and providers for both (A) the acceptance of access-based consumption and (B) the return of phones in ownership-based consumption?

RQ2: What design interventions could enable users to accept accessing mobile phones instead of owning them?

RQ3: What design interventions could influence users to divest their mobile phones and voluntarily return them?

This research is guided by the research paradigm of constructivism, abductive reasoning, and qualitative methods. As social change starts with the individual, the individual user was stipulated as agent to approach the envisioned user behaviour change (versus a collective level or other stakeholders). The Consumer Decision Process (CDP) model by Blackwell et al. (2006) was selected as the basis of the conceptual model for this research to structure the concepts, relationships and actors deemed relevant to achieving the objective. The new conceptual model builds on this CDP model and provides further detail based on literature and empirical studies to answer research question RQ1.

The first part of this dissertation concentrates on the acceptance of access-based consumption. It answers RQ2 through systematic literature reviews and in-depth semi-structured interviews.

The second part relates to the voluntary return of devices in ownership-based consumption. This part answers RQ3 through literature reviews and takes a Research through Design (RtD) approach to generate new divestment knowledge for design practitioners and researchers.

Main findings: The contractual return at the end of the contract in access-based consumption

From a CE perspective, access-based consumption seems to be an interesting avenue to explore. In this consumption mode, the legal ownership of a product remains in the hands of the service provider, who sells the right of use of a physical product for a limited period of time (e.g., through lease or pay-per-use). By retaining the control over their products in this manner, companies could ensure closed loops and secure a steady stream of used products to be reused, remanufactured, refurbished and/or recycled. Nevertheless, the acceptance of access-based consumption is limited as ownership-based consumption remains the dominant mode of consumption.

To address the lack of acceptance, factors influencing the rejection of access

services for mobile phones were explored based on interviews with adopters and non-adopters. These findings were then compared to those from car access services to identify areas for improvement. During the adoption phase (i.e., up to the purchase of the service based on expectations), the factors leading to the rejection of smartphone access services were the unawareness and unfamiliarity with these unusual services, the perceived poor image of the service provider, the unsatisfactory compensation for the sacrifice of owning, sustainability concerns, and the innate habit of owning things. During the acceptance phase (i.e., after the purchase of the service based on actual experiences of the services), factors such as the misunderstanding of the access service, the perceived stranglehold of the service provider and the perceived subpar service by the service provider hindered acceptance.

RQ2

A social and business logic shift is required to transition from the industrial exchange logic of value creation where manufacturers create value and their customers destroy it during consumption, to a new logic of co-creation where all stakeholders contribute to value creation. The car access service interviews demonstrated the need for service providers to prompt trust by lowering expected risks and uncertainties, to take over risks and issues of ownership with an all-inclusive service, and to leverage users' gut feeling (vs rational decision-making). Based on these insights, design interventions prompting the adoption and acceptance of access services for smartphones would include clear and homogeneous communication to avoid misunderstandings and negative repercussions during the use and divestment phases. By taking over the issues specific to ownership while retaining its enjoyment, a desirable experience could be created for users. Special attention should be paid to developing a carefree repair process.

Main findings: The voluntary return after their use in ownership-based consumption through divestment

Even though access-based consumption is emerging in the B2C market, owning a product is still the dominant form of consumption. In ownership-based consumption, users are not contractually obliged to return their mobile phone after use. The product is theirs and they have the legal right to do whatever they please with it. As illustrated above, the return rates of mobile phones are relatively low despite the range of return options (e.g. municipal waste collection sites, trade-in programmes or donations to charity).

The exploration of how to stimulate the return of these products after use started by reviewing the literature to create a better understanding of the concept of divestment for design researchers and practitioners. The term 'divestment' refers

to the final phase of the consumption cycle after the purchase and the use phases. Divestment is the combination of the disposition process, during which the user physically separates from the product, and the detachment process, during which the user mentally and emotionally separates from the product. Despite its importance for a CE, divestment receives little attention in comparison to the purchase and use phases. To remedy this imbalance, the divestment phase was structured in six distinct stages. (1) Dilemma recognition occurs when the user considers whether to keep the product in the current use cycle or to end its use cycle. (2) The user starts to search for divestment options (i.e., a way to separate from the product). (3) These divestment options are evaluated and the user selects one to pursue. (4) The product and user are prepared for divestment. (5) The user acts on their divestment intention by performing the final act of disposition, physically severing with the product through the chosen divestment option. (6) The user is left with the divestment outcomes of the action taken in the past stages.

Numerous factors influencing the stages of divestment were gathered from the literature. Several parallels could be drawn with previous findings on the acceptance of access services. For instance, users are also unaware of and unfamiliar with mobile phone-specific divestment options such as trade-in schemes. Users are uncertain as to what to do with their unused devices and what happens to their products (and data) when returned. Moreover, users are not stimulated enough by the compensation offered in exchange for the product (e.g., a discount or the feeling of doing a good deed). The perceived effort to return the devices through the return options does not contribute positively to return rates. Finally, here again, users seem stuck in a habit; they are in the habit of passively going through the decision process of divestment which leads to the lion's share of mobile phones ending up in drawers.

RQ3

To address the lack of design literature on the topic of divestment from a user perspective, a Research through Design (RtD) approach was adopted through seven design projects with design professionals and students on the design of a divestment experience for smartphones. The empirical studies focused on what factors were considered during the creation of design interventions, as well as on what design insights and design principles could be derived from them. Several patterns emerged from the literature and empirical studies. These design insights were summarized in a proposal of ten 'design for divestment' principles to help design practitioners and researchers create solutions for a more valuable and valued divestment experience. The design principles are visualised in Figure S1.

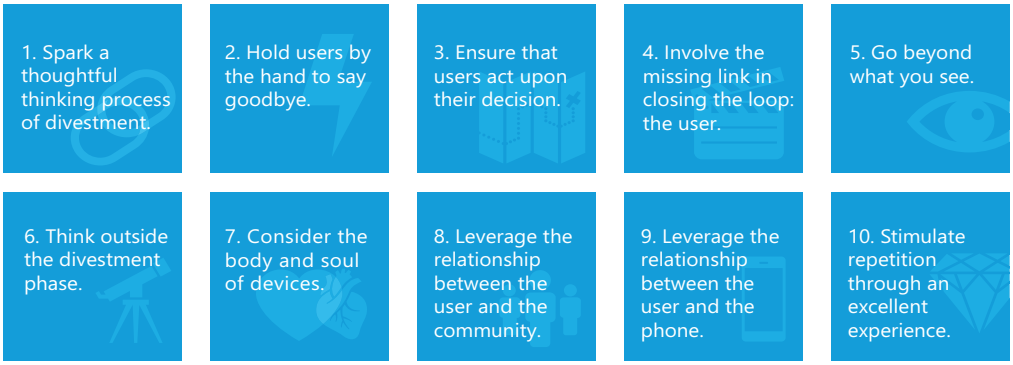

Figure S1. Proposal for Design for Divestment principles in the case of mobile phones

Contributions to science and practice

To find potential solutions to increase the return of mobile phones after use, this research has brought behavioural science and design research together by emphasizing the user perspective in Design for Circular Economy and integrating divestment knowledge into design research.

Throughout the research process, the conceptual model was enriched based on the insights from the literature and empirical studies. This is presented in Figure S2. The resulting conceptual model fittingly conceptualizes user behaviour regarding the return of mobile phones. As the decision process itself is not linear, the process model is iterative and represents the situation once it has occurred.

RQ1

To improve the acceptance of access-based consumption, access services for mobile phones were explored from a user perspective through an in-depth field study. It contributed to the body of work on access-based consumption for smartphones by identifying influencing factors and design interventions to improve their acceptance. As this mode of consumption is still in its infancy, these findings support practitioners in the development of access services.

To increase the return rates in ownership-based consumption, the lack of attention for the last phase of the consumption cycle – namely, divestment – was addressed. The new research field of design for divestment was explored using the still formalizing approach of Research through Design (RtD). The research contributed scientifically by providing a better understanding of divestment by studying the case of mobile phone return after use. It defined the concept of divestment in design, structured the phase in six stages, provided design insights from design projects on smartphone divestment experiences, and drafted design

for divestment principles. In addition to the scientific contributions, this new design for divestment knowledge shows practitioners how the user perspective could be considered (as opposed to solely focusing on the technological and business aspects) to improve the return rates of products.

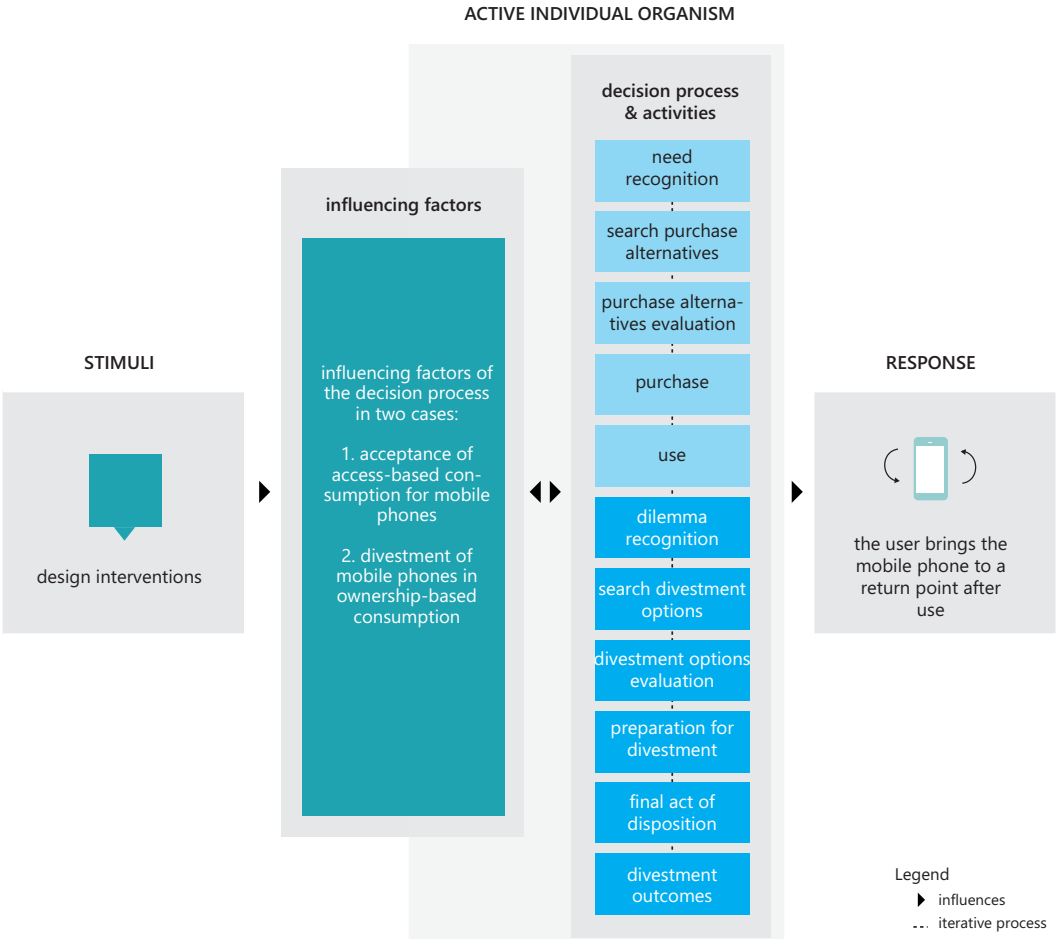

Figure S2. Conceptual model used for this research (based on the CDP model by Blackwell et al., 2006)