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Sustainability Through Meaning

Providing Information to Promote Meaningful Products

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Abstract Products that fulfill their functional purpose soon after purchase may become disposable and thus contribute to unsustainable consumption practices. Alternatively, products surrounded by rich stories can become more meaningful to their owners and thus more likely to be kept around beyond their initial use. We propose using sensing and online publishing technologies to capture and share stories from the entire product life cycle, encouraging consumers to become more involved with the production, use, and post-consumer stories of the products they purchase.

Keywords Sustainability · Sensors · Materialism · Design

1 Introduction

As humans, we rely on the control of the material world for our survival, and it is difficult to escape the environmental impact of our relationship with the material world. Too often, product life cycles are characterized by a "cradle-to-grave" mentality, progressing quickly from production through use to disposal. We propose that more sustainable behavior can be fostered by the creation of meaning attached to consumer goods.

Currently, many products are designed and marketed to have little meaning beyond their initial intended use and are viewed as disposable once they have fulfilled that function. One way of encouraging more sustainable behavior is to change the "meaningfulness" of commodities, creating stories around products that allow consumers to build stronger connections to their possessions, incentivizing them to keep products around longer, and engendering concern with their goods' pasts and futures.

With the emergence of fine-grained sensor information and detailed product information on the Web, consumers can gain unprecedented awareness concerning the products they buy. This information constitutes a product's inherent "story". Individuals can augment this information through collaborative "Web 2.0" tools to create personal stories about products they buy. It is our hope that these stories will naturally lead to more sustainable consumer practices as people are more personally connected to their possessions [4,3]. In this paper, we give an overview of these emerging technologies and outline the types of stories that can be built through the data they make available.

2 Motivation and Related Work

A number of scholars have commented on the relationship between commodities, stories, and meaning. Appadurai [1], drawing on Simmel's [18] argument that the value of an object is created through exchange, where two parties reciprocally determine the worth of the object, introduces the concept of *regimes of value*. He argues that the value system surrounding a commodity is a politically-constructed phenomenon based on cultural values shared by the parties involved. These values are encoded in the trajectory of the object itself: "Their meanings are inscribed in their forms, their uses, their trajectories... It is things-in-motion that illuminate their human and social context." That is, objects have a life history [13]. Appadurai breaks from the Marxist view of commodities, which focuses primarily on the creation of value through production, and considers the total history of an object "from production, through exchange/distribution, to consumption."

Our proposal to capture the stories of objects through sensors and product use data encodes meaning directly in objects, so that the object is the key to its own story. This approach reveals the life histories of things-in-motion, making more of their story visible and thus actionable in an ex-

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panded regime of value. By creating a regime of value in which stories become negotiable in the politics of exchange, value can be added to objects later in their life cycle, extending the life of an object as a commodity (thus keeping it from being discarded or disposed of).

Our proposal resonates with Csikszentmihalyi's [4] two types of materialism: *terminal* and *instrumental materialism*. Terminal materialism is a "runaway habit of possession", where goods are purchased because possession is viewed as an end in itself. Alternatively, instrumental materialism is the possession of things that serve goals "independent of greed itself". One of the ways Csikszentmihalyi proposes to change and "escape the deadly inertia of terminal materialism", is to "change the meaning we derive from possession of goods." We agree that transitioning from terminal materialism to instrumental materialism will promote sustainability by encouraging the consumption of fewer, more meaningful objects. Blevis [3] similarly notes that products can reduce their environmental impact by "achieving heirloom status", with designs that "create artifice of long-lived appeal that motivates preservation such that transfer of ownership preserves quality of experience." Stories are one way to create the lasting appeal of heirloom objects. Helms [10] also proposes the idea of *agathonic design*, or the design of items that improve with use. Much like heirloom items, these items functionally improve with use, resulting in personal investment in long-term ownership of the item.

In discussing possible stories that might be associated with a product, we use the product life cycle [2] to frame our exploration. Other researchers have proposed technological systems that reveal stories from various parts of this process. For example, [20] created a system allowing consumers to find product sustainability information by entering UPC bar code numbers, and Mankoff *et al.* [15] propose a system allowing consumers to share information about their sustainability footprint more generally, focusing on social networking among groups of consumers. Our alternate perspective complements these specific examples, highlighting more general examples across the entire product life cycle. We also focus on allowing users to tell individual stories about individual products, creating meaning more directly tied to specific practices around specific objects.

3 Building Stories through Technology

Recent advances in a number of technical areas are enabling unprecedented insight into the product life cycle, facilitating the generation of stories around products. Technology enables associating stories with objects by collecting multiple data sources, aggregating those data sources into a useful form for consumers, and allowing stakeholders to contribute to and share stories about the objects. These technologies can then be integrated throughout the product life cycle to create a complete "product story" that brings greater meaning to the consumer. We discuss the enabling technologies below.

Emerging sensing technologies such as RFID [7] and wireless sensor networks [5] can provide detailed information about a product's life cycle. RFID (Radio Frequency IDentification) is an electronic tagging and tracking technology that can provide product-level tracking information. Wireless sensor networks use small, battery-powered computing devices coupled with sensors to provide fine-grained introspection into environmental conditions. Large organizations such as WalMart are beginning to deploy these technologies to track product information. Other sensing devices such as cameras, coupled with portable devices like cellular phones, enable consumers to create their own detailed stories about the products they use.

In addition to sensor data, the rapid growth of data available on the Web has led to increased transparency into the entire product life cycle. Official corporate sites are increasingly providing more detailed information about their products in response to consumer demand. For instance, Tesco, a major UK supermarket chain, recently announced that it would be make available data regarding the sustainability impact of its products [19]. The explosion of user-generated content has also provided vast amounts of product data. User-review sites (e.g., TripAdvisor.com) create centralized forums for sharing experiences, blogs and wikis enable a more distributed form of expression, and social networking sites allow people to create and share details of their consumption with others [15].

Given this vast amount of data, another technical aspect crucial to creating stories around products is collecting and aggregating this data and displaying it to consumers. There are many emerging infrastructures for managing this influx of sensor and RFID data that address real-time collection, aggregation, and correlation of sensor and RFID data with other sources of information [17, 8]. These infrastructures can be coupled with efforts aimed at large-scale integration of heterogeneous web data [9, 14] to provide a coherent picture of consumer product data. Complementary to data aggregation technologies is the development of appropriate technologies and interfaces for presenting stories about products. There are a number of different delivery possibilities, each aimed at different phases of the product life cycle. Mobile access gives consumers actionable information at point of purchase, traditional websites allow consumers to explore more detailed product information, and community-based sites enable expression of personal stories [15].

The prevalence of data available about products raises a number of issues, most notably personal privacy concerns. Systems using this data must address these issues, but detailed recommendations are beyond the scope of this proposal. We do note that much of the data being presented is either publicly available or would be voluntarily contributed by people involved in the story of a product.

3.1 Product Life Cycle Data

The technologies described above can be used to collect and share data throughout the product life cycle, allowing consumers to create rich stories around their products. Here we discuss possible stories created at each phase. Table 1 illus-

trates more examples of stories that can be developed from data concerning different stages of the product life cycle.

Material Procurement/Manufacturing. At the beginning of the product cycle, RFID and other sensors (e.g., environmental sensors) provide information on the exact origins of a product, such as what factory produced a given product and when, as well as the environmental conditions surrounding production. This detailed tracking and monitoring information can be correlated with the information companies are releasing as a result of pressures toward production transparency (e.g., the Dole Organic Program [6]). Image-based sensors such as webcams and camera phones, combined with personal online publishing, can be used to further reveal production information about goods and the people who produce them to help add a more personal view on manufacturing.

Distribution. An RFID-enabled supply chain can provide information on the location of a product throughout transit, the mode of transportation (e.g., by air or truck), and how long it spends at various waypoints (e.g., distribution centers) along its journey.

Point of Purchase. At the point of purchase, consumers can come into contact with the history of the products they are considering purchasing, utilizing web or RFID-enabled mobile devices [16] to access information collected during the first phases of the product's life cycle. Knowing the origin of a commodity and who produces it helps build stories around a product before it is purchased. As such, consumers can build a deeper connection to the products they buy.

Consumer Use. Various technologies being developed for "smart" or "digital" homes [12, 11] can be used to gather product use information throughout the consumer use phase. Additionally, the widespread use of consumer media devices (e.g., camera phones) in conjunction with ubiquitous communication enables consumers to create additional stories and share those stories with others. For instance, websites such as zebo.com allow consumers to upload information about the products they own and share that information with others.

Post-Consumer Use. If consumers discard a product, they can determine where it might go using online data about recycling plants or second-hand stores. Exchange sites such as throwplace.com offer alternatives to disposal by passing products from one person to the next. If the product is passed on for reuse, all of the above information can be made available to the second owner (and data from the second owner shared with the original user), further enhancing the stories around the product (see, for example, the money-tracking site wheresgeorge.com).

4 An Example Life Cycle Scenario

The technologies and data we have described above afford different possibilities for enriching a product's story at different stages in its life cycle, providing the opportunity to build stronger connections between consumers, products, and their producers. We envision these different possibilities working together, capturing and enhancing the story of a product as it circulates in socio-physical space. We now describe a scenario of one product's story across its entire life cycle. While living in Berlin, one of the authors purchased a football shirt (Figure 1) in a thrift store; we imagine its story:

Fig. 1 A Bayern-München football shirt

While attending a Bayern-München football match, 13-year-old Klaus decides to purchase a team T-shirt to remember the experience. While there are several less expensive options, one of the T-shirts was made in his home town. Scanning the RFID tag on the shirt at a kiosk in the store, he reads a blog entry about the manufacturing plant written by someone from his neighborhood. He chooses to purchase the T-shirt because it was made in his home town, and he indicates this when he pays.

Because the T-shirt reminds him of the match he went to, and because he's proud of telling people that it was made locally, Klaus wants to keep wearing the T-shirt. He takes care of it for several years, bringing it with him when he moves to Berlin where he continues to wear it proudly, even though his friends tease him about supporting Bayern-München. Eventually, Klaus outgrows the shirt and decides to donate it to a second-hand store rather than throw it out because of its meaning to him. When he donates the shirt, he adds a story to the product's blog about how he bought it and brought it with him to Berlin, where he was subsequently teased about it. This story is associated with the RFID tag in the shirt, along with existing data about where it was purchased and new data about the thrift shop.

Later, Lora visits the second hand store during her trip, and wonders why a Bayern-München shirt is in Berlin. She uses her cell phone to look up the T-shirt's story. Amused by the story, she purchases the shirt, bringing it back to the United States. After Lora makes her purchase, Klaus gets an e-mail telling him that his shirt was purchased by someone from America. Several years later, when Lora decides to get rid of the T-shirt, she passes it on to a friend who is moving to Germany, continuing its story.

5 Conclusion

We argue that increased meaning around products, achieved through stories, will encourage consumers to develop deeper connections to their material possessions, resulting in increased instrumental materialism and more sustainable behavior. It is our hypothesis that the creation of meaning around products can make sustainability a viable alternative to terminal materialism. In this proposal, we have highlighted a number of technologies enabling the creation, representation, and transmission of product stories. We have also suggested that the product life cycle can be a generative tool for enumerating potential sources of stories. We hope that this work will encourage design explorations of product stories and studies of the impact of those stories have on consumer behavior and sustainability.

	Geographic Space	Social Space	Material Space
Material Procurement	Locations that the materials came from; how they were shipped	Conditions and stories of workers who grew/ mined the material	Ecological footprint of material extraction; history of materials and reasons for choosing them
Manufacturing	Locations of manufacturing and assembly plants	Conditions and stories of workers in the plant; relationship of the plant to the local community	Ecological footprint of manufacturing, including wastes, disposal practices, energy use, and pollution; description of manufacturing techniques
Distribution and Purchase	Route that product followed to purchase point, including travel and storage time	Conditions and stories of distributors; types of stores product was purchased in	Ecological footprint of distribution, including mode of transportation
Consumer Use	Where consumers in the life of the product came from; where the product traveled	Types of consumers and why they purchased the product**;** stories of product use in specific communities of consumers	Impact of use on the product, including repairs/ changes, number of times it is washed, seasonal changes, energy consumed, etc.
Post-Consumer Use	Where the product goes after it is discarded	Conditions and story of workers who work at recycling/reclamation/etc. facilities; stories about people who reuse the product	Anticipated future of the product — what the product will be turned into via recycling, disposal, reuse, etc.

Table 1 Data collected from each part of the product life cycle can be developed into meaningful stories, centered around geographical, social, and material themes.

The creation of meaningful objects has the potential to extend sustainable practices beyond "sustainability conscious" customers. Sustainability conscious customers find meaning in sustainable products because their values resonate with those put forth by the products. Other consumers may resonate with different types of stories, such as those related where a product was made or the workers who produced it. We argue that these alternate sources of meaning will similarly promote sustainable consumption practices.

Of course, this proposal suggests many open questions: do people want to be completely surrounded by meaningful objects? Are there types of products where meaning is socially or culturally inappropriate? It is also important to note that we believe people should be given this detailed product information in an objective manner such that they can make their own stories around the products they buy and use. However, we hope that by providing a framework for users to overlay their own meanings on to material objects, they will learn to value them as more than a disposable commodity and instead as a material and emotional investment.

6 Biography

The authors come from a diverse set of backgrounds: human-computer interaction, data management, and mechanical engineering, which they hope will provide interesting perspectives on the technical and the social aspects of sustainability.

Lora Oehlberg is a doctoral student in mechanical engineering at UC Berkeley. She is affiliated with the Berkeley Institute of Design (BID) and works with Prof. Alice Agogino. She is interested in how new media can be used to help designers in new product development teams document their design process. Her background includes both corporate product design and development and human-computer interaction research. She has a B.S. in mechanical engineering from Stanford University.

Ryan Aipperspach is a doctoral student in computer science at UC Berkeley. He is affiliated with BID and works with Prof. John Canny. His work includes studies and designs exploring how technology is used in the home and how technology might be better integrated into the domestic environment. He is interested in exploring how technology that better integrates with people's lives can help to create more meaningful, restorative, and sustainable interactions. He has a B.S. in computer science from Rice University.

Shawn R. Jeffery is a doctoral student in computer science at UC Berkeley working with Prof. Michael Franklin. His research deals with data management for emerging applications, focusing RFID and other sensing technologies as well as web-scale data integration. He has a B.S. in computer science from the University of Wisconsin, Madison.

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