Next steps for sustainable HCI

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We want to change things for *real*, not just write papers.
—E. Eriksson, workshop participant

SIX YEARS AFTER the workshop on "defining the role of HCI in the challenges of sustainability" [2], that role remains unclear. In 2010, DiSalvo, Sengers, and Brynjarsdóttir identified five distinct genres in sustainable HCI (SHCI). Between the genres, they found striking unintentional redundancy; significant but unexamined differences in assumptions, methods, and outputs; and little connection to sustainability work outside HCI [1]. Since 2010 SHCI has continued to grow through, e.g., accounts of everyday practices; rich connections to practice theory; discussion of "undesigning"; design fictions; calls to activism; and speculations on large-scale social collapse. But we have done little so far to explicitly address the conceptual inconsistences in the field.

Motivated by this state of affairs, the SIGCHI HCI & Sustainability Community (HCI&S) held a workshop at CHI 2014 to "grapple seriously with the community's unresolved differences; find concrete ways to support work that builds on existing sustainability knowledge within and beyond HCI; and find concrete ways for HCI to contribute to achieving sustainability" [5]. The overarching question orienting discussion was: What have we learned in sustainable HCI? Organizers asked participants to consider eight questions:

1. What is sustainability?
2. What do we know, from within and beyond HCI, about how sustainability might be achieved?
3. What crucial open questions remain?
4. How can HCI research help achieve sustainability?
5. How should HCI & Sustainability research be evaluated (e.g., is it possible or desirable to review papers in different genres with one coherent framework)?
6. How can the community use critiques of past work to develop new, more productive approaches?
7. How can we make better use of sustainability knowledge from outside HCI?
8. How can we encourage work that contributes substantively to practical efforts to achieve sustainability?

Drawing from insights revealed by the workshop discussion around these questions, this article focuses on lessons and next steps.

WHAT HAVE WE LEARNED FROM SUSTAINABLE HCI?

Our six core lessons derived from the first seven years of SHCI research can be summarized shortly: *The issues indexed by the term "sustainability" pose severe challenges to existing HCI theories, methods, and institutional processes*. HCI "business as usual" is not well positioned to contribute substantively to efforts to address the challenges of sustainability. Specifically:

Refraining from articulating clear sustainability aims and metrics impedes assessment of our efficacy in contributing to sustainability. In answer to the first four questions, most of the 23 participants rejected the idea that we could devise a single interpretation of sustainability to orient and evaluate all future SHCI research. The salience of diverse sustainability issues (related, e.g., to energy, pollution, poverty, employment, water, climate, ecosystem health) varies widely among the communities SHCI researchers work in and with. But we cannot assess our effectiveness at contributing to sustainability if we do not make clear what we mean by the term. Participants agreed that SHCI research should articulate clear study- or design-specific sustainability goals and metrics on a project-by-project basis, not restricted to HCI criteria such as usability, efficiency, or user satisfaction. Rather, SHCI researchers should evaluate their work with sustainability criteria derived from relevant natural and social scientific research and the communities within which they work. Most (but not all) participants agreed that "sustainability is a process, not an endpoint." Even as we develop focused assessments, we must keep in mind that such assessments are partial: the communities we study are connected to other systems, whose sustainability may hinge on other factors.

The processes that give rise to the issues indexed by the term "sustainability" are larger in time, space, organizational scale, ontological diversity, and complexity than the scales and scopes addressed by traditional HCI design, evaluation, and fieldwork methods. For example, humans have been burning fossil fuels for centuries, and while consequences have only become clear in the last few decades, they will likely intensify for at least another century [6]. These effects, and knowledge about them, affect everyday practices through complex webs made up of ecosystems, institutions, and infrastructures, all of which change over periods of months, years, and decades [4]. Studies that last weeks or months are rarely long enough to capture these dynamics or substantively explore the potential roles of information technologies in responding to or preparing for such changes.

Most sustainability-oriented work takes place outside HCI. The foundations for a popular awareness of sustainability issues were laid in the late 20th century by researchers in the environmental sciences. In the last 20 years, robust and interlinked sustainability discourses have developed within policy, industry, and civil society. These discourses predate SHCI, which developed around 2007. But like SHCI, they include a commitment to translating knowledge into action. To better integrate knowledge from within and beyond HCI, participants proposed SHCI researchers strive to understand the broader ecological, economic, social, political, and historical contexts of our work, especially the dynamics of the processes through which sustainability challenges have arisen. We can do this by reading outside HCI and by collaborating with researchers in other disciplines and with practitioners in government, business, civil society, and

activist movements. While such collaboration is hard, it is essential to developing more rigorous and impactful SHCI work.

There is a great deal of research and practice outside and within HCI that does not explicitly address sustainability, but is relevant to SHCI. For example, work aiming to support the "sharing economy;" "collaborative consumption;" "do-it-yourself" activities; repair, appropriation, reuse, and maintenance; civic engagement; social movements; and effective democratic governance may align well with explicitly sustainability-oriented work.

There is a tension between the historical focus on technological novelty in HCI and sustainability goals. This has been acknowledged since the inception of SHCI. And in the last five years, HCI broadly and SHCI specifically have hosted a growing discourse on designs that do not produce technological novelty, focusing, e.g., on appropriation, maintenance, and repair; the "implication not to design"; "undesigning"; and technology non-use. Yet some SHCI researchers see the development of novel technology as a critical part of how HCI as a whole moves forward. Navigating the tensions between sustainability discourse's sometimes anti-technological implications and HCI's traditional focus on invention and innovation as central to its work calls for a nuanced, flexible, and sensitive discourse on the respective roles of innovation, novelty, and responsibility in the face of historically unprecedented challenges. Thus, a challenge for SHCI researchers—and HCI in general—is to use "old" and new technologies effectively in service of meaningful sustainability goals.

Thus far, sustainable HCI research has had little impact outside HCI. Most early system development efforts within SHCI saw sustainability as an application domain for HCI business as usual. As we have come to realize the severity of the challenges of sustainability and the multi-scalar, transdisciplinary nature of the processes that drive them, we have come to see sustainability less as an interesting research topic and more as a practical ethical imperative. This view drives our current efforts to reach beyond HCI for theoretical and methodological inspiration and for allies in doing the practical work of grappling with the complexities and unsustainabilities of particular sociotechnical situations.

NEXT STEPS

To contribute more substantively to efforts to promote sustainability, SHCI researchers should:

Specify and operationalize sustainability goals in our work, and articulate approaches to evaluating our work in view of those goals. Discussion of sustainability goals and how to operationalize them has been part of SHCI since its early days. But we have yet to develop a vigorous discourse of sustainability evaluation. We call on SHCI researchers to be as clear as possible in orienting and evaluating design work with respect to sustainability goals discussed in sustainability discourses outside HCI.

Do research that considers longer time scales. To more fully appreciate the interlinked social, economic, and ecological contexts and effects of design interventions, and their implications for future designs, we call for an expansion of the temporal scope of analysis in SHCI user and field studies. This does not necessarily mean longer studies, although they would be welcome. It

means considering, as rigorously as possible, the long-term social, economic, political, and ecological processes that might influence the adoption, use, and effects of particular technologies and practices.

Draw from and support relevant work outside HCI. To substantively engage sustainability issues on the appropriate social, physical, and temporal scales will require connecting with concepts, methods, people, and work in other fields and sectors (policy, industry, civil society, and social movements). It is increasingly clear that this is the way forward if SHCI research is to contribute to addressing sustainability issues in practice.

Build and support systems people use in their everyday practices, and do studies that inform design and operation of such systems. HCI researchers have built and maintained systems used in people's everyday practices—i.e., outside the methodological context of a user study. But most HCI studies—prototype-based and fieldwork-based—aim primarily to influence design practice through the production of knowledge. Directly supporting or influencing particular practices over long-term use are secondary aims—if they are aims at all. This is largely true even of prototype persuasive systems that aim to influence user behavior. We call for more action research, "HCI in the wild," and participatory projects in SHCI.

Address the full diversity of sustainability issues. SHCI has focused on consumer behavior with respect to energy, transport, food, and water. The sustainability literature proper considers both larger scales (e.g., metropolitan, national, global) and a broader range of topics, including, population, health, poverty and affluence, peace and security, disasters, social transformation, cultural renewal, and governance. Outcomes in these domains depend on the conditions of both natural systems and human institutions. Information plays a key role in the operation of human institutions, and institutions affect the health of natural systems. Thus information system researchers, designers, and operators can contribute to addressing a much wider range of sustainability issues than have been studied in SHCI.

Move beyond simple models to grapple with the full multi-scalar complexity of "wicked" sustainability problems. Neither climate change nor any other sustainability challenge will be addressed at a single point. While sustainability "leverage points" may exist, many are in the hands of policy makers—whose hands are tied by social norms, political inertia, and industry lobbyists. The recent explorations of "practice" in sustainable HCI constitute strong steps toward grappling with this multi-scalar complexity. When we look at individuals through the lens of practice, the ways in which their behavioral choices are constrained becomes more clear. This realization motivates us to consider ways SHCI researchers might support broad efforts to make changes to larger systems such as institutions, infrastructures, and policies.

CONCLUSION

Workshop participants also identified four practical challenges to developing and supporting the steps outlined above: 1) the difficulty of collaboration, especially across fields and sectors; 2) the perceived benefits of short-term, one-off projects due in part to the one-year conference publication cycle; 3) the blind, one-step review process in our most prestigious publication venue, the CHI conference, limiting engaged dialogue and learning between reviewers and authors; and 4) the difficulty of finding support for action research and other socially-oriented

work from research funding agencies and our home institutions, many of which are oriented toward technologically novel solutions. As initial steps toward addressing these challenges, the SIGCHI HCI & Sustainability Community ("HCI&S") is organizing two projects: 1) a community pre-review process for submissions to the sustainability track at the CHI 2015 conference and 2) a collaboratively-maintained HCI&S online "knowledge base." We believe these projects will help address some of the barriers to more engaged and effective SHCI research. Yet more fundamental issues loom. Workshop participants identified four of particular relevance to future SHCI work. They are:

1. The tension between sustainability and the aim of economic growth that supports and orients, if implicitly, the industry of which HCI is part.
2. The tension between the need to read broadly, think deeply, and collaborate widely and the need to act quickly.
3. The tension between respecting the values of users and preventing users from acting on values whose enactment harms others.
4. The relationship between technology and sustainable social change.

We postpone discussion of these challenges to a future publication. But we note that while they may appear theoretical or abstract, they have concrete consequences.

The complexity and urgency of sustainability issues present significant challenges for HCI. But by reading and collaborating widely; specifying sustainability goals; engaging with long time scales; and building and informing design and use of systems used in people's everyday lives, we believe sustainability research in HCI could contribute significantly to practical efforts to achieve sustainability and address environmental issues of real importance. These adjustments call for change in our own institutions and practices. While we do not know yet how to address all the barriers to more impactful research, the SIGCHI HCI & Sustainability Community has begun projects to help address some of them. And we believe that all of the barriers will prove surmountable. At the same time, the goal of contributing directly to sustainability efforts presents an opportunity to collectively reflect on deep but ultimately practical questions about the aims of HCI as a field.

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