*Product Lifetimes And The Environment*
*2017 - Conference Proceedings*
*C. Bakker and R. Mugge (Eds.)*

*DOI: 10.3233/978-1-61499-820-4-181*

PLATE conference
Delft University of Technology
8-10 November 2017

PLATE
Product Lifetimes And The Environment

# What's hot what's not: the social construction of product obsolescence and its relevance for strategies to increase functionality

Jaeger-Erben M.[a] and Proske M.[b]

*a) Center for Technology and Society, TU Berlin, Germany*
*b) Environmental and Reliability Engineering, TU Berlin, Germany*

**Keywords**
Obsolescence
Material culture
Public discourse
Design scenarios

**Abstract**
"Is it ethical to deny our products what we wish ourselves: A long live?" is one of the major questions the German documentary "Do mixers go to heaven?"[1] from 2016 asks. The star of this documentary is the RG28, a mixer once produced by a former GDR electronic factory, which became famous for its robustness and longevity. The factory didn't survive the Wende in 1989 but the mixers are still available on internet platforms and un junk-shops, some spare parts for the easy-to-repair mixer are still produced. Although it appears as a somewhat pathetic humanization of objects at a first glimpse, it makes an important point: Product lifetimes are more than a property of objects, a rationally calculated number that is inscribed in a product's design. The lifetimes of things made, used and disposed by humans can also be seen as an important characteristic of a given material culture and is rooted in current human-object relationships. This paper discusses both aspects – material culture and human-object relationship – with relation to the highly-contested term obsolescence[2]. Starting with the observation that obsolescence received most public attention in times of crisis, we report results of an analysis of current media discourses. Subsequently we present an alternative praxeological approach to obsolescence than the usual rational choice related explanations. The closing section discusses opportunities to increase a product's "affordance" to be kept alive longer.

## Obsolescence as a contested issue

Latest since the term "throw-away society" has been taken up in the second half of the 20th century (Packard 1960) the question of how long consumer goods last and how much waste is produced has been the issue of much debate, particularly driven by an increasing number of consumption- and growth-criticists (O'Brien, Barnett 2013). According to Weber (2014) the public interest in longevity or short-lived products started even earlier and has risen in three waves since the industrial revolution, indicating critical turning points in the history of mass consumption society. First occurring in the interwar period in the USA, obsolescence became an issue again around the first environmental crisis in the 1970s and is coming up another time around 2000 when issues such as toxicity, resource scarcity and digitalisation gained more and more public interest. Particularly since 2011 obsolescence enjoys constant media attention, at least in Germany.

### *Results of a media analysis*

Any sensible analysis of social phenomena particularly socially contested ones like obsolescence need to pay attention to how it is perceived as well as constructed in public discourses. As indicated above obsolescence is not a neutral description for a specific "natural" state of an object. It refers to a process where something is actively discarded, or seen as antiquated and outmoded. Even if an object like an electric device seems to be terminally broken it persists, and might still be useful, and be it only for art[3]. Hence, what is outmoded or not or worth being repaired, upcycled or re-used or not is socially negotiated. One approach to the communicative construction of obsolescence it to investigate media discourses.

A comprehensive search of online archives of German national and regional newspapers revealed over 200 newspaper and online articles that included the term "obsolescence" or "product lifetimes" from the last 30 years. The analysis was guided by the Discourse Analysis

[1] *German: "Kommen Rührgeräte in den Himmel", see also www.rg28.de*

[2] *The paper presents some initial results and concepts of a 5-year transdisciplinary research studying on obsolescence of electronic devices as a challenge for sustainable consumption. It is financed by the German Ministry for Education and Research and started in 2016 (www.challengeobsolescence.info)*

[3] *See also Baudrillard's notion of the aesthetic transfiguration of materials where "old objects, being obsolete and hence useless, automatically acquire an aesthetic aura" ( Baudrillard, Turner 2007)*

approach (DA). The DA is a qualitative method to examine texts with a focus on how the social world and social meaning is constituted through discourse, it is often used in the analysis of media. In the following we present some first insight into the results of the ongoing analysis.

The online archives sometimes went back to the late 1980ieth but it was an interesting first insight that despite a few random articles a broad media coverage started in 2011. This coincides with the wider release of the "The Light Bulb Conspiracy" from Cosima Dannoritzer, a documentary denouncing planned obsolescence as the core of the modern throw-away society. An analysis of the articles' contents revealed that they mostly dealt with planned obsolescence presenting it as a conscious – and often malicious – decision of producers and product developers to reduce the serviceable life of products[4]. A linear cause-and-effect perspective pointing to the producers prevailed, there were few "systemic views" that reflected obsolescence as an outgrowth of the modern consumer society. The malicious purpose of producers was presented as a certainty, but the evidence mostly consisted of anecdotes. Many articles began with an introduction like "as everybody has already experienced…" presenting cases where products broke down as soon as the warranty had expired. Obsolescence is presented as a kind of regular or normalised experience that almost everybody makes, like bad weather on a holiday. Scientific studies or evidences for a malicious fraud are rarely cited, instead of that the same narratives are regularly reproduced like the story of the Phoebus cartel, a "conspiracy" among major lightbulb producers to control the manufacture and sale of light bulbs in the 1920th and 1930th. Consumers on the other hand are often presented as victims, who should feel tricked or manipulated and are seduced to consume and waste[5]. This clear offender-victim juxtaposition is modified in a few articles where consumers are presented as hungry for trends and insensible for the environmental and ecological impacts of their consumption patterns. Approximately half of the articles reflect on solutions or ways out of the "throw-away"-culture. Almost all of them find that more political regulation is necessary, only a few also mention the responsibility of consumers or broad economic change as possibilities. In recent years, a new narrative evolves around so called repair-cafés and maker spaces. These are presented in a kind of "David-against-Goliath"-story as actors who fight with "a screwdriver against an avalanche of electronic waste"[6].

### *Implications of media discourses around obsolescence*

If we consider print- and online media as a powerful player in public discourses and a significant influence on the perception of citizens, our findings raise some problematic issues. First of all, the clear linear attribution of responsibility and power over the lifetimes of products to product developers and the obvious mistrust against producers can evoke a denial of responsibility among consumers that neither feel responsible nor capable to influence their products' lives. Surveys indicate that consumers often allocate the responsibility for short life-spans to producers and do not question their own practices of usage and disposal (Wieser et al. 2015; European Economic and Social Committee 2016). Even though objects and products seem to be the protagonists of every article they remain passive. Products are presented as objects for projections, that are used – by producers to maximize profit, by consumers to satisfy needs – as some kind of passive plaything. The materiality of consumption and the dynamics of physical human-objects relationship, like the practices of storing, using, caring, adjusting and maintaining as well as the know-how involved in these practices is almost absent in media presentations. Nevertheless, the repair-narratives that come up recently shows that there is a sensibility for this issue. They tell the story of an ongoing emancipation of consumers, of the regaining of know-how about products and their functioning and of a bypass curing the alienation between consumers and their products.

### Obsolescence - by choice or by practice?

Current production and consumption patterns in industrialised countries are characterised by an immense growth in personal properties, an increasing equipment of everyday life with electronic gadgets and infinite loops of new product generations (Oetzel 2012, (DESTATIS 2017; Spinney et al. 2012; Brouillat 2015;) 2015), causing tremendous mountains of toxic e-waste on the other side of the coin (UNEP 2011, Chan et al. 2008).

Nevertheless, in times of reflexive modernization (Beck et al. 2003) the fragile material basis of current forms of consumption as well as their tremendous ecological and social costs gain increasing public awareness. In this realm the issue of obsolescence of consumer goods or short-lived electronic devices can be seen as a topic where the problematic preconditions and consequences of modern production and consumption practices intensify and create discomfort. The media analysis and the recent upswing of interest in obsolescence can be seen as emblematic for this discomfort and the way society tries to find a way to deal with it: By searching for scapegoats. The linear perspective and monocausal attribution of responsibility can also be found in other more scientific debates. Here, a central driver for obsolescence is seen in an economic paradigm according to which science and technology is subordinate to economic premises; thus, product life spans are defined by an economic optimum and not by material and technological possibilities (Krajewski 2014; Feldmann, K., Sandborn, P. 2007; Slade 2006, Bodenstein, Leuer 1977, Packard 1960). Although some of these authors adopt a more systemic view than our argument suspects, they have in common that they

[4] *Examples are „Der geplante Defekt", [The planned defect"] Welt, 21.3.2013; https://www.welt.de/print/welt_kompakt/print_wissen/article114625303/Der-geplante-Defekt.html; „Hersteller sorgen mit perfiden Tricks für Umsatz", [Producers create sales with perfidious tricks] Welt online 29.8.2013. (https://www.welt.de/wirtschaft/webwelt/article119505169/Hersteller-sorgen-mit-perfiden-Tricks-fuer-Umsatz.html)*

[5] *An example is „Verführung mit Methode", [Seduction with a method] Der Spiegel Online, 6.10.2011. http://www.spiegel.de/netzwelt/gadgets/apples-design-strategie-verfuehrung-mit-methode-a-790318.html*

[6] *http://www.braunschweiger-zeitung.de/verbraucher/article150790896/Mit-dem-Schraubenzieher-gegen-die-Elektroschrott-Lawine.html*

reconstruct obsolescence as a product of choices – be it by profit-oriented producers, hedonistic consumers, or manipulative engineers – as well as the choice-makers motive to maximize their own benefit.

Without calling the efficacy of economical logics on production and consumption patterns into question we encourage to look beyond such a linear attribution and emphasise a reconstruction of obsolescence as a part of modern material culture.

### Obsolescence as a part of material culture

Studies of material culture deal with relationships between people and their things, they emphasize how apparently inanimate things act on people, and are acted upon by people (Woodward 2007). We would argue that a study of obsolescence need to differentiate analytically between practices interacting with objects on the one hand and practices communicating about objects on the other hand. Obsolescence is materially produced when short-lived artefacts are designed, created, appropriated, used, devaluated and disposed of and which can be observed among others in measurable lifetimes or amounts of waste production. But obsolescence is also created in communications qualities of consumer goods, their values and meanings are negotiated. Both aspects are deeply interrelated and form the background for a material culture where short-lived products became a normality. Material culture is inscribed into and reproduced by human-object relationships, therefore they are key to understanding obsolescence.

Science and technology studies (e.g. (Akrich 1992; Hughes 1986), material culture studies (e.g. Miller 2001) and theories of practice (e.g. (Reckwitz 2002, Schatzki 2003, 2009, Shove 2007) are approaches that shed different but somehow converging lights on the dynamics of human-object relationships. They approach consumer goods as "becoming in the course of their lives in the domestic" which are "neither finished nor inviolable forms at the points of production and acquisition, but […] continually evolving, positioned within and affected by an ongoing flow of consumer practice." (Gregson et al., 2009:250). Their study goes beyond the 'objectness' of things, investigating the formative processes through which objects come into being (Rinkinen et al. 2015). Concepts like domestication (Silverstone, Hirsch 1992), affordance (Fisher 2004) or "in-/de-scripting" (Akrich, 1992). consider objects more or less as "fluid" and describe the dynamic interrelatedness of designers, users and the products themselves. In addition, practice theories focus on practical understanding (or know-how, competences) as an integral element of using, maintaining, restoring, fixing and caring for objects. Practical know-how is based on shared understandings, but also emerges in and is formed by everyday interactions.

### A different perspective on design for longer lasting products

Taking the perspectives mentioned above as a background, we can ask some questions that go beyond the "homo economicus"-model. Focusing on the communicative production of obsolescence or short-lived products we can ask how the practical meanings of products are produced. Consumer goods often carry "immaterial" meanings like "novelty", "innovation", "desirability" and "distinctiveness". Meanings that do not necessarily connect to their practicability or functionality in terms of consumption needs. For example, Vodafone introduces one of their mobile plans with the questions "Love the buzz of getting a new phone?" and – assuming the answer must naturally be yes – offers: "Get that new phone feeling every 12 months with New Phone Every Year on Vodafone Red+"[7] Consequentially a phone whose role is to generate a "new phone feeling" need not to be designed for lasting long but for looking and feeling new. Of course, a phone still needs to fulfil practical needs like communication. But its meaning goes way beyond practicability and it does not entail or is even impeded by longevity (the longer the products lives the weaker gets the new phone feeling) "Up-to-date" products" (Cox et al. 2013) like smartphones might be exceptional here. But the fact that also "workhorses" (ibid.) like washing machines are replaced when still functional or at least repairable (Cox et al. 2013; Evans, Cooper 2010, Prakash et al., 2016) can be related to a material culture where getting the new is more usual than "maxing" out the old.

A further interesting question relating to the material construction of obsolescence is what the practical understanding of object consists of. How much do producers and consumers know about their products, their technical functioning and ways of maintaining, upgrading, caring for and repairing it? Modern production processes form a complex web of dispersed actions, it grows more and more impossible, even for product developers and producers themselves to have profound knowledge of the technical composition and of all (mal)functions of their devices and to keep track of the global supply chains of their production[8] (Ying Kei Tse et al. 2011, Lehmacher 2015). This systemically produced intransparency is passed on to the consumer added or enforced by a more or less systematic "closure" of products: Many electronic devices can hardly be opened, their "hearts" and "brains" are invisible, their components are assembled in units and can't be reached or replaced component-wise (Prakash et al. 2016) The major slogan of the Repair Manifesto by IFixIt "If you can't fix it you don't own it." assumes that a full appropriation of the whole object is impeded if products stay "black boxes". A little less programmatically spoken we can hypothesize that practical experiences with the materiality of our products and the material foundation of their functional properties

[7] http://www.vodafone.co.nz/red/new-phone-every-year/

[8] Sustainability oriented enterprises like Fairphone and NagerIT make some efforts to increase the transparency of their supply chains but still face many unknowns. The list of suppliers for the Fairphone 2 so far contains almost 100 suppliers https://www.fairphone.com/wp-content/uploads/2017/01/List-of-Suppliers-final-December2016.pdf.

are not at the forefront of human-object-relationships. Practical knowledge relates more to make use of products and not so much on how to exploit them "to the max" by practices of maintenance, care, repair, tinkering, up- or recycling. But how can this "material alienation" between humans and objects be bridged?

## Design scenarios to stimulate longer lasting products

Several authors have dealt comprehensively with the question of how to increase product lifetimes and serviceable lives by design (most prominently van Nes, Cramer 2006). Our suggestion is to juxtapose concepts like design for reliability and robustness, reparability or upgradability to our present material culture and its inherent human-object relationships that in different ways produce and built upon obsolescence.

Modular design is often named as the solution for longer lasting products. Thereby "modular" itself does neither automatically lead to a longer-living nor a more environmentally friendly product (e.g. if modular only means "more add-ons", see also Schischke et al. 2016). But our suggestion is, that a sensibly introduced design for reparability or modularity, has the potential to transform the human-object relationship and impact material culture. As an example we focus three modularity scenarios and designs for longer lasting smartphones and reflect some research questions concerning practical understandings and human-object-relationships.

In the *"Fairphone[9]-Scenario"* design concepts build upon the assumption that product lifetime can be increased through repairs. The design is modular to enable the replacement but not the upgrading of components. Even this basic modularity requires higher input material than the usual "compact unit" form which only pays off (from an environmental perspective) if a product is actually used longer and repaired in case of damage. The design of the Fairphone offers different stimuli – like the transparency of physical properties, the invitation "yours to open" and the pre-installed app from IFixIt – that target the user's practical understanding of the product's functioning or at least his or her curiosity. What does it make with users if they can easily look inside their phones, if they are invited and supported to physically "enter" into their devices? Based on our previous reflections we can hypothesize that the affordances in this scenario to get to know the object and to repair if needed enlarges the scope of practical understandings and create a new meaning around maxing out the device.

In addition to reparability the design in the *"PuzzlePhone[10]-Scenario"* seeks to increase the lifetimes by offering a module-wise possibility for upgrades. The phone in this scenario is somehow "future proof" and materially efficient, since devices can be adjusted to changing needs or new technological developments without having to replace the whole device. At the same time the psychological and financial barriers for an upgrade might be lower and modules might be changed much more often than a whole device would be replaced otherwise (so called rebound-effect). At the same time the device can potentially trigger a more profound reflection of users about their practical needs. The three modules of the PuzzlePhone (brain, spine, heart) scenario represent different functional units which further opens up the "black box" and increases the understanding of how things work together inside of a smartphone. A hypothesis is here that in this scenario a more sufficient consumption can be triggered by both: Getting to know better one's own practical needs as well as how they correspond to different functional modules of the device.

The assumptions and questions in the *"Phonebloks[11]-Scenario"* are similar to the previous one but can be pushed a little further. In this case modules are available with a wide range of different functions (screen, cameras, sensors, audio equipment, different kinds of batteries and power chargers, etc.) enabling the creation of a personalized smartphone. Product configuration can be changed constantly which allows the "feeling" of a new device without actually having a new one. From the purchase on this design scenario prompts users to reflect about practical needs, but is flexible enough to react upon changing needs. The possibility of personalization further might deepen the human-object-relationship, users get what they need and no possibly oversized standard package. But also here, rebound-effects are likely and ecological efficiency still needs to be proved. Nevertheless, we can hypothesize that the affordance is high that users realize the complexity and diversity of functions that their small device is offering and might develop a deeper appreciation of it.

The three scenarios correspond to actual cases which are in different phases of realisation: Fairphones do already exist since a while, PuzzlePhone are at least likely to be produced one day, Phonebloks (or Google ARA) are still a fiction. Still, they might represent three possible (maybe also consecutive) steps to bridge materially alienated human-object relationships.

## Conclusions

Our paper works with a lot of assumptions that still are somehow sketchy and hypothetical and which are currently further investigated. One of our main observations is that current human-object-relationships in case of modern electronic products are quite ambivalent: Although the relationship is so close that people and electronics almost become hybrids in the course of their everyday practices they live like strangers: A deeper understanding of electronic devices, of their functioning and content as well as their "material needs" in terms of care, maintenance and repair, seems to be inferior and – in view of technological trends towards miniaturisation,

[9] www.fairphone.com

[10] http://www.puzzlephone.com/

[11] https://phonebloks.com/, see also the now cancelled effort by Google to push this idea further https://atap.google.com/ara/

automatisation and integration – is very likely to decrease even more. Technological progress might not be reversed, and it would be naïve to suggest that everybody needs to become an electronics expert or to learn fixing conductor plates if obsolescence should be resolved. Our major point and hypothesis is that longer lasting products are an effect of longer lasting relationships between people and their objects and both, the social significance and practical meaning for objects and the practical understanding of objects in relation to their materiality is crucial. We briefly discussed some design options that might be able to evoke these questions as well as appropriate answers. We would argue that easily repairable and modular smartphones for example are more than just innovations in design but require and evoke a transformation of alienated human-object relationships. Nevertheless, innovative product designs that foster longer lasting relationships are just a tiny part of future scenarios for longer lasting products. It still needs to be proved if they have a potential to compete against or even lighten the path dependencies of present economic and socio-technical regimes.

## References


Akrich, Madeleine (1992): The De-Scription of Technical Objects. In W. Bijker, J. Law (Eds.): Shaping Technology, Building Society: Studies in Sociotechnical Change. Cambridge, Mass, MIT Press, pp. 205–224.

Baudrillard, Jean; Turner, Chris (2007): The intelligence of evil or the lucidity pact. paperback ed. repr. Oxford: Berg.

Beck, Ulrich; Bonss, Wolfgang; Lau, Christoph (2003): The Theory of Reflexive Modernization. In Theory, Culture & Society 20 (2), pp. 1–33. DOI: 10.1177/0263276403020002001.

Brouillat, Eric (2015): Live fast, die young? Investigating product life spans and obsolescence in an agent-based model. In J Evol Econ 25 (2), pp. 447–473. DOI: 10.1007/s00191-014-0385-1.

Chan, Jenny; Haan, Esther de; Nordbrand, Sara; Torstensson, Annika (2008): Silenced to Deliver: Mobile phone manufacturing in China and the Philippines. Edited by SwedWatch SOMO.

Cox, Jayne; Griffith, Sarah; Giorgi, Sara; King, Geoff (2013): Consumer understanding of product lifetimes. In Resources, Conservation and Recycling 79, pp. 21–29. DOI: 10.1016/j.resconrec.2013.05.003.

DESTATIS (2017): Ausstattung privater Haushalte mit Informations- und Kommunikationstechnik – Deutschland. Available online at https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/EinkommenKonsumLebensbedingungen/AusstattungGebrauchsguetern/Tabellen/Infotechnik_D.html, checked on 2/6/2007.

European Commission (2011): A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy. In COM(2011) 21.

European Economic and Social Committee (2016): The influence of lifespan labelling on consumers. Brussels: EESC.

Evans, Sian; Cooper, Tim (2010): Consumer Influences on Product Life-Spans. In Tim Cooper (Ed.): Longer lasting products. Alternatives to the throwaway society. Farnham, Burlington, VT: Ashgate, pp. 319–350.

Feldmann, K., Sandborn, P. (2007): Integrating technology obsolescence considerations into proudct design planning. Proceedings of the ASME 2007 International Design Engineering Conference. Las Vegas. Available online at http://www.enme.umd.edu/ESCML/Papers/DFMLC-35881_Final_Manuscript.pdf.

Fisher, Tom H. (2004): What We Touch, Touches Us: Materials, Affects, and Affordances. In Design Issues 20 (4), pp. 20–31. DOI: 10.1162/0747936042312066.

Hughes, Thomas P. (1986): The Seamless Web: Technology, Science, Etcetera, Etcetera. In Social Studies of Science 16 (2), pp. 281–292.

Krajewski, Markus (2014): Fehler-Planungen. Zur Geschichte und Theorie der industriellen Obsoleszenz. In TG 81 (1), pp. 91–114. DOI: 10.5771/0040-117X-2014-1-91.

Lehmacher, Wolfgang (2015): Globale Supply Chain. Technischer Fortschritt, Transformation und Circular Economy. Online-Ausg. Wiesbaden: Springer Fachmedien Wiesbaden (EBL-Schweitzer).

Miller, Daniel (Ed.) (2001): Home possessions. Material culture behind closed doors. Oxford: Berg.

O'Brien, Karen; Barnett, Jon (2013): Global Environmental Change and Human Security. In Annu. Rev. Environ. Resour. 38 (1), pp. 373–391. DOI: 10.1146/annurev-environ-032112-100655.

Oetzel, Günter (2012): Das Globale Müll-System. Vom Verschwinden und Wieder-Auftauchen der Dinge. In Matthias Maring (Ed.): Globale öffentliche Güter in interdisziplinären Perspektiven. Karlsruhe, Baden: KIT Scientific Publishing (Schriftenreihe des Zentrums für Technik- und Wirtschaftsethik am Karlsruher Institut für Technologie. Hrsg. von Matthias Maring, 5), pp. 78–98.

Packard, Vance (1960): The waste makers. 4. pr. New York: McKay Comp.

Reckwitz, Andreas (2002): The Status of the "Material" in Theories of Culture. From "Social Structure" to "Artefacts". In J Theory of Social Behaviour 32 (2), pp. 195–217. DOI: 10.1111/1468-5914.00183.

Rinkinen, Jenny; Jalas, Mikko; Shove, Elizabeth (2015): Object Relations in Accounts of Everyday Life. In Sociology 49 (5), pp. 870–885. DOI: 10.1177/0038038515577910.

Schatzki, Theodore R. (2009): Social practices. A Wittgensteinian approach to human activity and the social. New York: Cambridge University Press.

Schatzki, Theodore R. (Profess (2003): The Site of the Social. Pennsylvania: PENNSYLVANIA STATE UNIVERSITY PRESS.

Schischke, Karsten; Proske, Marina; Nissen, Nils; Lang, Klaus-Dieter (2016): Modular Products: Smartphone Design from a Circular Economy Perspective. EGG 2016+, September 2016.

Shove, Elizabeth (2007): The design of everyday life. Oxford: Berg (Cultures of consumption series). Available online at http://www.loc.gov/catdir/enhancements/fy0743/2007033748-d.html.

Silverstone, Roger; Hirsch, Eric (1992): Consuming technologies. Media and information in domestic spaces. London: Routledge.

Slade, Giles (2006): Made to break. Technology and obsolescence in America. Cambridge, Mass.: Harvard University Press.

Spinney, Justin; Burningham, Kate; Cooper, Geoff; Green, Nicky; Uzzell, David (2012): 'What I've found is that your related experiences tend to make you dissatisfied': Psychological obsolescence, consumer demand and the dynamics and environmental implications of de-stabilization in the laptop sector. In Journal of Consumer Culture 12 (3), pp. 347–370. DOI: 10.1177/1469540512456928.

UNEP (2011): Recycling Rates of Metals - A Status Report. Edited by International Resource Panel - Working Group on the Global Metal Flows.

van Nes, Nicole; Cramer, Jacqueline (2006): Product lifetime optimization. A challenging strategy towards more sustainable consumption patterns. In Journal of Cleaner Production 14 (15-16), pp. 1307–1318. DOI: 10.1016/j.jclepro.2005.04.006.

Weber, Heike (2014): Einleitung. „Entschaffen". Reste und das Ausrangieren, Zerlegen und Beseitigen des Gemachten. In TG 81 (1), pp. 3–32. DOI: 10.5771/0040-117X-2014-1-3.

Wieser, Harald; Tröger, Nina; Hübner, Renate (2015): Die Nutzungsdauer und Obsoleszenz von Gebrauchsgütern im Zeitalter der Beschleunigung. Eine empirische Untersuchung in österreichischen Haushalten. Stand. Wien: AK Wien. Available online at http://emedien.arbeiterkammer.at/viewer/resolver?urn=urn:nbn:at:at-akw:g-489956.

Woodward, Ian (2007): Cultural sociology, materiality and object-relations. Reframing modes of cultural understanding through the study of things. Griffith University.

Ying Kei Tse; Kim Hua Tan; Sai Ho Chung; Ming Kim Lim (2011): Quality risk in global supply network. In Jnl of Manu Tech Mnagmnt 22 (8), pp. 1002–1013. DOI: 10.1108/17410381111177458.