



Study to support the Commission's policy development on promoting repair of consumer goods and contracts in the data economy

Part A: Extending useful life of consumer goods
Final report

Annex 2 – Explanatory note on the use of product-specific information

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1. Explanatory note on the use of product-specific information in the study

The main study was based on evidence collected on a selected number of consumer products which were deemed to be representative. This product selection was used across all the data collection activities carried out:

- Secondary (literature review, desk research)
- Primary (consumer survey, business survey, mystery shopping, behavioural experiments)

In order not to overlook any relevant product types, a horizontal approach was chosen, i.e., different product types from all relevant product groups were considered for research. Focusing on a selection of consumer products ensured that the data collection and analysis could be carried out with the required level of specification and granularity. Therefore, in the first step, the most relevant and representative product categories in terms of frequency of purchase and potential to generate significant environmental impacts were identified by analysing relevant policy instruments related to the EU's circular economy objectives.

The main study presents the horizontal findings across all product groups, mentioning where relevant differences and similarities between different product categories. The products selected for in-depth data collection were the following: Mobile phones/smartphones; Televisions; Refrigerators; Laptops; Clothing; Shoes/footwear; Cars; and Wooden furniture. The full rationale and method used for the product selection is presented in Annex 1 of this study.

While the results of the primary data collection activities are also presented at product-level in the main study and Annex 1, the results of the literature review are only presented in a horizontal manner in the study, which highlights the main findings stemming from the exercise. Following the product-level assessment on the problem definition and the market analysis of the repair sector, the results were extrapolated and analysed in a horizontal manner.

The next paragraphs provide key takeaways regarding product-level insights stemming from the literature review for the study's problem definition and market analysis.

Problem definition

Regarding the problem definition, the results of the product-level research shows that different factors contribute to the phenomenon of premature disposal of consumer goods (see Chapter 3 of the main study). In this regard, relevant scientific literature indicates that it is difficult to draw general conclusions concerning relevant factors across different product categories because depending on the type of product various factors can affect premature disposal. The problem analysis has, to a considerable extent, been based on insights from product-specific assessments for eight different product categories. Insights concerning these product categories resulted in more general indications concerning the problem of premature disposal.

Table 1 - Overview of the problem of premature disposal in the product categories assessed

Product	Is there a potential problem of premature disposal?
Mobile phones/Smartphones	<p>Yes.</p> <p>Data suggest that the average consumption lifetime of smartphones has decreased over the last decade. Smartphones are often subject to replacement although they still function. Besides other factors, this behaviour contributes to a discrepancy between the absolute lifetime and the consumption lifetime of smartphones. This discrepancy indicates that premature disposal represents a relevant problem in the case of smartphones.</p>
Televisions	<p>Yes.</p> <p>While the sales numbers of televisions are increasing, their average first-use period reveals a decreasing tendency. This can mainly be attributed to the fact that a large share of televisions is disposed of despite still being functional. Furthermore, televisions are rarely repaired and purchasing a new device in the event a failure has become more customary than in the past.</p>
Refrigerators	<p>Yes.</p> <p>Refrigerators have a relatively long absolute lifetime. However, data suggests that the consumption lifetime of refrigerators might be significantly lower than the absolute lifetime. Thus, a considerable number of refrigerators is disposed of before having reached the end of their absolute lifetime. Furthermore, high repair costs seem to represent a main barrier to repair.</p>
Laptops	<p>Yes.</p> <p>Data shows that a large share of laptops fails within the first service years due to malfunctions and/or accidents or are replaced despite being functional. As a result, laptops often have a very short consumption lifetime. Repair is limited especially due to the integrated design of laptops and the high repair costs.</p>
Clothing	<p>Yes.</p> <p>As a result of the 'fast fashion'¹ business model, clothing is produced for a small price leading to cheap quality and a short absolute lifetime. Moreover, the consumer behaviour also contributes to such a short consumption lifetime. Therefore, the phenomenon of premature</p>

¹ The EU Strategy for Sustainable and Circular Textiles defines fast fashion as trends of using garments for ever shorter periods before throwing them away and that contribute the most to unsustainable patterns of overproduction and overconsumption. More information at: https://eur-lex.europa.eu/resource.html?uri=cellar:9d2e47d1-b0f3-11ec-83e1-01aa75ed71a1.0001.02/DOC_1&format=PDF

Product	Is there a potential problem of premature disposal?
	disposal is highly relevant in the case of clothing. In addition, the repair rates in the case of clothing are low.
Shoes/Footwear	<p>Yes.</p> <p>Although there is a lack of data on the absolute and consumption lifetime of shoes and footwear, there are indications that the consumption lifetime is decreasing and that a significant share of shoes is disposed of before having reached the end of their absolute lifetime. Similar to clothing, the 'fast fashion' business model contributes to the premature disposal of shoes and footwear.</p>
Cars	<p>No.</p> <p>Even if clear evidence is not available, data indicates that both the average age of cars in use and the average age of End-of-Life Vehicles (ELV) tend to increase. Premature disposal of cars may be an issue at least in some cases however, considering the consumer propensity to repair, this problem is less relevant for this product group. Repair and second-hand car markets seem to gain more importance.</p>
Wooden furniture	<p>Yes.</p> <p>for products made of lower quality. In low-cost furniture, solid wood is replaced with other cheaper wood-based materials like chipboards and medium density fibre boards (MDF). The use of cheap wood replacements affects the strength and quality of furniture items, thus reducing the absolute lifetime of the products. Typically, lower quality products are poorly designed, not robust enough and not intended for disassembly and reassembly.</p> <p>No. for products of high quality. Solid wooden pieces of furniture, if well designed, constructed, and maintained, may last almost indefinitely.</p>

Market analysis of repair services sector

The main study presents the market practices and value chains in the repair services sector, extrapolating product-level results to the whole economy. At the beginning of the research process, the study focused on a selection of products in order to focus the research. The product-specific results are presented in this annex while horizontal results are presented in Chapter 4 of the main study.

The product-level analysis found that for all eight products selected for the purpose of this study, repair and reuse structures exist. Refurbishment (i.e. resale after functional and aesthetical reconditioning) is common in the electronics sector (mobile phones, TVs, and laptops) and emerging in the clothing and furniture sector. Self-repair is partly performed for clothing, whereas for electronics professional repair services are typically used. Many repair activities are still very expensive, e.g. the replacement of a mobile phone screen. However, as the screen is one of the parts which is most likely to break down, it is also repaired relatively often. When a product shows a defect that was present since delivery within the legal guarantee, the claim can be made towards the seller. However, in practice the legal guarantee often overlaps with the commercial guarantee offered by the manufacturer. In these cases, the seller directs the repair to the manufacturer or to sub-contracted repairer networks. In-house repair from manufacturers is rare today; however, the manufacturer pays the repair under the guarantee and provides the spare parts. Due to expensive

logistics and repair costs, manufacturers and sellers often prefer replacement over repair.

When the product breaks outside the legal guarantee, consumers must bear the costs of the repair. Therefore, consumers can either acquire a commercial guarantee which gives additional protection outside the legal guarantee or repair the product at their own cost. If the manufacturer offers repair beyond the guarantee, they might use the same infrastructure as under the guarantee to provide repair. Outside guarantees, consumers can perform self-repair, visit a repair café, or turn to an independent or an authorised repairer. Local repair shops seem to be the consumers' favourite option (between 25% and 53% of consumers prefer it, depending on the product). Smaller defective products repaired (e.g. phones, shoes etc.) are normally mailed in or carried to a repair shop. Larger products (e.g. refrigerators) are inspected and repaired by a technician coming to the consumer's premises.

For certain products (e.g., shoes, refrigerators) the amount of repair activities has decreased over the last few years, whereas repair activities for electronics increased. The analysis of general Eurostat market data according to categories defined in NACE Rev.2 (e.g., repair of consumer electronics) confirmed that in some repair sectors the number of repair companies decreased (e.g. in the case of repair of footwear and leather goods), whereas in other sectors an increase was observed (e.g. for 'other personal and household goods' such as bike repair). Although the repair market seems to have been quite stable over the last 10 years, before 2014 a decline, and after 2014 a slight recovery could be observed. The turnover of the repair sector (including automotive sector) reached a peak in 2017 and was slightly declining in 2018. Many barriers are still hindering the development of a fast-growing repair market. According to stakeholders, one of the most striking barriers is the non-availability of spare parts. As manufacturers are not obligated to make spare parts available for every product, especially independent and DIY repairers are suffering a lack of spare parts. Moreover, the price and the delivery time of spare parts are barriers to a convenient repair.

The results of the impact assessment are also based on the product selection. The collection of data was firstly done at product level, while the results of impacts were extrapolated to the whole economy, by using an extrapolation method (see Annex 3 for more results).

Explanatory note:

The following sections are based on a working document containing product-specific literature review. This preparatory work supported the choice of the product sample and fed into the main report of the study. As the *Impact Assessment Accompanying the document Proposal for a Directive of the European Parliament and of the Council on common rules promoting the repair of goods and amending Regulation (EU)*² (impact assessment) was published

² COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT REPORT
Accompanying the document Proposal for a Directive of the European Parliament and of the Council on common rules promoting the repair of goods and amending Regulation (EU)

prior to the approval of the final report of this study, it contains references to the working document, which eventually was summarised in Annex 2 and fed into the main report. The respective sections referenced in the impact assessment are reproduced below for the purpose of transparency.

2017/2394, Directives (EU) 2019/771 and (EU) 2020/1828 {COM(2023) 155 final} - {SEC(2023) 137 final} - {SWD(2023) 60 final, Brussels, 22.3.2023 SWD(2023) 59 final.

2. Additional information on problem aspects and drivers per product category

2.1. Additional information on mobile phones/smartphones

Technical drivers

Material obsolescence:

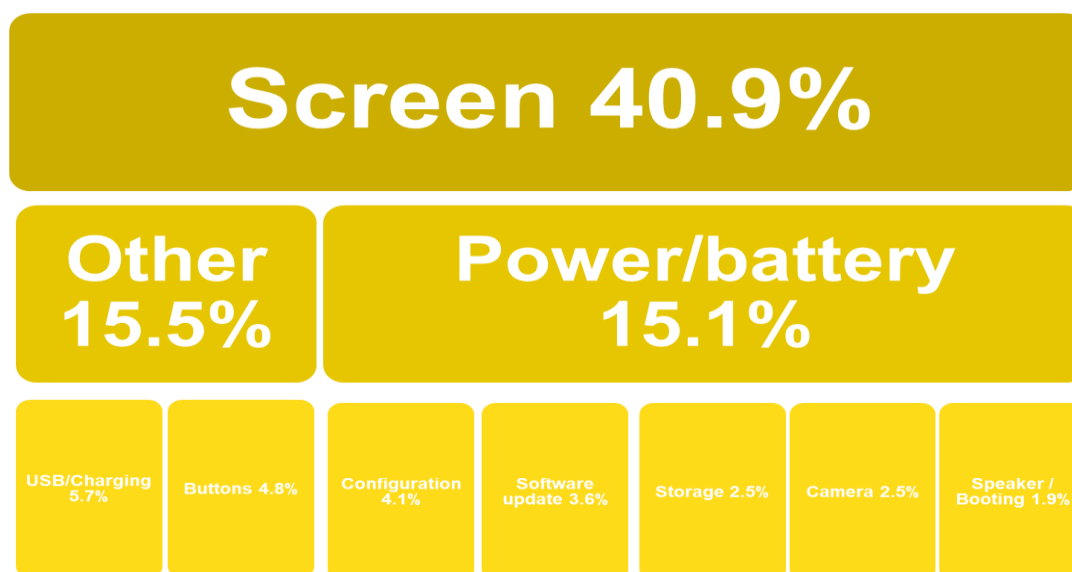
Material obsolescence refers to an insufficient performance of materials and components. Typical defect components for phones include the display unit, battery, audio control and power button cable³, the power button, the rear camera, the earphone socket or the loudspeaker (Prakash et al., 2019).

Technical defects, including low battery or keys that have fallen off, represent one of the main reasons (approximately one third of replacements) for replacing smartphones (Wieser, Tröger, 2015). Figure 1 **Error! Reference source not found.** shows main phone defects that were examined during community repair events (Open Repair Alliance, n.d.). Malfunction and damages account for approximately 40% of replacements, but are not the sole reason for discarding mobile phones (Watson et al., 2017). Many failures are reported to occur within the first two years of use, problems related to battery (42%) and the operating system (14%) being most prevalent (Cordella et al., 2020). For the example of iPhones, besides broken batteries, a broken display unit, power button and home button have been identified as main reasons for repairs (Prakash et al., 2019). As batteries have a strong impact on mobile phone lifetimes, they will be analysed in more detail in the following paragraph.

Technical-mechanical defects are thus considered as the most common reason for the end of use of a mobile phone. However, restricted functionality does not necessarily mean that a phone can no longer be used (Tröger et al., 2017), so material obsolescence is often not the sole reason for replacing a mobile phone.

³ The power button cable connects the power button to the motherboard when pressed in order to start up the phone.

Figure 1 - Main defects on phones (Analyse of 1900 repairs of smartphones at community repair events)



Source: Open Repair Alliance

Batteries: Concerning defects, for the example of the iPhone, batteries are most likely to be in need of repair or replacement; besides, the display unit, power button and home button seem to be the main components that often have to be repaired (Prakash et al., 2016). Thus, the exchangeability or replaceability of batteries might be decisive for a longer use of a smartphone. The estimated share of mobile phones with permanently installed batteries has grown steadily between 2010 and 2013 and was estimated at almost one third of all mobile phones sold in 2013. Smartphones with batteries that are not interchangeable and of poorer quality may be replaced more frequently (Prakash et al., 2016). As many smartphones have built-in batteries that are expensive to replace or repair and last around 2 years, those batteries restrict their lifetime in advance. This is coherent with findings from an evaluation of various iPhone models, showing that batteries are by far the most frequent reason for a repair or replacement (Prakash et al., 2019). Being designed for making repair inviable, non-removable batteries lead to so-called planned or programmed obsolescence (Aladeojebi, 2013; Bachér et al., 2020). Another issue is that even if consumers were willing to repair their devices, a high number of repairs is unsuccessful (Laitala et al., 2021).

Functional obsolescence

From a technical perspective, frequent replacements can also be due to technological improvements, regular upgrade offers within contracts, consumers being forced to regularly upgrade hardware due to new incompatible technologies and processing demands of the latest technologies (EEB, 2019).

Functional obsolescence is mostly due to changes in technical and functional requirements, often driven by software-induced factors (Manhart et al., 2016).

Software support: Functional obsolescence takes place when the functionality of a device is decreasing, which becomes for example noticeable through slower “reaction” of the device, often due to increasing demands on technology. Often, when new models are launched by mobile phone producers, they no longer provide regular updates for previous models. The fact that older product models often do not support recent software upgrades can be a reason for faster replacement of devices (Bakker, C., & Schuit, 2017). A shorter support period for operating systems will also lead to a faster replacement due to a lack of compatibility with new applications and less protection against viruses (Tröger et al., 2017). In case of smartphones using Android, the support period vary between 2 and 3 years, i.e., many smartphones do not run the most updated version of the OS (Cordella et al., 2020). Thus, the offering of software support by manufacturers, has an impact on the functional lifetime of mobile phones, and a lack of updates could make smartphones with fully functioning hardware obsolete (Cordella et al., 2020). If new operating systems are not compatible with the hardware performance of older devices, those will likely be discarded even if they are still technically functioning (Manhart et al., 2016). Thus, new incompatible technologies and technological innovation lead to shorter lifetimes of mobile phones (EEB, 2019).

Technological progress: A major factor that leads to increasingly shorter replacement cycles is the rapid technological progress of mobile phones, whether perceived or real (Laitala et al., 2021). Technological developments lead to obsolescence and thus replacement of smartphones in two ways: on the one hand, the relative performance compared to newer models decreases, and on the other hand, the fact of a previous model not being the most recent one becomes increasingly apparent due to frequent design changes of new models (Tröger et al., 2017). Thus, technological and psychological drivers also seem to be interlinked, and it is rather the higher functionality offered in newer versions, rather than the functional lifespan, that drives the lifespan of a device down (Bakker, C., & Schuit, 2017).

Use intensity: The use patterns, which strongly vary between young and old people, lead to differences in the use-time of the phone. Phones that are used more intensely wear out more quickly. This has been found to be mostly the case for young people, who use their phones on average more than 4 hours per day. Additionally, mobile phone users regularly have to change to a newer model if they want to use a large number of recent apps, frequently because of limited memory capacity (Tröger et al., 2017). The increasing use intensity and variety of functions offered by smartphones compared to standard mobile phones may also be a driver for a more frequent need to repair or exchange the batteries (Prakash et al., 2019).

Mobile phone contracts might be another factor distorting the users' perception of a phones' useful life, making them accustomed to the regular replacement rhythm of around 2 years (Tröger et al., 2017). In Germany, mobile phone contracts usually cover a 2-year period. The duration of these contracts correlates strongly with the period of use, as users often get a new model when signing a new contract, while the old phone is taken out of service (Prakash et al., 2019). Through regular upgrade offers in their contracts, offering free phones or discounts, service providers thereby incentivize users to change their phones

more frequently due to their business model (Bakker, C., & Schuit, 2017). Often, the seemingly low purchase prices of smartphones compared to the total contract costs, which are however hidden in monthly overall contract costs, create an incentive for consumers to exchange their devices faster (Manhart et al., 2016).

2.2. Additional information on televisions

Technical drivers

Material obsolescence

An analysis of Prakash (2016) has shown that for televisions the main causes of material obsolescence are related to the:

- Display/screen unit;
- Power supply cord;
- Aluminium electrolytic capacitors; and
- Damage to sensitive components caused by transport.

Additionally, other components, such as the motherboard, may also fail (Prakash, 2016). Inadequate heat sinks may also cause overheating and the consequential failure of components. In the case of broken LCD (liquid-crystal display) screens that are repaired by manufacturers, the latter often provide their customers with a new television (TV) to meet their desire for a quick service, only subsequently refurbishing the old TVs and giving them a second life (Osmani et al., 2013).

Functional obsolescence

Instead of material defects, faults related to software are seen as the main cause for failure of televisions (Prakash et al., 2019). Functional obsolescence of televisions is often caused by software-related faults. Due to the rapid development of newer TV formats including improved resolution, new functions and a lack of uniformity of transmission standards, older televisions may become obsolete more quickly. The frequent development of new formats (standards) leads to functional obsolescence because as a result, the TVs lack hardware (transmitter and receiver) chips capable of reading the corresponding new formats or reproducing the broadcast content in the desired quality (Prakash et al., 2019). As old receiver chips are often not capable to process the bandwidth of new formats, the hardware becomes obsolete, which leads to a shorter lifetime of the television.

New functions, such as the development of hybrid TVs which have a built-in Internet interface, lead to significantly higher software demands. Thus, a lack of

upgradeability of relevant hardware components can reduce the overall lifetime of televisions (Osmani et al., 2013). While smart TV manufacturers usually offer software updates, they might still become obsolete when updates cannot be installed due to insufficient pre-installed memory (Sanfelix et al., 2019). Also, the significant increase in the source code of smart TVs may lead to a lack of testing of the entire code, which may induce more frequent software errors as a consequence (Prakash, 2016; Prakash et al., 2019). Due to the increasingly high performance required from televisions, new contents and functions may lead to the fact that a TV set reaches its limits faster if its software is not modular and its memory not scalable (Prakash et al., 2019). The fact that each manufacturer uses a different transmission standard can also induce that a televisions' use is limited to a certain geographical region, meaning that it has to be replaced if the user moves to another region (Prakash et al., 2019).

Finally, the fact that streaming service providers, such as Netflix, can decide to end support for older operating systems, may make some smart televisions obsolete after only five years (Bachér et al., 2020). Smart TVs might already after a few years not be compatible anymore with the most common video streaming apps, which then turns them into non-smart TVs (Sanfelix et al., 2019).

2.3. Additional information on refrigerators

Technical drivers

Reliable data on the causes of refrigerator failures during the first few years of service life is only available to a limited extent (Boulos et al., 2015). The most commonly occurring problems concern the following components (Boulos et al., 2015):

- thermostat;
- refrigerant tubing and joints;
- compressors;
- defrost heaters (and controls);
- door seals;
- thermistor;
- door hinges; and
- fan motors.

The list indicates that relevant failures which lead to the replacement of a refrigerator can be of a technical, cosmetical or user convenience nature (Boulos et al., 2015).

In the case of refrigerators, consumers consider the basic functionality more important than technological innovation (Glöser-Chahoud et al., 2021). However,

literature suggests that also for refrigerators technological obsolescence⁴ might play a role. According to Gutiérrez et al. (2011), 5 % of respondents to a survey carried out among Spanish households declared that technological obsolescence has been the reason for replacing their refrigerator. Moreover, a considerable number of consumers is replacing their refrigerators although the old one is still functioning. One technological driver contributing to the obsolescence of large household appliances including refrigerators is the improved energy efficiency of new appliances (Prakash et al., 2016).

A further technical aspect which needs to be considered are the developments towards “smarter” household appliances such as smart refrigerators which include complex electronics (WRAP, 2017). This could lead to further hardware or software problems as an example of a broken application programming interface in Samsung refrigerators shows (Montello, 2020).

In addition, a study by Nishijima & Oguchi (2021) demonstrates that consumer's expected product lifetime⁵ directly relates to the actual product use duration. By doing an experiment with refrigerators Nishijima & Oguchi (2021) showed that when increasing the expected product lifetime by 1, 2 and 3 years the actual product lifetime of a refrigerator extends respectively by 0.52, 1.05 and 1.59 year. Thus, expectations on the product lifetime are an important factor affecting the consumption lifetime of a product.

2.4. Additional information on laptops

Technical drivers

Laptops contain many electronic components which could fail, which increases the risk of functional or material obsolescence (Prakash et al., 2019; Sands, Tseng, 2009). Failures can be due to hardware malfunctions and due to accidental damages. Thus, the main reasons for failures are reported to be (Cordella et al., 2019; Prakash et al., 2019; Sands, Tseng, 2009; Tecchio et al., 2018):

- Mechanical wear and tear;
- Thermal problems;
- Poor design; and

⁴ Technological obsolescence occurs when a product is no longer used or needed even though it still works, often due to a new version of the product having become available.

⁵ The expected product lifetime refers to the consumers' expected product lifetime, and the gap between the expected and actual product lifetimes can be recognized as the product lifetime extension that could potentially be achieved.

- Improper handling.

The components that are most frequently damaged or broken as reported by Tecchio et al. (2018) are:

Screen;

Keyboard;

Hard disk drive or solid state drive;

Battery;

AC adapter;

Ports or connectors;

Trackpad or pointing device;

System board; and

Optical drive or PV card slot.

Further data indicates that the battery, the screen and the storage drives are the components which fail most often (Cordella et al., 2019). Special attention must be paid to the battery life. Accordingly, a study by the International Data Corporation (IDC) revealed that 68 % of respondents consider their laptop's battery life to be insufficient and 22 % reported that they had to purchase a replacement battery during the lifetime of the laptop (IDC (2010) as referenced in Tecchio et al., 2018).

Functional obsolescence can also be driven by innovations, new features, functionalities and interfaces (Hennies, Stamminger, 2016). Since laptops are subject to short innovation cycles, there is a risk for premature disposal (André et al., 2019; Bakker et al., 2014). Although literature indicates that the innovation cycles for laptops are slowing down, i.e., the risk for technological obsolescence is decreasing, possibilities for upgrading certain laptop components are still lacking which is negatively affected a laptop's lifetime (Oldyrevas, Catriona, 2020). Laptops often show a lack of upgrade possibilities due to several aspects such as the challenges associated with the replacement of spare parts (e.g. the battery) (Oldyrevas, Catriona, 2020). According to the study carried out by Hennies & Stamminger (2016), 26 % of respondents reported functional obsolescence⁶ as reason for the laptop's disposal.

Another technical driver contributing to premature obsolescence of laptops concerns software and firmware constraints (Oldyrevas, Catriona, 2020). Old laptops might not be able to fulfil the minimum requirements of new operating

⁶ In this study, functional obsolescence referred to the following answers: "I was not satisfied with the features" and "The resource efficiency of the appliance was not satisfying" (Hennies, Stamminger, 2016).

systems and new operating systems and programmes might slow down the device and prevent an effective operation (Oldyrevas, Catriona, 2020). Furthermore, relevant software or firmware e.g., for the protection against viruses might be no longer available in case the support for older operating systems is discontinued resulting in premature replacement of laptops (Oldyrevas, Catriona, 2020; Prakash et al., 2019). Furthermore, the potential for repairing or upgrading certain components of laptops is limited since the warranty of many producers voids if seals are broken (Oldyrevas, Catriona, 2020). It can be assumed that these factors could also contribute to the premature disposal of laptops.

Based on the descriptions above, it can be concluded that technical drivers strongly influence the consumption lifetime of laptops. In particular, technical drivers contributing to premature obsolescence of laptops are i) failure or lack of performance of certain components, ii) short innovation cycles and a lack of upgradeability and iii) software and firmware constraints.

In this context, it should be noted that a recent publication by Oldyrevas & Catriona (2020) emphasises that the EU instruments for Ecodesign and energy labelling requirements could significantly contribute to prolonging the life time of laptops and therefore reducing associated environmental burdens. To this end, Oldyrevas & Catriona (2020) have formulated several recommendations focusing on aspects such as replaceability and upgradability of priority parts, battery durability, provision of information on Ecodesign aspects for consumers.

2.5. Additional information on clothing

Technical drivers

High quality means durable materials and high manufacturing quality. The ageing process of a pleasant, aesthetic garment requires not only maintaining high quality but also the use of durable materials. Some textile materials look old after a short use, because the material might experience pilling or may look old after a few washes. Garments needing frequent washing may look old rather quickly. Recognising materials that age in a more aesthetically pleasing manner is therefore important. Studies have shown that consumers experience e.g., wool and real leather to age in an aesthetically pleasant way. With high quality wool the ageing process does not show as obviously and in leather the ageing process is experienced as an attractive upgrading (Niinimäki, 2012).

Psychological drivers

Among behavioural factors that influence the use phase are the different standards and habits, such as the amount of washing cycles and temperature the laundry is washed in, in different countries and for different garments. A reason for different maintenance of clothing items can be due to consumers not reading the maintenance guidelines provided by the producer, or to the type of fibres in the product. If several fibres are combined in a textile, consumers are not sure

how it can be cleaned, e.g. chemical laundry or washing machine (Gwozdz et al., 2017). The number of cleaning cycles is thus connected to the physical lifespan, but also to consumer laundry habits such as cleaning frequency, detergent use and following the washing instructions for proper maintenance. The chosen detergent depends on consumer behaviour and the availability on the market (Klepp et al., 2020). In general, products associated with pleasure are more likely to be taken care⁷ of rather than products that are less comfortable to wear or do not fit properly (Ackermann et al., 2018).

2.6. Additional information on shoes and footwear

Technical drivers

Although no information referring specifically to shoes could be identified, it can be assumed that, similar to clothing in general, materials used in the footwear industry might look old after a relatively short use period (Niinimäki, 2012). In this context, data indicate that poor appearance and wear and tear are important reasons for the disposal of shoes (Luximon, Jiang, 2016). At the same time, Fletcher et al. (2012) point out that, in comparison with other consumer goods, new fashion products rarely offer a better functionality. Therefore, it can be assumed that functional obsolescence in the case of shoes does not play a significant role.

Maintenance

Although not specifically referring to shoes, a study by the European Commission (2018) highlights that providing information to consumers on the treatment of fibres and fabrics could significantly improve their durability. As regards shoes, it can therefore be assumed that proper maintenance could reduce the number of shoes disposed of due to for instance, poor appearance (material obsolescence).

2.7. Additional information on cars

Technical drivers

⁷ In the context of the study of Ackermann et al. (2018), the term 'product care' was defined to clarify 'taking care of a product': The term product care 'does not only include repair and maintenance, but all activities initiated by the consumer that lead to the extension of a product's lifetime. These activities can be executed by the consumer him/herself or by a service.'

With regard to the lifetime mileage of cars, Weymar & Finkbeiner (2016) point out differences depending on the **engine type and vehicle segment**⁸. Car manufacturers use different approaches in their Life Cycle Assessments (LCAs), e.g., Volkswagen supposes 150,000 km or Daimler applies a different lifetime mileage for LCAs depending on car segments (A-Class: 160,000 km, CLS-Class: 250,000 km, S-Class 300,000 km). The study of Weymar & Finkbeiner (2016) shows that the lifetime of cars with an Otto engine is in every segment 18 years, while the mileage driven at the end of life varies from 150,000 km (A00 segment) to 210,000 km (C segment). In contrast, the lifetime of cars with diesel engines was found to reach from 13 years (A0 segment) to 15 years (A00 and C segment) and the lifetime mileage varies from 180,000 km in the A0 segment to 240,000 km in the C segment. Therefore, it was concluded that in comparison diesel cars have shorter lifetimes expressed in years but can reach higher mileages. The authors explain that the empirical data used to estimate the end of life of a passenger car in the study is based on the time when the car is deleted from the registered stock in Germany.

Regarding average ages of ELVs it can be observed that they differ across EU Member States and that the average age of ELVs increased in recent years. **Error! Reference source not found.** below shows the corresponding developments for selected EU Member States (Potrykus et al., 2020).

Table 2 - Average ages of ELVs in selected EU Member States in 2014 compared to 2016/17

Member State	Average ELV age in 2014	Average ELV age in 2016/17
France	17.5	18.5
Germany	14-15	17-18
Netherlands	n.a.	18.1
Poland	18.7	20
United Kingdom	13.6	14.2

Source: (Potrykus et al., 2020)

Detailed information or clear evidence on technical drivers like a tendency towards more aggregated components impeding disassembly or access to spare parts could not be identified. In general, it is assumed that the potential issue of material obsolescence is very unlikely for cars since the reliability of the product is one of the main drivers for purchase. Technical failures would include many risks for car manufacturers such as potential safety risks for drivers, financial risks of recall campaigns or potential negative impacts on the manufacturers image regarding reliability.

⁸ Segmentation of passenger cars is differentiated according to vehicle size from A000 (urban small cars) over A00, A0, A, B, C, and D to E (ultra luxury) (Weymar, Finkbeiner, 2016).

2.8. Additional information on wooden furniture

The weak regulations and lack of over-arching policies on furniture allows for the market to continue with little regard to repair and reuse of products. Even though a voluntary EU ecolabel for furniture was adopted in 2009 and revised in 2017, the uptake has been minimal (European Commission, 2017). Donatello et al. (2021) attributes this to the complexity and inflexibility of the criteria, making it almost impossible to achieve.

The quality and the material of a piece of furniture influence the desire of consumers to repair it or to buy a new one. Products made of low-quality materials are more likely to be disposed of (Forrest et al., 2017). Low-cost wooden furniture may be fulfilling the short-term needs of consumer in an affordable way; however, it also causes consumers to value products less. It becomes more likely for low-cost and low-quality wooden furniture to be disposed of instead of being fixed. In the event of moving to a new house or office, low-quality products tend to be discarded thus increasing the early disposal problem (European Commission, 2019; Renda, 2014).

3. Product specific assessment of a possible phenomenon of premature disposal of consumer goods

3.1. Mobile phones/smartphones

3.1.1. Problem definition

Over the last decade, the rapid development of mobile phones has led to an almost equally rapid replacement of older devices by consumers, and thus an increasingly high turnover (Tanskanen, 2013). The use-time is nowadays strongly disconnected from the product lifespan. However, this is not only due to a throwaway mentality and the desire for new products, as commonly assumed, but also due to the fact that some consumers feel put under pressure by the rapid introduction of new models resulting from the interaction of different players on the market (Tröger et al., 2017).

Consumption lifetime

Frequent replacements, which can be due to various technical and behavioural reasons, lead to the fact that the actual consumption lifetimes of smartphones become increasingly shorter (Bachér et al., 2020; EEB, 2019). Smartphones are considered fashion electronics or 'up-to-date' products, meaning that they are often replaced before they break.

On average, the consumption lifetime of smartphones is estimated around 2 to 3 years (EEB, 2019; Manhart et al., 2016; Thiébaud (-Müller) et al., 2018; Zhilyaev et al., 2021). Other studies report even shorter lifetimes: while the designed lifetime is 2 years, their real consumption lifetime is often only 1,8 years (Bachér et al., 2020). Another study reported that average smartphone lifetimes in France, Germany, Italy, Spain and the UK in 2013 were around 18.3 months, rising to 21.6 months in 2016 (Kantar Worldpanel, 2017). An empirical study from the US with college students aged 18-21 found that the average consumption lifetime for mobile phones of this group is one year or less. Around one third of the respondents had owned 4-8 mobile phones in their lifetimes, whereby wealthier respondents had owned even more (Hanks et al., 2008).

A survey of Wieser and Tröger (2015) found that smartphones are currently only used approximately half as long as conventional mobile phones. This means that the phenomenon of premature disposal is especially prevalent for smartphones, which are often replaced before being broken, because hardware and software have to be up-to-date to operate with the newest versions of applications (Bachér et al., 2020).

The consumption lifetime of a mobile phone is determined by both the physical lifespan in a technical sense, which depends on the durability of the device, and the social lifespan, which is the time during which the phone is still considered socially acceptable. The disposal of mobile phones is often related to limited social lifespan and reasons such as fashion and product obsolescence, resulting in the high likelihood that they will be disposed of although they are still functioning (Laitala et al., 2021). According to the results of the consumer survey carried out for the purpose of this study, 21% of consumers reported to think that a defect, which results in the mobile phone or smartphone no longer functioning properly, occurs within the first year after buying the product. Almost half of the consumers (49%) stated to think that such a defect occurs within the first two years. Furthermore, 29% of consumers experienced such a defect within the last two years. Thus, the responses to the consumer survey indicate that mobile phones and smartphones frequently fail within the first year(s) of service. If the products are not refurbished or repaired, this can be expected to contribute to a short consumption lifetime of mobile phones and smartphones.

In any case, it is clear that mobile phones are predominantly replaced 'before their time' and should be (re)used for longer, although the determination of an exact replacement moment constitutes a challenge (Bakker, C., & Schuit, 2017).

Short absolute lifetime as designed by producers

A survey on consumer experiences with product breakdowns found that smartphones are amongst the most often reported products that failed prematurely, and more than 85% of the reported mobile phones were less than four years old when they failed for the first time (Thysen, Berwald, 2021).

The technological shift from feature phones to smartphones might also have reduced service lifetime even more, decreasing from around 3 to 2 years over the period from 2008-2012 (Zhilyaev et al., 2021). While there might have been material savings through the substitution of many single devices by smartphones, they have relatively short service lives because of their increasingly complex and fine structures and the growing difficulty in repairing them (Berwald, Clemm, 2020). There might also be brand differences, such as the slower technological aging of Apple products compared to other brands suggested by Zhilyaev et al. (2021), but these differences seem to be less prevalent in recent years.

3.1.2. Main drivers of the problem

1.1.1.1. Economic drivers

'Economic obsolescence' is defined as a decline in the performance of a product because necessary repair and maintenance measures cannot be implemented due to cost reasons (Manhart et al., 2016). According to a study by Tröger et al. (2017), only a third of users with a mobile phone which had a defect tried to repair it by themselves. The main reason for choosing a replacement purchase over

repair was the expected **large investment in time and costs**. According to repair statistics (clickrepair, 2019), more than two thirds of all smartphone damages are display damages mostly due to broken glass, often accompanied by a casing damage. The replacement of screens or back covers is very costly for consumers, which may motivate consumers to purchase a new device (Berwald, Clemm, 2020). The same argument is valid in the case of early failure of batteries, as complicated design, many working steps or high labour costs for repair staff may lead to the fact that batteries are not economically changeable by technical staff, and thus reduce the useful lifetime of a device (Manhart et al., 2016).

In the study of Tröger et al. (2017) many consumers stated that they would have considered a repair reasonable if the mobile phone had still been under guarantee or if they had considered the phone as still “young” and in good condition (Tröger et al., 2017). In many cases, consumers revealed that cost considerations influenced their decisions, as simply buying a new phone is generally preferred to a costly repair (Jattke, Blumer, 2020). Typical reasons for a cost-related lack of lifetime extension are the rapid price decrease for new products, short product development times, high repair costs and **insufficient availability of spare parts, tools and repair services** (Manhart et al., 2016). The limited availability of repair services is also reflected in the results of consumer survey (see **Error! Reference source not found.4**), but seems to be less relevant compared to the wish for a new model and the repair costs.⁹

Figure 2 - Reasons for not having a mobile phone or smartphone repaired¹⁰

QC6: Why did you not have the product repaired?



Source: Authors based on consumer survey exercise

The increasing prices of spare parts, accompanied by falling prices of mobile phones may also represent a barrier to lifetime extension (Türkeli et al., 2019).

⁹ Note: The answer item on QC6 was filtered and only offered in case the defect occurred within the legal guarantee period.

¹⁰ For the question ‘Why did you not have the product repaired’ several answers could be chosen by the respondent, i.e., the total percentage exceeds 100%.

According to the results of the consumer survey conducted for this study, consumers are willing to pay 27% of the original price for the repair of smartphones. If the original price of the product compared to the price for repair is relatively high, consumers will choose replacement over repair. The main barrier for consumers to engage in repairing a mobile phone is thus the **low price of new products**, leading to low profitability of repair work by businesses and low motivation by consumers to have their devices repaired (Laitala et al., 2021). In this context, the results of the business survey carried for the purpose of this study indicate that the average costs associated with the repair of the most recurrent defects in mobile phones or smartphones (mainly broken screens, bad battery life, and damaged charging parts) are approximately 99 €. In total, 23 respondents including sellers of new, second-hand and refurbished goods, repairers (authorised and independent) and refurbishers responded to this question of the survey. Furthermore, the results indicate that the length of repair is on average 3 days and ranges between 1 – 2 days (14 respondents), 3 – 7 days (6 respondents) and 8 – 15 days (3 respondents) revealing a relatively low length of repair in case of smartphones compared to other products. Considering an average price for smartphones of 373 € in Europe¹¹, the average price of repair indicated in the business survey is almost exactly in the same range of what consumers are willing to pay for repair (27% according to the consumer survey). Therefore, from an economic perspective, it cannot be ruled out that consumers decide against repair, especially in case of low-priced smartphones, where the average repair costs can be assumed to be higher than 27% of the original price. This is also reflected in the consumer survey: When asked about reasons for not having a product repaired, consumers most often mentioned the high repair costs (40%).

The business survey results indicate that the costs for spare parts (37 %) and personnel (31%) account for the largest fraction of total repair costs (based on 16 responses) indicating that high costs for these factors, and spare parts in particular, can prevent consumers from repairing their smartphones. According to the business survey, lack of spare parts is considered the main cause of irreparability of smartphones (12 respondents).

Another economic driver refers to the **product design which makes the repair of smartphones difficult**. Smartphones with batteries that are not interchangeable, combined with poorer quality regarding battery performance may be replaced more frequently due to weak battery performance (Prakash et al., 2016). As many smartphones have built-in batteries that are expensive to replace or repair and last around 2 years, those batteries restrict the lifetime of smartphones in advance. This is coherent with findings from an evaluation of various iPhone models, showing that batteries are by far the most frequent reason for a repair or replacement (Prakash et al., 2019). Being made irreparable by design or too costly to repair, non-removable batteries lead to so-called planned or programmed obsolescence (Aladeojebi, 2013; Bachér et al., 2020). Thus, the exchangeability or replaceability of batteries might be decisive for a longer use of a smartphone. The estimated share of mobile phones with permanently installed batteries has grown steadily between 2010 and 2013 and

¹¹ <https://www.statista.com/statistics/283334/average-smartphone-price-by-region/>

was estimated at almost one third of all mobile phones sold in 2013. In the consumer survey, 10% of respondents stated that the product design made the repair of the mobile phone or smartphone impossible showing that product design is an important factor affecting their repairability.

1.1.1.2. Psychological drivers

Interviews by Jattke and Blumer (2020) found that many consumers blame planned obsolescence by producers as the sole reason for the short useful lifetime of their mobile phones, and believe that it is not their individual responsibility to maximize the lifetime of their devices (Jattke, Blumer, 2020). However, psychological factors may also play a strong role in the premature disposal of smartphones.

Psychological obsolescence takes place when fashion trends, new technical trends and consumption patterns lead to the purchase of a new device. In the case of mobile phones, the **consumer preferences for new goods** are an important factor contributing to premature disposal. Accordingly, the majority of consumers seem to replace their phone after less than 3 years because they want a better device or because they regularly receive a new phone through their contract (Manhart et al., 2016). The desire for a better mobile phone, consumer preferences and upgrades lead to so-called relative obsolescence (European Commission, 2018). As launches of new mobile phone models and social expectations drive purchasing decisions, smartphones rarely reach their designed lifetimes and are disposed although they are still functioning (Bachér et al., 2020). This is supported by the results of the consumer survey. Accordingly, 27% of consumers stated that the wish for a new model as a reason for not having the mobile phone/smartphone repaired. Additionally, 8% reported that they decided against repair because they like to change mobile phones or smartphones regularly.

Thus, the early replacement of devices is driven by consumer perceptions such as attributing a high importance to aesthetic characteristics, specific functionalities and technological innovation (Glöser-Chahoud et al., 2021). Particularly in high-income countries, product obsolescence is strongly driven by psychological and behavioural factors. This “intangible utility” is depending on consumer perception of brand equity and was the most prevalent determinant for differences in life spans between products from top smartphone producers (Makov et al., 2019).

Regular replacement of mobile phones may be partially due to consumers' desire to have the latest models, driven by the continuous introduction of new phones on the market. Especially with regard to young consumers, following fashion and technology trends is essential and smartphones are used to differentiate themselves from others and display their social status. This is reinforced by advertisements praising smartphones as status symbols, e.g. through collaborations of manufacturers with fashion designers. (Tröger et al., 2017). Especially young people consider mobile phones as “fashion statements” (Katz, Sugiyama, 2006), and they are thus likely to purchase new devices due to their symbolic meaning, even if there is little change in the basic technology and

concept. The main replacement reasons for mobile phones were the desire for a better mobile phone (22.8%), the fact, that the old smartphone could not keep up with the consumers' needs (22%), and that a new phone was more attractive (14.9%) than the previous one (Tröger et al., 2017). Also, 14.2% of previous mobile phones were replaced due to upgrades offered by service providers (Tröger et al., 2017). In many cases, however, not only one factor was decisive (Tröger et al., 2017), but for young people above all, it is important to replace their mobile phones by new releases and better or more attractive mobile phones. The findings of the consumer survey also indicate that the wish for a new model is an important reason for consumers for not having a product repaired, while only a relatively small share of consumers stated that they like to change the mobile phone/smartphone regularly (8%) (see Figure 2). Although high repair costs represent the most important reason for not having a smartphone repaired according to the business survey, the wish for a new product represents an important factor as regards the premature disposal of smartphone. This supports the findings of Glöser-Chahoud et al. (2021), who state that early replacements of devices that are still functioning is often due to regular upgrades within consumer contracts, aesthetic characteristics and specific functionalities .

Manufacturers' strategies to increase sales and profits, such as frequent technological upgrades and style "facelifts" may thereby further reinforce the preference for a new smartphone (Wilhelm, 2012). Watson et al. (2017) found that the most frequent reason of all phone replacements was that consumers "want the latest phone model" (47%) or "the latest software" (13%). However, consumer expectations determine whether or not their mobile phones are perceived as up-to-date and replacement decisions are influenced by these subjective perceptions (Tröger et al., 2017). In this regard it should be noted that advertisements by mobile phone providers may influence social norms regarding the average use-time of mobile phones (Tröger et al., 2017). These findings suggest that advertising might distort customer opinion on how long a phone should be used and make them feel old-fashioned if they do not replace them regularly.

Consumer expectations concerning a product's lifespan are generally low for smartphones due to social norms and a lack of confidence in the longevity of smartphones. This also leads to the fact that consumers perceive **second-hand devices a particularly high risk purchase** due to a lack of guarantees, and thereby make new devices more attractive (Tröger et al., 2017). In general, the lifespan of mobile phones is rather driven by higher functionality offered in new phones, rather than the limited lifespan of the previous device (Bakker, C., & Schuit, 2017).

As part of the consumer survey conducted for this study, consumers were asked about the propensity to have a product repaired or replaced assuming that a defect occurred within the legal guarantee period. In the case of smartphones, 33% of respondents indicated that they would always have the smartphone replaced by the seller. 35% stated that they would probably have the product replaced, while only 8% indicated that they would always have the product repaired and 21% would probably have the product repaired. This suggests that consumers prefer replacement over repair, if a defect occurs during the legal guarantee period in the case of smartphones.

1.1.1.3. Other drivers

As technical faults are one of the main reasons for replacing smartphones, also technical drivers are relevant as regards the premature disposal of smartphones. Furthermore, besides the technological progress and the constant release of new models, also software-induced factors lead to functional obsolescence of smartphones and therefore reduce their lifetimes. In this regard, the results of the consumer survey show that electronic parts wear out, mechanical wear and tear and defects due to impact or shocks are the most frequently cited reasons for defect. Moreover, the duration of mobile phone purchase contracts correlates strongly with a smartphone's period of use.

3.1.3. Evolution of the problem

For analysing the future evolution of the problem of premature disposal of smartphones, the development of the most relevant drivers of the problem need to be assessed. This also includes analysing the influence of recent or future EU regulations on the development of these drivers. Concerning smartphones, the following relevant developments have been identified:

- There are currently 6.4 billion smartphone users worldwide and the smartphone usage is expected to continue to increase in the coming years, exceeding seven billion in 2024 before rising further to 7.5 billion by 2026 (Oberlo.com, 2021). However, the market has been changing and slowing down since 2016. Rather than bringing in new buyers, the market has shifted to replacing smartphones with newer models. The speed of smartphone innovation has slowed down and the latest technology is no longer the major driver for increasing profits. Consumers perceive a parity of product offerings and the newest technology is now available at a mid-price level (Kantar Worldpanel, 2017).
- According to stakeholder interviews, the second-hand market for electronics is growing meaning that more electronic products receive a second life. Moreover, companies are more often checking for refurbishment options when exchanging electronic equipment. At the same time, results of the consumer survey suggest that consumer behaviour concerning repair and replacement of mobile phones and smartphones will rather stay unchanged if the market for repair services continues to be as it is today.
- Based on stakeholder feedback, a general problem for ICT products is the move towards integrated designs and miniaturisation which makes repair of such products more difficult while there is no movement towards more modular design observable for the most relevant producers. In addition, stakeholders pointed out that the move towards foldable displays could lead to products being more vulnerable to failures. Furthermore, according to stakeholder feedback, 5G may contribute to the development of new services and technologies which might be incompatible with older devices. This could stimulate new purchases. At the same time, several

stakeholders indicated that mobile phones are nowadays used longer than they were 10 years ago.

- According to stakeholder interviews, market driven mechanisms alone won't solve the problem of premature disposal of mobile phones within the next decade. Only a small share of consumers today are willing to pay extra for higher quality or to avoid upgrading functioning phones for newer models. Thus, several stakeholders find that more regulation is needed in order to address the drivers of the problem e.g. by securing fast and easy repairability at low costs for the consumer. The evolution over the next decade will depend on the detailed formulation of such regulation, however none of the involved stakeholders believed premature disposal of mobile phones would cease to exist within the next decade. In addition, one of the stakeholders interviewed highlighted that Ecodesign requirements and battery endurance tests could increase the lifetime of smartphones, while it is not clear whether this will have significant effects.

In summary the descriptions above do not indicate that the problem of premature disposal of smartphones will cease to exist within the next decade. The market for new buyers is decreasing and second-hand markets are growing; however, sales are still increasing and prices for new phones are going down, making it cheaper and hence easier to stay updated with the newest phone.

3.2. Televisions

3.2.1. Problem definition

Televisions have become one of the most popular domestic products, with around 95% of households in the EU owning a television in 2017. Their sales numbers have increased constantly over the last decade (Bachér et al., 2020). The most prominent type of TVs currently found on the market are LCD televisions, also referred to as flat TVs, which have progressively replaced the previous cathode ray tube (CRT) technology (Sanfelix et al., 2019).

Consumption lifetime

The main issue that could be identified for televisions is that they are often being replaced although still being in working order, often stimulated by technological advances (Prakash et al., 2019). The average age of disposed televisions is estimated at approximately 10 years (Hennies, Stamminger, 2016).

According to Berwald and Clemm (2020), televisions are generally kept in a household or sold for second use as long as they are still functioning, and only discarded when being outdated or broken. However, another survey indicates that less than half of the disposed TVs were disposed of because of a technical

defect, over 50% of television sets must be disposed of despite still being functional (Prakash et al., 2019).

According to information provided by various TV manufacturers, the lifespan after which TVs are being replaced in the EU can range from 5 to 10 years (Sanfelix et al., 2019). A study by the European Commission found that the average lifecycle, meaning the replacement cycle of televisions is only 7 years, whereas 70% of surveyed consumers expected them to have a longer lifespan (European Commission, 2018). This is consistent with findings from another study by Echegaray, denoting this phenomenon as 'longevity gap', showing that reasonable lifetime expectations of 10 years exceeded the respondents' actual longevity experience with previously owned televisions by 2.4 years on average (Echegaray, 2016).

According to the Öko-Institut e.V. (2016), a flat-screen TV's average first-time use amounted to 5.6 years in 2012, which is only about half as long as the average use time of CRT televisions replaced at the same time (Prakash, 2016). Prakash et al. (2019) also noticed that replaced flat-screen TVs have a much shorter first use period than CRT televisions, and that the time period until they are being replaced because of a defect, whether being faulty or unreliable, is much shorter.

In general, there has been an overall decreasing trend in the average first use periods of both CRT and flat-screen televisions from year to year (Prakash et al., 2019). Of the televisions that are being replaced although still functional, approximately a third is being discarded instead of being passed on or set aside.

According to the results of the consumer survey, 16% of consumers reported to think that a defect, which results in the television no longer functioning properly, occurs within the first year after buying the product. 40% stated to think that it usually takes longer than five years until such a defect occurs. This share is significantly higher compared to other products assessed within this study like smartphones (10%), clothing (8%) or shoes and footwear (5%) indicating that the expected lifetime (in this case expressed as the time until a defect occurs) is relatively high in the case of televisions. On the other hand, 21% of consumers experienced a defect which resulted in the television not working properly within the last 2 years. If the products are not refurbished or repaired, this can be expected to contribute to a short consumption lifetime of televisions.

A survey on the satisfaction of television users with the lifespan of their television found that only 16 % were not satisfied with the lifespan (Prakash et al., 2019), so consumers mostly think that the television's useful life is long enough. According to a study by PROMPT, the lifetime expectancy can also strongly vary depending on the brand: while 47% of Loewe owners believe that they will be using their television for more than 10 years, only 23% of Haier owners think the same. The brands with the highest average real lifecycles have been found to be Thomson, Grundig, Sony and Philips, whereas only the real lifetime performance of Thomson exceeded customer expectations (PROMPT, 2021).

Short absolute lifetime as designed by producers

According to Wieser (2016), the absolute lifetime, i.e., the designed lifetime, of LCD monitors and TVs have fallen by 10% between 2000 and 2010. Hardware-related failures (defects) may be a reason for replacing a TV. According to experts, material obsolescence is not the primary cause for obsolescence of television sets and the decision to replace an old TV. This is consistent with a PROMPT study, which found that on average, only 34% of TV's were replaced because of 'reliability-related reasons', which referred to the television being completely out of use, not working well anymore, repair costs being too high and no availability of spare parts (PROMPT, 2021).

Apparently, hardly any repair takes place in the television sector, mostly attributable to the broad range of models and technologies (European Commission, 2018). However the study by the European Commission also found that, depending on the availability of durability information, consumers have a significant willingness-to-pay for an additional year of durability ranging between 77 and 171 € (European Commission, 2018), indicating that TV users would prefer a television that has a longer lifetime. This is however not fully consistent with findings of Bakker et al., indicating that product lifetime labelling would not significantly affect purchasing decisions for televisions (Bakker, C., & Schuit, 2017).

Hennies & Stamminger (2016) found that, while there is a significant difference in lifespan between low-cost and expensive TVs, they differ at most by one year. Repair can extend the lifespan of TVs by approximately one year, but this also depends on the price, with expensive televisions being significantly more frequently repaired than low-cost TVs.

3.2.2. Main drivers of the problem

1.1.1.4. Economic drivers

Economic obsolescence might be a frequent reason for replacing television sets due to the **high repair costs**, which can amount up to several hundred euros for components that frequently fail, such as the display, screen unit or power board. Since the sales prices of TV sets are falling at the same time, consumers increasingly purchase a new television set instead of having their TV repaired when it is defective (Prakash, 2016). Concerning televisions that were faulty, 34% of participants of a behavioural study on consumers' engagement in the Circular Economy commissioned by the European Commission reported that the high costs were the major factor preventing them from repairing it (European Commission, 2018). As price and guarantees were ranked as most important factors for having a product repaired (European Commission, 2018), an excessive repair price combined with an absence of guarantees may lead to shorter lifetimes due to replacement instead of repair of televisions. However, in this regard, it should be noted that televisions are on average replaced after 7 years (European Commission, 2018), which is after the expiry of the commercial guarantee period.

Sanfelix et al. (2019) assume that the increasing price of the total repair operation cost, which leads to the preference for replacement over repair, is due to the need for electronic knowledge from the repairer as well as access to the service manual of the television. **Spare parts** also pose a main barrier for repairing televisions, as they are often expensive or not available, which is potentially due to the rapid succession of models (Sanfelix et al., 2019). A main issue in this context is the cost of the replacement of LCDs, as the replacement parts are so expensive that a cost-effective repair cannot be realized (Prakash et al., 2019). The cost of certain service parts, such as LCD screens, which is on average more than 50% of a new TV price, might thus constitute a barrier to repair (Osmani et al., 2013). Another issue leading to higher repair costs is that, due to increasingly larger sizes of TVs, repair must mostly take place on-site, which significantly increases the cost as technicians must reach the user's house to repair the TV (Sanfelix et al., 2019). Thus, the high costs of certain service parts as stated above and the willingness of consumers to pay for the repair of TVs (26% of the original price according to the consumer survey conducted in the context of this study) might result in consumers preferring replacement over repair, thereby contributing to a short consumption lifetime of TVs.

A major obstacle to repair is the product design, which makes televisions **difficult to repair**. Often, parts of the housing are stuck together, making it difficult to access and repair parts that are inside the television without damaging it (Prakash et al., 2019). The previously mentioned European Commission study found that self-repair rates are especially low for televisions, with only 2% of respondents having repaired them themselves (European Commission, 2018). Disassembly of televisions becomes increasingly difficult due to thinner displays, specific types of connectors and the use of adhesives, hindering the access to parts with common tools. Additionally, the more complex electronics in smart TVs complicates the repair by non-professionals (Berwald, Clemm, 2020). As repair activities require a certain amount of knowledge, especially due to higher complexity, and the availability of disassembly information is often limited to professionals (Sanfelix et al., 2019), consumers might prefer replacement over repair of a television.

Hence, economic drivers – especially the high costs of repair – seem to strongly contribute to a short consumption lifetime of TVs. This is also reflected in the results of the consumer survey conducted in the context of this study. Accordingly, 39% of consumers cited high repair costs as reason for not having the TV repaired.

1.1.1.5. Psychological drivers

As televisions, compared to smart phones, are considered less of a status symbol, it may be expected that fashion is not as relevant, and innovation plays a larger role in the purchasing decision (European Commission, 2018). Nevertheless, the most important reason for replacing an older television set has been found to be psychological obsolescence (Prakash, 2016; Prakash et al., 2019). The study by the Öko-Institut e.V. has found that over 60% of replaced

flat-screen TVs in 2012 that were still functional had been replaced because of the **consumers' desire to own a better TV set**.

The main reasons for replacing a television set were the need for a larger screen size, better picture quality and falling prices (Prakash, 2016). The same findings are confirmed by a market research assuming that TV replacement in nearly all countries is mostly driven by the desire to trade up in size and to own a flat panel TV with improved picture quality (Osmani et al., 2013). Concerning televisions that were faulty, major reasons for not repairing them have been found to be the **preference for a new television over a repaired one** (by 31%) as well as fashion obsolescence by 30% (European Commission, 2018). Thus, behavioural aspects are strong drivers for shorter television lifetimes. As part of the consumer survey conducted for this study, consumers were asked about the propensity to have a product repaired or replaced assuming that a defect occurred within the legal guarantee period. In the case of televisions, 32% of respondents indicated that they would always have the television replaced by the seller whereby 35% stated that they would probably have the product replaced. When it comes to repair, only 8% would always have the product repaired and 22% would probably have the product repaired. This suggests that – in the case of TVs – consumers prefer replacement over repair if a defect occurs during the legal guarantee period.

As innovation cycles¹² are becoming increasingly short, the duration of first use also decreases if purchasers want a more innovative appliance. Innovations stipulate the wish for a better and more innovative television (Prakash et al., 2019) and thereby reduce the lifetime of TVs. Prakash et al. also noted that the desire to own a newer and better television occurs sooner for flat-screen owners compared to CRT television owners, the latter being replaced when still functioning after approximately 9 years, while the former is already replaced after around 5 years (Prakash et al., 2019). Often, consumers replace their television following technological advancement, solely because they want to have the latest model with the most up-to-date technology (European Commission, 2018). This effect has been found to be particularly significant amongst young people under 18 years, revealing the importance for adolescents to own the latest product generation, which leads to replacement and thus shorter lifetimes due to technological obsolescence (Gutiérrez et al., 2011). Technological progress, which leads to the technology of a television being considered as old after less than 5 years, might additionally prevent consumers from investing into more durable products (European Commission, 2018).

Another point concerns a **lack of trust in repaired televisions**, combined with a preference for brand new products and the general opinion that new products are of better value for money (European Commission, 2018). Consumers' expectations about reparability have a strong impact on the actual repair of the product, and it has become more common to replace a television because it is expected to be easier, faster and relatively cheaper (European Commission, 2018), thus leading to shorter lifetimes.

¹² The typical stages an innovation goes through are the initial idea generation to development, implementation, evaluation, and adoption.

1.1.1.6. Other drivers

Other aspects that contribute to the premature obsolescence of televisions are software-related faults, different transmission standards as well as the rapid development of new TV formats and functions with specific software and hardware requirements which result in televisions becoming obsolete faster. Based on the results of the consumer survey conducted as part of this study, it can be concluded that the wear out of electronic parts (37%) and mechanical wear and tear (18%) are the most cited reasons for defects.

Furthermore, the reputation and brand of a television drives a customer's expectations on quality and durability, and thus on the expected lifetime, which could impact its actual lifetime (European Commission, 2018).

3.4. Laptops

3.4.1. Problem definition

Consumption lifetime

With respect to the consumption lifetime, it should be highlighted that laptops are subject to short innovation cycles and fast-moving market conditions which increase the risk of premature obsolescence and rapid replacement cycles (André et al., 2019; Bakker et al., 2014). Many consumers tend to upgrade to the latest available technology at regular intervals, resulting in laptops often being replaced prematurely even though there is no malfunction (Knight et al., 2013; Prakash et al., 2012). In addition, the discontinuation of support for previous operating systems and software and shrinking battery life contributes to a premature replacement of fully-functioning laptops (Oldyrevas, Catriona, 2020; Prakash et al., 2019). Hence, laptops often show a very short consumption lifetime of less than 3 years. On the other hand, it should be noted, that the innovation cycles of laptops have slowed down and new developments rather focus on other sectors such as tablet computers (Prakash et al., 2019). Moreover, data suggests that consumers would like laptops to last longer than they are currently used and that there is a willingness on the side of the consumers to extend the lifetime of their laptops (Oldyrevas, Catriona, 2020; Tecchio et al., 2018).

Average lifetimes of laptops indicated in different studies range between 4 and 6.5 years, depending on the time period considered (Bakker, C., & Schuit, 2017; Bakker et al., 2014; Hennies, Stamminger, 2016; Prakash et al., 2019). In this context, Bakker et al. (2014) observed a decreasing median lifetime of laptops from 2000 to 2005 (4.3 years to 4.1 years), whereas an analysis performed by Prakash et al. (2019) could not show any clear trend for the average first use periods of laptops in Germany between 2004 and 2012/2013. The analysis further indicates that the percentage of still-functioning laptops being replaced with a

better device decreased between 2004 and 2012/2013 (Prakash et al., 2019; Tecchio et al., 2016). Consequently, based on the available data, no clear trend for decreasing or increasing average lifetimes of laptops can be identified. It can be noted, that a higher use frequency significantly decreases a laptop's lifetime (Hennies, Stamminger, 2016).

As regards the repair rate in terms of consumer willingness to repair, literature suggests that more expensive appliances including laptops are repaired more often compared to smaller and less expensive appliances, while expensive laptops are not repaired more frequently than less expensive ones (Hennies, Stamminger, 2016). Data shows that laptops are the products which are most commonly brought to repair events. Many of these laptops (40%) are older than 6 years indicating that consumers are willing to use laptops for a longer time period (Oldyrevas, Catriona, 2020). As regards the insufficient infrastructure, the results of the consumer survey reveal that 12% of consumers mentioned the lack of repair services as reason for not having the product repaired.

Short absolute lifetime as designed by producers

As regards short absolute lifetime, it must be considered, that laptops contain a relatively large number of electronic components which are subject to heavy use (e.g. keyboard, hard and media drives) and sensitive to heat (e.g. motherboard, memory). This leads to higher failure rates compared to other electronic devices mainly stemming from mechanical wear, thermal issues, careless handling but also poor design (Prakash et al., 2019; Sands, Tseng, 2009; Tecchio et al., 2018). A study performed by Sands & Tseng (2009) indicates that around 4.7 % of laptops fail within the first year and around 12.7 % in the second year of service life. By the end of the third year, ca. 20.7 % of laptops break due to malfunctions, while an even higher share of ca. 31 % fails by the end of the third year if failures due to accidents are taken into account¹³. Further available data suggests a mean annual failure rate for laptops of 18 % (Tecchio et al., 2018). Moreover, by the end of the fifth year, more than half of the laptops (61 %) had a defect which required some kind of repair (Tecchio et al., 2018). Results from the study of Prakash et al. (2019) suggest, that 25 % of the laptop replacements in Germany 2012/2013 could be attributed to failure of the current device. Generally, the failure rate increases with increasing service life (Tecchio et al., 2018). These findings are also reflected in the consumer survey conducted for this study. Accordingly, the results of the consumer survey demonstrate that 18% of consumers reported their expectation that a defect, which results in laptop no longer functioning properly, occurs within the first year after the purchase. Moreover, 40% of consumers expect that such a defect occurs within the first 2 years and a total of 26% of consumers reported to have experienced such a defect within the last 2 years.

¹³ . In this regard, it should be noted that laptops are exposed to potential damages such as compression loads, dropping or liquid spillages to an increased extent, since they are intended for mobile use (Tecchio et al., 2018; WRAP, 2011)

When it comes to repairability, the trend towards unibody designs with permanently fitted batteries and hard-drives as well as the need for certain tools for opening special bolts in front of motherboards or memory discs represent barriers for repair and contribute to a decrease of a laptop's lifetime (Bakker et al., 2014; Prakash et al., 2019; WRAP, 2011).

Limited availability of second-hand goods

As regards the possibilities for reuse, refurbishment and the second-hand market prices of laptops, several factors have to be taken into consideration. On the one hand, the reuse and refurbishment of laptops is gaining importance due to improved post-refurbishment guarantees, the rising demand for affordable laptops and the relatively high market prices which can be obtained especially for second-hand products of premium brands (Hennies, Stamminger, 2016; Oldyrevas, Catriona, 2020). For instance, the second-hand market price of Apple's MacBooks can be up to 70 to 90 % of the initial price (Oldyrevas, Catriona, 2020). Conversely, laptops are often stored instead of being refurbished or sold on the second-hand market due to concerns regarding data privacy (Oldyrevas, Catriona, 2020).. In this context, the findings of Hennies and Stamminger (2016), based on an internet-based questionnaire in Germany, indicate that laptops are mainly set aside (41 %), whereas a comparably smaller share of 33 % is passed on (given away or sold).

As the description of problem aspects above demonstrates, the premature obsolescence of laptops cannot or if at all only be assigned to one specific reason or driver. Therefore, the most relevant drivers identified are described below.

3.4.2. Main drivers of the problem

1.1.1.7. Economic drivers

The **costs for repairing laptops can be significant**, particularly if major components such as the main board, processor or graphics card need to be replaced (Prakash et al., 2019). Furthermore, a unibody and integrated design makes the replacement of certain parts such as the keyboard, the screen or battery difficult and time-consuming and therefore leads to increased repair costs (Oldyrevas, Catriona, 2020). For producers, integrated designs are associated with benefits such as lower manufacturing costs and a more rigid and uniform design of their devices (Tecchio et al., 2018).

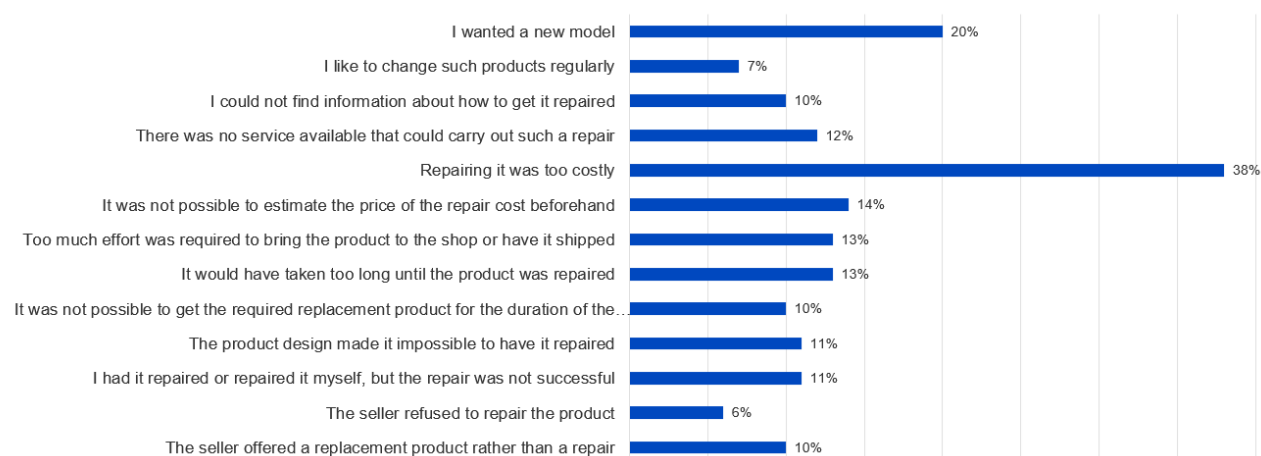
Another important factor which needs to be considered is the average price of the appliances. In the case of laptops, the average price has decreased from 1,600 € in 2003 to around 600 € in 2013 in Germany (Prakash et al., 2016). Data from Statista (2021) also referring to Germany indicates that the average price decreased from 2005 from 1053 € to 539 € in 2011. From 2011 to 2020 a slightly increasing trend up to 732 € can be observed. **Decreasing costs for new laptops** can contribute to a short consumption lifetime (Prakash et al., 2012)

From an economic point of view, further factors that need to be taken into account with regard to the repair of laptops are the labour costs involved, the **high costs for spare parts and the need for special tools** (Oldyrevas, Catriona, 2020; Tecchio et al., 2018). These comparatively high costs may drive consumers to purchase new appliances rather than repairing the old ones leading to economic obsolescence (Bachér et al., 2020; Prakash et al., 2019). Furthermore, the **time necessary** for the repair of laptops and/or the delivery of spare parts might be perceived as too long by consumers, leading to replacement rather than to repair (Oldyrevas, Catriona, 2020). In this regard, the results of the consumer survey conducted in the context of this study indicate that the average costs associated with the repair of the most recurrent defects of laptops are around 148 € and therefore below 25%¹⁴ of the average price of a new device indicated in the paragraph above (732 €). In total, 367 respondents including manufacturers, sellers of new, second hand and refurbished goods as well as repairers (authorised and independent) and refurbishers responded to this question of the survey. The survey results reveal that the costs for spare parts (32 %) and personnel (38 %) account for the largest fraction of total repair costs (based on 30 responses) indicating that high costs of spare parts can prevent consumers from repairing their laptops. In addition, according to the business survey, irreparability by design and lack of spare parts are the most relevant causes of irreparability in the case of laptops. Respondents to the business survey indicated that issues with the battery and the keyboard are the most recurrent defects when consumers ask for repair. Furthermore, the results indicate that the length of repair is on average 4 days. Thus, the length of repair is relatively low compared to other product categories. Although consumers are willing to pay for the repair of a laptop up to 25% of the original price and the most recurrent defects of laptops are around 20% of the original price (see statements above), repair costs as a barrier towards repair were reflected in the results of the consumer survey: When asked about reasons for not having a laptop repaired, high repair costs were mentioned as most relevant reason by consumers (38%) (see figure below).

¹⁴ According to the results of the consumer survey, the willingness to pay for the repair of a laptop is 25% of the original price.

Figure 3 - Reasons for not having a laptop repaired

QC6: Why did you not have the product repaired?



Source: Authors based on consumer survey exercise

Thus, it can be concluded that integrated designs affect the technical repairability of a laptop, while high labour costs and high costs for spare parts might represent further barriers to repair, especially considering the relatively low costs of new laptops. Thus, economic drivers are highly relevant in the case of laptops.

1.1.1.8. Psychological drivers

Fashion trends might contribute to the premature disposal of electronic devices and therefore contribute to psychological obsolescence (Bachér et al., 2020). As regards laptops, available data suggest that the importance of laptops as fashion accessories or status symbols has been decreasing, indicating that psychological obsolescence in the case of laptops is relatively insignificant compared to other electronic devices, such as TVs (Prakash et al., 2019). The results of Hennies & Stamminger (2016) show that only 6 % of respondents in Germany disposed of their laptop due to psychological obsolescence¹⁵. Nevertheless, aesthetics and design influence purchasing decisions and therefore outdated aesthetics might limit the reuse of laptops (Oldyrevas, Catriona, 2020).

A further relevant driver which might influence premature disposal of laptops concerns the knowledge of consumers. According to Oldyrevas & Catriona (2020), very little information on the durability and repairability of laptops is provided at the point of sale and consumers often lack knowledge on commercial guarantee periods and obligations.

As part of the consumer survey conducted for this study, consumers were asked about the propensity to have a product repaired or replaced assuming that a defect occurred within the legal guarantee period. In the case of laptops, 61% of respondents indicated that they would always or probably have the laptop

¹⁵ Psychological obsolescence referred to the following answer: "I no longer liked the appliance" (Hennies, Stamminger, 2016).

replaced by the seller, while only 10% would always have the laptop repaired. This suggests that consumers prefer replacement over repair when a defect occurs during the legal guarantee period in the case of laptops.

In summary, available data shows that psychological obsolescence might play a role in the case of laptops. Nevertheless, in comparison to economic drivers, psychological drivers can be assumed to be of limited relevance for the premature disposal of laptops.

1.1.1.9. Other drivers

In the case of laptops, technical drivers can have an important influence on premature disposal. Laptops contain many electronic components that could fail, which increases the risk of functional or material obsolescence (Prakash et al., 2019; Sands, Tseng, 2009). Furthermore, a lack of upgrade possibilities in combination with short innovation cycles as well as software and firmware constraints are relevant factors contributing to short consumption lifetimes of laptops.

4. Product specific assessment of market practices and value chains in the repair services sector

As outlined in this annex, there is a lack of incentives and insufficient infrastructure to repair products. However, all products selected for this study are theoretically repairable. Hence, the following part aims to present the different repair practices for mobile phones, TVs, laptops, refrigerators, clothes, shoes/footwear, cars and wooden furniture independently from the scale of repair. A distinction is made between repair activities within and outside the legal guarantee in the EU. Additionally, typical second-hand activities will be presented per product group, whereby the focus will be on refurbishment and on reuse.

4.1. Mobile phones/smartphones

The descriptions outlined in the general assessment of market practices in the main report (see chapter 4) are correct for mobile phones as well. Therefore, only additional information is provided in this section.

Repair within the legal guarantee

According to the consumer survey results, the main causes of defects in a phone were impacts/shocks and a wear out of electronic parts. As especially batteries are a typical part of phones that get defective, the mystery shopping exercise conducted as part of this study tried to understand the sellers' first reaction when consumers asked for a solution in case of a defective phone battery within the legal guarantee (results of the mystery shopping are available in Annex 1). The results show that a high number of sellers offered to repair the product immediately or re-directed the customer to their physical shop so that an assessment of the defective product could be done. In other instances in the mystery shopping exercise, the sellers did not immediately offer repair, but did by the end of the call with the consumer. Within the legal guarantee, 74% of phones' sellers offered a repair solution to their consumers by the end of the call. Among the shoppers that have been offered a repair solution, the mystery shopping exercise tried to understand what repair options were offered by phones' sellers. A high number of sellers (73%) offered to return the product to the shop directly, where the repair would be carried out by the seller.

Internet research on large phone manufacturers shows that repair services are offered by them within and outside the legal guarantee. For example, according to the Apple website, consumers can reach out to an Apple Store, an Apple Authorised Service Provider ('carry-in repair') or send the iPhone to an Apple Repair Centre ('mail-in repair'). Apple promises that in any case (no matter if the repair is within or outside the guarantee) the phone will undergo an Apple-certified repair and service and will be backed by Apple. It seems that only the repair price is the distinguishing factor. On the Apple website an overview of the out-of-guarantee fees for repair activities can be found. These fees apply to repair

activities which are outside the legal guarantee and the commercial guarantees offered by Apple (e.g. including a one-year hardware repair coverage) (Apple Website, 2022).

Repair outside the legal guarantee (including repair infrastructure and services)

The mystery shopping exercise also tested sellers' first reaction when consumers asked for a solution outside of the legal guarantee. The results show that a high number of sellers still offered a product repair immediately (if the commercial guarantee was mentioned) and asked if consumers had a commercial guarantee or re-directed them to their physical shop for further assessment. The main repair options offered to the customer outside of the legal guarantee are either to return the product to the shop where the repair will be done by the seller (if the commercial guarantee was mentioned) or to take it to an affiliated repair shop where repair would be done at the consumer's cost. Alternatively, consumers can repair their phones themselves in private spaces or in public spaces such as repair cafés (e.g. offering repair events). Results from a study from Tröger et al. (2017) show that only about every third user tried to repair its mobile phone themselves. A study from the European Commission (2018) confirms that self-repair of mobile phones is rare. Moreover, self-repair of phones risks being unsuccessful. The Open Repair Alliance analysed 1900 repairs of smartphones at community repair events (Open Repair Alliance, n.d.). The outcome of the study showed that about half of repairs are successful today. It should be noted that 22% of the devices brought to the repair events were 5 to 10 years old, which makes a repair challenging. A third option is to make use of independent repairers. To make use of an independent (local) repair shop the customer usually has to bring in the broken device. The mobile phone repair industry is growing and there is especially an increase in independent repair shops worldwide (Watson et al., 2017). According to Türkeli et al. (2019) local and independent repair shops for phones are often cheaper than certified shops. According to the Apple website, independent repair providers, who naturally do not provide repairs covered by Apple's guarantees and service offers, have however access to Apple genuine parts and repair resources (Apple Website, 2022). However, this is not the normal case. Many phone manufacturers do not provide repair parts or guides to independent repairers. As a consequence, independent repairers are not only competing with other independent repairers, but also with authorised/certified repairers who have easier access to original spare parts.

In the mystery shopping exercise, the shoppers were also asked about the cost of repairing their phone with the sellers. A high number of shoppers did not manage to get a clear estimate as it required a detailed assessment of the product's issue. Yet, outside of the legal guarantee, some sellers mentioned that the average cost to repair a battery is 50 €. In the business survey, the average reported price of smartphone repairs was 106 €. ¹⁶ Other (more specific) sources show that battery replacement can cost up to 80 € (see **Error! Reference source n**

¹⁶ This refers to a generic repair as the specific defect to repair was not mentioned.

ot found.) Costs for a display replacement – which is another crucial issue for phones – can amount to 42% of the original phone price (input stakeholder; note: the given percentage is true for Germany). Although battery and display replacement seem very costly, both replacements are the main repair activities for mobile phones outside the legal guarantee (input stakeholder).

Table 3: Costs and cost composition for repair of mobile phones/smartphones

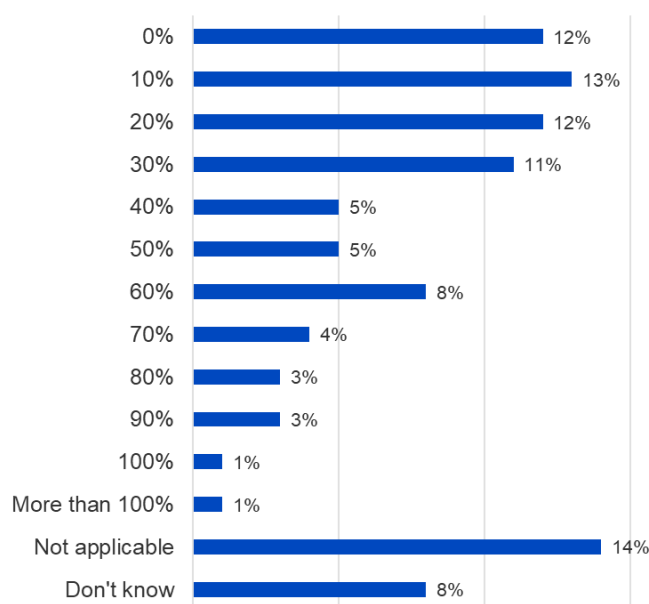
Repair activity	Average repair cost / price range		
Average repair cost screen replacement	iPhone: 80-300 € Note for non-original equipment manufacturer (OEM) parts: 80% of this value corresponds to labour cost, 20% spare part cost Note for OEM parts: 40-30% labour cost and 60-70% spare part cost	Samsung: 200-350 € Note: 80% of this value corresponds to spare parts cost	Other phones: 100-200 €
Average repair cost battery replacement	iPhone: 60-70 € Note for non-OEM parts: 10% of this value corresponds to spare part costs	Samsung: 80 € Note: 20-30% of this value corresponds to spare part costs	Other phones: 14% of the phones purchase price (focus Germany)
Average repair cost camera/audio/loudspeaker	10% of the phones purchase price (focus Germany)		
Purchase price range (according to producers' website)	iPhone: 500-1300 €	Samsung: 160-1300 €	

Source: Data input from Rüdener (2020) and stakeholders

The consumer survey carried out for the purpose of this study shows that many respondents replied that their mobile phone repair cost corresponded to 10% to 30% of the original product price. On average, the repair cost was 32,3% of the original purchase price.¹⁷

Figure 4 - Approximate repair cost for mobile phones/smartphones in relation to the initial price of the product

¹⁷ More than 100%" were excluded from the calculation. The share of those who gave this response was minimal, mostly 0-1%.



Source: Authors based on Consumer Survey results

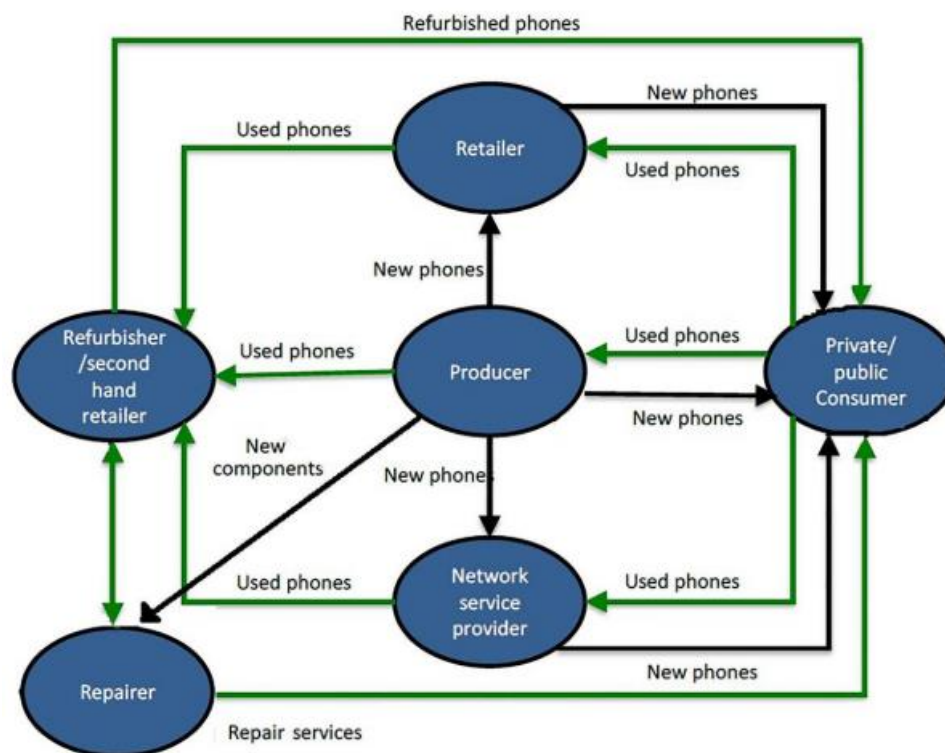
Refurbishment and reuse

Data indicates that the second-hand market for mobile phones exists. In the Netherlands, 12% of the currently used phones are either reused or refurbished. Popular reuse/refurbished phones are Apple IOS phones (19%), LG (12%), Sony and Samsung (each 9%) and Huawei (4%). In Poland, mobile phones from Samsung (30.39%), Huawei (29.14%), LG (12.71%), Xiaomi (5.07%), Lenovo (3.22%), and Sony Ericsson (3.06%) are typically reused (Türkeli et al., 2019).

In the EU, several companies exist that perform mobile phone refurbishment. Typically, the used phones are bought via trade-in, i.e. the refurbisher pays the customer for its used phone. After the contracting, users send their phone(s) to the refurbishment provider where the mobile phones are sorted, tested and, depending on the condition, restored. Refurbished devices are typically resold in different categories (such as 'new', 'as new', 'really good' and 'good'). It can be added that many repair shops also engage in second-hand repair and sale activities as a side business (Türkeli et al., 2019).

It is also common to sell phones on platforms like eBay without any refurbishment activity (Rizos et al., 2019). Especially mobile phones are often given to friends, family or sold on an online marketplace to extend the product lifetime. Sources of supply for commercial reuse activities are either waste collection or donation (e.g. reuse shops; donation containers, supermarkets containers or self-delivery). Although collection schemes have the legal obligation to test collected devices and determine whether potentially functional devices can be sent to the second-hand market, it is estimated that this flow is negligible (data from France) (Rochat et al., 2019). **Error! Reference source not found.** gives an overview on repair, reuse and refurbishment flows within the mobile phone sector.

Figure 5 - Overview on repair, reuse and refurbishment flows within the mobile phone sector



Source: Türkeli et al. (2019)

4.2. Televisions

The descriptions outlined in the general assessment of market practices in the main report (see chapter 4) also apply for TVs. Therefore, only additional information is provided in this section.

Repair within the legal guarantee

When it comes to a defect, consumers normally turn to the seller or the manufacturer. Depending on the size of the TV, the device has to be sent in or a technician has to come to the consumer's home. According to internet research, several manufacturers offer the possibility to mail in TVs for repair after an online registration. According to the LG website, the consumer needs to log in online or to contact the hotline to find an LG repair centre nearby and to register the repair for a defect TV there. In general, the mailing is only for free within the legal guarantee or within a commercial guarantee period. It seems to be common that the product or model number has to be known to be able to proceed on the repair support websites (LG Website, 2022; Philips Website, 2022). One stakeholder knows from experience that bigger TVs get repaired more often than small ones.

Repair outside the legal guarantee

As the main defect with TVs is the wear out of electronics, it makes sense that typical repair operations for TVs concern the power supply, electronics or the background lighting. TVs are mainly repaired by experts, whereas self-repair is rare (European Commission, 2018). Spare parts are bought from licensed spare part providers or manufacturers. Besides the price and the availability of spare parts, the age of the device influences the decision whether a repair is worthwhile. However, spare parts are often too costly to perform repair. Moreover, due to increasingly large sizes of TVs, repair mostly needs to take place on-site, which significantly increases the cost as technicians must repair the TV at the user's house (Sanfelix et al., 2019). To date, typical repair costs amount to 60-150 €. However, according to stakeholders, the current repair prices are lower than 10 years ago, as only less expensive repairs are carried out. On the other side, consumers are willing to pay for a repair instead of replacing the device, as TVs are not considered to be a status symbol (European Commission, 2018).

Refurbishment and reuse

Like other electronic devices (see mobile phones, laptops), used TVs are sold on reuse platforms and can be found in refurbishment (online) stores. However, only a few consumers buy second-hand TVs. The main reasons for the decision against second-hand TVs are the lacking trust in second-hand products (European Commission, 2018).

4.2. Laptops

The descriptions outlined in the general assessment of market practices in the main report (see chapter 4) are correct for laptops as well. Therefore, only additional information is provided in this section.

Repair within the legal guarantee

According to stakeholders, laptops within the legal guarantee which need a repair can be mailed in or carried into the seller or manufacturer. These perform the repair themselves or contract an authorised repairer.

Repair outside the legal guarantee

The laptop parts which are most likely to break are the screen, keyboard, data storage drive and battery (Cordella et al., 2019). Typical repair activities concern the battery, ventilation and ports. Other frequent repair activities concern the main memory and SSD (solid-state drive) (Rüdenauer, Prakash, 2020). On average, the repair price (focus Germany) of the battery amounts to around 80 €, the main memory to 79 € and the SSD to 130 € (Rüdenauer, Prakash, 2020). As for other

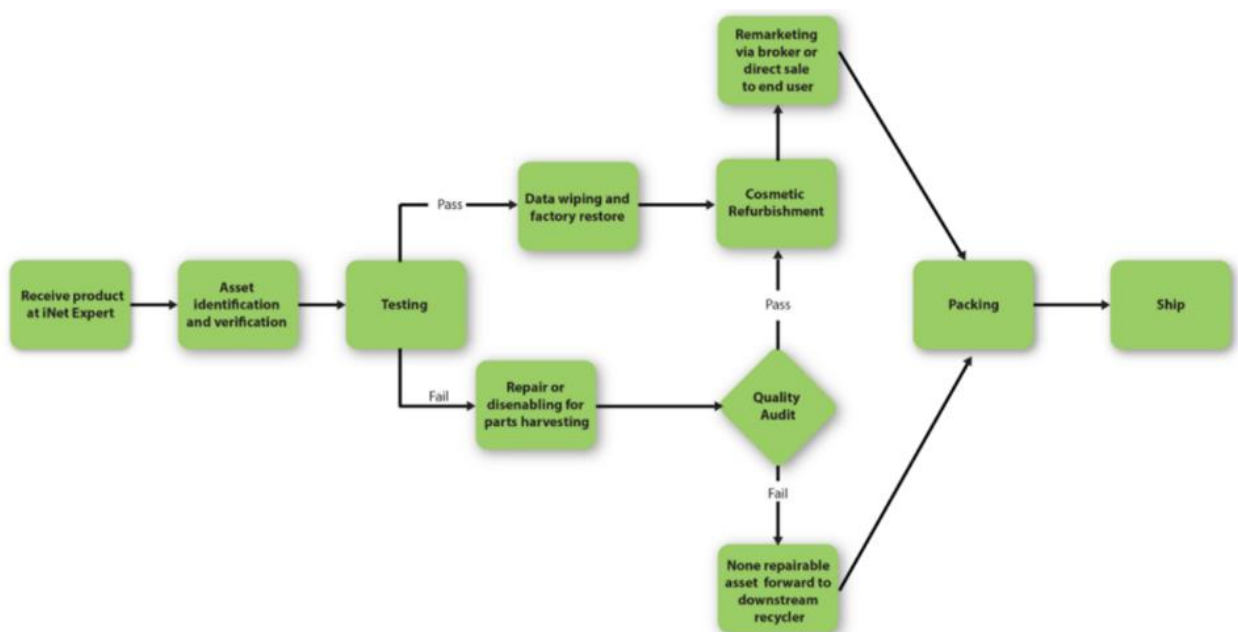
products, the repair cost related to the original product price is about 30% for a laptop (result from Consumer Survey). According to stakeholders, a typical repair process includes a defect audit, cleaning and parts change.

The electronics producer Dell describes an 'Out of guarantee repair process' on its website, including guidance for consumers to find out its current guarantee status. In case the product is out of guarantee, the Dell Technical Support can be contacted. According to Dell, the technician will diagnose the defect over the phone and provide a quote if requested. However, the product must be identified by the customer (e.g. indicate product ID) to view appropriate support options (DELL Website, 2022).

Refurbishment and reuse

There is a significant market for selling old (over one year old) desktops and laptops. Many private (e.g. dedicated manufacturer outlets) and third sector organisations are operating in this area. Commonly, end-of-life products and other well-preserved devices are sourced. Electrical and electronic equipment rescued from waste treatment plants is only used to a small proportion (Gustavsson et al., 2020). Similar to phones, refurbished laptops are resold in different categories ('new', 'as new', 'really good' and 'good'). According to an interviewed stakeholder, there seems to be a clear potential for increasing the service life of laptops and tablets through re-sale, repair and refurbishment. Figure 15 shows a refurbishment process of the company iNet. The main steps to ensure resale are testing, repair, data wiping and cosmetic refurbishment.

Figure 15 - Refurbishment procedure of iNet expert for laptops



Source: iNet Expert (2021)

4.3. Refrigerators

The descriptions outlined in the general assessment of market practices in the main report (see chapter 4) are correct for refrigerators as well. Therefore, only additional information is provided in this section.

Repair within the legal guarantee

The mystery shopping exercise tried to understand sellers' first reaction when consumers asked for a solution in case of a defective refrigerator within the legal guarantee. The results show that a high number of sellers advised the shoppers to get in touch with the manufacturer. In many other cases, the sellers said that a technician will be sent to assess or repair the issue directly.

Data from literature gives indication that repair requests to manufacturers within the legal guarantee are successful: According to APPLIA (Home Appliance Europe), the data collected from their membership in 2018 showed that 91% of the repair requests to manufacturers resulted in an actual repair (APPLIA, 2020). Although home appliances get often repaired, this is less true for refrigerators as certain refrigerator constructions are not easy to repair. Especially repair concerning foaming in the cooling circuit is difficult and costly. Other parts like gaskets or the compressor are easy to exchange.

Repair outside the legal guarantee

The mystery shopping exercise also tested sellers' first reaction when consumers asked for a solution outside of the legal guarantee. In many cases, the seller asked the shopper if he/she had a commercial guarantee. Regarding the repair option offered by the seller, consumers were advised to get in touch directly with the manufacturers. Yet, a high number of shoppers were told to take the product to a non-affiliated repair service provider at their own cost. For some shoppers no clear repair options were given at this stage of the process: they first had to provide more details such as receipt, invoice, and a serial number to be identified. The duration of repair outside of the legal guarantee for a defective refrigerator can vary from 7 to 14 days on average.

As many refrigerators are built-in in the kitchen, and therefore the repair is more challenging (input stakeholder), it seems realistic that professional repair services are preferred. According to results from the consumer survey conducted for this study, typical reasons for defects in a refrigerator are mechanical wear and tear and wear of electronic parts.

Repair activities of refrigerators costs around EUR 100-200. The labour costs represent an important share of the repair price, whereas the spare part costs account for 20-50% of the repair price. In the last years, the average repair costs did not change significantly. However, in total, less refrigerators get repaired nowadays (input stakeholder). The consumer survey found out that the average repair cost of a refrigerator related to the original purchase price is around 30%.

As described above, a similar percentage of repair costs (i.e. around 30% of initial product price) applies to all products examined in this study, with the exception of cars.

Reuse

Door-to-door collection, municipal recycling centres or other return schemes (e.g. via seller) represent common collection methods for used refrigerators. A typical model for reuse are partnerships from social companies with municipalities. The social/reuse companies collect bulky items from households to access products for reuse. They cannot choose which product they collect but can transfer any unwished product to the partner municipality. Most of the time reuse companies are paid for doing so.

According to stakeholders, refurbishment is typically not performed for refrigerators. However, reuse combined with some reconditioning is a common practice. Afterwards, the device can be used for other 3 to 4 years.

4.4. Clothing

The descriptions outlined in the general assessment of market practices in the main report (see chapter 4) are correct for clothing as well. Therefore, only additional information is provided in this section.

Repair within the legal guarantee

Using the example of a manufacturer of outdoor clothing (VAUDE), the repair process (under the legal guarantee) is recapped: VAUDE offers a repair service for all clothing items (regardless of whether they are still under the legal guarantee). They ask the consumer to bring the defective clothing items to the seller and to request repair. After a feasibility check and a cost estimate, the repair is conducted and the item resent to the seller. Outside the legal guarantee several repair activities might be conducted for a cost, but the repair service (mailing in etc.) is the same than within the legal guarantee (VAUDE Website, 2022). VAUDE was chosen as an example because the company is known for its pioneering role in environmental protection, i.e. other clothing companies do not necessarily offer repair services or repair information on their website.

Repair outside the legal guarantee

Clothing is mainly repaired by specialised craftsmen (e.g. tailor shop) (ADEME et al., 2014) or via self-repair (24.4%) (Deloitte, 2016). One third of respondents of a study said that they would repair the clothes if they had the skills (Didi, Yan, 2019). Fisher et al. (2008) conducted focus groups and workshops to clarify the general public's understanding of sustainable clothing. They asked the

participants if repairs had ever been made to working or damaged clothing. The results show little evidence of repair work being undertaken as a normal activity other than minor tasks such as sewing on buttons or fixing hems. The research also identified the main factors influencing clothing repair according to the participants: household skills (self-repair), attraction to new and relatively cheap clothes, price of repair compared to new clothes, and the availability of repair services. Overall, participants had mixed reactions to professional repair services, which some would use for more difficult repair tasks only. According to the Consumer Survey carried out for the purpose of this study, mechanical wear and tear is the most typical reason for defects in clothing items.

Refurbishment

According to stakeholders, refurbishment of clothing is still a niche. For clothing, the terms refurbishment, remanufacturing and upcycling are often used interchangeably. The main idea behind all of these concepts is to achieve the extension of a product lifetime by reworking the used garment. This includes modifications, design changing and purpose changings (e.g. a dress is made into a skirt) (Gustavsson et al., 2020). Typical input for upcycling/refurbishment/remanufacturing are second-hand clothing, discarded textiles or household textiles (curtain, duvet covers, etc.) retrieved from charity shops, second-hand collection/sorting centres or recycling companies.

As a first step, collected clothing items are checked, cleaned, sometimes washed and sorted based on the colours or fabric type. Afterwards it is decided whether the garment will undergo full, semi or no disassembly. A disadvantage of disassembling is that it is a time-consuming, manual operation. It is not always reasonable to destroy a complex garment by disassembly. However, disassembling allows more flexibility for further designs (Sinha, Muthu, & Dissanayake, 2016). Due to the heterogenic input, upcycled/refurbished/remanufactured clothing items are often unique (Sinha et al., 2016).

Most of the fashion refurbishers/remanufacturers are small independent (design) companies or social enterprises with a few employees (Sinha et al., 2016).

Reuse

Donation of clothing to charity or thrift stores is common practice (Didi, Yan, 2019). According to a stakeholder representing the reuse industry, the majority of its members are social companies that perform reuse of clothing. Typical sources of supply for reuse companies are waste collection or donation (e.g. reuse shops; donation containers, supermarkets containers). Stakeholders estimate that the majority of clothing is exported as the second-hand market for clothing is saturated in Europe.

The consumer survey, carried out for the purpose of this study, confirms that donation of clothing is very typical and widely accepted. 42% of the respondents stated that they did not sell their used clothes because they preferred to give the product away or donate it. Other reasons (such as 'the product was too damaged

or worn to sell' or 'the price I would receive was not worth it'), which are typically given as a reason against selling when it comes to other used products, are relatively less important for clothes. 22% of respondents claimed that 'they do not have clothes to sell or give away'.

4.5. Shoes/footwear

The descriptions outlined in the general assessment of market practices in the main report (see chapter 4) are correct for shoes/footwear as well. Therefore, only additional information is provided in this section.

Repair within the legal guarantee

The mystery shopping exercise tried to understand shoe sellers' first reaction when consumers asked for a solution in case of defective shoes within the legal guarantee. The results show that a high number of sellers re-directed the shoppers to their physical shop. Shoppers were often asked for the serial number, the order receipt, the invoice etc. to identify them or for proof of the defect (regardless of the cause), such as pictures to send via email. The results of the mystery shopping exercise also looked at the percentage of sellers that offered a repair solution to the customer by the end of the call. Within the legal guarantee, 67% of shoes sellers offered a repair solution to their consumers by the end of the call. Among the shoppers that have been offered a repair solution, the mystery shopping exercise tried to understand what repair options were offered by shoes sellers. A high number of sellers (80%) offered to the customer to return the product to the shop directly, where the repair would be carried out by the seller.

Repair outside the legal guarantee

The mystery shopping exercise also tested sellers' first reaction when consumers asked for a solution outside of the legal guarantee. The results show that a high number of sellers offered repair immediately. In many cases, the seller also re-directed the shopper to their physical shop. Regarding the repair option offered by the seller, many shoppers were told to take the product to a cobbler shop at their own cost. For some shoppers no clear repair options were given at this stage of the process, as they first had to provide more details such as receipt, invoice, and a serial number to be identified, as well as proof of the defect. Some of the sellers (32%) also offered to bring the product to the shop.

According to the mystery shopping, the use of a commercial guarantee for shoes did not appear to be a common practice. Nevertheless, internet research shows

that specific manufacturers (e.g. Eddie Bauer¹⁸, Rainbow Sandals¹⁹, Duluth Trading²⁰, Dr. Martens²¹) do offer guarantees (sometimes 'lifetime guarantees') through which the consumer is entitled to repair for a longer period than under the legal guarantee. Other manufacturers like Patagonia²² or Arc'teryx²³ offer weaker guarantees but repair services. In most of the cases, they will repair defective items for a fee. Filson²⁴, Tilley²⁵, Columbia²⁶, and The North Face²⁷ protect against rips and damages incurred during the products' intended use with their guarantee service, whereas normal wear and tear, accidents, improper care, or alterations are not covered by the guarantee (The Manual, 2020). Literature confirms that shoes are mainly repaired by specialised craftspeople (e.g. cobblers) (ADEME et al., 2014). According to a stakeholder from the repair industry, typical repair activities for shoes concern the soles and the heels, whose repair requires specific tools and skills and, therefore, specialised repairers. This data is in line with the Consumer Survey carried out for the purpose of this study, indicating that mechanical wear and tear is the most common reason for defects in shoes.

High quality and more expensive shoes (e.g. hand-made shoes, leather shoes, hiking shoes) seem to be repaired more often as they reveal a better reparability (Dalhammar et al., 2020; Rahimifard et al., 2007). One explanation of this phenomenon is that high original purchase prices make the repair reasonable from an economic point of view (Dalhammar et al., 2020). 'My shoe hospital'²⁸ or 'ShoesSpa'²⁹ are examples of luxury repair providers.

Reuse

¹⁸ Eddie Bauer: <https://www.eddiebauer.de>

¹⁹ Rainbow Sandals: <https://www.rainbowsandals.com/>

²⁰ Duluth Trading: <https://www.duluthtrading.com/>

²¹ Dr. Martens: <https://www.drmartens.com/de/de/>

²² Patagonia: <https://eu.patagonia.com/de/de/home/>

²³ Arc'teryx <https://arcteryx.com/de/en/>

²⁴ Filson: <https://www.filson.com/>

²⁵ Tilley: <https://tilley.com/>

²⁶ Columbia: <https://www.columbiasportswear.de/>

²⁷ The North Face: <https://www.thenorthface.de/>

²⁸ My shoe hospital: <https://www.myshoehospital.com/>

²⁹ ShoesSpa: <https://shoespa.co.uk/>

Reuse of second-hand shoes is a well-established method of collecting worn or unwanted shoes for either local redistribution or exportation to less developed countries. Such reuse schemes are mainly supported by charitable organisations or private companies (Rahimifard et al., 2007; Van Rensburg et al., 2020). The import into third countries is controversially discussed, as it might damage the economy in the receiving countries and weaken the local environmental system (Staikos, Rahimifard, 2007).

Similar to clothing, donation is a common practice for shoes, which was confirmed by the consumer survey. 30% of the respondents stated that they did not sell their used shoes because they preferred to give the product away or donate it. However, another part of respondents (around 30%) claimed that 'the product was too damaged or worn to sell'. 24% of respondents claimed that 'they do not have shoes to sell or give away'

4.6. Cars

Repair

A large market for repair and maintenance services exists for cars. The well-established aftermarket in the automotive sector covers all repair, maintenance and servicing activities for the EU network of vehicles on the road. The annual volume of the aftermarket is approximately 100 billion € for automotive spare parts (consumer level without VAT) (Parker et al., 2015).

Car manufacturers typically offer commercial guarantees (e.g. new car guarantee, used car guarantee) additionally to the legal guarantee. However, these guarantees are typically voided if the consumer does not perform the maintenance work prescribed by the manufacturer. Even after the expiration of the guarantee, loyal consumers can hope for goodwill when they have carried out maintenance or repair work at a manufacturer-affiliated workshop (ADAC, 2021).

The vehicle aftermarket is carried out either through approved vehicle manufacturers' garages or through a network of garages and parts suppliers excluding vehicle manufacturers (Parker et al., 2015). In 2020, on average, 1.05 maintenance services (with an average cost of 315 €) and 0.44 wear-and-tear repairs (with an average cost of 146 €) were carried out per passenger on German cars (ZDK, 2021). The results of the Consumer Survey carried out for the purpose of this study show that mechanical wear and tear and wear of electronic parts are the most common reasons for defects in cars.

In the automotive sector, relevant actors are OEMs, non-OEMs and component manufacturers that manufacture components to provide to manufacturers directly or to sell on the aftermarket for parts (Parker et al., 2015). Parker et al. (2015) divides the component supplier in the automotive industry in three tiers:

- Large, sometimes international, high-volume operators that supply businesses requiring large quantities of usually new parts.

- Smaller businesses that can regain parts from used cars and hence provide moderate volumes of good quality parts that require significant technical skill to produce. These businesses usually specialise in a certain product or area.
- Micro-businesses, usually employing 1-5 people and serving smaller, niche markets. They have capabilities to carry out a range of services. Vehicle manufacturers and component manufacturers utilise these companies to supply replacement parts or other services to consumers during their guarantee period.

According to Regulation (EC) No 715/2007³⁰, manufacturers are obliged to make spare parts, technical information and other relevant information available to independent operators, authorised operators and repairers (e.g., via websites). However, manufacturers are allowed to charge 'reasonable and proportionate' fees for the access to vehicle repair and maintenance information. The implementing and amending Regulation (EC) No 692/2008³¹ details the requirements laid down in Regulation (EC) No 715/2007.

Refurbishment

Cars are either refurbished as a whole or components are refurbished or remanufactured. It was identified that remanufacturing of automotive components is well established and has been carried out for decades. According to Parker et al. (2015), component remanufacturing is well integrated into the industry, but only a few end-users are aware of its prevalence. Large automotive manufacturers are quite often involved with remanufacturing; however, it represents only a small part of their overall business. Small repair and maintenance organisations carry out proportionately much larger amounts of remanufacturing, although employing far fewer people per firm (Parker et al., 2015).

When it comes to refurbishing cars as a whole, car workshops are used to upgrade and clean cars (sometimes also referred to as "restoration"). However, the trend towards "factory refurbished" cars is newer. Several car manufacturer websites indicate that refurbishment of entire vehicles, especially leased vehicles, has just started or is planned. For example, since 2022, Toyota³² has offered a light overhaul for some of its vehicles, which includes the replacement of wear parts such as steering wheels, seat cushions and upholstery. Tesla's³³ previous refurbishment process, for example, involved a "recertification" process that checked whether the vehicles were in order and made cosmetic corrections as needed. After this process, Tesla had issued a new warranty on its electric

³⁰ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32007R0715>.

³¹ <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32008R0692&from=DE>.

³² Example of Toyota: <https://www.autotrader.com/archive/toyota-offers-factory-refurbishment-for-certain-models-in-japan>

³³ Example of Tesla: <https://electrek.co/2018/04/11/tesla-stops-refurbishing-used-cars/>

car. In 2018, Tesla changed its overhaul policy and no longer cares about cosmetic issues, among other things.

Reuse

The supply and demand for second-hand cars throughout Europe is immense, with sales of second-hand cars surpassing new car sales in all countries, especially in Eastern Europe (European Commission, 2014). Via contract models like trade-in the customer leaves the used car to a reseller. Private and commercial car resales can also be observed on (online) platforms like eBay. In cases where the local supply of second-hand cars cannot meet the demand, consumers purchase second-hand cars from abroad. The results of a consumer study showed that countries with the highest proportion of cars imported by respondents were Romania (30%), Malta (28%), Luxembourg (18%) and Bulgaria (16%) (European Commission, 2014). The most important second-hand car market within the EU is Germany, since approximately 42% of all imported cars cited in the consumer survey were imported from Germany. The most common car brands that are purchased cross-border, especially from Germany, were BMW (11%), Volkswagen (11%), Audi (8%), Opel (7%), Ford (6%) and Mercedes-Benz (6%) (European Commission, 2014). These figures are in line with a study by Mehlhart et al. (2011), who conclude that only a few countries have net exports of second-hand vehicles. Among the main exporters are UK, Italy, France and particularly Germany, accounting alone for approximately 50% of all exports of second-hand vehicles. The main destinations of exported German used cars were primarily Poland (47 %), Romania (14%), the Czech Republic (11%), Bulgaria (6%) and (4%) Lithuania.

The average second-hand market price at EU level detected in the consumer survey was 9,358 €. The prices vary strongly according to the type of seller ranging from 12,700 € for a car bought at a franchise seller to 7,000 € for a car bought at an independent seller or at an auction (European Commission, 2014). In Germany the average price for a used car was 14,730 € in 2020, representing a price increase of 18% compared to the previous year. The price range according to the seller type in Germany varies from an average price of 9,740 € for private sales to 13,310 € for independent seller and 18,570 € for franchise seller (ZDK, 2021).

For instance, in the German market the purchasing prices for used cars increased by around 18% from 12,470 € in 2019 to 14,730 € in 2020. Prices for new cars in Germany increased by around 8% from 33.530 € in 2019 to 36.340 € in 2020. Revenues from German used car sales grew from 2019 to 2020 by around 33% in the independent sellership sector (19.62 billion €) and by around 15% in the franchise sellership sector (62.58 billion €). The revenues of sales of all used cars combined exceed those from new car sales (62.86 billion €), which decreased by around 14% from 2019 to 2020 (ZDK, 2021).

4.7. Wooden furniture

The descriptions outlined in the general assessment of market practices in the main report (see chapter 4) is correct for furniture as well. Therefore, only additional information is provided in this section.

Repair the within legal guarantee

According to a stakeholder from a furniture sellers association, many manufacturers leave it to the sellers to take over repair activities if a seller's shop is close to the consumer and if the product can be transported there. If a seller cannot offer any repair (e.g. due to a lack of skills) the product is sent to the manufacturer. If a seller can offer the repair, the manufacturer supplies the spare parts. In the small and medium furniture industry, many furniture shops still have in-house joineries making repair possible. However, as the sellers' first aim is to satisfy the consumers, they often propose replacement instead of repair. Repair of furniture requires extensive logistical effort (collection and return) and is often related to long waiting times, which makes replacement the more attractive solution. A study by Forrest et al. (2017) confirms that repair of furniture is expensive due to transport and labour costs. It is also said that many furniture sellers have so few complaints that replacement is more worthwhile. Moreover, the decision for or against replacement has an aesthetical dimension. A repair of a couch (e.g. covering) is more visible than the repair on an inlay in a kitchen drawer. Thus, replacement depends on the product and the repair type.

Especially in the countryside, sellers offer to visit and to check a broken product (e.g. couch) at home. It was not specified by stakeholders if this is limited to products within the legal or commercial guarantee.

Service agreements and partnerships between manufacturers or sellers and repairers are common in the furniture industry as well. As in other industries, contracted repairers must ensure to comply with the manufacturer's specification and to maintain high quality repair, a stakeholder explains. For instance, the furniture manufacturer BoConcept mentions that repair within the legal guarantee is carried out by them directly or by a selected partner (BoConcept, 2022).

Repair outside the legal guarantee

Similar to other product groups, the repair outside the legal guarantee is similar to repair within the legal guarantee. However, within the guarantee period, sellers and manufacturers take a closer look at the repair costs. Outside the legal guarantee, the consumer has to bear the costs. However, in the SME sector it is common to carry out repair and replacements as a gesture of goodwill.

According to a stakeholder from a furniture seller association, many manufacturers or sellers give commercial guarantees on high-priced furniture as they expect few complaints. IKEA Austria, for example, offers a maintenance programme to consumers (min 130 €), including activities like tightening screws

or joints, readjusting doors and drawers or refinishing worktops³⁴. The wooden chair manufacturer Giroflex also offers a repair service, including cleaning of some parts and exchanging and renewal of whole components. They run their own warehouse with spare parts to enable the exchange of parts (Gustavsson et al., 2020).

One stakeholder highlighted that it is a challenge for furniture sellers to repair products that they do not know. In this case, they need to redesign the product (e.g. for upholstery and covering), which makes the repair even more expensive. According to another stakeholder, typical repair activities of wooden furniture concern the hinges. The consumer survey indicates that the major reason for defective wooden furniture is mechanical wear and tear. Additionally, defects due to impact/shock and due to temperature/moisture are common.

Refurbishment

According to a furniture manufacturer association, the market for refurbished furniture is now growing faster than in the last years. Moreover, in the last years, European furniture manufacturers started to provide support services and to build up take-back schemes (by nearly half of the manufacturers in the furniture sector). Third-party subcontractors are most often responsible to remove, process and resell old furniture (Gustavsson et al., 2020). The focus of refurbishment activities is often on office furniture.

Examples from companies show that used furniture in good condition is cleaned and refurbished and then made available to consumers through specific (online) shops. The scope of refurbishment can include aesthetic changes, like the change of colour, but also upgrading steps like relacquering, cleaning or reupholstering. Steps like new gluing (e.g. a table top), grinding, sandblasting and varnishing are possible as well. After restoring the furniture to a 'good as new' condition, some companies offer their consumers a guarantee matching that of a new product (Parker et al., 2015). Components made of PUR (polyurethane), which is a material that could be problematic (e.g. due to containing regulated flame retardants), are most often removed during a remanufacturing or refurbishment process as they are included in upholstery and similar applications which have a high wear and tear (Gustavsson et al., 2020).

Upgrading and resale of furniture from private consumers is also performed in vintage or antiques stores (Gustavsson et al., 2020).

Refurbishing and reconditioning of furniture is generally less extensive than remanufacturing, but more extensive than repair. guarantees on refurbishment and reconditioning cover the entire product (Ramirez, 2019).

³⁴ <https://www.ikea.com/at/de/customer-service/returns-claims/troubleshooting/laengeres-leben-pubdc91c551>.

Reuse

Furniture reuse without any refurbishment is quite common for private resell. Online-Platforms (e.g. Ebay, Facebook marketplace) make it easy for consumers to resell and rebuy used furniture. Charity organisation or second-hand warehouses sell reused furniture as well (Parker, et al., 2015). In addition to their reuse products, many operators also offer services like upcycling, dismantling and cleaning or tailor-made elements (Gustavsson et al., 2020).

Only a few furniture manufacturers are engaged in actively selling their furniture for reuse. These second-hand products can originate from 'clearance sales' for ex-display items or returned products. Other manufacturers offer trade-in and buy-back systems for used furniture. Afterwards, the recovered pre-owned furniture is sold as-is through second-hand distributors' networks. The IKEA Tempe store in Sydney, for example, is piloting a furniture buy-back scheme, where consumers can exchange their used IKEA furniture for a store voucher (Ramirez, 2019).

Second-hand commercial furniture is widely sold through online auctions, online classified ads sites (e.g. Gumtree, eBay) or by office furniture liquidators, who buy furniture from companies that are closing down. A newly formed Green Furniture Hub is also in charge of salvaging office furniture and to sell it as second-hand items (Ramirez, 2019).

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