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Sustainable Information System Design and the Role of Sustainable HCI

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ABSTRACT

Sustainable Human Computer Interaction (HCI) is a heterogeneous developing field of research, typically focusing on persuasive system design to influence users to behave and live more sustainably. So far this change of behavior towards sustainability has been limited more or less within the scope of environmental topics. This paper extends the notion of sustainable HCI beyond the ecological sphere of sustainability. This paper has followed a previous research work in which sustainable system design principles were formulated without explanation of how to practice them in a system development process. Design principles originating from HCI design principles are an approach to showing how they could influence the classical system development life cycle to produce a sustainable system. A theoretical framework is proposed to explain this. Then sustainable HCI is redefined from the perspective of different parameters associated within the universal design concept from HCI.

Categories and Subject Descriptors

H.5.m. [Information interfaces and presentation (e.g., HCI)]: Miscellaneous. K.6.1. [Management of computing and information systems]: Project and People Management. K.4.m. [Computers and society]: Miscellaneous.

General Terms

Management, Design, Theory.

Keywords

Sustainability; Sustainable HCI; System Design; Sustainable System Design; Universal Design.

1. INTRODUCTION

Bearing in mind the importance of sustainability in HCI design is not a new practice. Blevis [2] in his groundbreaking paper pub-

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lished in 2007 established sustainability as important and of concern for the HCI research community. The concept of sustainability in HCI was reflected through the system design for complex shaping of the individual's attitude towards the action in real world system for which it was designed. The possibility to expand this concept of sustainable HCI should be considered to be a relatively new issue in research, since sustainable HCI has been focusing to work like a lens in the field of interaction design. Designing a system for sustainability could altogether refer to more than just a changing of attitudes towards a set of actions. For example, previous research by Mustaqim and Nyström [28] showed how designing of systems for sustainability could be addressed differently under the shed of open innovation and marketing through the use of an extended concept of sustainable HCI. Design principles and theories in HCI could therefore contribute in different ways for creating interactive design, leading towards a particular sustainable action. While ecological strength is the most common issue for sustainability concern, this concept could further be motivated based on different design and sustainability relations. Information system design involves performance of some basic tasks which must be completed even though their organization could be changed. These basic task performances were originated in the form of system development life cycle (SDLC) in the early 1970s. Nevertheless, the uncertainty about the success of a system design still remained a major issue of concern since this success could depend on several factors like system size, technology familiarity, and problem structure—not to mention that when this success is identified for achieving sustainability the problem becomes more complicated. Despite previous research showing how design principles for sustainable system design could be generated from HCI design principles (e.g. universal design principles) [26], no valid framework was proposed for showing how to deal with the suggested design principles during a SDLC.

We in this paper have argued that even with suitable design principles and factors in hand the output of a design or a design procedure to be called 'sustainable' is quite vulnerable. In brief, the underlying research question in this paper was "how to use SDLC with the design principles for sustainability and to understand the role of HCI in sustainability?" We took the design principles for sustainable system design which had been derived from HCI design principles and made a contribution into the SDLCs. Our proposed framework was called Sustainable System Development Life Cycle (SSDLC). The notion of sustainable HCI was then revisited for redefining it by the argument that sustainability in HCI could be more than just designing the system for changing

the user’s attitude towards any specific action. To put it differently, a new addition to the concept of sustainable HCI could be to use HCI design methods and theories in the information system development to result in a sustainable system in which sustainability could refer to actions that would not only be limited within the issues of ecological viabilities. It was acknowledged by research that HCI design could support people in interacting and behaving in a way that influences and changes society [17], since recent research was broadened and aimed towards cultural and societal concerns [23]. Designing in HCI could be compared with a double-edged sword. This is because it could help people and society act towards sustainability. But on the other hand, the design could often bring us ‘more’, e.g. constant updates of user content in social networking and the development of artifacts to be faster and smarter and thereby urge for more consumption [17]. People’s attitudes and behavior may be, are, and will be influenced by the design of information systems and this is something that the designer should be mindful of [31]. This paper is divided into four major sections. The background in Section Two presents an outline about sustainable HCI and SDLCs, followed by the next section in which we have discussed the relationship of information system development and its importance with HCI and sustainability. In Section Four we have described our proposed sustainable system development life cycle. The paper is concluded by a discussion and the possibility towards further research that will be initiated by this research work.

2. BACKGROUND

To understand how the notion of sustainable HCI can be re-conceptualized, it is important to get an initial clear picture about sustainable HCI. Therefore in the next section we have given a theoretical background and description about sustainable HCI. The following section presents the method of SDLC that has been elaborated and the context of its use in this paper has also been illustrated.

2.1. Sustainable HCI

Sustainable research is pervasive in academia today and scientific research articles have been written in different research fields about this topic. This has also included the field of HCI and a good review of this field was made in 2010, by DiSalvo, Sengers and Brynjarsdóttir [8]. One issue that should be acknowledged by the reader is the fact that “Mapping the Landscape of Sustainable HCI” is concerned only with sustainability of the environment and, in other words, the issued question, “What are, or should be, the boundaries of sustainable HCI?” is very relevant. What is sustainable HCI? No straightforward answer exists to this question. One definition of ‘sustainable’ is made by the World Commission on Environment and Development (WCED): “... that it meets the needs of the present without compromising the ability of future generations to meet their own needs” [42]. At present, sustainability works by reversing or minimizing the effect of different processes on sustainability, thus leaving impacts for the future. Also Tony Fry’s use of the expression ‘sustainment’ as an act of elimination, a redirective practice and development are a means to adding to the understanding of sustainability as not just reduction of greenhouse gas emission but more towards a change and adoption of lifestyles that need less use of resources [15]. We think that the scope must be extended from mainly focusing on environment issues. One perspective previously used by the authors was Elkington’s ‘triple bottom line’ (TBL) [26] that includes three components, society, and economic performance, and the natural environment [11,12] see Figure 1. Another extension is

the quadruple bottom line (QBL) that has been introduced as tool for understanding sustainability as human fulfillment [40]. QBL acknowledged that sustainability could be related to environmental/practical, personal/spiritual and social needs where economic concerns mediates the ability to satisfy these three needs (economic is not seen as natural condition of being a human but as a human construction, see Figure 2) [23, 40]. Brynjarsdóttir et al. [3] demonstrated the complexity of sustainability and the damage a narrowing perspective and framing can have.

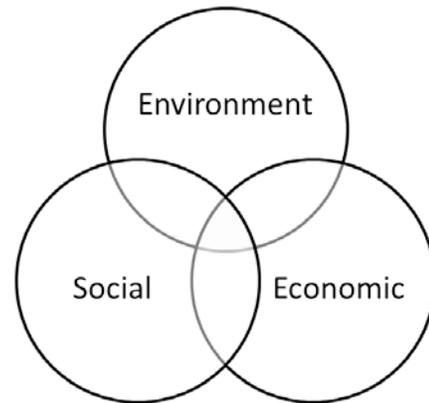


Figure 1. The components of the Triple Bottom Line.

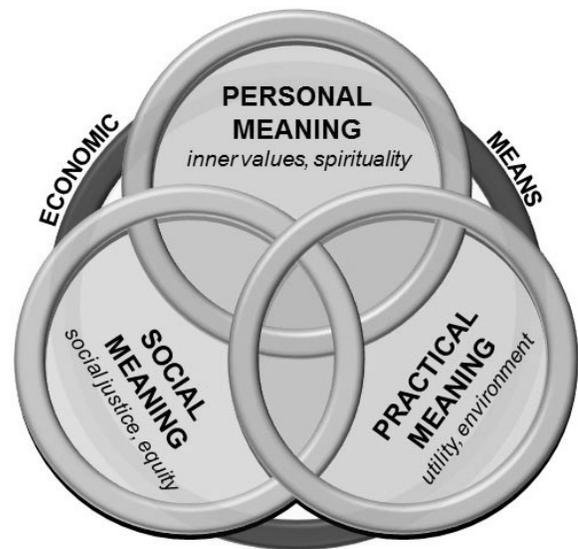


Figure 2. Quadruple Bottom Line of sustainability [7].

In addition, Hirsch and Andersson [18] found in their research about water scarcity that economic, political, and cultural factors are influencing the socially situated practice that impacts water consumption and conservation. The importance is not to choose between TBL and QBL, but to reflect on that they contribute towards an understanding of the multidimensionality and complexity of sustainability. Sustainable HCI should thus address WCED’s sustainability (understood as a process) put into the multidimensional analysis tool that TBL or QBL provides. Furthermore, Blevis claimed that, a perspective which he called Sustainable Interaction Design (SID), could and should be of the central focus of interaction design [2] which turned the research in sustainable HCI to be multiplied [9]. A conclusion from reading

academic articles in sustainable HCI is that no clear definition exists. Our view on sustainable HCI could be derived from the previous discussion about sustainability that included a multidimensional angle on designing sustainable systems that have an impact on both the individual and society. A parallel of this could be seen in Håkansson and Senger’s research about a holistic view of sustainability that included both environmental and personal sustainability and the relationship among individuals, community, and organizational levels [17]. This paper would, in DiSalvo, Sengers and Brynjarsdóttir’s categorization, be considered to be within the SID genre for which the rethinking of methods in HCI is needed [8]. This paper’s core message was the necessity to rethink the role and outcomes of design in a sustainable framework and to address what Brynjarsdóttir et al. observed—a failure to include actors in the design of solutions within collective practices [3]. In SID, sustainability works as a lens to rethink the outcomes and the role of a design [9]. SID is focused on material effect, e.g. reduction of paper waste or pollution [8], and again, this trend was observed in the field of information technology where a technical solution was often seen as the solution to reaching sustainable goals [26]. Another example was a paper using SDLC, named “A Green Software Development Life Cycle for Cloud Computing” by Chauhan and Saxena [4], which focused on energy-efficient development of software for cloud computing.

The current main focus of sustainable HCI is on shaping the individual’s choice to reduce consumption, based on a negative motivation towards it and consumers’ guilt regarding consumption [3, 10, 13, 14, 22]. Another issue is that sustainable HCI seems to be designed for people with enough resources to care about sustainability [3] thereby excluding people with fewer resources. An interesting approach is a gamification-based design that uses more positive motivational forces in a gamification context, making things fun and increasing user-involvement, e.g. when users can compete or collaborate towards a defined sustainable goal [21]. An effective and improved way to design the sustainable system could be with the help of different stakeholders, e.g. user-involvement [26] that could promote a positive motivation to reach sustainable goals in system design—it is also a solution to Huber and Hilty’s [21] fourth requirement for a gamification-based approach to sustainable consumption: “Enabling Collective Action”. The importance of a broad user-involvement is also elaborated in the proposed design principles for persuasive system design for sustainability, namely principle two: “Diversify the design by including more users and then focus as group,” developed by Mustaqim and Nyström [27]. One way could be to introduce social facilitation by connecting users with peers, [39] something that now can be seen in gamification when users compete to reach a goal that for example could be within the domains of sustainable environment, health, and well-being. To design a sustainable system could perhaps remedy the recognized need of sustainable practices [17] that could fit multiple levels of practices, e.g. community, family, and individual, and further consider multidimensionality, i.e. the QBL.

A fundamental rethinking needs to be done if information systems that benefit sustainability are to be developed. A more holistic view on sustainable HCI could be taken if the focus would not be limited on material and energy; one should focus on the whole SDLCs of a system. It is thus with a change in the mindset of the designers and the process of designing a system that a large and lasting impact towards a sustainable system could be done. The developed IT system should, as the authors previously explored,

unite user inclusion, increase the user satisfaction, and give improved usability [26].

By making a quick literature review we thus would find a theoretical foundation and further would be able to discover what was and was not researched—a so-called “research gap” [41]. This paper answers the call for research that is not redundant [8]. After a systematic search (2014-04-23) in the Web of Science (WoS) and Scopus, the search resulted in quite a few hits (Table 1) but after reading abstracts only 12 articles had values for our research. No paper has addressed what the authors thought to be the core issue, namely how to develop sustainable systems with the guidance of HCI design principles, thus constituting a research gap. Although we found three articles, two by Huang [19, 20] and one by Shenoy and Eeratta [34] that touched upon upgrading SDLC with consideration for sustainability, in addition we found the idea compelling although the models did not acknowledge the complexity of sustainability (see last paragraph in section 2.2, on SDLC).

Table 1: Result from keyword search.

		HCI	Human Computer Interaction	SDLC	System Development Life Cycle
Scopus	Sustainable	121	242	6	4
	Sustainability	101	169	2	1
WoS	Sustainable	36	70	4	2
	Sustainability	29	39	3	1

2.2. System Development Life Cycle

SDLC is a development methodology with origins from the 1970s. One of the pioneers in system development, Winston W. Royce, depicted the classical waterfall model in “Managing the Development of Large Software Systems” in 1970 [33]. SDLC was characterized by its identification of stages/phases in the process of building computer-based software, that this approach would improve the management of system development [1]. Royce’s waterfall model consisted of seven stages: Systems requirements, Software requirements, Analysis, Program design, Coding, Testing, and Operation. The SDLC method was based on the assumption that “there is a well-defined process by which an application is conceived, developed, and implemented” [6].

Enhancements of SDLC approach were advocated in the form of user-involvement [5]. The development stages must be followed in a sequential order, often consisting of: feasibility study, systems investigation, analysis, design, development, implementation, and maintenance [1]. A set of deliverables or outputs would be required to be produced before the next stage could begin and if problems would arise, an iteration around the stages could also be commenced [1].

The design process could in the simplest way be described by three activities: identification of a need, development of a solution, and the implementation of the solution [5]. In this paper these three stages were considered to be equivalent with definition, development, and operation as shown in Figure 3. The desired functionality and performance of some components were specified in the requirements specification and facilitate understanding [32]. An important question in the requirement could be in line with DiSalvo, Sengers, and Brynjarsdóttir’s emerging issues in sustain-

able HCI: “Whose needs are met, and whose values matter?” [9]. A modified version of SDLC by Huang, named “Sustainable System Development Life Cycle” acknowledges the need for modification and included environmental considerations in all stages and adds a disposal of IT equipment as the last stage [19, 20]. Shenoy and Eeratta’s [34] model, “The Green Software Development Life Cycle Model”, was also similar, for which the authors considered environmental factors into the SDLC’s stages. These modified SDLCs were all in all an enhancement towards one side of sustainability, i.e. the environment [19, 20, 34] but did not acknowledge the complexity of sustainability and the multi-dimensionality of analysis (given by TBL or QBL) that would be necessarily considered.

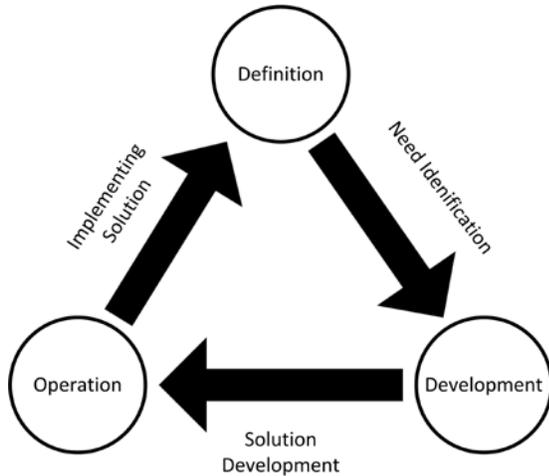


Figure 3. Activities in the System Development Life Cycle.

3. HCI and Sustainable Information System Development

Social challenges like sustainability could be addressed in an inspiring way if the higher potentiality of interaction between information system, HCI, and its long-term influences on the human condition could be understood and practiced. However the question in this issue could be, ‘What is the meaning of sustainability in the context and how would we even know whether a system that is going to be designed and developed would be sustainable or not?’ Sustainability is a complex social challenge which involves ethical issues and could have impact affecting many generations. We believe that choosing the right process would not be the only thing to consider about achieving a sustainable solution in design and development. Instead the factors that affect a process and the different steps of the process too should be given priority. For example, for furthering the sustainability concern the HCI community took the approach of SID, where the goal was achieving sustainability focusing the relationship of sustainability in design procedure and steps. HCI still took the approach of creating interfaces or devices to increase sustainability concern for end users in which sustainability was strictly limited within the scope of ‘green features’ [8, 16, 30, 35]. This strategy has been criticized lately as being ‘dogmatic’ [30] and lacking established benefits [8, 30]. Moreover, issues like the Jevons Paradox, when people end up using more resources [30], left questions on creating technologies, focusing only on the ecological part of sustainability [29, 37]. Altogether the limitation of changing users’ behavior on decision-making regarding ecological consumption would be that it could be socially structured [30] and the outcome of such practice in research would likely have limited uses [24, 25, 30]. We also have

‘collapse informatics’ that is concerned with the potential effects and role of IS systems in handling changes that humans must adapt in order to last in their environments (the dynamic mix of economic, social, political, and ecological forces) [38]. It would be beneficial for mankind if we could understand how to design systems that enable social well-being in critical times of collapse [36, 38]; consequently SID is crucial.

Although HCI communities seriously considered the issue of sustainability as an urgent need in their research since 2007 and wanted to express the issue with other closely related fields of research, the focus strictly remained within the behavioral change of the consumer towards ecological sustainability. It is thus worth using HCI for creating values on information system research to define what sustainability could really mean in SDLCs. That is, taking a point of view from the perspective of HCI design principles, system development procedure could result in a sustainable designed system in which the sustainability notion would not be limited to the scope of ecology only. We used this concept to form a framework for SSDLC presented in the next section.

4. Proposed Framework

An inclusion of users in the design process is a way of moving forward in sustainable HCI research [3]. As mentioned earlier, the previous research from Mustaquim and Nyström [26] showed how design principles for sustainable system design could be generated from HCI design principles. We took those derived design principles and showed how they could fit into the classical SDLC. The theoretical framework divided into three sections was illustrated in Figure 4. From the bottom part of the framework we could see how to follow the classical SDLC. The middle part of the framework showed how each phases of the SDLC were grouped into three phases: definition, development and operation, and what the different goals were in these phases. Finally, the top section of the framework showed how each individual design principle for sustainable system design could fit into the three different phases and thereby fit into the different stages of SDLC. The three phases with corresponding design principles and stages from SDLC were then described.

Definition:

The analysis phase of the SDLC is within the definition group together with design phase. The design principles associated with them were balancing requirements of the future together with simplicity and flexibility. We believe that, narrowing down the requirements for the future could be an important practice for a design process aiming for sustainability. Sometimes need and requirement could come into the picture, even though practically they would not be needed or may not be usable or useful for the end users. A balance between actual and perceived need would make the analysis phase easier to move into the design phase. Too many requirements could initiate multiple new problems and the process could iterate over time. By balancing the requirements’ finding, selecting the appropriate target would be easier. Again the target here could mean the real need and use of a system to be designed. The analysis phase could be broken down into different parts depending on the system that would be designed. Individual economic, environmental, and social analysis could be made for balancing the requirements. Simplicity and flexibility in design would give a system to be designed different benefits after properly identifying the right target. With simplicity property in design, a system to be developed would provide improved usability, which in turn could leave positive impacts on balancing the requirements for the future.

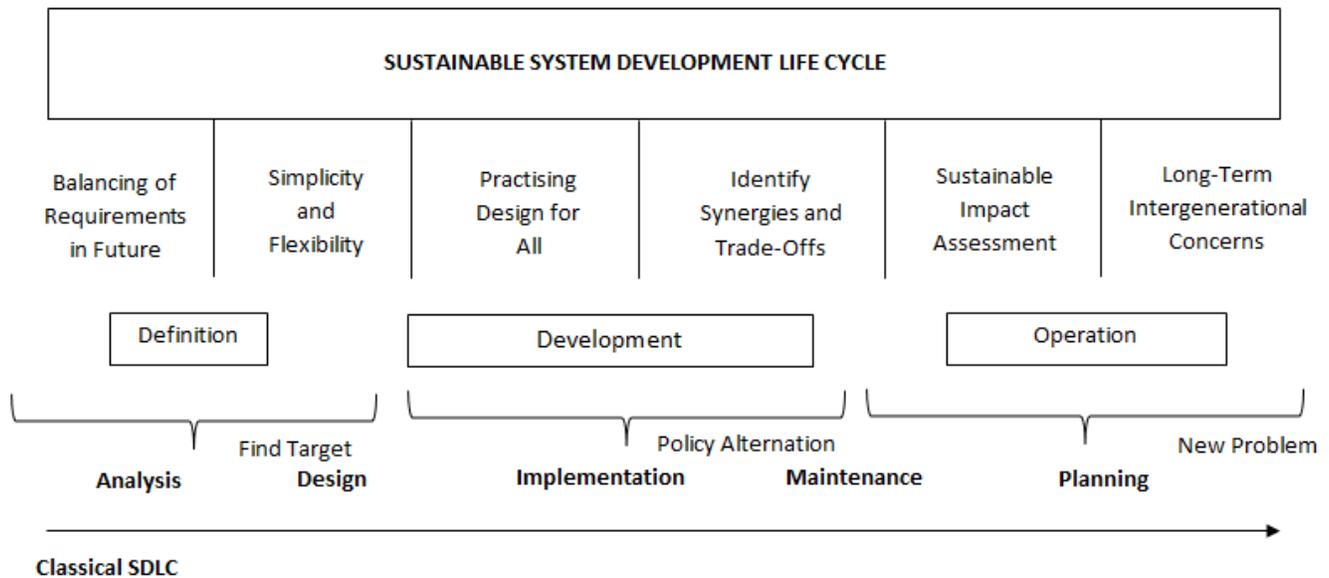


Figure 4. A Framework for Sustainable System Development Life Cycle.

Development:

The development phase consists of implementation and maintenance, in which the associated design principles were practicing design for all and identifying synergies and trade-offs. Traditionally, development phase would seem to be a relatively easy phase in the life cycle, but concerning sustainability this becomes an important and critical one. Design of program, coding, and testing would be involved in this process of implementation and maintenance. On the other hand, after the requirements were fetched and targets were found, a wide variety of possible users should be on focused on during implementation. Target identification is a difficult process. Many systems that were designed for achieving a specific target would tend to fail in usability performance, whereas a system not meant to be designed for a target group would show higher usability. Such an uncertain behavior of system could be controlled while the ‘design for all’ metaphor would be considered following the HCI design principles. In HCI the design for all is usually used to categorize design for people with special needs. However this concept could be extended beyond the scope of accessibility and universal design could be thought out of the box of disability issues only. In brief, using the concept of design for all for which the target group of users have nothing to do with physical limitations, could result with additional values put into design. The notion of universality could thus be thought as a parameter for including possible thoughts that would otherwise be ignored if the phenomenon of ‘universal’ or ‘universality’ would not be used. When such an inclination would be used in a design, the possibility would be that the policy might need to be altered according to the situation and need in a design phase. Eventually, considering universal design approach could probably refer to changing of policy, which would have positive impacts towards balancing the requirements in the future. Besides, the development phase includes identifying different synergies and trade-offs. Regardless of policy alternation initiation synergies could still exist. Some of the analysis methods used in the requirement analysis phase could further be repeated here for identifying different synergies. For instance, if the risk assessment were done with a static risk threshold, the degrees of risk that were reduced could be identified. A utility analysis could present the impacts in a rated and weighted form on a scale, whereas a comparative value analysis could

present the impacts based on the pre-set values. Cost-benefit analysis in design phase could find and compare any positive or negative impacts that were associated with monetary values. Combination of both qualitative and quantitative impact measurements could be another way to find trade-offs. In short, different analyses could be re-run in design and evaluation phases to add values in the process of decision-making for altering policies.

Operation:

The operation phase consists of maintenance and planning from SDLC and the associated design principles were sustainability impact assessment and long-term intergenerational concerns. These phases were concerned with maintaining the system for which it was designed and thereby planning for future development by identifying new problems to contribute to the requirement phase. In these phases it would be required to assess the sustainability impact. There could be many different aspects for which sustainability assessment could be performed. However, some factors like involvement of stakeholders, involvement of appropriate agencies to carry out assessment, communication of assessment results, legal status of assessment recommendation, and level of seriousness of measuring sustainability, etc. should be considered as important procedural aspects. By doing too much analysis, the risk is that the whole procedure might be affected by too much information and it then could be suffering from too much assessment embedded into the system, losing the purpose of assessment. Identification of any long-term intergenerational concern would be very important because design for sustainability would not be a matter of instantaneous action. Rather the process would go on over time. Some of the methods, like capital indicators, trend lines identification, burden-shifting, irreversibility, and cost of inaction calculation could be useful for identification of any long-term concerns in the SDLC. By presenting the findings from such assessment to the stakeholders, appropriate future targets could be identified.

The three phases described above with their corresponding stages from the SDLC and sustainable system design principles could work together in a loop and in simpler terms could be called another life cycle. The proposed framework differed from the classical SDLC in a way that this framework would trigger an aim of

sustainability so as to be a goal for the system to be designed. Again the framework is complex as it encapsulates a lot of different measurement approaches and design principles into one place. In contrast, it would be possible to practice the framework together with design principles and in the end the designed system's sustainability could be assessed.

5. Discussions

The proposed framework opened few new ways of looking into the interdisciplinary nature of research in HCI and information system. Firstly, while it is an advantage to understand what tasks to perform in which phases of a life cycle of sustainable system development, the whole procedure would not be an easy task to perform. It could be a big challenge to give equal attention on three different sustainability spheres. The framework could not tell us what kind of sustainability would be achieved if we would follow it in a system development process. If we undertake that 'sustainability in general' would be achieved, then the challenge addressed here would be very important, which could take us back to our initial question that was raised in Section 3: What does sustainability actually mean and in which context? Concerning ecology, the sustainability goal would be to protect the natural environment and ignore everything that was human-built [16]. That is, the importance of understanding the concept of 'the environment' was a key issue for the initiation of sustainability research in HCI. For proposing this framework we took similar approaches of considering environment out of its conventional understanding. If we would consider the whole system development procedure to be our 'environment' then the focus of our proposed framework would become wider-ranging than it actually looks like. So instead of trying to protect an ecological environment directly, with this framework we would be trying to protect our conceptualized environment. By doing this successfully we could achieve the goal of sustainability as an artifact from the system, which would leave positive impacts on our real surrounding environments over time. In short, adequate attention should be given to the three different spheres of sustainability during an assessment for long-term benefits. This would be equally important for reducing the conflict between three spheres of sustainability in TBL or the three motivational needs and economic concerns in QBL and thus should create a strong basis for the decision-makers of system design.

Secondly, we in this framework used sustainable system design principles and SDLC, in which the design principles were generated from the universal design principles of HCI. Use of these design principles in our framework and mapping them with different phases of SDLC showed that the possibility of expanding the concept of universal design could in addition be promising in the system development field. The support for a new way of looking into universal design concept beyond the design for people with physical limitations only was strengthened here.

Finally, the concept behind this paper's framework showed how to look into the notion of sustainable HCI differently. The traditional concept of embedding ecological information through system design, visualization of resource consumption, and persuasive applications [16] to be the only agendas of sustainable HCI might thus not be true. It was argued and shown in this paper that existing HCI design principles could add values in other fields of research and a combinatorial approach could then lead towards achieving the goal of sustainability, depending on the context and purpose. Sustainable HCI notion could in particular be thought and re-conceptualized as an appropriate use of HCI design princi-

ples with other fields of research for designing the sustainable system. The research question presented in the first section could therefore be answered here now. It would be possible to use the classical SDLC with sustainable system design principles for designing the sustainable system with a positive role from HCI design principles and thus the notion of sustainable HCI could be expanded from its traditional understanding. Again going back to the question raised by DiSalvo, Sengers, and Brynjarsdóttir's emerging issues of sustainability [9] that was addressed before, the answer could be given here by stating that the need that could be met by making a system sustainable would be for the identified proper target and the values that were created for doing so would be what matter most.

6. Future Work

Few new research ideas were initiated from the research work of this paper. The proposed framework is promising for empirical verification. It would be worth assessing a real-life SDLC aiming for sustainable system development both with and without following the proposed framework. Sustainability achievement level could then be quantified and compared, to see the differences between two different designed systems. As has been said, further research could focus on finding general steps of sustainability assessment using this development life cycle, since different assessment methods might be ideal for different system types. For contribution in HCI, this research could initiate the idea of considering sustainability to be incorporated into a standard HCI design practice, i.e. how system development phases could be integrated into HCI to improve its own design principles and methods, which would be promising to explore. Assessment of a design from the sustainability perspective could be another interesting research idea, in which a life cycle could be reverse engineered for finding the flaws in a development procedure and thereby it could be modified to increase sustainability effects.

7. Conclusion

In this paper, an SDLC titled as SSDLC was proposed, which would aim to generate systems with higher sustainability to be the end goals. Sustainable system design principles were taken into account, which was previously derived from HCI design principles. An analysis with the classical SDLC resulted in the proposed SSDLC. The proposed SDLC could contribute to the research of sustainable HCI, in which a more holistic view has been demanded lately to expand the research scope. The unsustainable nature of the factor of 'sustainability' itself is a threat for sustainable HCI research and therefore more large-scale design thinking is necessary instead of the traditional thoughts of sustainability, limited only within the scope of interaction design or persuasion. The proposed framework could open similar opportunities to think outside the box of traditional HCI research for sustainability and could therefore contribute to product or system design for regular users, reflecting the research role of sustainability into daily life, since the interdisciplinary nature of HCI is becoming rapidly visible with the ever fast expansion of this applied field of research. Sustainable HCI has relatively been a new concept in recent years, with encouraging opportunities to contribute as a multidisciplinary field of research itself within HCI. The concept of sustainable HCI could be given a new shape and step ahead through the work of this paper, in which HCI design principles were shown as influencing on the research field of information system. This was done by showing how classical SDLC could work together with previously derived design principles from HCI for resulting in sustainable system development.

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