Sustainable Interaction Design: Obsolescence in a Future of Collapse and Resource Scarcity

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ABSTRACT
Electronic waste, caused by the advancements of technology and its rapidly increasing obsolescence, represents a major threat to environmental sustainability. Research in Sustainable HCI has proposed a variety of solutions to tackle this issue, but has yet to create a major impact in product design. While currently industry's goals are opposed to research's concepts of addressing obsolescence, a future of collapse and resource scarcity requires a revisit of those contributions: changes in society at large, such as a decrease of resource availability, different needs, requirements, and desires of the consumer, but also new directions of industry and marketing might enable researchers to bring their old concepts into practice. We take a look at a variety of obsolescence-related research in Sustainable HCI and foreshadow its potential for such a future of collapse and resource scarcity.

Categories and Subject Descriptors
H.5.m [**Information Interfaces and Presentation (e.g., HCI)**]: Miscellaneous.

General Terms
Design, Human Factors.

Keywords
Sustainable HCI; Obsolescence; Collapse Informatics; Attachment; Product Design.

1. OBSOLESCENCE AND SUSTAINABLE HCI
Obsolescence, in particular the obsolescence of technology, has been an important topic of discussion in Sustainable HCI (SHCI) and Ubiquitous Computing in recent years [e.g., [6], [8], [10], [15], [16], [27], [39]]. While some form of obsolescence – namely planned obsolescence – is brought upon us by industry (cf. [[28], [35]]), the general term obsolescence encompasses a much larger meaning which does not necessarily imply bad intent. One origin for unintentional obsolescence stems from the very fields of HCI and Ubiquitous Computing themselves: the development and discovery of new technologies and opportunities for interaction enables and exacerbates obsolescence, since consumers aspire and acquire such new technology. The combination of those two field's goals – research's new discoveries in technology and industry's urge to sell more products – leads to a dreadful impact on environmental sustainability. According to the EPA, in 2010 alone 374 million units of technology were disposed of, with only 19% of them going into recycling and 310 million units ending up as electronic waste.

SHCI has produced a variety of solutions to address obsolescence (cf. [[32]] for a survey of obsolescence-related research in SHCI), but has yet to produce an impact on product design in practice. While the problem of bringing guidelines and theoretical frameworks from research to practice, also known as the theory-practice gap, is a well-known problem in the general field of HCI that has been frequently mentioned [[11], [33], [34], [37]], the solutions to obsolescence face another obstacle: most of the approaches to address obsolescence are opposed to the goals of industry and marketing. The overarching goal in any attempt to address obsolescence is to get consumers to keep and use their devices longer, which results in a decrease of sales.

2. COLLAPSE INFORMATICS AND LIMITS TO GROWTH
Basic theories that are often cited to undermine the exponential nature of obsolescence are Moore's Law [[24]] or Jevons' Paradox [[18]]. Moore's Law states the observation that about every two years the number of transistors doubles, and a similar growth has been attributed to other measurable factors in technology development as well. Jevons' Paradox (often referred to as "Rebound Effect", e.g. [[19]]) describes the effect that any increase in efficiency does not lead to a decrease but rather an increase in resource consumption, as the increased efficiency is met with an even higher increase in demand. Both theories are an almost paralyzing obstacle when tackling obsolescence. Although Moore's Law faced many predictions of slowing down, recent engineering discoveries hint that it might continue far longer than expected [[40]], destroying hope for an engineering-driven slowdown of technological advancement (which might indicate potential for reduced sales). Jevons' Paradox represents an even more difficult issue: increased efficiency in the production process would lead to even more resource consumption due to the increased demand, which would jeopardize all efforts and yield the opposite result of what was desired [[19]].

Those observations, combined with the aforementioned inherent problem of industry's disinterest of resolving obsolescence, paint a depressing picture for the future of sustainability research. However, the basic assumption for observations such as Moore's Law and Jevons' Paradox are that growth is infinite. While early predictions of the end of Moore's Law have been disproven, there is still agreement that it will not continue to go on infinitely as technological advancement will encounter a limit at some point. Similarly, the increase consumption of resources will hit a ceiling sooner or later, since all natural resources are limited. These limits

have only been brought up in the debate in SHCI recently [[29], [38]], and its implications for research have not been discussed in-depth yet in all aspects of the field. Therefore, the question arises: how do those "non-negotiable limits" [[29]] change and shape future SHCI research? In particular, how does the presence of limits affect the solutions to problems of obsolescence, as well as the discussion itself?

In this paper, we seek answers to this question by looking at some of the obsolescence-related research from the field of SHCI [[32]] in light of the concept of Collapse Informatics [[38]]. In our opinion, Collapse Informatics does not carry the apocalyptic meaning its term might suggest at first glance, but rather presents a new lens for looking at SHCI research: instead of treating the future as a binary entity (a perfectly sustainable society or the end of the world) the more likely future probably lies on a continuum somewhere in between, with neither of those extremes ever becoming reality. Another important insight from this work is that this future, whatever it may look like, will not arrive in an instant, but our society will slowly transition into it – and probably continue to undergo changes. Tomlinson et al. argue that *"there is a need for research in collapse informatics – the study, design, and development of sociotechnical systems in the abundant present for use in a future of scarcity"*. Besides the development of systems – which would likely fall into the category of *sustainability through design* [[23]] – there is just as much need to look at the design of products in light of *sustainability in design* [[23]], especially with regard to the well-established concept of Sustainable Interaction Design (SID) [[4]]. In the following, we will attempt to foreshadow what potential changes to SID are to be expected, how this affects obsolescence-related research in SHCI, and how existing contributions might be reinterpreted.

3. SUSTAINABLE INTERACTION DESIGN IN A FUTURE OF RESOURCE SCARCITY

3.1 Design for Repair, Re-Use, and Recycling

Many technological devices these days restrict the way users can repair the device or replace parts if hardware breaks or becomes outdated. For example, special tools are needed to open most smartphones, and replacing a battery is not possible without risking warranty for many phones, tablets, and computers. Maestri and Wakkary [[22]] argue that technology should be designed such that everyday users can repair them – a vision which seems far-fetched given that most products have gone the other direction in recent years by restricting reparability, but might change entirely in a future of collapse. When resources are scarce, providing replaceable components might become a desirable new opportunity for business, and consumer-reparable devices will hopefully see a comeback.

If repairing is not an option, the device might also be re-used in an entirely new way beyond its intended purpose [[27]] or even recycled entirely to harvest the scarce resources inside them. Kim and Paulos [[20]] developed a design vocabulary for re-used, which could be extended or re-envisioned based on the future needs for particular parts in a device, or different purposes of the device. An example for that can be found in a study by Huh et al. [[17]], in which participants bought outdated and partially broken PDAs off eBay for the use as music player or cheap GPS navigation. A study in developing countries even suggests the possibility for large-scale re-use of old technology as displayed by TVCs [[21]], a low-cost game console built from computing parts that were as old as 30 years.

3.2 New Luxury and Longevity as Lifestyle Choice

In our present world of virtually unlimited resources, at least from the consumer's perspective, acquiring the newest piece of technology is often considered a desirable lifestyle choice (e.g., for early adopters [[14]]). A future of collapse might see a different picture; there are already streams of different behavior present in today's society, as exemplified by the *Slow Movement* [[12], [13], [36]], but also upcoming projects such as the D4R laptop [[1]], Fairphone [[8]], Phonebloks [[30]], or Project Ara [[31]]. Although those are small projects that cannot compete with the large-scale industry that produces the majority of electronics, it hints that potentially sustainable options are already being developed. If the prevalent lifestyle choice were to change from early adopter, i.e., users striving to acquire the most recent technological advancement, to one in which it is desirable to own a device for a longer time span, such projects could become major milestones for a new product design paradigm.

Blevis et al. go one step further and discuss the concept of *New Luxury* [[2]], which means that products are associated with a notion of luxury not because they are expensive and exclusive, but because of higher standards of quality while being not too expensive. In a future of scarcity, products that require a large amount of natural resources would automatically be expensive, thus never fall into the category of new luxury. Coincidentally, almost all of the design recommendations of how to realize and achieve new luxury seem to align perfectly with a future of collapse, e.g., *"promoting services over new physical materials"* or *"promoting concern for secondary markets"* [[2]]. To some extent, the development proposed in their paper has already taken place – with the recent trend of cloud storage and digitalization of media distribution. However, many of the steps are still far from realization and contrary to current developments in technology design.

3.3 Attachment, Ensoulment, and Pleasure Engineering

Another approach to address obsolescence is that of changing the inherent design values of products to foster a deep connection between the device and its owner. Many concepts have been proposed that share one commonality – a product that satisfies the user's needs, addresses his desires, and creates a long-lasting connection to avoid early disposal. The underlying principle can be found in concepts such as *Attachment* [[8], [10], [27]], *Ensoulment* [[3], [25]], *Pleasure Engineering* [[39]], or *Emotional Design* [[26]]. Although this list (which is by no means exhaustive) highlights a large number of independent contributions that all hint the same solution to obsolescence, there is no sign of any of those concepts making its way into a successful, large-scale design principle to be found in electronics products. We can only speculate about the reasons, but one major obstacle obviously is that they all are contrary to industry's and marketing's goals, as discussed earlier.

It is safe to assume that in a future of collapse, companies still want to sell products, therefore the question remains: how can all those concepts – that certainly align with the sustainability requirements for a future in which consumers should hold on to

their devices longer than it is currently the case – be brought together with industry's goals? We believe that the answer to this question is hinted at in SHCI research as well, such as by Blevis et al. [[2], [5]] or Gegenbauer and Huang [[10]]: by promoting services over products. This would present a major shift for many companies, but might be an inevitable change to which there is no alternative, similar to what we have seen for the development of music and movie distribution in the past.

4. CONCLUSION

Limited resources in a future of scarcity and collapse represent a future that is often perceived scary, negative, and difficult – and sometimes even described as almost apocalyptic. While the scenarios in this future certainly come with restrictions and severe changes in our everyday life as well as for industry, these changes also imply that we have to rethink our approach to research, in particular in the field of SHCI. For the particular problem of obsolescence, this future even holds a positive aspect: the motivation to finally implement concepts that have been developed and refined over many years in our still relatively young field. With the potential changes to consumer's perception towards technology acquisition, industry's goals and focus on production, and the inevitable scarcity of resources, old concepts that were deemed to be unrealistic might become viable and new approaches might arise.

In this paper, we made a first attempt to look at those potential changes and its impact on some of the concepts that can be found in today's SHCI research. However, this can only be the start of a discussion on many levels: How do we approach the transition phase in which all parties – consumers, developers, and researchers – undergo a paradigm change? Which concepts can be applied "as is", which concepts have to be refined, and which concept have to be completely reworked? What are the limits to those concepts – are they all feasible in all possible futures, or depend on a particular state of resource scarcity or societal change? Those and other questions can not only inform the research of today, but even create entirely new fields of research in the future – whatever this future might hold for us.

5. REFERENCES

[1] Beigl, P., Hickey, S., Obersteiner, G., Fitzpatrick, C., Schischke, K., Maher, P., et al. Towards zero waste in industrial networks: a case study of the D4R laptop. In *Proc. ICT4S '13*.

[2] Blevis, E., Makice, K., Odom, W., Roedl, D., Beck, C., Blevis, S., et al. Luxury & new luxury, quality & equality. In *Proc. DPPI '07*.

[3] Blevis, E. and Stolterman, E. Ensoulment and Sustainable Interaction Design. In *Proc. IASDR '07.*

[4] Blevis, E. Sustainable interaction design: invention & disposal, renewal & reuse. In *Proc. CHI '07*.

[5] Blevis, E. SUSTAINABLY OURS: Two Digital Divides and Four Perspectives. *interactions 15, 1 (2008)*.

[6] Cooper, T. *Longer Lasting Products*. Gower Pub Co, 2010.

[7] DiSalvo, C., Sengers, P., and Brynjarsdóttir, H. Mapping the landscape of sustainable HCI. In *Proc. CHI '10*.

[8] Fairphone. (n.d.). *Fairphone*. Retrieved from http://www.fairphone.com/

[9] Gegenbauer, S. and Huang, E.M. Inspiring the design of longer-lived electronics through an understanding of personal attachment. In *Proc. DIS '12*.

[10] Gegenbauer, S. and Huang, E.M. iPods, Ataris, and Polaroids: a personal inventories study of out-of-use electronics in Swiss households. In *Proc. UbiComp '12*.

[11] Goodman, E., Stolterman, E., and Wakkary, R. Understanding Interaction Design Practices. In *Proc. CHI '11*.

[12] Grosse-Hering, B., Mason, J., Aliakseyeu, D., Bakker, C., and Desmet, P. Slow Design for Meaningful Interactions. In *Proc. CHI '13*.

[13] Hallnäs, L. and Redström, J. Slow Technology - Designing for Reflection. *Personal Ubiquitous Comput. 5, 3 (2001)*.

[14] Hanks, K., Odom, W., Roedl, D., and Blevis, E. Sustainable millennials: attitudes towards sustainability and the material effects of interactive technologies. In *Proc. CHI '08*.

[15] Huang, E.M. and Truong, K.N. Breaking the disposable technology paradigm: opportunities for sustainable interaction design for mobile phones. In *Proc. CHI '08*.

[16] Huang, E.M., Yatani, K., Truong, K.N., Kientz, J.A., and Patel, S.N. Understanding Mobile Phone Situated Sustainability: The Influence of Local Constraints and Practices on Transferability. *IEEE Pervasive Computing 8, 1 (2009)*, 46–53.

[17] Huh, J., Nam, K., and Sharma, N. Finding the lost treasure: understanding reuse of used computing devices. In *Proc. CHI '10*.

[18] Jevons, W. S. *The Coal Question* (2nd ed.). London: Macmillan and Co., 1866.

[19] Kaufman, S.J. and Silberman, M.S. Rebound effects in sustainable HCI. In *Proc. CHI '11 workshop*.

[20] Kim, S. and Paulos, E. Practices in the creative reuse of e-waste. In *Proc. CHI '11*.

[21] Lomas, D., Kumar, A., Patel, K., Ching, D., Lakshmanan, M., Kam, M., et al. The Power of Play: Design Lessons for Increasing the Lifespan of Outdated Computers. In *Proc. CHI '13*.

[22] Maestri, L. and Wakkary, R. Understanding repair as a creative process of everyday design. In *Proc. C&C '11*.

[23] Mankoff, J.C., Blevis, E., Borning, A., Friedman, B., Fussell, S.R., Hasbrouck, J., et al. Environmental sustainability and interaction. In *Proc. CHI EA '07*.

[24] Moore, G.E. Cramming More Components onto Integrated Circuits. *Electronics, (1965)*.

[25] Nelson, H.G. and Stolterman, E. The design way: intentional change in an unpredictable world. The MIT Press, 2012.

[26] Norman, D.A. Emotional design: Why we love (or hate) everyday things. Basic Books, 2004.

[27] Odom, W., Pierce, J., Stolterman, E., and Blevis, E. Understanding why we preserve some things and discard others in the context of interaction design. In *Proc. CHI '09*.

[28] Packard, V. *The Waste Makers*. Vance Packard Inc., 1960.

[29] Pargman, D. and Raghavan, B. Rethinking Sustainability in Computing: From Buzzword to Non-negotiable Limits. In *Proc. NordiCHI '14.*

[30] Phonebloks. (n.d.). *Phonebloks*. Retrieved from https://phonebloks.com/en

[31] Project Ara. (n.d.). *Project Ara*. Retrieved from http://www.projectara.com/

[32] Remy, C. and Huang, E.M. Addressing the obsolescence of end-user devices: Approaches from the field of sustainable HCI, In: *ICT Innovations for Sustainability*, Springer, Heidelberg/New York, 2014.

[33] Roedl, D.J. and Stolterman, E. Design Research at CHI and Its Applicability to Design Practice. In *Proc. CHI 2013*.

[34] Rogers, Y., Preece, J., and Sharp, H. *Interaction design*. Wiley ; John Wiley, 2011.

[35] Slade, G. Made to break: technology and obsolescence in America. Harvard University Press, 2007.

[36] Strauss, C.F. and Fuad-Luke, A. The Slow Design Principles - A New Interrogative and Reflexive Tool for Design Research and Practice. In *Proc. CtC '08.*

[37] Sutcliffe, A. On the Effective Use and Reuse of HCI Knowledge. *ACM ToCHI. 7, 2 (2000)*.

[38] Tomlinson, B., Silberman, M.S., Patterson, D., Pan, Y., and Blevis, E. Collapse informatics: augmenting the sustainability & ICT4D discourse in HCI. In *Proc. CHI '12*.

[39] Woolley, M. Choreographing obsolescence - ecodesign: the pleasure/dissatisfaction cycle. In *Proc. DPPI '03*.

[40] Yirka, B. (2013, May 2). *New nanowire transistors may help keep Moore's Law alive*. Retrieved from http://phys.org/news/2013-05-nanowire-transistors-law-alive.html