Human-Centred design approaches as an attempt to reduce project failures

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ABSTRACT

Over the years, researchers have sought to better understand why IT projects fail and consequently develop techniques to prevent these project failures. One of such techniques is the use of improved project management methodologies. Through a literature review, this paper explores human-centred approaches as a means of reducing project failures. The paper looks at six approaches of human-centred design and outlines their evolution in the software engineering landscape. Conclusions drawn from the literature review highlight the importance for one to understand the design process and select an appropriate methodology to adopt, and the significance of effective communication and engagement strategies in human-centred design. Finally, the paper draws from literature to provide a recommendation of a suitable methodology to follow when designing a data management system for and with users from a culinary school.

Keywords

Human-centred design; user-centred design; design methodology; ICT4D

1. INTRODUCTION

Software engineering projects frequently fail. With 15% of projects deemed failures and only 62% meeting requirements as of 2016, researchers in software engineering seek to understand reasons for project failures to improve the outcome of these projects [3]. Heeks [7] attempts to uncover this and suggests that a significant plague to the success of Information Technology (IT) projects is the design versus reality gap, whereby there is a mismatch between the requirements made by researchers and/or designers during the design phase and the realities of the people being designed for. This problem is particularly critical in Information and Communications Technology for Development (ICT4D) initiatives, where the focus is on humans and developing products and services that improve their lives. This need to understand project failures has resulted in a shift in the software engineering landscape to improving project management tools and methods. Thus, the need for researchers to understand software development methodologies. Human-Centred Design (HCD), which can be broadly defined as the set of design processes in which potential users influence design [1], has been identified as a means to reduce the gap between design and reality. In this paper, the terms user-centred design and inclusive design will be used interchangeably to refer to human-centred design, although there are slight nuances in the definitions of these terms.

This paper provides a review of literature on the topic of design methodologies and seeks to select an appropriate methodology to be applied in CHEFREG, an ICT4D project. The project will involve designing a mobile and web application for Infinity Culinary Training, a local culinary school, while working with members of the organisation to better understand their needs. The purpose of this paper is to explore human-centred design methods in an effort to recommend a project management methodology for the CHEFREG project so as to minimise the gap between the products designed and realities of the users and consequently lead to the success of the project.

This paper is structured as follows: the next section describes human-centred design, its evolution in the design space as well as its advantages and disadvantages in comparison to traditional design methods. In Section 3 we provide literature on common HCD practices. We then review case studies of projects which illustrate application of HCD methods in Section 4, discuss the implications of the literature on the CHEFREG project in Section 5 and conclude in Section 6.

2. HUMAN-CENTRED DESIGN (HCD)

In the continuously evolving design space, three major developments can be identified as significant movements in design. These are technology driven design, human centred design and environmentally sustainable design [6]. The primary goal of technology-driven design approaches is to promote the technology in design activities [4] while environmentally sustainable design is guided by the principles of environmental sustainability [10]. Both approaches encourage reactive and not proactive user involvement. Human-centred design, on the other hand, is rooted in active user participation. The remainder of this section gives insight into the principles of human-centred design, its key benefits and drawbacks.

2.1 What is HCD?

In HCD researchers and developers work together with potential

users of the products or services they are developing [22]. HCD aims to collaborate with the end-users and involve them in the design process in order to develop products or services that meet their needs and requirements [22]. While many definitions of HCD are congruent, Krippendorff [12] extends these definitions with his perspective that human centeredness considers the close association between behaviour and understanding, and maintains that there is an inseparable link between design artefacts and how their users perceive and engage with them in their lives. In addition, Krippendorff suggests that people do not respond to physical objects but rather to what the objects mean to them. The implication of Krippendorff's view is that human-centred approaches must be concerned with understanding the motivation behind people's interaction with artefacts and their experiences, rather than the product itself. HCD methods conform to four key principles namely the active participation of users in design, iterative design solutions, multi-disciplinary design teams and an appropriate distribution between user and system tasks [23].

2.2 Benefits and challenges of HCD

Various studies show that effective user involvement in a system design yields the following benefits: capturing more accurate user requirements and consequently improved overall quality of the system; better understanding of the system by the user; improved quality of the system and improved user acceptance [13].

While the benefits of HCD approaches have been demonstrated, Norman [18] argues that HCD can be harmful. Norman raises two major concerns about the principles of HCD: first, too much focus on humans might detract from the design activities and second, placing too much focus on the users' needs can result in a system with increased complexity and a lack of cohesion. Heylighen et.al. [8] challenge the popular notion that inclusive design automatically translates to good design. The authors argue that including end-users in the design process is not guaranteed to lead to good design because good design is not defined by a design that is appreciated by both the designers and the users but rather one that makes full use of the information provided to the designer.

3. HCD APPROACHES

The significant types of HCD practices have been identified to be participatory design, applied ethnography, the lead user approach, contextual design, empathic design and co-design. While these methods share the common attribute of involving the user in the design phase, there are slight characteristics which set them apart as distinct practices. [24, 22]. These are differences mainly in the degree of use involvement, research and design activities, and the attitudes of end-users. The remainder of this section discusses all HCD methods in detail.

3.1 Applied ethnography

Ethnography can be defined as the study of people in their own environments. In applied ethnography, researchers document cultural similarities and differences through fieldwork to understand the cultural system of users [26]. The main goal of applied ethnography is to capture the end-users' perspectives to better understand their needs. In ethnographic studies, primary data collection is done mainly through fieldwork however there are other methods such as secondary data analysis, observations, participating in activities, physical mapping of the social setting, and ethnographic interviews, which can range from informal to structured interviews [26].

A key benefit of the ethnographic method is that researchers are personally immersed in the activities of targeted end-users and this enables them to capture users' needs that might not be directly expressed. A drawback of this approach is the seemingly inherent bias resulting from the presence of researchers, which might change the culture and how users behave, and the fact that they can bring their experiences into the study.

3.2 Lead user approach

The lead user approach identifies lead users as innovative people who are inspired to create new solutions when existing products do not fulfil their needs, and encourages these users to assist researchers and developers in a joint design [22]. Lead users can be differentiated from ordinary users by their capability and motivation for innovation, as lead users are ahead of the market and benefit from creating solutions to their needs. This approach is mainly used by organisations developing commercial and business products and its method involves firstly identifying important trends and customer needs, then identifying lead users, and finally working with lead users to develop products [15]. Engagement with users is mainly done through lead user workshops.

The biggest advantage of the lead user approach is that researchers work with a group of users who can anticipate the needs of ordinary users to develop concepts that fulfil users' needs. On the other side this can also present a drawback if the identified lead users' needs are not representative of ordinary users' needs.

3.3 Empathic design

The empathic design approach is deeply rooted in empathy. In this method, researchers attempt to understand and share the end-users' experiences [22]. Implementation of this approach often involves a five-step process led by observations; followed by data capturing; then reflection and analysis; brainstorming; and finally developing prototypes [14]. Common empathic design techniques include observing users and role-playing activities. One key benefit of empathic design is that through observation, unarticulated user needs can be discovered.

3.4 Participatory design

Participatory design can be defined as a design approach in which the targeted end-users contribute significantly in the design process. In participatory design, potential users are viewed as experts of their experiences, with their knowledge being brought into the design process. The goal is to let users, researchers and designers work together to create a tool that will enable the user to do his or her work better [23]. Participatory design began in a political context as part of the Scandinavian workplace democracy movement [17] thus, many participatory design projects remain grounded in the value of democracy and they attempt to promote this principle to develop better products. Participatory design techniques include interviews, questionnaires, mock-ups, simulations, future workshops, prototyping and scenarios [19].

3.5 Contextual design

Contextual design is a design methodology that fosters participatory design through working with users to help them articulate their current work practices [17]. Contextual design gathers data through observing and interacting with end users while they work to gain a deep understanding of current practices and bring that understanding into the design process [2] to design a system that supports users' work. The method applies principles of contextual enquiry, where users engage in dialogue with

researchers and designers as they perform normal activities. Contextual design techniques include paper prototypes, metaphors and future workshop [9]. An advantage of contextual design is that it helps people express their work experiences.

3.6 Co-design

Co-design developed out of user-centred design as an instance of co-creation where designers work together with non-designers in the design process. Co-design is a community-centred methodology used by designers to enable people who will be served by a design outcome to actively participate in designing solutions to their problems [5]. This definition implies that rather than simply providing input, users are directly involved in designing solutions tailored to their needs. The primary objective of co-design is to enable all participants to jointly contribute their skills and knowledge to create products that meet the needs of end users involved in the process [25].

Research on co-design raises questions about and challenges the changing roles of players in the design process, i.e. users, researchers and designers. This shift in the description of roles is best described by [21] and is depicted in Figure 1. This image illustrates that classical design promotes designated and disjoint roles whereas co-design promotes collaboration and roles can overlap.

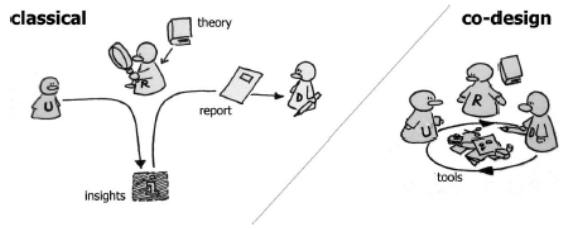

Figure 1. Roles of users, researchers and designers in classical design vs co-design [21].

Sanders and Stappers suggest users can sometimes assume the roles of designers throughout the process, depending on their levels of expertise and creativity. The authors propose a division of creativity levels – doing, adapting, making and creating - and urge researchers and designers to invite users with a high level of passion and knowledge to become co-designers. In co-design, researchers do not simply play the role of being a translator. Instead, they are facilitators who are responsible for bringing

people into the design process and finding appropriate ways to engage with potential users in a manner that is most conducive to their ability to participate [21, 16]. The changing role of the user in co-design raises concerns about whether there still exists a role for professional designers in the future if users can create tangible products. [21] provides assurance that the role of the designer will not be diminished in the future because designers provide expert knowledge other stakeholders do not have.

4. APPLICATION OF HCD

This section illustrates application of human-centred design techniques in ICT4D projects. These projects are like the one involving Infinity Culinary Training in the sense that they all use technology to solve a problem. The section reviews, firstly, Common Sense Net for DSS, a project aimed at developing a wireless sensor network (WSN) based decision support system (DSS) for farmers in India, the problems encountered and the benefits of a revised approached incorporating HCD techniques [11]. Then we look at a project aimed at developing telecom applications for police officers and finally, one investigating robotic toys for children with special needs.

Common Sense Net for DSS is a project whose goal was to improve the livelihood of farmers through ICT. Researchers involved in the project did extensive research on the current situation and possible technologies to be implemented but put minimal focus on user needs and user participation in the design process. This resulted in the design of a product that did not address targeted users' needs and one in which users were not interested. The initial methodology followed highlights the problems associated with a technology-centred approach and the need for a technique with sufficient user participation. Thus, a revised HCD approach was implemented in the follow up project. The techniques used included field trips, interviews and participatory design activities such as creating personas, usage scenarios and storyboards. The preliminary result from this iterative HCD approach was actively involved target users [11].

Another project which illustrates HCD techniques is one in which researchers and designers collaborated with police officers to develop a telecom application that improves communication and cooperation. The project used concepts from participatory design, co-design, ethnography and empathic design through inviting the police officers to share their experiences and contribute to finding solutions, and the researchers empathising with them. Through various workshops, with a prototype produced after each one, the researchers and designers attempted to understand the needs of the police officers and design an application that meets these needs [22]. The major fault of this project was not involving the users in the final decision-making process, with the researchers deciding on the focus of the project based on their interpretation of the users and their experiences. An important lesson from this project is to pay attention to issues raised by users in informal communication to better understand what is important to them. Overall, the project serves as an example that shows how HCD practitioners decide when and how users contribute to the design process and in so doing, practitioners often prioritise their ideas over those of the users.

Another project which illustrates HCD approaches is IROMEC. The IROMEC project investigated how robotic toys can aid children's development, particularly children with physical disabilities. The project involved the children and their carers throughout the development process mainly through scenario-based activities with different levels of social mediation. The results of this project were two applications involving human-robot interaction, which were designed with input from a panel of experts [20]. This project illustrates the significance of designing for the targeted user and tailoring design activities to suit the user, as opposed to blindly following a strict methodology. Finally, the project highlights the need to cater for and involve various user groups in the design process.

5. DISCUSSION

The HCD approaches explored in this paper can be applied to the CHEFREG project involving a chef school. The recommendation is to follow a methodology that combined agile software development with human-centred design principles and techniques. Techniques which will be used in the data gathering process include focus groups with the staff, contextual enquiry of the staff, observation of students and participation in class activities. In initial engagement with the culinary school, we could identify a possible lead user who will play an active role in the design process and evaluating prototypes. The next step for the project is then to exploit various HCD techniques to engage with the users and encourage their participation in the design process to better understand their needs and design a system that addresses these.

6. CONCLUSIONS

This paper has reviewed literature in human-centred design and its various approaches. Of the six HCD approaches, namely participatory design, ethnography, the lead user approach, contextual design, empathic design and co-design, the literature presented in this paper identifies participatory design, contextual design and co-design as most applicable methodologies to be adopted in the project with the chef school. It is evident in this paper that the distinction between these approaches often overlap, with co-design adopting principles from participatory design and ethnography and participatory design implementing methods of contextual enquiry and empathic design in primary data capture. Conclusions drawn from this literature review are as follows: firstly, human-centred design is superior to traditional technology-centred design, leads to products or services that capture and respond to the end users' requirements, and reduces the design vs reality gap; secondly, human-centred design approaches are not often separate and therefore it is common for researchers to combine methods from different approaches in projects; and finally, communication is inherently significant in human-centred design approaches and as such it is important for researchers to select appropriate methods of engaging the users to encourage their participation and capture their knowledge and skills.

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