Overcoming Premature Smartphone Obsolescence Amongst Young Adults

Daniëlle Geurts
Atrina Oraee
Lara Pohl
Max Reichel

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Course convenors: Dr. Fred Basso & Prof. Saadi Lahlou
Other teachers: Dr. Liora Moskovitz, Dr. Maxi Heitmayer

Table of Contents

Background - Emergence and Manifestation of Obsolescence

In a capitalist, profit-oriented market economy, producing highly durable products is eventually doomed to fail (e.g., Mankiw, 2014). Manufacturers that adequately satisfy the needs of their consumers will ultimately be driven out of business for lack of revenue and profitability - unless they win new customers or conquer new markets (Homburg et al., 2013). The infamous *Phoebus Cartel* in the 1920s provides an excellent account of how competing manufacturers joined forces to intentionally engineer shorter-lived lightbulbs to ultimately maintain revenue and profit growth (e.g., Krajewski, 2014; Sasaki & Strausz, 2008). To this day, lightbulbs are expected to last only a couple of years, which seems ironic given that the illustrious *Centennial Bulb* burns almost uninterruptedly since 1901 (e.g., Hadhazy, 2016; MacIsaac et al., 1999). Unsurprisingly, then, manufacturers across industries started to deliberately reduce the lifespan of their products in an attempt to uphold demand and, as a consequence, profitability. This process of intentionally short product life cycles, often dubbed planned obsolescence, is particularly severe in monopolies and oligopolies where consumer scrutiny and power are severely limited (Bulow, 1986).

This dramatic form of demand generation, however, only marked the advent of the consumerism that has since followed. Like the lightbulb manufacturers in the 1920s, car companies, just before the great depression, saw themselves confronted with nearing market saturation (e.g., Sloan, 1990). Ford's Model T, arguably the most popular and robust car at the time, was so dependable that Ford, just as any other company, had trouble selling cars once people owned a Ford. In response, General Motors (GM) came up with an ingenious sales strategy that eventually supercharged GM's rise to the top of the industry (Sloan, 1990). Instead of building just one type of car that remained unchanged until technological innovation necessitated new constructions, GM designed and produced annually changing models (Sloan, 1990). By promoting the possession of the latest version of any given product, companies actively spurred social comparison and the desire to positively differentiate from one's peers. Social status, for millennia a fixed and inherent component of hominids (e.g., De Waal & Waal, 2007), now manifests itself in material possession (e.g., Belk, 1988). Novel model designs and the accompanying product variety further allows people to express their personality and identity by the products they purchase and possess (e.g., Belk, 1988). Although intensely promoted by emerging *marketing men* (e.g., Bridgens, 2017, p. 169), consumers soon started to perceive their current devices as outdated, a phenomenon now known as perceived obsolescence.

Thus, both planned and perceived obsolescence represent a vivid reflection of the prevalent *throwaway* culture (Cooper, 2005), rooted in companies' efforts to maintain profitability but equally influenced by consumer demand and taste. Ultimately, obsolescence is even promoted by governments that seek to boost economic performance through increasing consumer spending (London, 1932). Indeed, the current economic system is constructed around the notion of continuous consumption, which is eventually needed to fuel the ever more demanding capitalist system (e.g., Lobos & Babbitt, 2013).

The same pattern is readily observable in the realm of electronic devices, smartphones in particular (Hanks et al., 2008). While all stakeholders, except for the consumer, are expected to have a direct and augmented interest in the acceleration of obsolescence for profitability sakes, consumers also contribute their share to the problem of premature product replacements.

Manufacturers have, just like retailers and mobile service providers that earn a commission by distributing smartphones, a natural desire to sell the most possible devices. Yet, even companies that allegedly fight consumerism, such as refurbishers like BackMarket, benefit from rapid smartphone turnovers. In contrast, consumers theoretically gain from keeping their existing phones as long as possible. In reality, however, they routinely decide to replace their phones prematurely, a behaviour often at odds with the rational conception of homo economicus (e.g., Mankiw, 2014). For example, while experts estimate the potential lifetime around five years, the average lifespan for mobile phones in the US and UK, for instance, falls just short under two years (Benton et al., 2015). Furthermore, despite the rapidly growing second-hand market (e.g., Deloitte, 2016), most consumers that opt for a new phone still hold on to their old device, which inevitably results in a vicious cycle that permanently requires new products and endangers natural resources, particularly raw earth elements (e.g., Bookhagen et al., 2020). The subsequent accumulated demand for smartphones has detrimental environmental and social consequences. While the manufacturing process and preceding resource extraction has severe ecological impacts, accounting for an estimated 74% of smartphones' lifetime greenhouse gas emissions (Suckling & Lee, 2015), a poorly designed end-of-life strategy proves equally harmful (e.g., Chapman, 2017), with roughly 90% of the smartphones discharged on landfills without some sort of recycling (Green Alliance, 2015). On top of the staggering environmental costs, excessive smartphone production, driven by premature obsolescence, comes with a heavy social price tag. While the benefits of novel devices are harnessed mostly in industrialized nations, the costs are almost exclusively borne by developing countries, thereby, further contributing to the existing development gap between rich and poor countries (e.g., Alvaredo

et al., 2017). Nnorom and Osibanjo (2008), for instance, demonstrate how inadequate waste management infrastructures and extended producer responsibility legislations in developed countries contribute to the 'digital divide', effectively forcing people in developing countries to burn, bury or dump electronic waste in highly polluting and sanitary harmful ways (Vaccaro et al., 2015).

Longer product lifetimes and well-designed end-of-life strategies are widely considered an effective solution for electronic waste (e-waste) reduction (e.g., Wilhelm, 2012). Yet, any attempt to tackle premature smartphone replacements requires a thorough and holistic problem analysis, which considers all direct and indirect drivers of smartphone obsolescence. Viable solutions must ultimately bridge the competing interests amongst all stakeholders.

Introduction - Defining the Problem

With growing populations, rising incomes, and increasing urbanization, solid waste is gradually becoming a major environmental, social, and economic problem (e.g., Hoornweg & Bhada-Tata, 2012; Wilson et al., 2015). In this context, the fastest-growing waste stream, e-waste (United Nations University, 2017), is associated with particularly severe environmental (e.g., Robinson, 2009) and socio-economic (e.g., Magalini, 2016) consequences. With global annual smartphone sales having tripled since 2011 (Gartner, 2020), smartphones represent an increasingly large share of e-waste (Singh et al., 2020). Obsolescence, "the process or fact of becoming old-fashioned and no longer useful" (Cambridge Dictionary, n.d.), and the associated premature replacement of smartphones, especially amongst younger users who replace their phones the most (Proske & Jaeger-Erben, 2019), has been identified as a major contributor to this detrimental increase.

To this end, the current paper investigates the determinants and consequences of premature smartphone obsolescence amongst young adults and proposes psychology-based solutions to reduce its detrimental environmental and societal impact. Activity theory is used to define the research scope, ultimately focusing on the first stage in the buyer behaviour model, reflecting the prototypical customer journey along five consecutive decision stages. Problem recognition, essentially the perceived difference between the current and desired state of being, is subsequently analysed through the three interrelated layers of installation theory, before deriving practical solutions to address premature smartphone obsolescence amongst young adults.

Activity Theory - Defining the Scope

While smartphone obsolescence is a complex and multidimensional process, influenced by distinct stakeholders across several stages (e.g., Proske & Jaeger-Erben, 2019), the final authority largely lies with the end customer (Guiltinan, 2009), whose behaviour and motivation represent an optimal starting point to investigate premature smartphone renewal. Though multiple approaches are conceivable to examine and analyse consumers' untimely smartphone replacements, Nosulenko and colleagues' (2005) interpretation of activity theory seems particularly useful given its seamless integration of subject-orientation and consideration of contextual factors into a holistic framework. In this sense, activity theory allows to dissect broader behaviour patterns into more fine-grained, goal-oriented sequences (Lahlou, 2017, p. 62). At its core, this notion of activity theory describes how individuals or collective agents seek to accomplish their goals and satisfy underlying motives through a series of activities[1] and subgoal-accomplishments. Importantly, a motive can be satisfied by several goals and a goal can satisfy multiple motives. Throughout the process, contextual factors and external conditions shape the agent's specific behaviour. In the context of smartphone replacement, activity theory can be conceptualized along Howard and Sheth's framework of buyer behaviour (1969), spanning from problem/need recognition to post-purchase behaviour (see Figure 1). In the first stage of his process, consumers recognize a need/problem and subsequently seek to meet that particular need through specific actions. In this vein, the intention to replace one's current smartphone with a newer model represents the desired goal, intended to satisfy some underlying motive that arose in the first stage of the buyer behaviour model. The subsequent phases in the buyer behaviour model represent concrete activities and subgoals needed to eventually achieve the overarching goal - acquisition of a new smartphone.

[1] Note the distinction between activity and behaviour: the former describes "what subjects do, experienced from their own perspective", whereas the latter is "what subjects do, as described from the outside by an external observer" (Lahlou, 2017, p. 346).

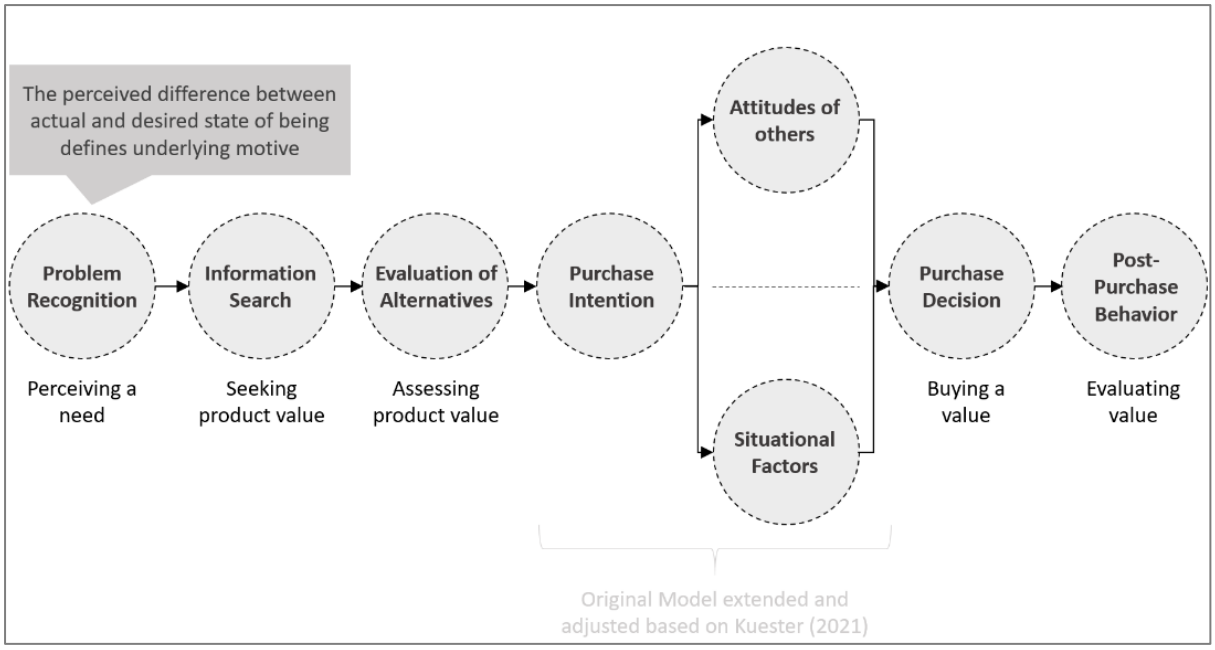

Figure 1 – Adaption of Howard and Sheth's (1969) Buyer Behaviour Model

While all five stages of the buyer behaviour model deserve a more detailed elaboration, expert interviews (see Appendix A & B) and a consumer survey ($N = 122$, see Appendix C) revealed and identified the first stage, problem recognition, as the most promising to investigate and understand premature smartphone replacement, thus, being the focus of this paper. The emphasis on problem recognition in the smartphone replacement process allows a frictionless analysis of the underlying needs along the three dimensions of installation theory (Lahlou, 2017). Ultimately, a person's perceived need for a new smartphone is shaped by a combination of physical affordances, embodied competencies, and social regulations. Each layer influences and contributes to the perceived difference between the actual and desired state of being, eventually channelling consumers to the subsequent step in the buying process, information search.

Installation Theory - Understanding and Addressing Premature Smartphone Obsolescence

Installation theory provides a holistic framework to analyse human behaviour that incorporates both psychological and sociological perspectives, thus, overcoming limitations associated with purely psychological theories (e.g., Ajzen, 1991) or purely sociological ones (e.g., Durkheim, 1895/1982). At the most fundamental level, installation theory explains and, to a certain extent, predicts behaviour through the interplay of physical affordances in the material world, agents' embodied competencies, and social regulations. Yet, as a macro-level framework, installation theory must be complemented with more nuanced concepts to gain a truly comprehensive understanding of a specific activity. Accordingly, installation theory serves as the overarching framework, supplemented with more detailed concepts for each layer. More specifically, this essay analyses the underlying drivers of smartphone obsolescence along the three layers. The challenges identified in each layer were further condensed and analysed for feasibility through the creation of an addressability versus impact matrix (see Appendix F), as to identify the most promising and likely areas more concretely for improvement. Accordingly, practical solutions were derived to overcome the identified problems (see Figure 2, see Table 1). The paper concludes with the limitations of this essay and a summary of the findings.

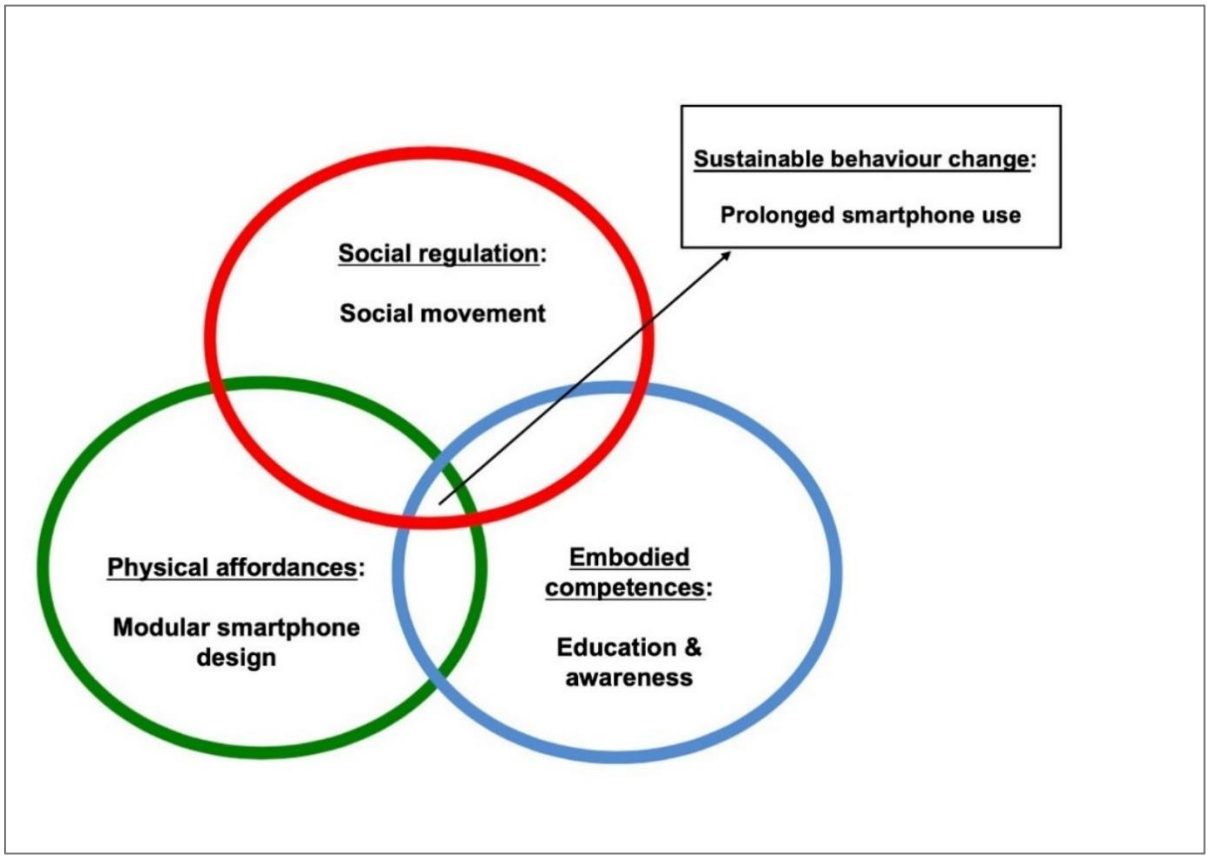

Figure 2 - Installation theory (Lahlou, 2017) applied to smartphone obsolescence

Layer of Analysis	Prioritised Challenges	Recommendation	Implementation
Physical Affordances	Physical dysfunctions	An alternative design that allows for continuous functional durability and material quality	Modular smartphones and Fairphone
	Replacement obstruction & repair costs		
	Technological advancements		
Embodied Competencies	Lack of embodied skills to replace dysfunctional components for modular smartphones	Effective transmission of the necessary knowledge and skills to the user	Educative *"How to..."* first person videos and clips
	Lack of awareness on the necessity for prolonged smartphone usage	Increasing consumer awareness and providing smartphone users with the necessary information to foster sustainable decision making through campaigns which focus on the harmful environmental impacts of premature smartphone obsolescence	Graphic visualisations
			Environmental ads with gain and loss frames
			Proper use of social media for enhance accessibility
Social Regulation	Social signalling	A social movement to revert the norms of smartphone obsolescence while instilling a sense of community	The "Slow Smartphone Movement"
			Online accounts with profile pictures that indicate through specific frames or colours how long a person has kept their smartphone
	Environmentally detrimental social norms	Dynamic social norms	"Over the past two years, more and more young adults have started to keep their smartphone for more than four years. Help grow the movement!"
		Promote 'slow' smartphone consumer behaviour	Social media influencers

Table 1 - Overview of the major challenges and proposed solutions identified in this paper

Physical Affordances - Properties of the Environment

The Problem

By enabling and constraining physical smartphone usage, the first layer of installation theory plays an essential role in technological obsolescence. Physical affordances comprise all objective conditions that constitute the built environment, ultimately guiding people's behaviour in a given context (Lahlou, 2017). According to this view, material objects can take on multiple roles, thus channelling people's activities through specific installations. They serve, for instance, as barriers, scaffolds, or trigger points for physical interactions. In the context of smartphone obsolescence, physical affordances constitute the technological and physical aspects that are constructed by various stakeholders, such as smartphone design and sales promotions, most of which deliberately promote premature product replacements. This process is officially known as planned obsolescence (Podoshen & Andrzejewski, 2012). Smartphone producers, software developers, hardware suppliers, mobile service providers, and smartphone retailers (Arvind, 2009) represent the key stakeholders (Freeman, 1984) that intentionally propagate this cycle of obsolescence by crafting physical aspects of smartphones for limited repair, limited functional life, reduced aesthetics, cyclicality and restricted technological updates (Fassin, 2009; Satyro et al., 2018). Ultimately, these stakeholders seek to stimulate the linear economy to ensure high sales volumes and ultimately, growth and profitability (Guiltinan, 2009).

Several studies have investigated the determinants of premature smartphone replacement, frequently reporting that physical and built affordances represent one of the main drivers (Proske & Jaeger-Erben, 2019). Dysfunctional batteries, broken screens, and cameras that cannot be replaced efficiently represent common manifestations of physical shortcomings in smartphones. According to our consumer survey, more than 50% of people cited this as a reason for replacing their phones prematurely. Similarly, common consumer experiences include the unavailability of replacement components and excessive repair costs (Jaeger-Erben et al., 2021), mirroring the 60% of our survey respondents that prefer to buy a new phone rather than having it repaired. Technological advancements further accelerate premature smartphone replacement as older devices often lack the processing power required to run the latest operating systems and apps (Proske et al., 2016). In our survey, around 65% reported this as their reason for buying a new phone.

The Solution

The key to addressing the physical aspects of smartphone obsolescence amongst young adults thus lies in a design that allows for continuous functional durability and material quality. In line with this, we suggest the concept of modularity to address the physical constraints of smartphone repair (see Figure 3).

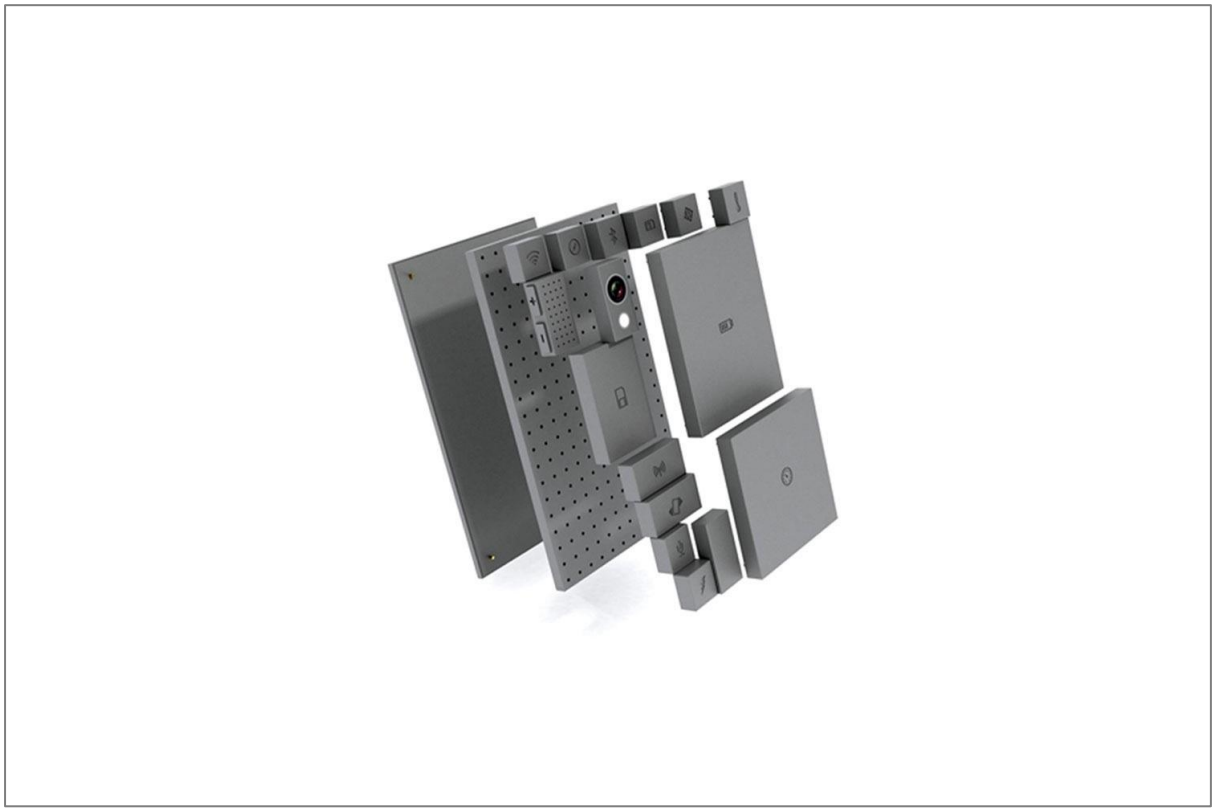

Figure 3 - Modular phone concept image (One Army, n.d.)

Modularity is the extent to which a system's components can be separated and/or recombined to increase durability and flexibility in use (Baldwin & Clark, 2000). Individual components can be exchanged without having to replace the entire product. Most importantly, however, modular devices are easily upgradable. Thus, in the context of ongoing technological advances, modular designs allow for physical upgrades such as larger storage, better cameras, and software upgrades (Schischke et al., 2016). Furthermore, modularity also enables individual customization through adapting functionality. Thus, depending on the aspects of the phone that are most important to an individual, these can be made more prominent (Hankammer et al., 2018). For example, if an individual needs a longer-lasting battery, they can install a larger battery pack. Moreover, our survey also revealed that one of the main barriers to repairing and

second-hand phones is that they worry about repair quality, however, modularity directly addresses this issue by allowing one to replace these parts.

Modular smartphones have already been around for several years but only recently begun to gain popularity. Fairphone, amongst other companies, has fully embraced modular design and is making significant strides towards reducing obsolescence mentalities. Owning a device such as the Fairphone will not only make it easier to repair and customize your phone but further acts as a form of social signalling. Signalling theory posits that individuals acquire items as a manifestation of symbolic capital through which they are able to signal to others their values and status (Bird & Smith, 2005). In this sense, owning a Fairphone will signal to others their pro-socialness and environment values (Glazer & Konrad, 1996; Johnson et al., 2018), which is increasingly relevant with the growing movement towards sustainability. Secondly, the customization of modular devices allows for personalized instruments, building on the idea of extended self (Belk, 2013), whereby possessions are regarded as a part of an individual's identity through the attachment and construction of meaning and experiences. This notion is complemented by the repairability of modular devices. Individuals are enabled to rapidly and seamlessly replace parts themselves. The individual is consequently empowered to build and mend, actions that would otherwise be outsourced and not experienced by the smartphone owner (Lockton, 2013), which further fosters an emotional bond and meaningful relationship with one's smartphone (Cushing, 2011). All these experiences act together to increase the lifetime of the smartphone and counter the culture of obsolescence.

While modular instruments and companies such as Fairphone provide solutions for the technological and physical aspects of smartphone obsolescence, modularity is limited in addressing the personal and social dimensions of smartphone replacement, namely psychological obsolescence. Further problem analysis and solutions are required from the perspective of the remaining two layers to more comprehensively tackle this topic and further popularize modular devices.

Embodied Competencies - Users' Interpretive Systems

The Problem

The human contribution, conceptualised as embodied competencies, is paramount in the execution of behavioural sequences, effectively reducing the possible behaviour choices provided by physical affordances. In other words, not everything that is physically possible will eventually be realised. Therefore, understanding the concept of obsolescence requires a careful consideration of the essential protagonist, the user, who responds to physical affordances provided by the smartphone (Lahlou, 2017). As explained by Wieser (2016, p. 157), "psychological and behavioural manifestations of smartphone replacement may lie deep within human psychology and are partially determined by the perception of an obsolete smartphone". Therefore, it is necessary to couple analyses of physical aspects with in-depth investigations of users and their preferences. Accordingly, Proske and Jaeger-Erben (2019) state that "looking at the user is important if we want to address the actual use-time (as compared to the technical lifetime) of the device" (p. 58). One reason for this lies in the meaning users give to their smartphone in everyday life and in the relationship that evolves between the smartphone and its user. Similarly, our survey indicates that people tend to perceive their smartphone as an important part of themselves and who they are. In addition to having certain representations of what a "smartphone" entails, the possession of the most recent smartphone also contributes to the sense of identity as the user's "extended self" (Belk, 1988) and serves as means for self-actualisation.

Existing research (e.g., Wieser & Tröger, 2015) has demonstrated expectations for smartphone lifetime and its quality are relatively low. Consequently, it becomes highly convenient for consumers to replace their smartphones, thus, becoming less motivated to repair them. Interestingly, consumers tend to prefer an average lifetime of 5.2 years for mobile phones, although they actually use the device for 2.7 years. Furthermore, consumers have even lower expectations for the reality, assuming the average lifetime of one to two years. Low technical lifetime expectations for smartphones mostly arise from poor quality and planned obsolescence (Wieser & Tröger, 2015). Therefore, consumers ultimately become reluctant to spend more on durable smartphones with higher quality. In other words, exceeding the smartphone lifetime leads to the device becoming mentally depreciated and perceived as obsolete, making it easier for the consumer to replace it prematurely.

Accompanying the psychological factors, users' behavioural characteristics, such as intensity of usage, also influence life cycles of smartphones (Batarfi et al., 2017). Careful or careless usage emerge from users' attitudes towards the device. Also, smartphone users gravitate to certain manufacturers or models, while feeling pressured by newly introduced smartphone models.

Considering the significance of the users' competences in the context of their relationship with the smartphone, it is evident that a "durable" device alone cannot solve premature obsolescence. Therefore, besides focusing on the technical life-time of the products by robust and repairable design, addressing the user directly is crucial. As such, effective strategies must be created to increase perceived durability. Addressing perceived durability and obsolescence demands a detailed consideration of the meanings of smartphones in everyday life and the relationship that evolves between a device and its user.

The Solution

This layer of installation theory (interpretive systems) is distributed over individual human minds and bodies, by the means of experience, education and exposure to discourse (media, advertising, etc.). Therefore, solutions offered in the first layer of our analysis are coupled with those which bring the user into the scope of the project. While modular smartphones technically enable the user to replace defective parts, it is essential to complement this with the transmission of the necessary knowledge and skills to the user. To this end, companies that aim to address premature smartphone replacement, such as Fairphone, need to educate users and ensure that they have the required embodied competences to realize all that modularity may physically offer. Educative YouTube videos, added *"How to…"* sections, first-person repair clips along with continuous and convenient customer support may be implemented to further facilitate behaviour change (e.g., see Figure 4).

Figure 4 - Exemplary advertisement (Picture adapted from Fairphone, 2019)

Moreover, to achieve sustainable behaviour, it is essential to supplement bottom-up solutions while aiming to increase the transparency of environmental information (Liu et. al, 2015). To this end, the involvement of various stakeholders ensures more comprehensive strategies, for they can reach and impact a wider audience through mutual collaborations. Environmental awareness acts and campaigns can be held by involved stakeholders, including governments, businesses, ENGOs and others, in an attempt to further facilitate prolonged smartphone usage by impacting perceived obsolescence (Abuzeinab & Arif, 2014).

Additionally, green awareness is a significant contributor in consumers' sustainable consumption. Studies indicate that increasing awareness of environmental issues such as depleting natural resources, global warming, and pollution, causes people to consider such issues more during purchasing decisions (Banytė et al., 2010; Young et al., 2010). Therefore, increasing consumer awareness and providing smartphone users with the necessary information to foster sustainable decision making may be implemented through various awareness and empowerment campaigns which focus on the environmental impacts of premature smartphone obsolescence. As such, campaigns can use graphic visualisations (see Figure 5) to properly frame the harmful impact of such unsustainable behaviour. In designing user awareness campaigns, in addition to utilising gain/loss framings of ad messages in environmental conservation campaigns, stakeholders may benefit from using contextual cues that stimulate feelings of guilt, shame and

anger. Such emotions may invoke environmental activism, thus eliminating the gap between attitudes and behaviour, while also harnessing consumers' sense of self-efficacy (Harth, 2013). Moreover, while the internet and social media platforms have significantly increased accessibility, appropriate media platforms should be chosen, according to the emotional context of the ad messages. In this sense, emotions which are context-induced have been demonstrated to stimulate consumer response to the underlying environmental messages (e.g., Baek & Reid, 2013; Shapiro & MacInnis, 2002).

Figure 5 - Illustrative awareness and empowerment campaign

Furthermore, materials like wood, leather and stone are "commonly described as aging gracefully" since they become more valuable and visually enhancing as they age (Bridgens et al., 2017). As such, coupling these materials with the fact that phone cases are already extensively used for protective and visual purposes could foster and motivate prolonged smartphone usage by creating an emotional connection between the user, the smartphone and the outer appearance of the device (see Appendix D).

Although embodied knowledge of how to use the affordances offered by modular smartphones and enhanced consumer awareness will impact the desirability of prolonged smartphone use through highlighting the importance of longevity, these measures are not always sufficient to execute appropriate behaviour. As such, we must analyse the third dimension to ensure that the resulting behaviour is also appropriate and socially accepted.

Social Regulations - Channelling behaviour through Institutions

The Problem

The third layer, social regulations, ensures that behaviour is socially appropriate. Different entities can be involved when it comes to social regulation: communities, organizations, and institutions. In the context of smartphone obsolescence, these (inoffical) codes can consist of rules, social norms, rewards, etc. and contribute to when and why smartphone users consider their devices obsolete. It is important to note that social regulatory processes can take on three different forms: direct feedback from others, internalized standards within the individual, and "anonymous devices or signs" (Lahlou, 2017, p. 114). In the context of smartphone obsolescence, a combination of all these forms is relevant and manifests itself first and foremost in the form of (a) peer-influence and social norms, and (b) status and roles.

Roles and status are "learned expectations about which behaviour people should have in a given situation" (Lahlou, 2017, p. 122), expressed, for example, through fashion (Simmel, 1957). Users carry their smartphone with them almost at all times, most of them actively spending up to six hours per day, according to our survey. This has transformed smartphones into accessories and fashion objects that convey their users' identity, rather than mere technical devices (Fortunati, 2005). Fashion is a vehicle to construct our identity, which, in turn, influences how others see us, resulting in our socially-constructed self (Lahlou, 2017). Studies have demonstrated the importance of possessing the latest smartphone as a means of social status signalling, especially amongst agents from lower socioeconomic backgrounds (e.g., Abeele & Roe, 2013). Similarly, the brand of a smartphone serves as a means to signal status. Both our expert interviews and our survey results indicate that brands play an important role when making smartphone purchasing decisions. For example, specific 'necklaces' have been brought to the market, allowing people to overtly carry their smartphones around their necks (see Figure 6).

Figure 6 - Necklace smartphone carrying case (Trend Hunter, 2020)

In addition, peer-influence and social norms are further reinforcing premature disposal of smartphones. Wieser and Tröger (2015) found that the newness of smartphones in people's direct social reference group, i.e., friends, has a stronger impact on interpurchase intervals than functional failures such as incompatibilities and technologically outdated software. Similarly, nearly 25% of the respondents to our survey indicated that using an old phone around their friends made them feel embarrassed. This phenomenon can be explained by the need-to-belong theory (i.e., the fundamental motivation to form social bonds; Baumeister & Leary, 1995) as well as social identity theory (Tajfel, 1974). The latter defines social identity as "that part of an individual's self-concept which derives from his knowledge of his membership of a social group (or groups) together with the emotional significance attached to that membership" (Tajfel, 1974, p. 69). In this sense, smartphones work as social instruments (Moscovici, 1984), and to stay a part of the social (peer) group, agents need to display the most recent model as "entitlement" for being a member. If a person refuses to do so, it may ultimately result in social exclusions (Elster, 2007).

While peer pressure in the previous example is enforced through specific social norms, there are multiple other norms that influence smartphone users' behaviour on a regulatory level. For example, one issue that is preventing a more sustainable, circular smartphone industry is that users tend to store old smartphones at home rather than giving them back to the manufacturer

or reselling them (e.g., Sarath et al., 2015). As long as the social norm is to exchange one's smartphone frequently and storing the old device in a drawer, the agents' behaviour will be channelled accordingly. A similar logic applies to the concept of repairing one's smartphone: Litvine and Gadenne (2020) found that people are not used to repairing their devices and seem to be overwhelmed by being presented with a repairability score. While this score represents a social regulation that should facilitate more sustainable behaviour, steps within the other two layers of installation theory would have to be taken to prove this intervention successful (Litvine & Gadenne, 2020).

Other aspects that constrain and artificially shorten smartphone life cycles include product warranty and fixed-term phone contracts with service providers, which stimulate regular phone replacement cycles, i.e., every one to two years (Tröger et al., 2017). Lastly, many stakeholders, especially mobile service providers and smartphone retailers, further cultivate the rapid replacement mindset by subsidizing newer products, thus, essentially ensuring that the customer is persuaded to replace than to repair (Proske et al., 2016). These issues were further supported by our survey and interviews with BackMarket and Refurbed.

The Solution

Tackling the challenges associated with the social layer of installation theory in the context of smartphone obsolescence means, first and foremost, to address the underlying motive that sparks premature smartphone replacement amongst young adults: the need to belong and to be part of a social group one identifies with. Therefore, we suggest the creation of a social movement to revert the norms of smartphone obsolescence while instilling a sense of community.

Social movements have already been formed in other sustainability contexts, for example, the Slow Fashion Movement offers a platform to take collective action and demand change (Slow Fashion Movement, 2021; see illustrations in Appendix E). The "Slow Smartphone Movement" could work in a similar way, including a website that offers members the opportunity to connect and engage with each other, for example, through a community forum in which slow smartphone "activists" could exchange tips and success stories. The movement could make use of dynamic social norms, for example, informing people that "Over the past two years, more and more young adults have started to keep their smartphone for more than four years. Help grow the movement!", which could lead to a behaviour change in their members (e.g.,

Sparkman & Walton, 2017). Furthermore, members of the Slow Smartphone Movement would create online accounts with profile pictures that indicate through specific frames or colours how long a person has kept their smartphone - for the tech-savvy generation, this could be achieved via blockchain[2] - with a golden frame for those who have not replaced their phone in, say, five years (see Figure 7). This would add a reward as incentive for sustainable behaviour and serve both as a way of signalling (Bird & Smith, 2005) and reinforce social identity (Tajfel, 1972).

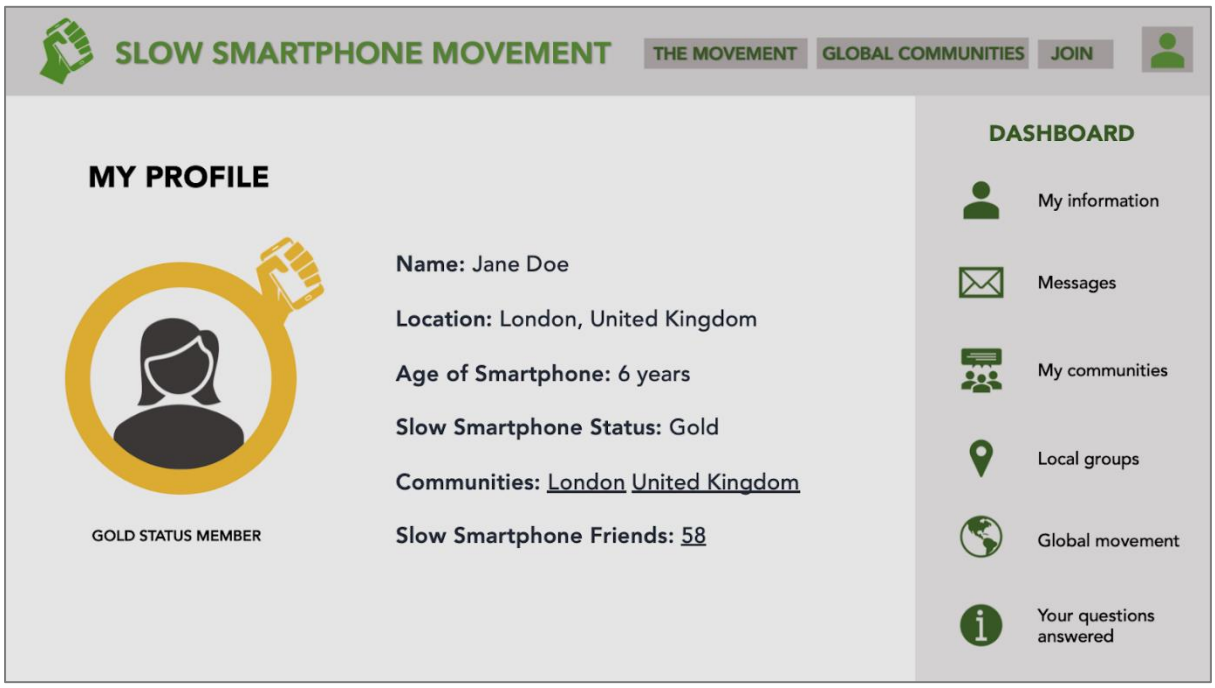

Figure 7 - Illustrative *Slow Smartphone Movement* Interface

Another activity of the movement could consist of pledges that members make to commit to keeping their existing smartphones for a longer time. Pledging has shown to be an effective measure to increase sustainable behaviour, particularly when made in the public sphere (e.g., Costa et al., 2018; Koessler, 2019) as it strengthens the commitment to actions in line with one's values and thus counters cognitive dissonance (i.e., a discrepancy between people's beliefs and actions; Festinger, 1962).

The role of social media - Instagram in particular - is of high relevance in this context, for two reasons: Firstly, it offers the opportunity to reach a greater number of people, and secondly,

[2] Using cryptography to trace individuals' behavior, such as smartphone retention duration.

influencers can help promote the cause of the movement. Especially for young adults, influencers on social media can have a significant impact on consumers' behaviour, even in the absence of environmental awareness (e.g., Johnstone & Lindh, 2017). To be more concrete: Popular influencers of the target group could promote their 'slow' smartphone consumer behaviour by emphasizing that they are keeping their phone as long as it lasts, or by promoting sustainable alternatives such as the Fairphone or a second-hand phone.

In addition, to get to a critical mass of adopters - following Rogers' diffusion of innovation theory (1962) - and moving away from the individual level, companies could provide their employees with modular phones such as the Fairphone or strive to keep employees' smartphones in circulation as long as possible. These suggested measures would ultimately result in the creation of a 'new normal' and establishment of a new social norm: that of not replacing one's smartphone every (other) year.

Limitations

Despite the attempt to investigate premature smartphone obsolescence holistically, the limited scope of the project and the inherent nature of scientific inquiry inevitably results in conceptual and methodological limitations.

From a conceptual perspective, this paper does not explicitly follow the conventional classification of planned and perceived obsolescence, frequently found in the academic literature (e.g., Mellal, 2020), but instead applies and harnesses the logic proposed by installation theory, which arguably provides a better toolkit for deriving and structuring practical solutions (Lahlou, 2017), rarely the focus of traditional academic papers. Thus, although advantageous for the purpose of this paper, this approach complicates a seamless integration of the present research into the existing body of academic literature. Additionally, the consumer-centric perspective, deliberately chosen for the purpose of this paper, represents just one of many possible angles from which to study smartphone obsolescence. However, extensive research, expert interviews, and a consumer survey mitigate the drawbacks of an overly narrow consumer focus, eventually allowing for more holistic and realistic solutions. Moreover, this paper only narrowly touches on governmental interventions, mainly because they are considered as the last refuge, and can potentially supplement the proposed solutions. That is not to say, however, that governments blindly approve of planned obsolescence and remain inactive agents on the sidelines. For example, recent fines for the two major smartphone manufacturers, Apple and Samsung, provide a vivid example of the increasing governmental pressure regarding consumer rights and environmental protection (e.g., Amante & Blamer, 2018). Lastly, this paper only briefly examines the limits of the overarching economic system, which, given the current legislation and incentive structures, actively promotes consumerism and makes large-scale changes virtually impossible (e.g., Speth, 2008).

Methodologically, this paper heavily relies on empirical research and secondary data for both problem identification and potential solutions but is supplemented by primary data in the form of a small-scale survey and several expert interviews. Yet, because of the novelty and uniqueness of the above-presented solutions, which stem from a combination of various theoretical concepts and streams of thoughts, some still require empirical validation. An avenue for future research, therefore, is to test the above-articulated solutions for feasibility and efficacy.

Conclusion

The current paper investigates the determinants and consequences of premature smartphone obsolescence amongst young adults and proposes psychology-based solutions to reduce its detrimental environmental and societal impact.

Activity theory was used to define the research scope, ultimately focusing on the first stage in the buyer behaviour model, reflecting a prototypical customer journey along five consecutive decision stages. Problem recognition, essentially the perceived difference between the current and desired state of being, was subsequently analysed through the three interrelated layers of installation theory, physical affordances, embodied competencies, and social regulations. Eventually, potential solutions, grounded in academic literature, expert interviews, and a consumer survey, were organized along the three dimensions of installation theory, creating a holistic and effective strategy for tackling smartphone obsolescence.

Smartphone modularity represents a promising starting point to address the problems associated with physical affordances such as broken parts, worn batteries, and planned obsolescence more generally. Yet, modularity merely addresses one, arguably minor aspect of obsolescence, essentially neglecting the psychological determinants of premature smartphone replacements. Therefore, extensive consumer education coupled with awareness campaigns, highlighting the alternatives to purchasing new products, could tackle issues associated with embodied competencies. As such, we suggested that various stakeholders, including refurbishers, engage in and expand already existing consumer awareness campaigns on the harmful environmental impacts of premature smartphone replacement.

Lastly, social regulations, manifested partly in the universal need for belonging and social inclusion, represent the last driver of smartphone obsolescence. As inherently social creatures, people are naturally influenced by their respective peer groups and underlying social norms. Thus, addressing conformity pressures and normative expectations essentially requires a redefinition of social norms. Such a change could be induced by social movements, promoted by prominent influencers that serve as credential early adopters, evoking a sense of urgency to change these harmful behaviour patterns prevalent amongst millennials. Virtual communities and reward schemes could further foster lasting normative change, eventually helping redefine the detrimental consumerism culture.

Ultimately, beginning with the above-presented solutions, the significant detrimental consequences associated with premature smartphone obsolescence can be addressed and overcome, thus, ensuring a greener, brighter, and more equitable future.

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Appendix

Appendix A - Interview Cover Sheets

Interview 1 - Cover Sheet

Interview

Duration: 25:44 minutes

Date and time: Friday 5th of March 2021 - 9am CET

Place: Virtual Zoom®-Meeting - Researcher and participant were at their respective homes

Contextual notes: Temporarily poor internet connection (video was temporarily suspended)

Interviewee

Age: 31

Gender: M

Education / Employment status: Employee at BackMarket (BM in transcript)

Relation to the topic: BackMarket is a leading platform for refurbished electronics, especially smartphones

Interview 2 - Cover Sheet

Interview

Duration: 31:22

Date and time: Friday 29th of April 2021 - 10am GMT

Place: Virtual Zoom®-Meeting - Researcher and participant were at their respective homes

Contextual notes: n/a

Interviewee

Age: 28

Gender: F

Education / Employment status: Employee at Refurbed

Relation to the topic: Refurbed is a leading platform for refurbished electronics, smartphones in particular

Appendix B - Interview Excerpt[3]

Length: 25:44 minutes

Legend:

[Interrupts] = Interruption by either side

(?) / (!) / (,) = Anticipated punctuation (for readability purposes)

(.) = Short pause (primary for readability)

(…) = Longer pause

[...] = Continuation of the conversation without transcription

- Proper names, brands, and media names are in italic (e.g., *Apple* for Apple Inc.)

R: how long do you think I could use a very old *iPhone* say of the first or second generation (?) I know that this is not possible with *Apple* that you can just update the software (.) still is that possible with other manufactures so that I just take the hardware and upload the newest software (.) is that possible theoretically (?)

BM: mhh (.) it really depends (.) I think we still need to differentiate between the very old smartphones and newer generations (.) so an *iPhone* of the first generation in 2008 you naturally cannot expect the same processing power as from the most recent *iPhone* (.) Yet, I think we did experience a real transition in terms of performance around 2014/15 (.) and in particular those devices mhh I don't see any real reason why they should not be compatible for longer

R: mhh interesting (.) which role does based on your feeling play customer perception (?) so how the consumer perceive that their device is outdated (.) mhh in the literature on obsolescence it is highly emphasised that much is driven by consumers (.) so eventually I guess it is a mutual process that people see advertising and then crave the newest smartphone mhh because everyone in the peer group possesses the most recent device and that is naturally very difficult to counteract (.) but still this is being reinforced by *Apple* releasing a new *iPhone* every year

[3] For the purpose of this essay, interviews were transcribed orthographically, thus, transcribing only verbal utterances, using Braun and Clarke's (2013, p. 166) notation system. To avoid changes in meaning, the raw data was edited as little as possible (Braun & Clarke, 2013, p. 162-165). This also includes punctuation.
This interview was originally conducted in German.

but counteracting is very difficult I imagine especially if it is about the natural tendency of people to seek status and prestige

BM: [interrupts] correct you will never fully erase status seeking

R: [interrupts] mhh

BM: mhh and you must mhh eventually this is also ok (…) the new devices must be sold because there are no used devices without new ones that it the same for cars right (?) if everyone drives old cars nobody will buy new ones and the market crashes

R: [interrupts] yeah

BM: [interrupts] and this will hinder innovation and much more mhh (.) so I think it is important to find the right balance also among consumers to really balance the trend (…) you will always have people for whom status is the most important and the newest device mhh and you will also always have a lead user group that really uses the new devices with all their functionalities right (?)

R: yes

BM: you always have those lead users and I think that is good this way (.) I think that what is needed to keep the innovation density and speed mhh and at the same time the majority of the consumers (…) the majority of the consumers is not status driven (…) mhh (.) at least not substantially right (?)

R: mhh

BM: maybe at the moment mostly driven by discounts and special offerings yeah but that's where we see our purpose to show people that there actually is no reason to buy new right (?) if it is not driven by status (.) so it does not make any sense to spend over a thousand dollars for a new device

R:[interrupts] yes absolutely

BM: [interrupts] especially if you get a device that is only mhh slightly older for half the price with a similar performance (.) and that is where we just have to inform and also educate consumers right (?)

R: yes makes sense (.) but isn't it that much turnover is caused by mobile service providers (.) mhh so if you are renewing your two-year contract many provider also give a new phone mhh so people have little incentive to keep their their old phones (.) that is I think another lever that needs to be activated

BM: yes and currently there are few mobile service providers that offer refurbished phones (.) in their plans or bundled with their plans mhh and there too I think we will see some innovation happening over the next say five to ten years right (?)

R: mhh

BM: I am very convinced that we will have several mobile service provider that have both rental models (.) so it is more flexible you can change your phone and especially look out for refurbished electronics (…) but the *Deutsche Telekom* has quite a different motive (.) it is basically just using the incentive of the new device to promote their own plan right (?)

R: yes right

BM: for the *Deutsche Telekom* the sale of end devices is not really important and profitable but rather mhh selling a service contract (…) mhh and by creating those bundles (.) it is almost like a leasing contract that is how you can imagine it

R: [interrupts] mhh

BM: leasing for new cars is very similar (.) you have very low rates and mhh at the end return the car and get the next one (.) and so as a consumer you are kind of trapped in the system of replacement (.) and you tend to always pay the highest price (.) because you have to pay the price either way mhh you commit to pay everything on time (.) and all this comes along with this leasing scheme right (?) but again I think that we are about to see a paradigm shift within the next few years mhh

R: [interrupts] ok

BM: [interrupts] and especially with the topic sustainability becoming more and more popular mhh and I think you can reach the consumer by showing them that there is a smarter way of doing things right (?) and that they realize that after all they are being manipulated mhh I think many if not most people are not actively aware how strongly they are being influenced and

manipulated (.) and nobody likes being manipulated right (?) and that is where we see as *BackMarket* our duty to inform consumers (…) the more we spend in consumer education or brand building the more this trend will intensify

R: ok yes (…) before our call I was just browsing through your website mhh and noticed that you do have quite some *Apple* products (.) is that because *Apple* is in such a high demand (?) I mean in the headline on *Google Search* most products were *iPhone*s mhh it was *iPhone iPhone* (…) it that because *Apple* is in such a high demand and it coveys this status elements (?)

BM: yes

R: ok

BM: the demand for refurbished *Apple* products is enormous

R: [interrupts] yes

BM: much stronger than all other brands so *Android* (.) we have the *Galaxy* devices from *Samsung* which also work and sell quite well

R: mhh

BM: they also have a solid demand but especially when mhh (.) you could look up the search volume for the respective brands on *Google* for instance there are certain tools that allow you to analyse search demand for words and brands

R: yes that is excellent yes

BM: there are tools like *Semruch* and there is also a tool from *Google* itself

R: yes I have seen this one

BM: and you can nicely analyse the trends (.) *Google Trends* is a free tool that allows you to check all that (…) and for *Apple* this consumer demand is extremely high

R: yeah (…) and maybe one more question what is the main reason for people mhh to sell mhh to sell their phone (?) is that physical damage so that there is an actual damage on the phone itself like batteries that stopped working or mhh do you information regarding that (?)

BM: [interrupts] yeah most people sell their old device because they are actively looking for a new one

R: ok

BM: and that mhh (…) we see that one factor is that people have issues with their device (.) for instance the screen is broken mhh so what do I do (?) do I send it in for repair (?) or do I buy a new one (?) that certainly is a factor mhh (.) in most cases however the devices we get are not broken or damaged

R: [interrupts] ah interesting

BM: so few devices are returned or handed in with damages mhh most devices come from customers that are simply actively upgrading their device so we have many customers that are currently (.) so if you take *Apple* that are on *iPhone* 6 or 7 and you feel it is time to replace those

R: mhh and maybe another question regarding your customer base (.) do you only target end-customers or also mhh companies directly because I know from consulting (.) with a new entry people get a new smartphone mhh is that also a potential target group for you or currently not (?)

BM: at the moment not (.) but it is also interesting to think about how to approach big companies (.) the first step for us which will be crucial is that we start with smaller companies […]

Appendix C - Consumer Survey

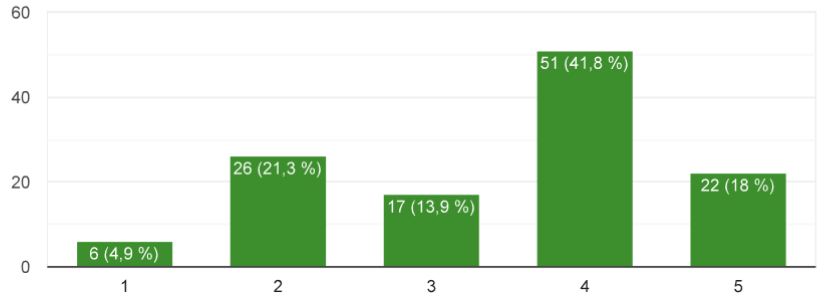
Smartphone Survey

122 Antworten

Relationship with Smartphone

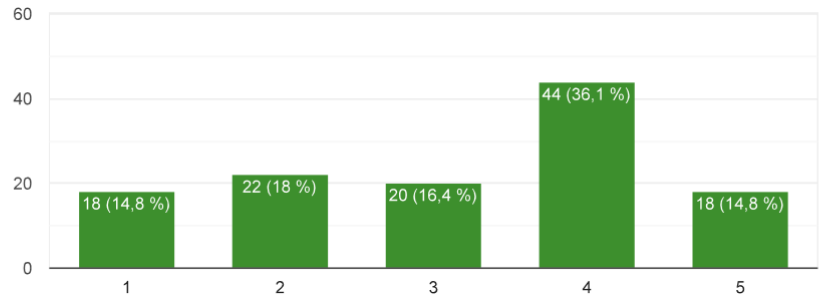
"I usually find buying a new phone easier and/or more convenient (e.g. less costly, etc.) than having it repaired."

122 Antworten



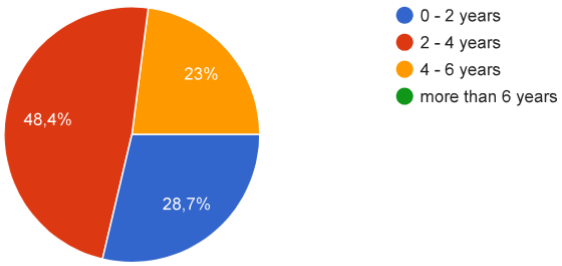
"I normally decide to replace my current phone when a part of it is defective (e.g., cracked screen, broken camera, etc.)"

122 Antworten



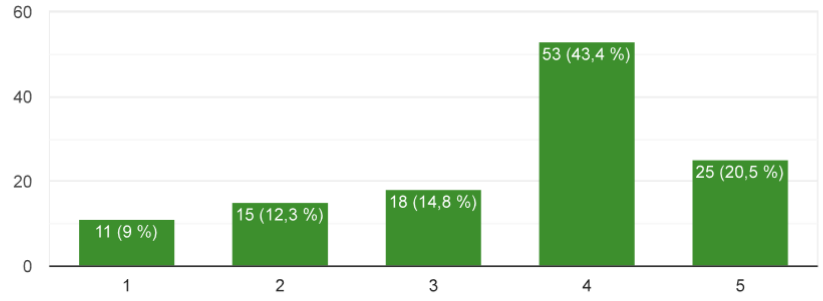
How long would you normally expect your phone to last?

122 Antworten



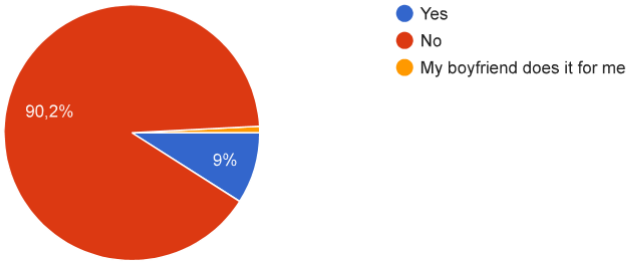
"I normally decide to replace my current phone when software updates and/or the apps I usually use require high processing power." (i.e. phone starts shutting down, takes a long time to open apps/load pages)

122 Antworten



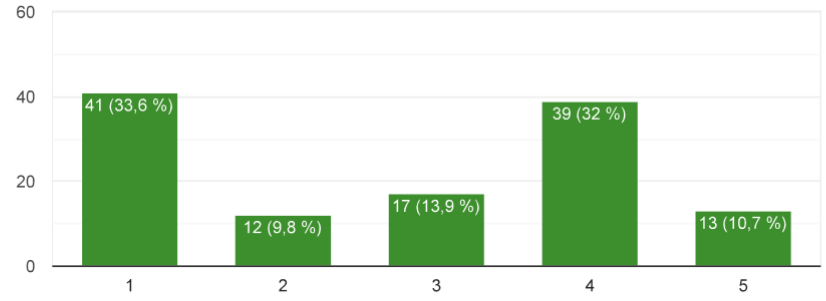
Do you check any durability and/or repairability indicators (e.g., iFixit score) before purchasing a smartphone?

122 Antworten



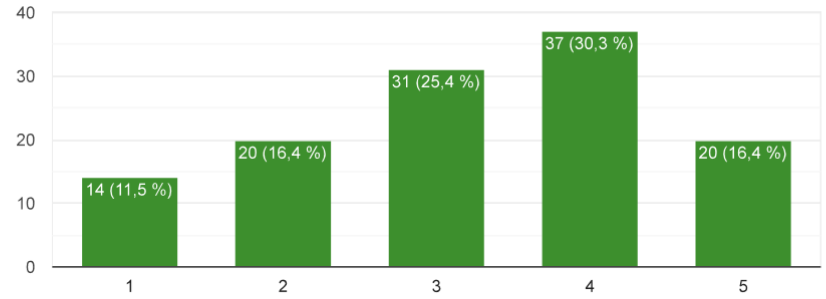
"I normally replace my phone according to the type/length of contract with my service provider (i.e., how frequently the contract allows a smartphone replacement)."

122 Antworten



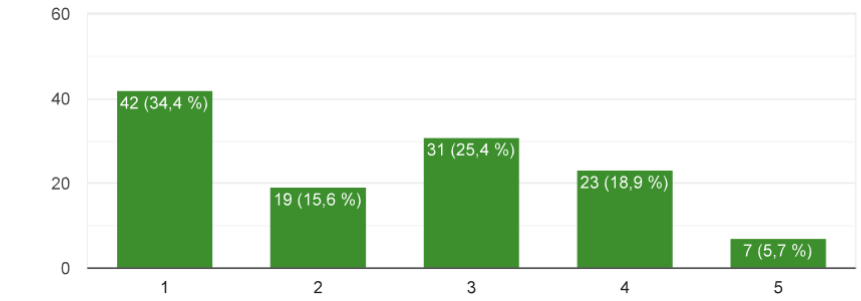
"I find it pleasant to own the most recent model of a particular smartphone."

122 Antworten



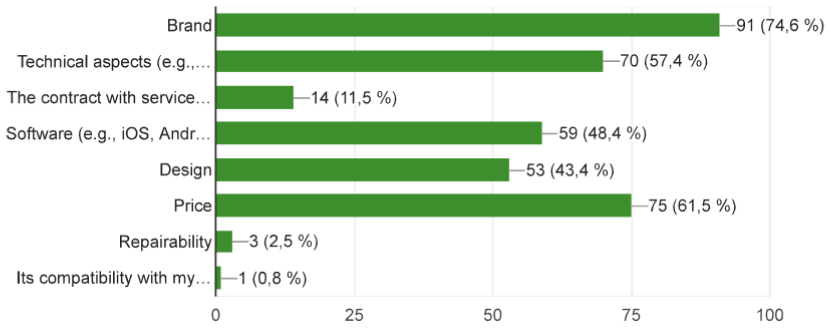
"I find it embarrassing to use an old phone when accompanied by friends/others."

122 Antworten



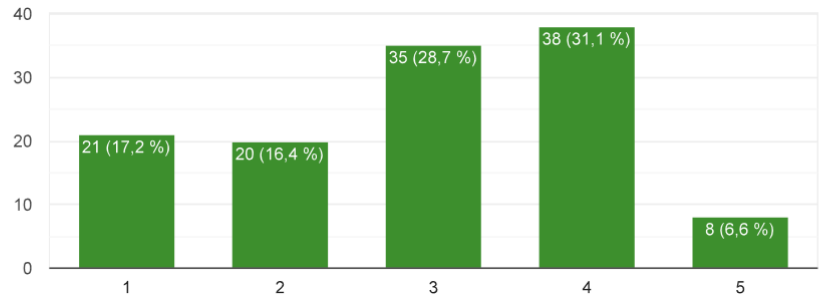
When purchasing a new smartphone, I pay attention to...

122 Antworten



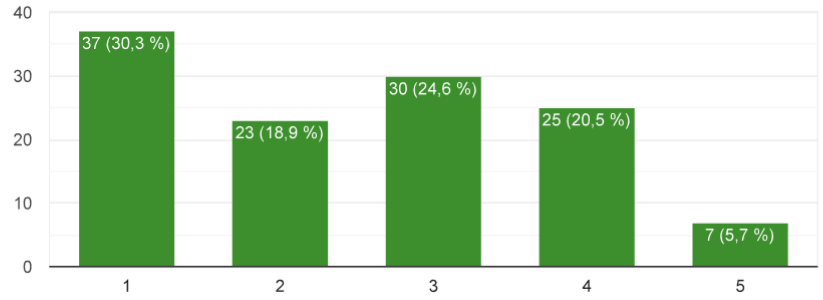
"I consider my smartphone as an important part of myself and/or who I am."

122 Antworten



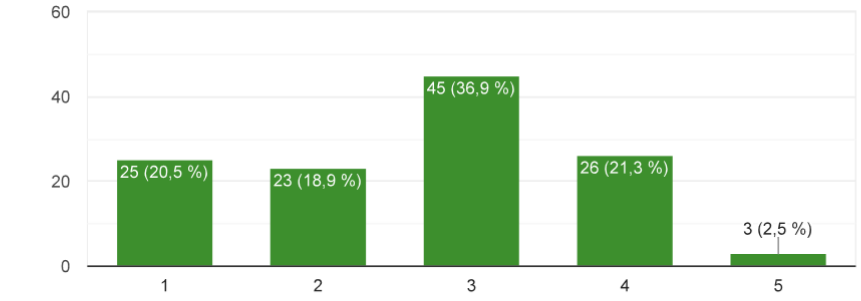
"My smartphone is an important element in how others perceive me."

122 Antworten



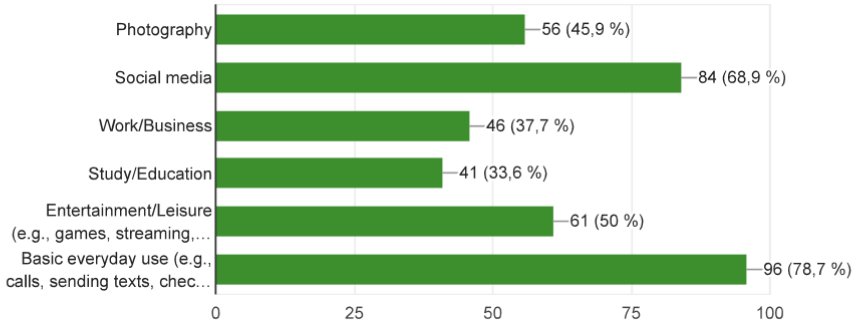
"I normally pay attention to and/or consider what type and model of smartphone others (e.g., groupmates, classmates, colleagues, etc.) are mostly using."

122 Antworten



What do you mostly use your smartphone for?

122 Antworten



Have you ever considered buying a second hand phone? Why/Why not?

84 Antworten

Yes because it has already been produced and hence its carbon footprint is lower than that of a phone which needs to be produced for me.

Quality

Yes if it's in good condition because it would be cheaper and easier

No. I prefer to get the newest one and then use it for a longer time (due to budget constraints, otherwise I would upgrade every year). I'd be afraid that a used phone might have damages or other quality issues that I cannot see during purchase. Also I like the prestige of owning the newest phone which, however, I currently cannot afford.

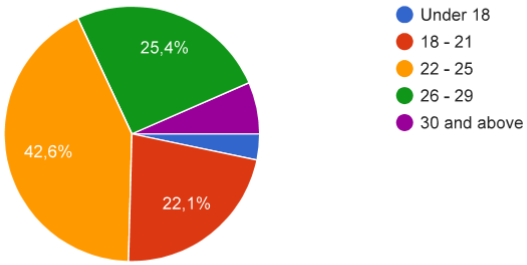
Yes. All of my phones is the past 8 years were second hand. I think a second hand phone (as long as it is in a good condition) is just as good as a new one. I also like that I can save money that way.

No

Demographic Profile

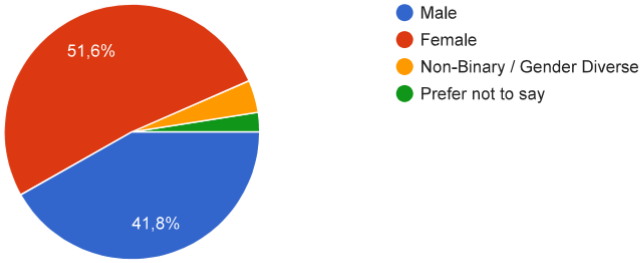
What is your age group?

122 Antworten



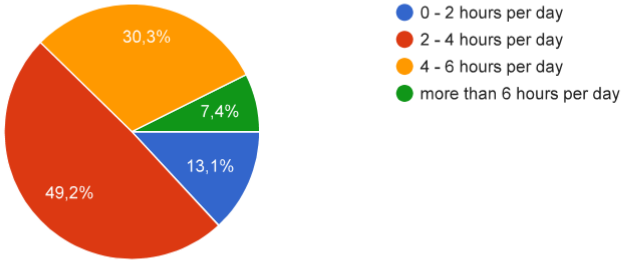
What gender do you identify with?

122 Antworten



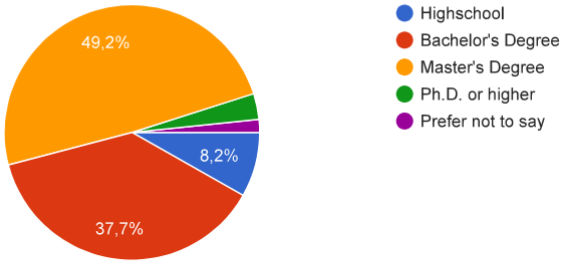
How much time do you normally spend on you smartphone?

122 Antworten



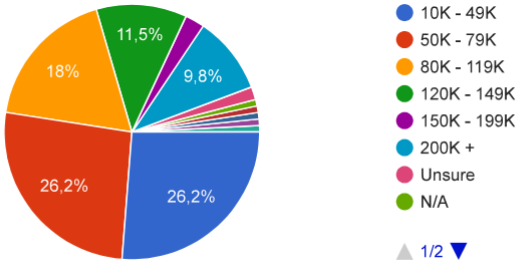
What is the highest degree or level of education you have completed?

122 Antworten



What annual income range do you identify with? (if you are being financed by family what do they identify with)

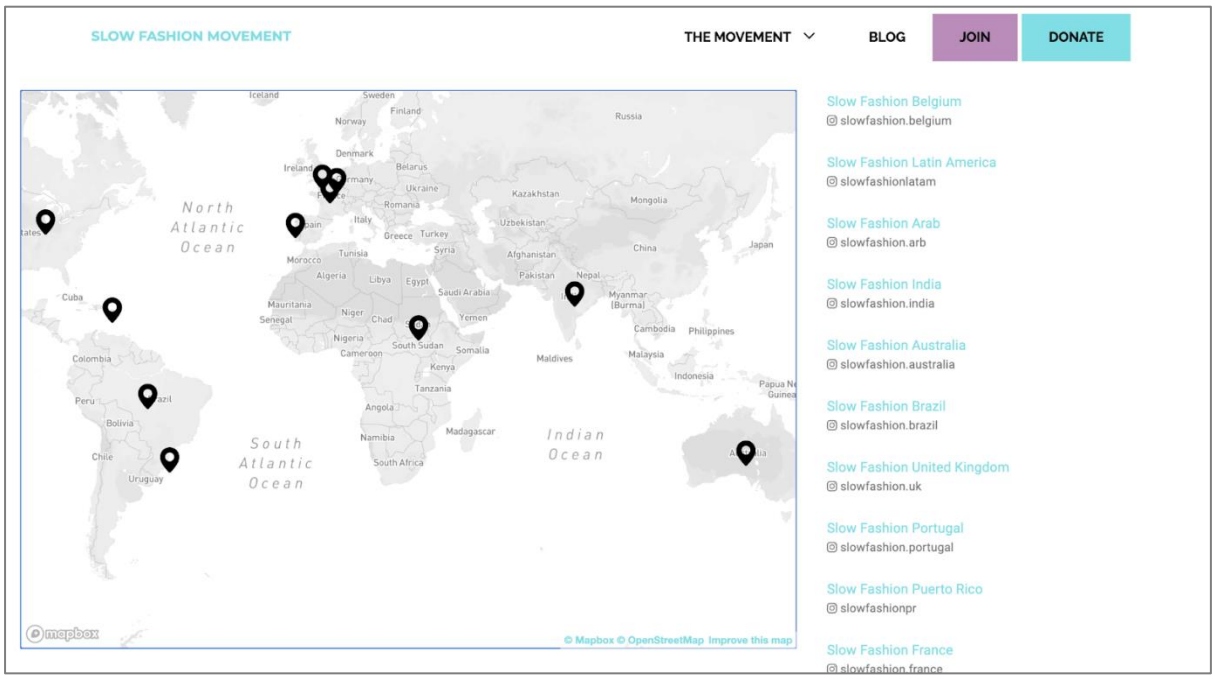
122 Antworten

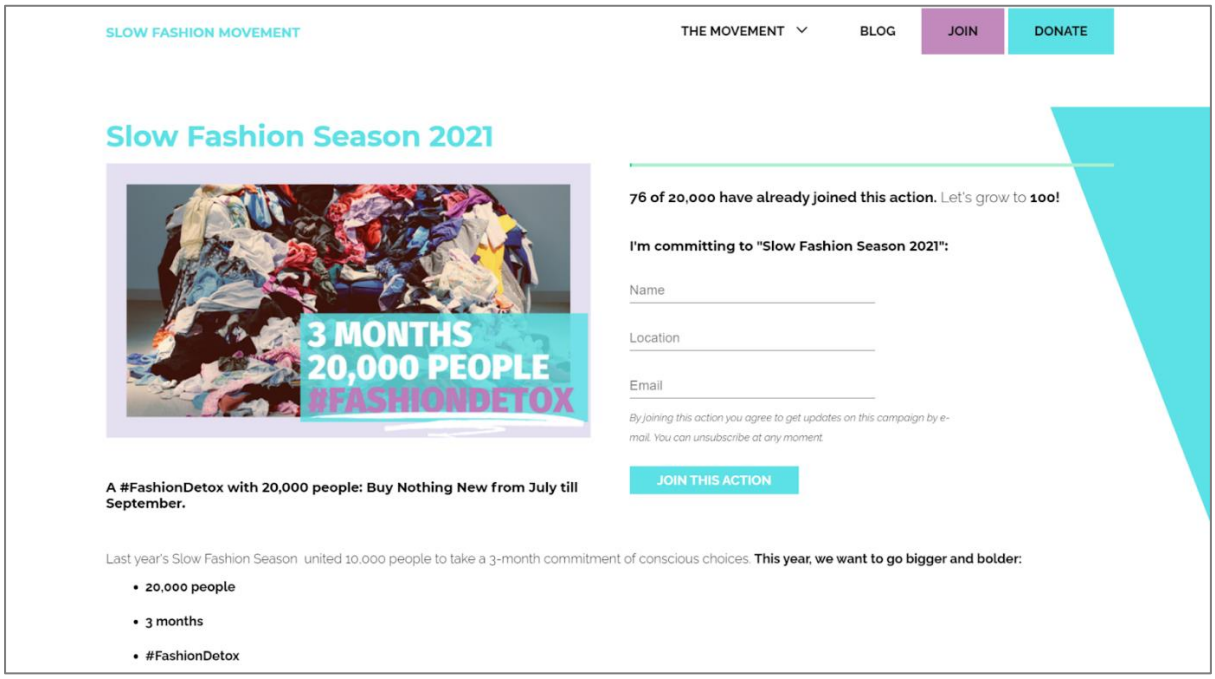


Appendix D - Aging Gracefully

Appendix D - Example of grace fully aging smartphone case (Bridgens et al., 2017)

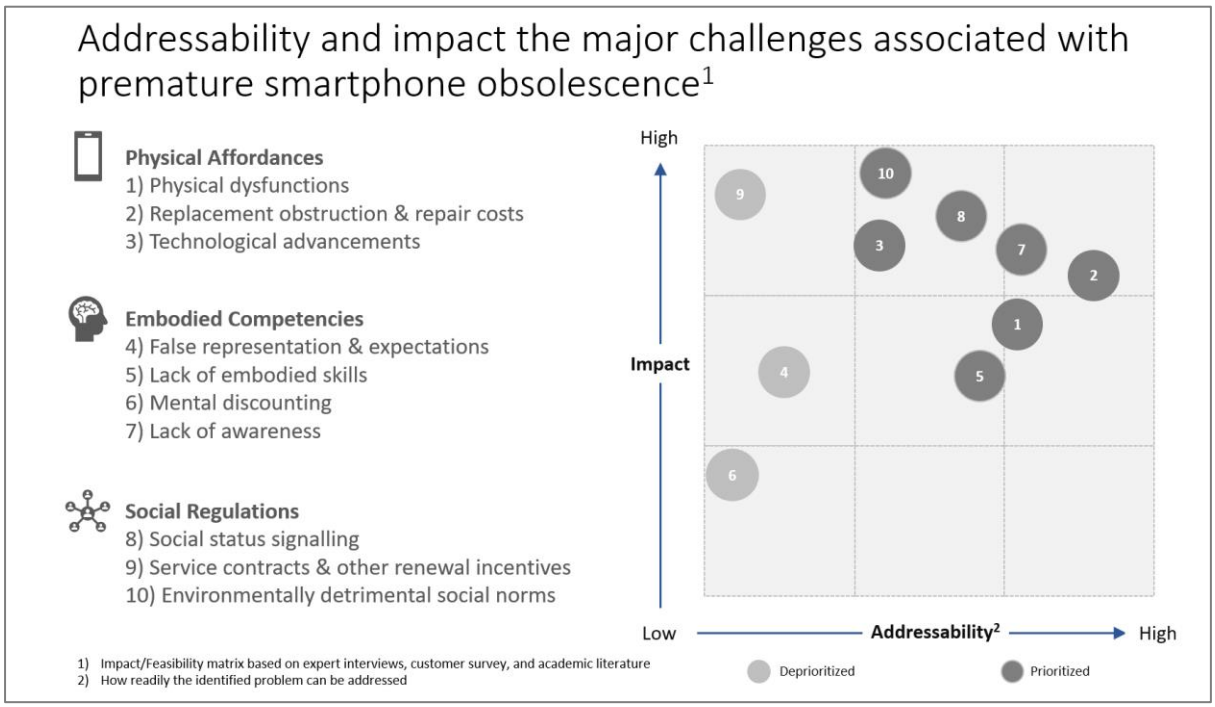
Appendix E - Slow Fashion Movement





Appendix E - Website excerpts from Slow Fashion Movement

Appendix F - Addressability/Impact Matrix



Appendix F - Identifying the most relevant challenges associated with smartphone obsolescence