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Open Sustainability Innovation—A Pragmatic Standpoint of Sustainable HCI

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Abstract. The importance of sustainability in design became a major topic of interest in HCI research. Past research has shown how classical HCI design principles could be used to create values of the design through the open innovation concept. The scope of this paper follows from an earlier work of open innovation design principles that established the basis of open sustainability innovation since contributions from a dissimilar applied form of HCI could be promising. We in this paper have analyzed the concept of open sustainability innovation from the perspective of sustainable HCI. The paper outlines seven design principles for open sustainability innovation and has illustrated them in the form of a framework. The notion of open sustainability innovation and sustainable HCI are then revisited and the role of sustainable HCI for developing sustainable products, services, and initiatives using open innovation are clarified.

Keywords: Open innovation, Open Sustainability Innovation, Sustainable HCI, Design Principles.

1 Introduction

Sometimes referred to as a creative destruction activity, organizations are often considered by many to be the main causes that create a lack of sustainability in the society [21]. Even though it is a relatively new concept and approach for innovation, open innovation is considered to be a major shift for many organizations since often organizations could be restricted by their limited knowledge and resources. At the same time, very little attention has so far been given to the open innovation concept to understand its role for shaping and building a sustainable future. Perhaps this idea could play a great role in promoting sustainability if innovation strategy could be altered with a focused desired goal. Indeed the concept of open sustainability innovation was elevated when it was used to develop ideas or initiatives, products or services that were sustainable. At times this approach is practiced by organizations in their marketing phase for introducing new information to their consumers, given that the customers were totally unaware of a new product or service [1]. Sustainable HCI is a growing area of research concerning everyday practices focusing on sustainability, despite the fact that its scope should not only be limited to everyday

life but instead the approach towards sustainability for emerging in everyday life could be thought as a basis on which it is built [18]. Sustainable HCI research and studies (for example [12, 13]) contributed to supporting sustainable decision-making for product-purchasing [20] and on the whole it is important to understand the behavior of the consumer if HCI research would like to provide more support for this. We in this paper used the notion of sustainable HCI to enhance the open innovation concept towards open sustainability innovation. The underlying research question was: “How could sustainable HCI create values in marketing for developing sustainable products, services, and initiatives by using open innovation?” The structure of this paper’s argument was illustrated in the form of a block diagram shown in Figure 1. So far, previous research has shown how open innovation design principles could be formulated from HCI design principles. We took a similar approach and used HCI design principles to add values to the domain of sustainable HCI. We then used the enhanced concept of sustainable HCI as an approach for constructing values in marketing, aiming for sustainability goals to be elevated by using open innovation. The paper presented seven design principles for open sustainability innovation and a framework was proposed to explain how these design principles would work for promoting sustainability through open innovation. Finally we revisited the notion of sustainable HCI from the context of open sustainability innovation and redefined sustainable HCI in that context, in which it was argued that sustainable HCI could be more than creating products or services to change the consumer’s behavior towards any ecological action.

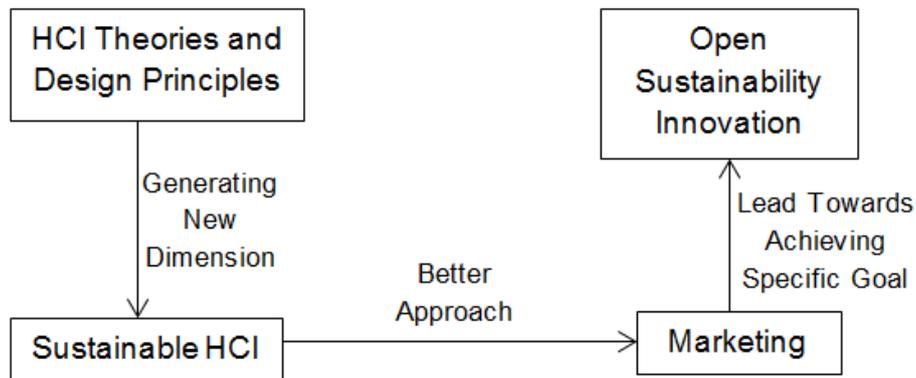


Fig. 1. Sustainable HCI and its impact towards open sustainability innovation.

2 Background

To grasp the connection between open sustainability innovation and sustainable HCI, it was important to explore some theoretical foundations. In section 2.1 the background for open sustainability innovation is presented, while section 2.2 discusses sustainable HCI in connection to open innovation.

2.1 Open Innovation and Innovation for Sustainability

By many, open innovation is considered to be a radical change in setting innovation strategy and managing innovation. Introduced a decade ago by Henry Chesbrough, the open innovation concept is debated as being something old to be packaged in a new format [22]. He stated that not any longer can a single organization have all the resources or knowledge that is needed for creating innovation themselves [4] and therefore they need more inputs from outside the organization's boundary. Previous research revealed that a collective intelligence as an approach for creation of ideas could often be better than a single mind. [2] Open innovation is a concept in which more stakeholders get involved in the innovation process compared to its opposite—"closed innovation", when the company innovates in solitude and behind closed doors. The stakeholders in the case of open innovation could, for instance, be suppliers, customers, or competitors.

In addition, no general definition of sustainability exists since it is dependent on the context and the research field (for comprehensive reviews of sustainability terms see [10]). Nevertheless, the negative impact that human activities could have on our environment is acknowledged in sustainability. One key definition for sustainable development was stated in the Bruntland Commission: "... development that meets the needs of the present without compromising the ability of future generations to meet their own needs." [23] The Bruntland Commission opened the awareness that existing processes for development, consumption, and production could be unsustainable. Thus sustainability would be about improving our life, not creating a negative impact but instead minimizing, if possible reversing or reducing the negative impacts. At the same time, observed sustainability research in information technology is mainly focused on technical solutions to reduce the emission of carbon dioxide from IT hardware [5].

Charter et al. [3] stated: "Marketing has a key strategic role as the interface between consumption and production, with a considerable influence over the construction of the company's product/market portfolio and also over its communications efforts." Environmental performances together with social indicators were seen as a key service and product attribute. This could be a source for differentiation to give potential competitive advantage [19], and thus both the innovation as well as the marketing process is important as a bundle to be offered in the market. Again, to achieve competitive advantages the marketing policy must be in alignment with the innovation strategy. Peattie and Peattie [17] pointed out the ineffectiveness of green marketing by claiming: 'Creating meaningful progress towards sustainability requires more radical solutions than just the development of new products and product substitutions amongst consumers.' A better solution to this problem could be to get more stakeholders involved in the innovation and marketing process. Open sustainability innovation uses the open innovation concept with an aim to reach sustainability through the marketing mechanism. With more stakeholders involved in the innovation process, chances of reaching sustainable goals could increase and this should be applicable for marketing too. Active stakeholder involvement is central for successful use of open innovation, as without it no new ideas outside the organization would be fetched.

2.2 Sustainable HCI and Open Sustainability Innovation

Research with a component of sustainability is ubiquitous and sustainability research in HCI is accelerating. The growth volume of academic papers about sustainable HCI has increased [8] and is now one of the fastest growing areas in HCI [9]. By reading a review made by DiSalvo, Sengers and Brynjarsdóttir [7] in 2010, it seems that there is a widespread use of sustainable HCI in research. Furthermore, the focus of sustainability research in IT [5] mimics the research in sustainable HCI, which is focused on the reduction of resource use and minimization of the emission of carbon dioxide through the design of systems that might change individuals' consumption and choice behavior [9]. The focus on shaping the individual's choice based on a negative motivation in order to reduce consumption is therefore a prevalent theme for research in sustainable HCI [9]. One of the two suggested promising directions for future research in which HCI would be related to the environmental issue was "participatory design" [11], when the issues of participatory design could be answered by including stakeholders in the innovation and marketing processes. In fact, sustainable system design should have a better chance to reach sustainable goals with more stakeholders involved, e.g. open innovation [15]. Thus an improved open innovation and marketing policy could promote positive incentives towards reaching different sustainable goals. In short, engaging users in the system development procedure with a goal of promoting sustainable action could be seen as a merger between sustainable HCI and open sustainability innovation research.

3 Open Sustainability Innovation Design Principles

Discussions from the background section clarified that open sustainability innovation initiative could take place as an enhanced approach of marketing by the organizations. Our aim in particular would be to use HCI design principles for adding new values to a marketing policy that organizations previously were unaware of, and to finally trigger the process of open sustainability innovation. At the same time, by using HCI design principles, the traditional understanding of sustainable HCI could possibly be taken into a new dimension and a new research process could be initiated.

We considered the "Buying Decision Process" approach by Kotler [14] as the principle basis of our research. Although first published by John Dewey [6] in 1910, the elements of this approach have been reformed over the years [20]. Moreover we took into account the characteristics of sustainability marketing, addressed by Belz et al. [1] as our second basis for formulating design principles. According to Belz et al. these characteristics are important to understand for organizations to build and maintain sustainable relationships with their customers. For our HCI design principles we chose the universal design approach and its principles. Mustaquim and Nyström [16] showed how open innovation design principles could be shaped from the angle of universal design. In their research it was shown how universal design could create values in other domains (open innovation in this case) which was not limited within the scope of physical disabilities [16]. To put it differently, we used a similar concept of universal design and mapped design principles from HCI research domain into the

two marketing approaches—one for creating better marketing strategies and the other for creating and maintaining better relationships with the clients.

Figure 2 shows a framework in which universal design principles are diagrammed with the five stage framework of the buying decision process model. In Figure 3 (see below) we have shown how the characteristics of sustainability marketing could be mapped with universal design principles.

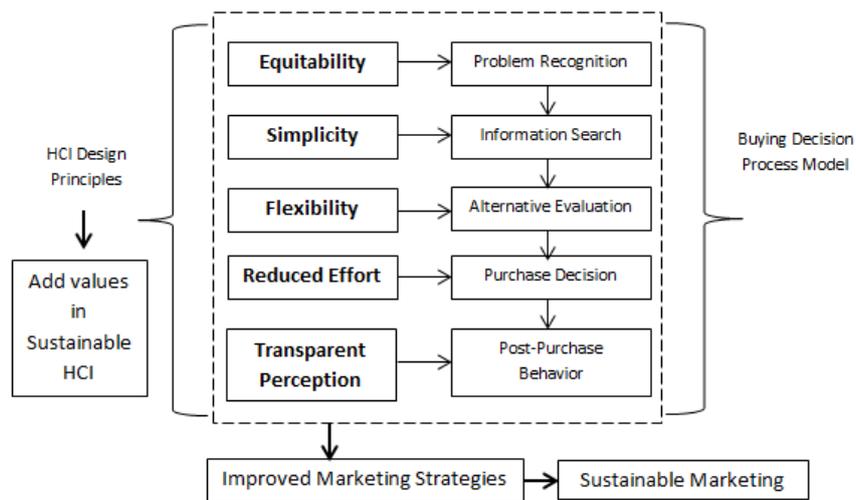


Fig. 2. A refined version of buying decision process [1] using HCI design principles.

These two frameworks were formulated using a combinatorial approach in which two different theories of marketing and HCI design principles were considered. Nevertheless, both frameworks are aimed towards achieving sustainable marketing.

It was illustrated in Figure 2 how our approach could improve marketing strategies, which would lead towards sustainable marketing. The phase of problem-recognition could be equal in the sense that it should be well balanced between the customer's requirement and their desired state, while they would decide to purchase a product. The customers would then try to find information from different sources about the product they would intend to purchase and this process should be simple. The third phase would be evaluation of various alternatives that should be flexible to let customers evaluate the primary requirements, initiated in an equitable state of problem-recognition. However, customers might often not follow these steps to come up with a purchase decision. They could just skip these steps and buy a product without collecting too much information about it. Hence we added the reduced effort design principle with the purchase decision factor. Subsequently, information about a product could be very powerful [20] for making customers buy the product and it should be designed by keeping in mind that too much effort should not be required to spend for understanding the information about it. In fact this would make the direct purchase decision process easier for the customers. The final phase from the buying

decision process model was post-purchase behavior, mapped with the transparent perception design principle. When customers buy a product they might either like or dislike it; they could either recommend it to others or not. Customer decision on an action would depend on how a product was designed and what effect it would leave on shaping the customer's attitude. In particular, if information provided by the designer were transparent and easy to perceive by the customers, it should create a positive post-purchase behavior for them.

Figure 3 took into consideration the characteristics of sustainable marketing and four design principles from HCI. If we want to maintain a product's cost parallel to the purchase cost, cost of use together with the post-use costs, a design should have a smooth approachability characteristic for it. Without being able to approach easily towards any of the cost properties, it would be a challenge for the organization to maintain the customer cost in general.

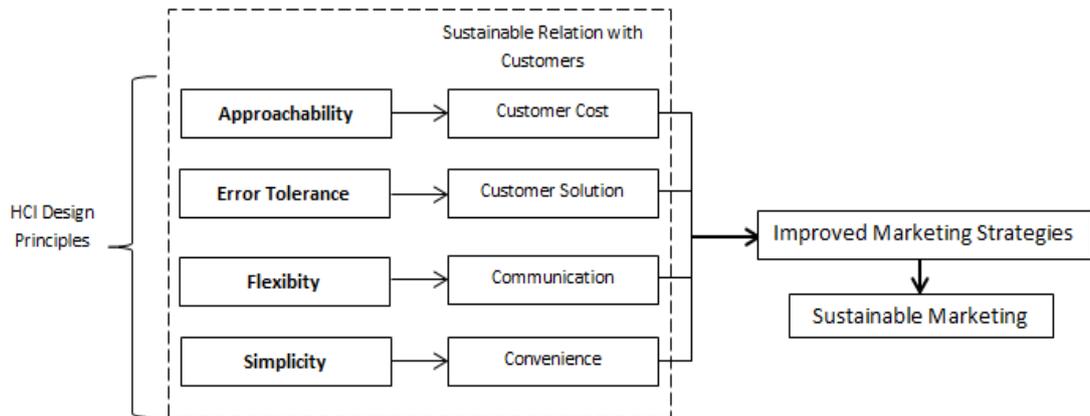


Fig. 3. Sustainable relationship with customers and HCI design principles.

Further, the elements of customer cost are a complex concept that is not limited within the three types of costs mentioned earlier but could include phenomena like risks and qualities. Therefore easy approachability in design to have a smooth transaction between these different variables would be important for balancing the customer cost. Providing better customer solution is the next characteristic, which should maintain higher error tolerance. The concept of providing customer solution aiming to offer solutions for different issues when customers use a product is not enough in today's business world. For many, the customer solution could mean many other different things that could leave impacts on the customer's decision whether to buy products from the same organization in the future. Therefore error-free or higher error tolerance is important while designing customer solutions. Communication is the third character of sustainable marketing and we assigned flexibility together with this character. Better communication is always good for customers, but flexible communication between company and client could have a long-term impact on the purchase decision of a product from an organization. Finally, convenience was one of

the key properties that could make customers choose to buy one product from a particular company. Convenience could create values in the customer's mind, which would be not just limited to the price. There could be several factors for producing success in convenience and a successful relation of these could create values for business. Again these factors could depend on the nature of business and product. We therefore took the simplicity design principle to map the convenience characteristic. Simplicity in design could lead towards convenience by relating other factors associated with the type of business or product. The approach of using these marketing characteristics together with selected design principles from HCI could improve marketing strategies and contribute positively towards sustainable marketing. In Table 1 we have shown a characteristic matrix of HCI design principles with the buying decision process and sustainable marketing features together with the bases for formulating open sustainability innovation design principles.

Based on the above discussion of the buying decision process and characteristics of sustainable relation with customer together with the design principles of HCI, we came up with seven design principles for open sustainability innovation. The proposed design principles are described in Section 3.1 below.

Table 1. Characteristic matrix for open sustainability innovation.

Buying Decision Process and Sustainable Marketing Characteristics	Corresponding HCI Design Principles	Open Sustainability Innovation Design Principle Properties
Recognizing the Problem	Equitability	Steadiness between requirement and desired state of customer
Searching the Right Information	Simplicity	Simple information presentation
Evaluating Possible Alternatives	Flexibility	Ability to evaluate various alternatives
Decision of Purchase	Reduced Effort	Better understanding of the product
Post-Purchase Behavior of Customers	Transparent Perception	Enhanced information provided by the designers
Customer Costs	Approachability	Even flow between different cost variables
Customer Solution	Error Tolerance	Reduced error for efficiency
Communication	Flexibility	Improved way of maintaining communication
Convenience	Simplicity	Keeping the product design simple and thereby add value on it

3.1 Proposed Open Sustainability Innovation Design Principles

Principle one: Reduce gap between customer's requirement and desire for improved problem identification

Having open sustainability innovation as a main goal, an important thing would be to design for a specific need and not to simply just design a product. If the real requirement of the customers cannot be realized, they might end up buying a product anyway, even though they would not find that it gave them higher usability results. On the other hand, if the desire is too high then customers might never be satisfied with what they buy, regardless of whether an offered product improved usability or

not. The gap between requirement and desire should therefore be reduced and this is an important thing to remember while designing a product or system to initiate sustainable practice.

Principle two: Make information presentation about a product for the customer an easy task

Customers should be able to find information about a product without much hassle and designers should remember this too during product design. Both an immediate and long-term decision-making process before purchasing a product could depend on how well customers were able to find information about it. Designers should focus on this matter since a successful presentation of information could leave optimistic impressions when balancing the decision of the customer's requirements and their desire to purchase a product.

Principle three: Expand the evaluation of product towards different alternative and enhance better communication with customer

Information provided to customers about a product in an appropriate style is significant, but it is better if customers are able to evaluate different products before they buy them. Designers should therefore reflect on this factor during design. Providing ability in evaluation to customers would open the door for improved communication with customers too. By providing improved information presentation about a product and better evaluation ability in contrast could create positive impacts on reducing the gap between customer's requirement and desire.

Principle four: Provide transparent information to customers for positive impact on their post-purchase behavior

Post-purchase behavior could trigger many things and one of them is whether or not it is going to reduce the gap between desire and requirement, i.e. providing clear and easily perceivable information to the client is important. If a design lacks in providing proper information or even provides limited information, the customer's way of using that product could be effected in a negative way. This could leave impact on other possible future clients who might share negative feelings about the product and even the organization while discussing with an existing client through word of mouth. Designers should thus remember these facts during design.

Principle five: Ensure balanced flow between different variables of customer cost

Customer's cost is a complex factor and designers could make sure how to have a balanced flow between different variables of customer costs. In cost maintenance or reduction, whatever the goal might be, the success would depend on the relation with many other associated variables that build up total customer cost. Easy approachability from one factor to another would therefore be a key issue for ensuring better customer cost and should therefore be considered by the designers.

Principle six: Provide error-free customer solutions for efficiency

Ensuring error-free customer solution is important and there is no doubt about that. But how this factor could influence the marketing of a product might not always be very easy to realize. A product cannot just be designed for achieving many different

goals without the designers being able to provide better instructions for support. This should be considered by designers for increased efficiency through their design.

Principle seven: Add value to product through simplicity in design for achieving convenience

Convenience and value are two issues that work with each other in the context of marketing the success of a product. By keeping the design simple, numerous values could be added to it, which would increase the convenience of a product. Simplicity is therefore a key factor that should be considered by the designers, which could help them achieve many goals including convenience and sustainability. On the contrary, designers should realize simplicity very contextually with specific design problems.

4 Proposed Framework

As an illustration, the proposed design principles are shown in the form of a theoretical framework in Figure 4 (see below) for explaining how they could work for the successful practice of open sustainability innovation. This would be a complex process, which is the result of a buying decision process and characteristics of sustainable marketing together with HCI design principles. The main goal here is to find a steady gap between the customer's requirement and the desire for the purchase of a product. Following the previous discussions of the design principles we could explore the proposed framework in Figure 4. Simple information presentation would allow customers to evaluate different alternatives before purchasing a product. This would follow successful transparent understanding of the product through the customer's post-purchase behavior. The customer cost and the variables associated with this could then be balanced, which would lead towards an error-free and efficient customer solution. These together could trigger the addition of positive values into a product for enhancing the convenience. Finally the cyclic process would achieve a steady balance between customer requirement and their desired state. If this could be achieved it would then be possible to claim that sustainability was the targeted achieved goal by the practice of the open innovation concept. Designers could be benefited from the use of this framework for enhancing a product development life cycle that could result in a sustainable end product. Besides, organizations practicing open innovation could consider this framework to make their innovation practice more sustainable and develop sustainable end products.

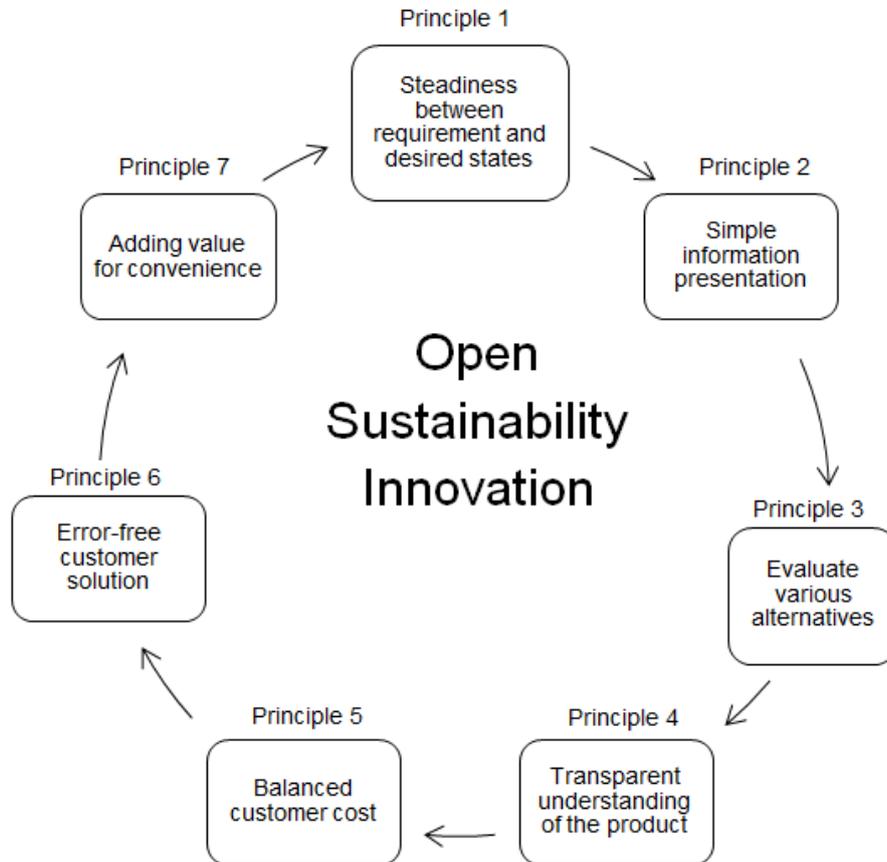


Fig. 4. A framework for open sustainability innovation process.

5 Discussions

The proposed framework was an abstraction of a very complex procedure that involved marketing, decision process, and HCI design principles. A few interesting research initiatives could be drawn from the outcome of this paper. First, the concept of sustainable HCI could be thought outside of the traditional box. Design principles from HCI could add value to the understanding of sustainable HCI. Second, we used universal design principles in this paper to compare the characteristics selected from two different theoretical bases. This showed us how universal design could be thought outside its traditional concept of accessibility issues, which is identified as a limitation. Previous research has argued and showed how a universal design concept could be expanded beyond the physical disability domain and this paper placed another milestone for adding values to this argument. Thus sustainability in HCI should not be limited only within the scope of creating persuasive technologies to

change user behavior. Instead the notion of sustainable HCI could also mean the design process or design for achieving sustainability. Besides, adding different factors to lead a design procedure and for the end product to be sustainable could further be considered in the study of sustainable HCI. Open innovation is one such procedure that was explored in this paper. Open sustainability innovation design principles proposed in this paper could be empirically verified and the proposed framework could then be altered and improved as required. It would be interesting to see how an organization practicing open innovation could take the proposed design principles into practice and then to observe how sustainable their resulting end product would be. How sustainable the overall product development process could become, considering the proposed design principles, would be worth exploring too. The role of sustainable HCI in open sustainability innovation is therefore promising and further research could find interesting correlation between different fields of research as we did here with marketing and decision process with HCI. In contrast this could help to analyze the influence of other research fields in sustainability achievement.

6 Conclusions

Two different research disciplines were considered and compared with the design principles originated from HCI to formulate the design principles for open sustainability innovation. The design principles were then structured into a theoretical framework for explaining how they would be working in practice. It was shown that the sustainable HCI concept could be expanded from its traditional understanding and this could be done by the use of existing design principles from HCI. Besides we understood that the universal design concept could be thought outside of the accessibility domain and thus be considered as a factor to enhance usability in other design issues. A way of looking into the effect of sustainable HCI on open sustainability innovation process could thus be viable and positive for designing products and services with a sustainability goal.

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