Puja Parakh and Robert Racadio
Human Centered Design & Engineering
University of Washington
HCDE 502 | Autumn 2010

DESIGNING A VIABLE FUTURE: SUSTAINABILITY IN HCI

INTRODUCTION

With escalating concerns about technology's impact on the environment, understanding the concept of sustainability in Human-Computer Interaction (HCI) is becoming increasingly important. Many definitions of sustainability exist, but perhaps researchers Kristin Hanks, et al. put it most succinctly by defining sustainability as the *viability of our collective future.* Once only discussed in smaller panels or sessions, entire conferences and publications in HCI are now devoted to the topic. For example, in 2009, User Experience Magazine published a special issue titled, "Designing a Sustainable world [1]" and in 2011, the International Professional Communication Conference will explore the theme of "Communicating Sustainability [2]." It's becoming clear that the next generation of HCI practitioners must be knowledgeable about sustainability and its implications to the field.

Our reading list hopes to impart some knowledge on the topic. To guide our choice of readings, we first identified three different perspectives that would be important for practitioners to consider:

- Present and future users
- Supporting sustainable behaviors
- Environmental and global repercussions of technology

Empirical research in the fields mentioned can be difficult to locate, as the overall topic of sustainable design is still in its infancy. However, these articles we selected each exemplify one of these perspectives and, taken together, serve to form a coherent glimpse of what sorts of HCI-related empirical studies are being conducted in sustainability.

PRESENT AND FUTURE USERS

Sustainable Millennials: Attitudes towards Sustainability and the Material Effects of Interactive Technologies [3]

Kristin Hanks, William Odom, David Roedl, & Eli Blevis
School of Informatics
Indiana University at Bloomington, Indiana USA

STUDY DESCRIPTION

Researchers at Indiana University surveyed 435 undergraduate students between the ages of 18 and 21 to determine their opinions and attitudes towards sustainability. Using the findings from quantitative

analysis and qualitative interpretation, the authors developed four profiles to characterize millennial attitudes and behaviors towards sustainability. The article concludes with key insights about understanding this population and their views on material success, and proposes strategies to get others to act in sustainable ways.

RESULTS

The article focused on the attitude and behavior of millennials, and their approach toward considerations surrounding sustainability. Survey results indicated that in general respondents were only "somewhat" worried about global warming. While they realized that global warming was caused by human intervention, they were not sure who should shoulder the responsibility. While the energy industry was cited as the most responsible, some of the lowest scores were attributed to individual consumers and product designers, including hardware and software designers.

Furthermore, even among those who indicated a high level of awareness, this did not translate to more sustainable purchasing practices. For example, there was little to no difference in buying practices from their peers when it came to choosing used items instead of new for such products as cars, laptops, smartphones, or mp3 players. Participants tended to perceive analog technologies like automobiles, bicycles, and home appliances to be more enduring than digital technologies. Those with more disposable income do not necessarily turn down used items as long as the item seemed retain its value, a recurring theme when it came to buying behavior.

Respondents also seemed to replace their technologies much more frequently than necessary. For example, over 32% of respondents claimed to have owned four to eight cell phones in their lifetimes. This is an extraordinary level of consumption considering that the average age of participants was 19.7 years old. Across all respondents, the preferred replacement cycle for cell phones was similar to that of fashion accessories such as shoes and watches.

A key theme emerged suggesting participants were less likely to share physical items, such as laptops or cell phones. However, most people preferred to share digital items like games, music and movies, perhaps because of their ability to be used by many without specific limitations. This was an interesting finding specific to the Western culture, as studies show that in other cultures it is common for several people to share a single cell phone or computer.

EVALUATION OF THE STUDY

The authors mention that academia, business and government advocate for incorporating sustainability at the design phase of product development, but have very little research to back the suggestion. This article attempts to remedy that by providing empirical evidence obtained from participants. By collecting and presenting both quantitative and qualitative data, the authors are mostly successful in this goal, and their evidence was a good starting point for strategies that may inspire future research.

However, this study had some limitations. The authors looked specific needs and desires of a specific generation (millennials) in a specific culture (American). Thus their findings might have limited

generalizability. For example, the strong sense of personal ownership of cell phones felt by the students from Indiana University might not be felt by millennials in another country where one cell phone is shared amongst many people. This research would be more compelling if they compared their findings with participants from other generations or other cultures.

IMPORTANCE

This article offers a perspective on a generation known for favoring community-based needs over individualistic needs, including their attitudes toward sustainability in design. Young people have an enormous stake in the present and future state of our planet, yet fail to make draw the connection between designers and the impact of the products they design. Millennials (defined as those who grew up in the 1990's and 2000's) already outnumber the baby boomer generation. Raised in a world where interaction with technology began at birth, this population generates a large volume of technology-related waste and is likely to continue to do so in ever increasing amounts. Therefore, there is a real need for designers to become pro-actively involved in a solution. In light of the attitudes and behaviors exhibited for this generation, designers need to begin to find ways to lengthen the product life, reevaluate ways to recycle and reuse products and materials, and ensure companies begin the process of product creation and development with sustainability in mind.

IMPLEMENTATION

OneBusAway: Results from Providing Real-Time Arrive Information for Public Transit [4]

Brian Ferris, Kari Watkins, Alan Borning
Dept. of Computer Science and Engineering, Dept. of Civil and Environmental Engineering
University of Washington at Seattle, Washington USA

STUDY DESCRIPTION

This study evaluates the effects of the OneBusAway system, a set of real-time arrival information transit tools available for Puget Sound region. Through a web survey, OneBusAway users respond to their transit behaviors and perceptions of public transit following usage of OneBusAway. Researchers collected both quantitative and qualitative data on demographics, transit use, technology use, and satisfaction. A second follow-up survey was sent to a group of the initial respondents to better understand the connections between OneBusAway and walking behavior.

RESULTS

The results of the surveys show that OneBusAway users had improved perceptions of using transit as well as engaged in a series of sustainable behaviors for both public and private benefit. Respondents indicated a number of positive outcomes as a result of their use of OneBusAway, including feelings of safety and efficiency. In addition, 91% of users self-reported spending less time waiting for the bus. The study suggests that this decrease in reported wait time is a combination of actual decreased wait time

and perceived decreased wait time. Additionally, not only did users report increased public transit use; they also reported more walking and an increased overall level of satisfaction with their transit experience. In particular, these findings might be of potential interest to policy-makers interested in boosting ridership.

EVALUATION OF THE STUDY

While the tool OneBusAway was created and studied by computer scientists, the study itself was written with careful attention to a broader audience. The authors discuss basic statistics of rider dissatisfaction prior to the implementation of OneBusAway, which provides a solid baseline to further inform the research. The study also clearly identifies that it is focused on meeting the needs of regional transit in King County, Washington.

The authors recognize there may be limitations caused by self-report bias and lack-of-control population. Additionally, in order to make any claims with statistical significance, they would require a larger study with both users and non-users of OneBusAway.

IMPORTANCE

This article highlights the successful implementation of a tool that helps users consider public transportation options, while improving their attitudes towards safety and timely arrival of transportation. An important contribution to this list of readings, it demonstrates the societal benefits of implementing systems that allow people to make more sustainable choices using existing technologies, such as mobile phones and computers. By helping travelers move from vehicles to public transit, communities can reduce congestion and environmental impact.

ENVIRONMENTAL AND GLOBAL REPERCUSSIONS OF TECHNOLOGY

Heavy Metals Concentrations of Surface Dust from e-Waste Recycling and Its Human Health Implications in Southeast China [5]

Anna O. W. Leung, Nurdan S. Duzgoren-Aydin, K. C. Cheung, AND Ming H. Wong
Croucher Institute for Environmental Sciences, and Department of Biology, Hong Kong Baptist University, Hong Kong, PR China, and Department of Earth Sciences, University of Hong Kong, Hong Kong, PR China

STUDY DESCRIPTION

This quantitative study examines the extent of heavy metal contamination in the village of Guiyu, China, one of the world's largest centers for e-Waste recycling, where workers try to recover the metals and plastic contained in printed circuit boards. Researchers measured the concentration of heavy metals in dust samples in workshops, nearby public spaces such as roads schools, and food markets, as well as several control sites located away from the e-Waste. Testing sites of both nearby and distant to e-

Waste recycling workshops allowed the researchers to estimate the potential health and environmental risk that e-Waste processing poses to the surroundings.

RESULTS

Contaminant levels within the Guiyu workshops were critically elevated. These were higher than samples collected from similar workshops in India. Surrounding locations, including roads, schools, and food markets were also significantly elevated, but to a lesser extent. As a consequence of the elevated levels of these contaminants in dust, the risk of human exposure was high, particularly in the areas closest to the workshops.

EVALUATION OF THE STUDY

Even though the study is very technical, it manages to be written in a clear way that pays careful attention to the methodology and context of the study. The authors provide basic demographic information about Guiyu, background on the process of e-Waste recycling, and even environmental details such as climate and wind patterns. To situate their research amongst similar work, they compare results to other studies. Additionally, they apply different measurement techniques to their data to provide a spectrum of results that can be compared to various scientific standards.

In the discussion, the authors acknowledge inherent uncertainties to their results, such as their calculation methods not being able to completely account for exposure duration, contaminant ingestion, and differing contaminant concentrations between environments. Additionally, they acknowledge that they only investigated dust contamination and not other possible types (such as water). A follow-up study that might strengthen the impact of this research might explore health impacts and conduct research in residences rather than just public spaces.

IMPORTANCE

While this article is somewhat different than the other two in that it does not directly come from the HCI community, it provides important perspective to the topic. One of the most important reasons for including it in this reading list is that by showing that purportedly sustainable behaviors (i.e. e-Waste recycling) can have an adverse global impact on people and the environment. In light of our previous discussion of millennial attitudes, this article also serves as a reminder to HCI designers to consider the whole product life cycle of the products they design, from manufacture to disposal.

CONCLUSION

Sustainability is a concept that will be increasingly important for designers and researchers to consider and incorporate. The empirical research is arguably thin, and hopefully these readings will provide some ideas for research directions in sustainability. Additionally, these readings should encourage HCI practitioners to think more broadly and reflectively about the products they design and the users they research.

These papers suggest a very real need for designers to become involved in the solution. Each article highlights the need to find ways to extend the lifespan of items, transform recycling and reuse to safe and less expensive processes, use existing technology to promote sustainable behaviors, and ensure that companies begin the process of product development with sustainability in mind. The impact of the tools and systems we engineer should not be designed with only the local present in mind, but also open with an eye towards the global future.

BIBLIOGRAPHY

1. Marcus, A. editor. User Experience Magazine. Volume 8, Issue 4, 2009. Usability Professionals Association.

2. IEEE Professional Communication Society (2010). *IPCC 2011: Communicating Sustainability*. http://ewh.ieee.org/soc/pcs/index.php

3. Hanks, K., Odom, W., Roedl, D., Blevis, E. (2008). Sustainable Millennials: Attitudes towards Sustainability and the Material Effects of Interactive Technologies. Proceedings of the ACM CHI 2008 on Human Factors in Computing Systems April 5-10, 2008. pp. 333-342.

4. Ferris, B., Watkins, K., Borning, A. (2010). OneBusAway: Results from Providing Real-Time Arrival Information for Public Transit. Proceedings of the ACM CHI 2010 on Human Factors in Computing Systems April 10-15, 2010. pp. 1807-1816.

5. Leung, A., Duzgorenn-Aydin, N., Cheung, K. C., Wong, M. (2008). Heavy Metals Concentrations of Surface Dust from e-Waste Recycling and Its Human Health Implications in Southeast China. Environmental Science and Technology. Volume 42, no. 7. pp. 2674-3680.