SEEKING SUSTAINABILITY IN INTERACTION DESIGN

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As consumers in affluent western societies, we see little of the cause and effect of our mundane, everyday actions or behaviors. It's terribly easy to consume without thought. If I purchase something online, it appears on my doorstep several days later, with no evidence of the quite possibly epic adventure it's taken across the globe. The website I visit does little to indicate what materials the product is made of and their origin, who manufactured it, or what part of the world it shipped from. Yet there is growing cultural awareness around issues of environmental sustainability. Current research shows humankind has already demanded more of natural resources than are available (Fiksel, 2006). Faddish labels like "sustainable" and "green" market everything from condominiums, the corporate practices of big-box stores such as Wal-Mart, to pricey handbags sold on 5th Avenue in New York City. These trends fit neatly into our comfortable, materialist lifestyle, but do not stop to reflect on the meanings behind the word sustainability.

The repercussions of our actions are often much more complex than we can imagine. For example, as organizations become more efficient in their use of natural resources, and therefore often more profitable, the result has been an overall greater ecological footprint for society (Fiksel, 2006). But we must shake off the attitude that the environment is something that sits divorced from human actions and needs. Despite the complexity of the social and environmental ecology we live in, we can incorporate ideas of sustainability into the design of our interactions with objects, services and our daily life.

If the term is considered literally, a sustainable system is one that can be sustained indefinitely. This is difficult to accept in a world where everything is in a state of flux and, occasionally, turbulent change. We're well aware that continents, planets and even stars do not sustain indefinitely, and any of our attempts to keep something fixed feels close to hubris. Yet the adaptability, flexibility and creativity of species on this planet are astounding. Humankind is especially adept at designing complex, efficient systems and tools.

Computing is one of our most sophisticated tools. It can be thought of as a tool for our mind, one that can analyze, visualize and model extremely complex information in ways we find more comprehendible. As computing becomes more entrenched in our lives (and our bodies), affluent western civilizations are transforming into an "information culture," with "knowledge workers" managing and strategizing the flows of energy, commerce and power around the globe. Yet we have done little to advance the health of our actions within our complex ecology, in fact, computing hardware, gadgets, cell phones, video and gaming consoles all innovate and change so quickly they increase the demand for more and new hardware. As new models appear, the current models quickly become obsolete, creating large amounts of electronic and digital wastes. This pattern has to shift.

The 1987 UN Brundtland report states "sustainable development...implies meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987), which has become a commonly cited definition of sustainable development. However the definition of sustainable development is still an elusive one.

In the article "Sustainability: science or fiction?," Pim Martens (2006) responds to the ambiguity of the term sustainability by compiling common themes from various interpretations. He found four shared characteristics. Sustainable development is an intergenerational phenomenon, for it considers at least two generations, typically

25 – 50 years. It includes examination of multiple levels of scale, from local to global. At least three domains are included in theories of sustainable development; economic, ecological, and socio-cultural. More domains are sometimes included, Martens notes that the "significance [is] in interrelation," however unfortunately, in practice they can sometimes contradict. Ironically, the fourth theme is the multiplicity of interpretations available. Uncertainty and competing perspectives are inherent because sustainable development involves projecting future needs, which can vary greatly according to author.

Joseph Fiksel (2006) finds the static nature of the term sustainability problematic. In his paper "Sustainability and resilience: toward a systems approach," he states "Forces of change, such as technological, geopolitical, or climatic shifts will inevitably disrupt the cycles of material and energy flows. Therefore, achieving sustainability will arguably require the development of resilient, adaptive industrial and societal systems that mirror the dynamic attributes of ecological systems". The study of the resilience in complex systems is a focus of multiple fields, from sociology to network theory. Fiksel defines resilience as "the capacity of a system to tolerate disturbances while retaining its structure and function" and organizations should adopt such a theory of sustainable development, which he feels more closely mirrors "natural organisms."

Yet how do we design in and for such complex, dynamic systems? Many blueprints throughout various fields have been set forth. Sustainable architecture or green building is a fast growing movement. In 1992 architects William McDonough and Michael Braungart set forth nine influential principles for structural design. These principles focus on the relationships between people, the built environment, and the long-term consequences of the design decisions that created such relationships. Titled the Hannover Principles, they are:

1. Insist on rights of humanity and nature to co-exist in a healthy, supportive, diverse and sustainable condition.

2. Recognize interdependence. The elements of human design interact with and depend upon the natural world, with broad and diverse implications at every scale. Expand design considerations to recognizing even distant effects.
3. Respect relationships between spirit and matter. Consider all aspects of human settlement including community, dwelling, industry and trade in terms of existing and evolving connections between spiritual and material consciousness.
4. Accept responsibility for the consequences of design decisions upon human well-being, the viability of natural systems and their right to co-exist.
5. Create safe objects of long-term value. Do not burden future generations with requirements for maintenance or vigilant administration of potential danger due to the careless creation of products, processes or standards.
6. Eliminate the concept of waste. Evaluate and optimize the full life-cycle of products and processes, to approach the state of natural systems, in which there is no waste.
7. Rely on natural energy flows. Human designs should, like the living world, derive their creative forces from perpetual solar income. Incorporate this energy efficiently and safely for responsible use.
8. Understand the limitations of design. No human creation lasts forever and design does not solve all problems. Those who create and plan should practice humility in the face of nature. Treat nature as a model and mentor, not as an inconvenience to be evaded or controlled.
9. Seek constant improvement by the sharing of knowledge. Encourage direct and open communication between colleagues, patrons, manufacturers and users to link long term sustainable considerations with ethical responsibility, and re-establish the integral relationship between natural processes and human activity.

The principles are meant to guide architects on a more spiritual and ethical level in design. It is a holistic approach, encouraging a more thorough examination of the relationship between people and built environment. It also attempts to treat the built environment as part of the natural world (rather than building fortresses that stand opposed to it) by mimicking natural processes, such as eliminating the concept of waste and focusing on interdependence. A similar philosophy in agriculture is called Permaculture. Introduced by Bill Mollison and David Holmgren in the 1970's, Permaculture is a set of principles for sustainable agricultural design with broader implications. Permaculture stands for both permanent culture and permanent agriculture. Holmgren's principles are:

1. Observe and interact
2. Catch and store energy

3. Obtain a yield
4. Apply self-regulation and accept feedback
5. Use and value renewable resources and services
6. Produce no waste
7. Design from patterns to details
8. Integrate rather than segregate
9. Use small and slow solutions
10. Use value and diversity
11. Use edges and value the marginal
12. Creatively respond to change

Permaculture also seeks to mimic nature by creating self-regulating systems and using observed natural patterns in design. For example, each element in a forest serves multiple functions. A tree provides habitat, shade and food to other species, fixes nitrogen into the soil, and releases oxygen into the air. A typical rule learned from this in Permaculture is to design elements that each performs at least three functions. In doing so, the designer becomes more conscious of the diversity and interplay of the elements of their design, and thus designs more efficient systems, reducing the amount of human work.

An often cited method of analyzing sustainability is the Life Cycle Assessment. It attempts to look at an object or product in terms of effects on the environment from the raw materials involved in the manufacturing process to the wastes it will eventually become. By looking at each stage it hopes to gauge the products full impact, and can be used to look for areas of improvement. Building upon this, the Natural Step process was introduced by the prominent Swedish scientist Dr. Karl-Henrik Robèrt in 1989. It is an organizational methodology for sustainable development based on systems thinking that has been adopted by some major corporations. Robèrt defines sustainability as “fundamentally about maintaining life on earth and the ecosystems required to support it." (The Four System Conditions) The process has four system conditions, which a sustainable society does not “systematically” increase: “concentrations of substances extracted from the Earth's crust, concentrations of

substances produced by society, degradation by physical means and, in that society people are not subject to conditions that systematically undermine their capacity to meet their needs." (The Four System Conditions)

The Natural Step has a four phase implementation methodology. The first is organizational education – in the sciences and the systems approach to design. Robèrt stresses the ties between the ecological, social, and economic, and focuses on healthy businesses and communities. Second is called baseline mapping, which is essentially a lifecycle sustainability assessment and cultural survey. Next is a visioning process, imagining how the organization might look in a sustainable society. This has resulted in some companies separating out their service from their products, which is an advantageous shift in thinking. Sustainable design creates new constraints for organizations, but focusing on essential services makes for a more open, flexible platform to work from. The vision is then used to strategize backwards and measurement goals are set in place.

The four common characteristics are at play in all of these principles for sustainable design; they are intergenerational, incorporate multiple scales, consider economic, ecological and socio-cultural domains, and are open and flexible enough for multiple interpretations. These characteristics can also be used to incorporate sustainability into the design of our interactions information and communication technologies, which most of us now use on a daily basis. Rethinking design considerations for our technologies is important because advancements have multiple consequences. "A society may in many ways compromise its ability to meet the essential needs of its people in the future - by overexploiting resources, for example. The direction of technological developments may solve some immediate problems but lead to even greater ones" (Brundtland, 1987). If technological developments are not designed in a holistic way, we might be in ignorance of some of the more severe effects of a design over time.

On an even more basic level than the objects and organizations we build, can our interactions, to some level, be designed? “The international research community that is concerned with global change has thus made huge progress in coupling the various relevant natural sciences. Unfortunately, however, despite great national and international commitment, there has been far less progress in understanding the interactions between humankind and environment” (Martens, 2006). Designing such interactions through technological advancements can play a role in making such interactions sustainable by making those sustainable actions more useful and usable to people.

Interaction Design evolved out of fields such as Human-Computer Interaction, Human Factors and Interface Design. Dan Saffer (2007) distinguishes interaction design from other forms by it emphasis on behavior when he writes “interaction design is the art of facilitating interaction between humans through products and services” (p4). Saffer also calls Interaction Design contextual by nature, for it “…solves specific problems under a particular set of circumstances” (p4). In his article “Introducing Interaction Design,” (2002) Bob Baxley writes that the five primary characteristics of Interaction Design are human/machine communication, action/reaction, state (as in, the “current state of the application”), workflow and malfunction. He relates Interaction Design to a conversation between the technology and the user. The designer serves as a translator between both parties.

Neither the design nor the designer exists in a vacuum, however. People and their interactions take place in a complex ecology. Users use designed objects in the physical world and in their own socio-cultural context. If interaction design sets out to solve a problem, as Saffer, puts it, a system already in place is then altered. It might be more efficient in some ways, but could potentially be more wasteful in others. Innovations may also create new, potentially wasteful and unsustainable “needs.”

How might an interaction designer situate a design in its ecology and measure its potential future affects? A culture without such reflection will continue to harm its environment in ignorance. Eli Blevis has introduced a method of sustainable interaction design, and an informal rubric to assess designs. In his paper, “Sustainable Interaction Design,” (2007) he calls for an overall "perspective" of sustainability to be introduced to design practice. Sustainable Interaction design examines the design and the behavior of the user in the context of the physical world. Some other recently introduced design methodologies look at users in their socio-cultural context, laying some of the groundwork of thinking critically about a user in his or her environment.

In the paper “Affect: From Information to Interaction,” (2005) Boehner, DePaula, Dourish, & Sengers critique what they see as measuring emotion in the more traditional cognitive approach in the field of Human-Computer Interaction. The authors advocate that the field of HCI develop strategies for “measuring things such as awareness, expression, and engagement” (p.67) and shift away from a more quantitative approach. They state that an individual’s experience of emotion is not a private affair; it is “mediated by cultural and social situations… [and] also used to enact and sustain those settings" (p.64). Information technologies should be understood on "multiple levels simultaneously – as technological artifacts, social facts, and cultural narratives" (p.67).

The authors also advocate viewing information technologies as participatory, flexible and hack-able systems. “Participation emphasizes the ways in which information systems act as platforms upon which social structure is enacted, rather than as entities employing representations of the world and therefore always at one step removed from it" (p.67).

In their paper “Reflective Design,” (2005) Sengers, Boehner, David, & Kaye propose that reflection should become a critical goal for design in Human-Computer Interaction. They state "technology design practices

should support both designers and users in ongoing critical reflection about technology and its relationship to human life" (p.50). By introducing a new methodology based upon critical reflection, they claim technology design will have a more "socially responsible" (p.49) outcome. The authors state that reflection has physical and sensual aspects to it as well as cognitive. They more specifically define the term reflection as critical reflection, which pulls “unconscious aspects of experience to conscious awareness” (p.50). By surfacing unconscious “attitudes, practices, values, and identities,” (p.50) Reflective Design provides the user opportunities to make decisions based upon that new awareness and experience themselves and the world in new ways. The authors put forth principles and strategies for their method, which emphasizes design for critical reflection both within the designers life and practice and the users, acknowledging reflection as an important part of experience.

In reframing information systems as “platforms upon which social structure is enacted,” technology, and its design as well, can be seen as an enabler for more sustainable social action. With a more critical reflective outlook through an interactions lifecycle, the theories of interaction design start to resemble the sustainable design principles mentioned previously. Using what Blevis calls a perspective of sustainability, interaction designers are encouraged in design to link physical material inputs and outputs over time to interactive technologies. He wants to narrow the focus from the current definition of designing behavior to designing for sustainable behavior. He also stresses throughout the paper the connections between software and hardware, and the linkage between innovation in software and the obsolescence of hardware (or vice-versa).

Blevis defines design as “an act of choosing among or informing choices of future ways of being” (p.503). Here the emphasis is on the future, which must take into account the current and future generation. It also implies the designers’ choice and interpretation of how people actions might be or change to.

He provides the beginning of a means to assess the “material effects induced by particular interaction design cases in terms of forms of use, reuse, and disposal from the perspective of sustainability" (p.503). What seems most important is the perspective of sustainability. If such a perspective is incorporated into design methodologies, we might begin to meet “the challenge…[of] motivating the will for sustainable behaviors as part of an economically-viable viable future, rather than by expecting such effects to be solely the dominion of legislation and public policy” (p.504). The principles of the rubric are disposal, salvage, recycling, remanufacturing for reuse, reuse as is, achieving longevity of use, sharing for maximal use, achieving heirloom status, finding wholesome alternatives to use, and active repair of misuse.

In a simple attempt to apply Sustainable Interaction Design, how might it apply to a basic website? I am currently in the process of designing a website for a small housing collective. The goals of the site are to market the collective and the concept of intentional communities to the greater community, recruit new membership and link in with the local online community to advertise events and share resources.

The first step would be to identify the tasks carried out in the creation, maintenance, and usage of the site. Next would be to consider the flow of the interactions or actions involved in each task. For example, a task for the collective’s website might be a member retrieving meeting minutes while they are away. In the decision to offer such information online, a traveling collective member would be encouraged to either use mobile technology or seek out computers away from home. If they have mobile technology, that device will have to be charged over time. Also, if we consider the time and labor involved, the actions of transcribing the notes and uploading them to the site must be considered as well. These actions might seem insignificant in the greater scheme of things, but providing access to meeting minutes to an absent member is important to maintaining the sustainability of the community. Yet at the same time, members might want to consider how sustainable they find current portable technology.

Each key action or behavior with the interface has some form of inputs and outputs. Interpretations and decisions can be made based upon what of the inputs/outputs are sustainable (or the least unsustainable). The aim is to seek ways to reorient the process to assist the daily flow of the user, use technology to circumvent what isn't sustainable or encourage what is, and make sustainability essential to the culture of designing interactions. Blevis has created an informal heuristic for his approach to sustainable design. I've included each heuristic with an example for how it might be used for a website, and several suggestions for the collective's site.

DISPOSAL "*does the design cause the disposal of physical mater, directly or indirectly"*

Websites with difficult to read print or overly cluttered with graphics may encourage users to print out a page for easier reading, leading to the eventual disposal of the paper. Asking users to sign up for catalogs also produces more printed material. What seems especially important is to consider each task to be carried out on the website, and then encouraging through design easy, sustainable options associated with that task. The collective can encourage it users not to print out something like its membership policy by using a clean layout and offering an easy way to increase or decrease text sizes.

SALVAGE "*does the design enable recovery of previously discarded material"*

A website can encourage salvage by taking the concept literally, for example by providing web space for users to text in posts about reusable goods put out to trash or at local dumps. Industries can offer up waste products they don't use to other local industries or individuals (assuming they're non-toxic). As a communication tool, the web offers countless opportunities for users to inform others of salvageable materials. The collective's site

might consider offering space on their site to encourage salvage. For example, a bottling factory nearby regularly gets rid of 55 gallon drums, and the collective could salvage them and offer them up to new homes.

RECYCLING "*does the design make use of recycled physical materials or provide for the future recycling of physical materials"*

There are many websites that enable recycling, such as craigslist.org, ebay.com and freecycle.org. Similar to the salvage heuristic, websites serve as excellent communication tools for sharing information on used goods. As the website grows, the collective can link to such sites, and post information about materials they have to be recycled. A designer could also think of recycling in terms of labor, for example, what is already in place that could be built upon (or recycled as something new) to save on human time. Building simple, flexible websites and web applications will help allow for the growth and change of a site, rather than continual re-designs. Installing an easy to use content management system will allow the site to change design and structure over time with less work involved.

REMANUFACTURING FOR REUSE *"does the design provide for the renewal of physical material for reuse or updated use"*

An interaction designer might do this by considering the lifecycle of a product or service, and not simply ending the design once someone has made a decision or purchase. Products or services with a short life-span can send reminders and incentives to users to return any discarded parts. They can also offer a platform for secure buying and selling of used parts for remanufacture by their customers. If the collective at any point sells items through their website, or has to ship printed materials to someone, they should send reusable packaging, and offer reuse suggestions on the site.

REUSE AS IS *"does the design provide for transfer of ownership"*

Again, offering a secure way for users to buy and sell used products online is an excellent way to do this. Amazon.com and abebooks.com are examples (however, the ability to search for used books locally would be a way to make transport more sustainable). The collective could offer a virtual "free room" to its members, where they can post items they no longer need for others to take.

ACHIEVING LONGEVITY OF USE "*does the design allow for long term use of physical materials by a single owner without transfer of ownership"*

Flexible, modular, customizable approaches all encourage such a perspective. Offering services to the owner for updating and repair throughout a products lifecycle is also a key part of the interaction design. While the collective's website does not sell anything that might need long term maintenance, the website can help members exchange skills for repairs in the community.

SHARING FOR MAXIMAL USE *"does the design allow for use of physical materials by many people as a construct of dynamic ownership"*

The web is the prime medium for sharing documents or even facilitating shared physical materials. ZipCar, a car sharing service, allows its members to reserve and see all available cars online. Such a service would be inconvenient without the ease and speed of the web to check car availability, etc. Online education allows people from different geographic locations to come together and learn various subjects, sharing eBooks, paper, conversations and audio/visual materials online. Open source software allows for dynamic ownership as well.

ACHIEVING HEIRLOOM STATUS *"does the design create artifice of long-lived appeal that motivates preservation such that transfer of ownership preserves quality of experience"*

Interactions designers must help in encouraging a culture of high-quality, long lasting products. The ease of the interactions through a website with the maker is helpful here, as is innovating in software design while keeping the constraints of the current hardware in mind. Fostering a culture online for people to discuss and review products will also help in creating long-term appeal.

FINDING WHOLESOME ALTERNATIVES TO USE *"does the design eliminate the need for the use of physical resources, while still preserving or even ameliorating qualities of life in a manner that is sensitive to and scaffolds human motivations and desires"*

Email and collaborative writing tools like wikis lessen the need to use paper and the energy to transport that paper. As do online books and newspapers. If the collective uses its site as its primary way to advertise itself and events, it will eliminate the need for paper flyers. They may also consider putting other paper based activities online, such as calendars and meeting notes.

ACTIVE REPAIR OF MISUSE "*is the design the specifically targeted at repairing the harmful effects of unsustainable use, substituting sustainable use in its place"*

If users have the option, and possibly even an incentive to ensure the products they order online come in packaging shared by others, or from a more local source, they might choose this option. Interaction designers can make the processes behind the scenes more transparent, and users can choose more sustainable actions.

Even if some of these design choices appear to have very small effects on the environment, what's important is creating a perspective and culture of sustainability. Without opportunities to reflect on what happens in our day to day actions, or useful and easy ways to act sustainably, we will continue to act unsustainably without thought.

Finding useful, practical approaches for approaching sustainable interaction design will be one of the most important next steps. Further thought and research must go into what makes sustainable actions, which consider all future implications and effects throughout our ecosystem. How to use technology to encourage sustainable behaviors without simply increasing our reliance on gadgets is the other challenge. By taking on such challenges we can decrease our harmful actions in our environment and work towards a more holistic, sustainable culture.

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