Sustainability and structural change: the role of HCI

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Abstract

The role of HCI in addressing the challenges of sustainability remains unclear despite sustained interest. This note suggests HCI can help people live more sustainably by amplifying efforts to remake institutions and infrastructures ("structures"). Individually, society's structures support the short-term well-being of their intended beneficiaries. But their unintended effects collectively threaten the long-term well-being and survival of both their intended beneficiaries and distant, unborn, and nonhuman others. Achieving sustainability will involve changing structures to support the short-term well-being of their intended beneficiaries without threatening their, or others', long-term well-being. Technology creates possibilities for structural change mainly by amplifying efforts to achieve existing, institutionally recognized goals. In the context of the transition to sustainability, such goals may include the reconfiguration of institutions and infrastructures themselves. HCI can contribute significantly to the transition to sustainability by exploring how information tools can support such efforts.

1   Introduction

Four years after the workshop on "defining the role of HCI in the challenges of sustainability" [29], that role remains unclear. In 2010, Carl DiSalvo, Phoebe Sengers, and Hrönn Brynjarsdóttir identified five distinct genres in sustainable HCI, with significant unintentional redundancy; significant but unexamined differences in assumptions, methods, and outputs; and little connection to sustainability research or practice outside HCI [16]. Since 2010 the field has continued to grow conceptually, with, e.g., work on "undesigning" [51] and "collapse informatics" [61]. But, with the exception of intensifying critiques of persuasive design (e.g., [52, 11]), the deep schisms in the field remain largely unaddressed.

One way to consider the differences between the genres is to ask how they answer three questions: What is sustainability? How will it be achieved? What is the role of HCI? Each genre's answers can be inferred from their research outputs (e.g., [21], pp. 2538-2541; [16], pp. 1977-1980). But these answers reflect historical orienting assumptions of the disciplines from which the genres spring, not considered positions on sustainability per se. This note offers explicit answers to these questions, and to the question "What is the role of HCI in addressing the challenges of sustainability?" (cf. [29]).

2   Approach

The view developed here is shaped by the literature on complex systems in a range of disciplinary traditions, including cybernetics and "systems theory" (e.g., [65, 42]), systems ecology (e.g., [50, 32, 63]), human-environment interaction (i.e., ecological economics, social-ecological systems, coupled human-natural systems, and social ecology; e.g., [47, 13, 15, 40, 48, 49, 38]), and the humanities (where they are often called "assemblages"; e.g., [33, 7, 8, 58]). The approach assumes that to understand the role of X in Y, we must look outside X. We must discern, to the extent possible, the whole structure and dynamics of Y, and identify the elements and dynamics that shape and are shaped by X. Understanding the structure and dynamics of a whole does not mean understanding it in abritrarily fine detail. It means refraining from making arbitrary analytical cuts for the sake of *convenience*, but making, to the extent possible, only those analytical cuts justified on the grounds that the dynamics of the excluded elements have a negligible effect on the outcomes of interest.

3   What is sutainability?

In practice, working toward sustainability goals is complex and often contentious. But the sustainability literature does suggest a rough international consensus both on what those goals are and on the nature and origins of the threats to achieving those goals. Synthesizing a vast, interdisciplinary body of research and policy documents, the contributors to the 1999 National Research Council (NRC) report *Our Common Journey: A Transition Toward Sustainability* wrote:

> ...the primary goals of a transition toward sustainability over the next two generations should be to meet the needs of a much larger but stabilizing [global] human population, to sustain the life support systems of the planet, and to substantially reduce hunger and poverty. Using goals outlined in international conventions, we define meeting human needs as providing food and nutrition, nurturing children, finding shelter, providing an education, and finding employment. We define preserving life support systems as ensuring the quality and supply of fresh water, controlling emissions into the atmosphere, protecting the oceans, and maintaining species and ecosystems. We define reducing hunger and poverty as ensuring income growth, employment opportunities, and essential safety net services [43] (p. 31). (See pp. 32-48, 59-101, and 233-264 for elaboration.)

The achievement of these goals is threatened by "global change," the interlinked, global, anthropogenic phenomena of climate change, ecosystem destruction and degradation, and nonrenewable resource depletion, among others (e.g., [57, 41, 25, 31]). Global change is a result of "development," the project of building complex systems—practices, technologies, institutions, and infrastructures—to enable improvements in human well-being (e.g., [64, 59, 27]). Development has been very successful in many parts of the world. But most of the human-made systems built as part of the development project were not designed to account for the limited ability of the nonhuman systems within which they are situated, and on which they rely, to furnish resources and absorb wastes. Nor were they, for the most part, designed to account for the unintended effects of their operation on parties beyond their intended beneficiaries (e.g., [13]). Indeed even the long-term well-being of the latter is often scoped out in the technical and political negotiations that accompany their design and redesign (e.g., [14]). As a result development thus far has led simultaneously to increased well-being for many people; reduced well-being for some people; extensive destruction and degradation of ecosystems, the destabilization of the climate system, and mass extinction of nonhuman species (the sixth mass extinction in Earth's history and the first to be perpetuated by a single species [57], p. 6); and degraded prospects for the long-term well-being of all, including nonhumans (e.g., [41], p. 1). "Sustainability" describes a condition in which society's institutions and infrastructures enable and

support survival and well-being for people currently alive without impeding the ability of others—including the unborn and the nonhuman—to develop effective strategies for their own survival and well-being (cf. [66], p. 43).

4   How will sustainability be achieved?

As understanding of the dynamics of "environment and development" has grown and spread, international agreement has emerged that the human-made systems implicated in global change should be reconfigured to improve prospects for the future well-being of humans and other species (e.g., [66, 43]). Yet our present well-being and survival relies on the continued operation of these systems. Thus achieving sustainability entails reconfiguring human-made systems to reduce the undesirable effects of their operation without interrupting their ability to provide for human survival and well-being in the present (cf. [66], p. 43). Further, systems cannot be reconfigured by just anyone. System change requires concrete action from specific people in specific institutional locations. "Decision makers" in such systems must respond to often conflicting short- and long-term desiderata and the interests of multiple stakeholder groups. Their agency is shaped by existing institutional policies and norms and their own knowledge and social and material capabilities. Institutions and infrastructures are interlinked, and change slowly. Susan Leigh Star and Karen Ruhleder, for example, in papers that have become foundational in the CSCW literature [55, 56], describe infrastructure as embedded in other "structures, social arrangements, and technologies"; transparent to use, in that it is often taken for granted, and "invisibly supports" tasks that become routine for particular groups; reaching "beyond a single event or one-site practice"; learned as part of membership in a particular community of practice; shaping and shaped by conventions of practice; standardized, often to facilitate transparent interoperability with other infrastructures; built on an installed base; becoming visible upon breakdown, and changing in modular increments, not all at once or globally [56] (pp. 381-382). Crucially:

> Because infrastructure is big, layered, and complex, and because it means different things locally [i.e., to different stakeholders in different contexts], it is never changed from above. Changes take time and negotiation, and adjustments with other aspects of the systems are involved. Nobody is really in charge of infrastructure [56] (p. 382).

The sociologist C. Clare Hinrichs uses the term "remaking" to describe this process in the context of food system change:

> The social location and resource endowments of different individuals and groups...afford different skills and opportunities for [food system change]

> work and, indeed, different understandings of what the work should be. Overall, remaking first involves deliberate, sometimes dogged efforts simply to grasp what currently exists, and it requires second a refashioning of some of the institutions and practices of agriculture and food in more desirable ways... Remaking the food system then suggests neither a revolutionary break nor a radical transformation but rather deliberate, sometimes unglamorous multipronged efforts in areas where openings exist to do things differently. Supporting a farmers' market may never shut down the local big box supermarket, but it does divert consumer dollars to local food producers, consequently helping them stay in business and providing some consumers with fresher, local foods. Such activities quietly and modestly remake parts of the food system. Whether pursued by individuals, groups, or communities, such remaking is not a linear or foreordained process that possesses some clear, known endpoint. It is instead movement in what is hoped to be a more promising direction [26] (pp. 5-6).

This notion resonates well with the metaphor of "navigation" adopted by the contributors to *Our Common Journey*:

> The metaphors of "journey" and "navigation" in the work reported here were adopted with serious intent. They reflect [our] view that any successful quest for sustainability will be a collective, uncertain and adaptive endeavor in which society's discovering of where it wants to go is intertwined with how it might try to get there. Also, they reflect the view that the pathways of a transition to sustainability cannot be charted in advance. Instead, they will have to be navigated adaptively at many scales and in many places [43] (p. 3).

In the language of third wave HCI (e.g., [10, 23, 54]), sustainability will be achieved through the *situated reconfiguration* of institutions and infrastructures to enable and support more sustainable ways of life. Sustainable ways of life support the well-being of their adopters and beneficiaries without harming others', or their own long-term, prospects for well-being. The transition to sustainability will occur gradually, as actors situated within existing structures adaptively and collectively find ways to continue "meet[ing] the needs of the present" [66] while reducing the harm those structures inflict on the prospects for others', and their own, long-term well-being.

5   What is the role of HCI?

If sustainability will be achieved through the situated reconfiguration of institutions and infrastructures ("structural change"), the motivating question—what is the role of HCI in addressing the challenges of sustainability? [29]—becomes: what is the role of HCI in structural change? To answer this question we must first ask: what is the role of technology, especially information technology, in structural change?

This question indexes a long history of theory and debate on "techno-logical determinism" and "social construction." This discussion has been broad—with roots in philosophy (namely, [24]), a central locus in science and technology studies (e.g., [30, 67, 9, 22]), and implications for fields as diverse as HCI (e.g., [20, 17, 23, 5]) and urban planning (e.g., [28])—and contentious. Yet a rough consensus seems to have emerged over the decades. Shaped by their contexts of design, technologies create new possibilities for human action. While an outcome of technology use may be physically possible or technically imaginable, social conditions may preclude its realization (e.g., [53]). Physical possibility is a necessary but not sufficient condition for changing human reality, which is both material and social. Technology is one class of factor among several that influence the outcome of a particular situation or the dynamics of a particular institution-infrastructure system (e.g., [39], pp. 120-137; [36]; [6], pp. 16-18; [62]; [34]). Consistent with this view is the "amplification model" developed by Philip Agre [1, 2, 3]. Drawing on a wide and multidisciplinary literature (among many others, [4, 18, 35, 37, 46]), he observes that new technologies are used mainly to pursue existing goals with existing strategies:

> When institutions change, it is not because a technology such as the In-ternet descends and, deus ex machina, reorganizes the institution's con-stitutive order in its own image. Institutions do often change as a result of the opportunities that a new technology makes available, but it is only through the workings of the institution that the dynamics of the change can be found. As Calhoun puts it, "the main impact [of the Internet], especially in the short to medium term, will be to allow us to do more of the things we were already organized and oriented to do" [12] (p. 382). Nor is the point restricted to the Internet: Fischer [19] concluded that Americans in the early 20th century used the telephone "to pursue their [existing] ends...more aggressively and fully" (p. 28) and "to widen and deepen existing social patterns rather than to alter them" (p. 262). People in a given institutional setting use a new technology to pursue the goals that the institution suggests, organized by the cognitive and associative forms that the institution instills. If the technology is incomprehensible within the thought forms of the institution then it will probably go unused [45]. If nobody can devise an action pattern for deploying the technol-ogy in ways that mesh with the existing gears of the institution, then no significant effects of the technology's adoption are likely to be found. It follows that the Internet creates little that is qualitatively new; instead, for the most part, it amplifies existing forces [2]. Social forces are nothing but coordinated human will, and institutions channel human will in some directions more than others. To the extent that institutional actors can pursue existing goals by reinterpreting existing action patterns in terms of a newly available technology, the forces that their massed actions create will be amplified. [3] (pp. 315-316).

Systems do not remake themselves, and technology does not by default tilt remaking or change toward sustainability (e.g., [60]). Rather, logics and dynamics internal to institution-infrastructure systems, in interaction with their environments, shape change, including technology development

and use. There is no a priori reason for such logics to be aligned with sustainability. Indeed many of our existing systems predate sustainability discourse. For example, US corporate law developed under the widespread assumption that indefinite economic growth would lead to indefinite improvements in human well-being. This doctrine is now understood to have serious omissions. Namely, it does not account for the finitude of natural resources or of ecosystems' ability to absorb human-produced wastes (e.g., [13]). Few institutions have yet been reconfigured to reflect this new understanding. Yet efforts are underway. As awareness of the risks of global change spreads, structural change efforts are initiated even in the biggest, oldest, most complex institutions: governments and transnational corporations. The existing structures of such institutions constrain the nature and pace of change, but not immovably. HCI can contribute to the transition to sustainability by exploring how information tools can support ongoing efforts to remake institutions and infrastructures.

6   Implications

DiSalvo et al. [16] identified seven "axes of difference" in sustainable HCI: *sustainability as research focus vs. application area*; *individual consumers vs. other users, groups, or scales*; *users as the problem vs. solving users' problems*; *improving vs. fundamentally changing lifestyles*; *technology as an adequate vs. inadequate solution*; *HCI as usual vs. HCI must be rethought*; and *political differences are relevant vs. irrelevant*. They suggest the present diversity in sustainable HCI should not be mistaken for healthy, informed pluralism. Rather, the disciplines that have shaped the genres have different orienting assumptions; the genres largely talk past one another [16] (pp. 1980-1981). The notion of a transition to sustainability achieved through situated reconfiguration of institutions and infrastructures reframes the questions implied by some of the axes of difference. Indeed some answers have already surfaced in the literature bordering, if not within, sustainable HCI. The contributors to the 2012 NRC report *Computing Research for Sustainability*, for example, wrote:

> Despite the profound technical challenges involved, [un]sustainability is not, at its root, a technical problem, nor will merely technical solutions be sufficient. Instead, deep economic, political, and cultural adjustments will ultimately be required... [44] (p. 1).

The historical divisions of labor that have shaped the genres of sustainable HCI may result in research that appears to imply a belief that technology alone can "solve" global change, or that political differences are irrelevant to achieving sustainability. But the clear consensus on both questions is to the

contrary—and such claims would be difficult to sustain if made explicitly. The debate to be had is not about whether technology alone can solve global change (we know it can't); whether politics matters to sustainability (we know it does); or whether supporting individual behavior change is enough (we know it isn't)—but about what is in scope for HCI. There is no reason to expect HCI will escape the deep institutional changes that broad-based responses to global change will entail. Thus the debate to be had is not whether HCI must be rethought or whether we can we get away with HCI as usual. Global change will reshape HCI—and much else besides. The debate to be had is: how shall we reshape HCI?

I omit, for now, my own opinions on the topic.

Acknowledgments

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