

Contextualizing User Centered Design with Agile Methods in Ethiopia

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Abstract—User centered design (UCD) provides principles and activities for improving usability. However, traditional UCD methods lack considering the context of users in low income, culturally diverse settings and where Information and Communication Technology (ICT) development is at its infant stage. Software development in low and medium income countries like Ethiopia is characterized by big difference in education and livelihood. Heterogeneous cultures both between different ethnic groups and between rural and urban contexts is another challenge for Ethiopian software development. The paper addresses how to adapt UCD methods and agile development to bridge these heterogeneities. To this end, a multi-case study was implemented, researching two projects in an Ethiopian software company. An action research approach has been complemented by a survey and interviews with other companies. It has resulted in contextualization of UCD practices: personas mediated between rural and urban users and developers. Personas helped also customer representatives as well as product owners to understand users and their requirements and allowed to test releases against persona requirements before deployment. Personas were updated throughout the project based on usability testing and experience from early deployment. Besides personas local IT personnel mediated between the rural users and software developers. Pairwise usability testing is an example for cultural adaptation for discount usability evaluation method that has been tried out. Releasing early version to support personnel and members of the company who are closer to the intended users helped to provide a more adapted version from the start.

Keywords—User Centered Design (UCD); Scrum; Discount usability; Personas; Local IT personnel; Culture; Usability testing; Workshops

I. INTRODUCTION

Software development in low and medium income countries is characterized by big difference in education and livelihood. Lack of experience and trained manpower and lack of project management skills also characterize the software development situation in Ethiopia for example [1]. Heterogeneity of cultures, both between different ethnic groups and between rural and urban contexts, makes software design and development difficult.

Developing for the rural user puts more responsibilities on the software engineers and other stakeholders. Building mobile applications for the rural users is also a challenge with respect to infrastructures. Besides cultural differences between the rural user and urban developers, different languages need to be supported by some mediations or agents.

In Ethiopia, lack of awareness on usability, lack of skills and lack of usability professionals has been reported in a survey [2]. Therefore, there is a need to find possible solutions for integrating usability and user centered design (UCD) to the development processes in terms of tools and practices that could be performed by practitioners with only basic knowledge of usability. Software developers need to be supported to understand users and their requirements. Developers indeed require a means to support them to clearly understand user needs [3], long chain of user representations and the different personnel talking about users differently were among the challenges mentioned at the usability workshops in the case organization.

While UCD provide important principles and methods making end-users as center of the design process, traditional UCD methods are not appropriated to the context of low income and culturally diverse settings with complex usability challenges.

Scrum as agile method is flexible and iterative software development method. However, the customer representative may not represent real end users and may not clearly know user requirements.

The paper addresses the question “How to adapt UCD methods, usability testing and agile development to bridge these heterogeneities?” The article is organized as follows: section II discusses related work, section III presents the research method, section IV presents research results and section V discusses and concludes the research.

II. RELATED WORK

A. User Centered Design

‘User-centered design’ (UCD) is both a philosophy and variety of methods for design processes in which end-users influence how a design takes shape. UCD provides principles and activities for improving usability and usable product development.

The international standards for ergonomics of human system interaction and human centered design for interactive systems [4] standardized UCD and defined it in terms of six principles and four activities. The four cyclic activities are depicted in the figure 1. Among the six principles is ‘users are involved throughout design and development’. It is an important principle, however the how part on the methods need appropriation of tools and techniques for the users who are in different contextual

situations than the context from which the existing UCD methods originated.

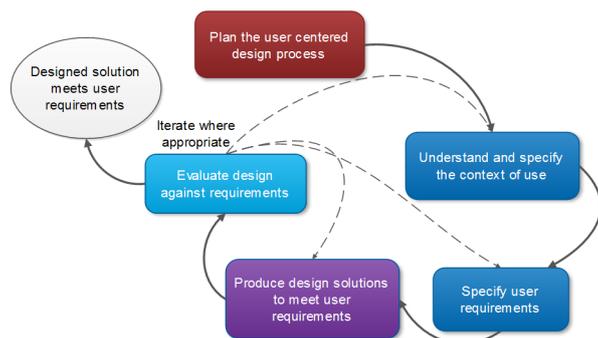


Fig. 1. The iterative user-centric design process

While UCD process and its principles are well accepted and useful in designing interactive systems, UCD methods do not explicitly consider the context of users in low-income and culturally diverse settings and where Information and Communication Technology (ICT) development is at its infant stage [5]. Ethiopia is of no exception. Design needs to consider geographic, environmental, economic and socio-cultural challenges that can affect physical access to Information and Communication Technologies (ICT). For example, basic infrastructure, such as electricity, telecommunications networks, and internet services have to be accounted for. Likewise heterogeneity in culture and socio-economic situation needs to be accounted for.

The publicly available methods need to be appropriated and adapted to the context and the environment. For example abstract and low-fidelity prototypes that are promoted at UCD design are problematic for less IT skilled users and, furthermore, software engineers lack experience working with it. Likewise, usability heuristics developed by Nielsen [6; p. 27] are developed based on the experience and context with respect to the western world. This is confirmed by other articles [7]. In a previous article [2], we argue that usability evaluation is difficult because of lack of ICT expertise by intended users.

UCD has been integrated with agile methods since both have some important common principles. They, however, also differ in their philosophical underpinnings and how they addressing quality. Next subsection introduces agile methods.

B. Agile methods

Agile development practices have been widely accepted and adopted in the software industry because of their flexibility and frequent delivery. Agile methods define how the development should be carried out under agile values and principles [8], to address challenges like requirements change. The frequent deliveries can support use orientation as they allows for early feedback by customers and users. Many agile methods do not explicitly distinguish between customers and actual users, and customers may not understand the need of end users [9, 10]. Close collaboration with customers and prototyping open up space for combining agile development with UCD techniques for improving usability. Agile methods lack considering UCD inherently, however, they share some of the same aims as usability and UCD [11, 12].

Scrum is one of the agile methods oriented towards project management. Schwaber, one of the founder of Scrum discusses that: “Scrum is not a prescriptive process. It doesn’t describe what to do in every circumstance. Scrum simply offers a framework and set of practices that keep everything visible” [13]. Scrum has been a development method adapted by the case company since the year 2014. It includes the fast delivery of early versions that can serve as working prototypes. The team applies unit and integration testing. The employees in the support department implement user acceptance tests, and, based on the result, the product is either deployed or differed for the next iteration for improvement and additional features. The Scrum roles include the development team, Scrum master (SM) and the product owner (PO). The PO is assigned by the management and the SM based on her/his domain knowledge to the projects. The Scrum ceremonies include: product planning meeting, standup meeting, sprint review meeting and sprint retrospectives. Further details of the in-house Scrum practice can be found [3]. Figure 2 shows the in-house Scrum process in the case company.

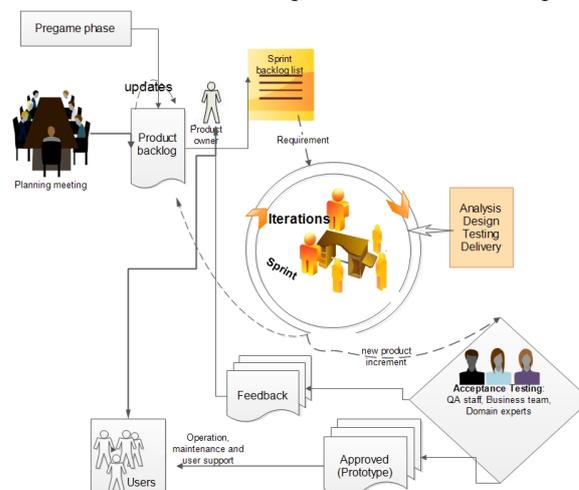


Fig. 2. The Scrum process in the case organization

There are several authors that discuss the need of flexible ways of addressing user needs to exist in a competitive market. A systematic literature study on the success of user involvement and participation indicates that the participation of users has demonstrable advantages [14]. The case study by Hansson et al. [15] shows that flexible development practices can successfully facilitate active user involvement. A combination of UCD techniques and agile approaches is possible as has been reported by [16].

Based on research of a Scrum project, Singh [17] stated that the involvement of the customer required in agile projects has been overloaded with too many responsibilities and oriented towards the technical development. He proposed that having two product owners can help the situation: the conventional product owner and an extra product owner focusing on usability and user experience. The experience report shows that having extra product owner improved usability compared with the traditional Scrum project.

Doerflinger and Dearden [18] proposed for ICT development in developing countries, a close collaboration and cooperation between project stakeholders involving multiple parties. The agile approach they proposed combines evolutionary and iterative development and the reflective action research of the researchers that generates input and feedback for the design.

Due to the light-weight nature and their simplicity, discount usability engineering has been a subject for integration with agile methods for enhanced usability [11, 12]. However, these discount methods are based on the experience from the developed countries context [7].

C. Personas

Programmers work hard to make their software easy to use, however in many cases their frame of reference is themselves and as a result, they make it easy for other software engineers like them but not the ordinary users [19]. Cooper [19] argues that programmers have too much influence over the design of the human interface and, due to a lack of skills in this area, they do a poor job of it. Pruitt and Grudin [20] argue that a good design does not come from users, but from designers. This is because users do not really know what they want until they get it. Personas is a useful technique to keep the developers focused on the users and avoid self-substitution.

Personas is one of the tools used in UCD and has been used to improve the usability in the agile development [21]. In their literature review on usage of personas in agile development Caballero *et al*, identified that the exploratory and refinement phases are the central phases where personas were applied. Personas were also used by researchers trying to integrate agile methods and UCD [10, 22].

D. Cultural context

Cultural variations have influence on the application and use of software products. According to Hofstede [23], Ethiopia is a high context country i.e. there is high power distance and hierarchical relationship in the society and there is boss subordinate relationship besides high collectivist society. However, the reality in Ethiopia is more diverse: Ethiopia is the home for more than eighty ethnic groups with each their own language. Further, rural communities and urban life differs substantially. The culture concept underpinning this study therefore refers to the concept of negotiated culture by Walsham [24]. Diversity needs to be a key focus when developing and using ICTs including software products. Walsham's cultural context [24] can be brought to the difference in livelihood and culture between urban software developers and rural users and further between cross-cultural systems development teams (for example: the internal team and offshore team in the case organization) are likely to confront issues of incongruence of values and attitudes towards users. One of the impacts of the difference in culture is on usability testing using the existing methods for users of different culture.

E. Usability testing

Usability testing is a way of testing the usability of a product or service by letting representative users use the products while being observed. According to Nielsen [25], usability testing is a technique used to evaluate a product by testing it on users. This can be seen as an irreplaceable usability practice since it gives direct input on how real users use the system.

Discount usability that has been popularized by Jakob Nielsen [25] and applied and proposed by other researchers [11, 12], rely on simple observation and interpretation than complex lab and statistical methods. The three main discount engineering methods are prototyping, simplified think-aloud and heuristic evaluation [25]. Discount usability method provides testing and designing guides when there is a challenge of getting users or with minimum resources. Usability testing helps for improving usability, checking whether the requirements are met or identifying new requirements. It involves testing for efficiency, effectiveness and satisfaction. Nielsen and Landauer [26] showed that it is possible with few users to uncover most of the usability issues. Nielsen's example is that 5 users will uncover 85% of the usability issues [25].

III. RESEARCH METHOD

Active cooperation among researchers and practitioners is considered to be important for successful introduction and integration of new technology. Technology here means any artifact, tool, concept or method. It has been suggested that future research should focus on working from the inside in order to identify the real challenges and propose for improvement [22]. Practical solutions for actual challenges could be achieved from working inside the organizations with the researchers acting as change agents [27]. Collaborated efforts and reflections of both practitioners, the researcher and users will help promoting in-house best practices as practitioners often do not follow formal methods: Based on surveys and interviews, Fitzgerald concludes that only 6% of all practitioners apply a formally defined method [28]. These collaborative efforts need to be mediated by meetings, workshops, frequent feedbacks and reflections. Artifacts such as personas, prototypes and other design tools mediates practitioners such as developers with users and customer representatives.

Software development is a human activity carried out by people; to understand this human behavior a qualitative approach is required. The research method used is a structured action research approach known as Cooperative Method Development (CMD). CMD is ethnographically inspired action research method developed and later refined through several projects [27].

CMD focuses on shop floor software development practices. The approach provides a structured research process, clearly defining three phases of research: understanding current practice, deliberate improvement together with the practitioners and implement and evaluate improvements. The CMD approach deploys qualitative methods such as ethnographic studies for understanding a practice from the practitioners' perspective. Interviews, workshops, observations, document analysis are some of the data gathering techniques used as qualitative methods for the empirical fieldwork in this research too. However, CMD does not prohibit using quantitative methods when desired like statistical or descriptive analysis of data.

Two projects have been researched in this research. For anonymity, they are here called project A (proj. A) and project B (proj. B). Proj. A is a rural project, new application and mobile based digital supply of the manual crop collection and input and seed distribution to the member farmers. Proj. B is an extension

of existing program for collecting bills for public utilities, adding a mobile client. The CMD phase 1 of proj. A (understanding the practice) has been detailed in the article [3]. CMD phase 1 of proj. A, understanding the software development and usability practices and challenges brought important input to the deliberation procedures in the next phase of the research. The analysis unfolds the challenges in the development with respect to UCD.

IV. RESEARCH PROCESS AND FINDINGS

The development has been supported by local IT personnel to communicate challenges of real users to the developers. The local IT personnel belong to the same culture and talk the same language as the rural end users, and are thus able to bridge between the rural users and the software practitioners at the center capital. The different stakeholders taking part in the project are shown in figure 3.

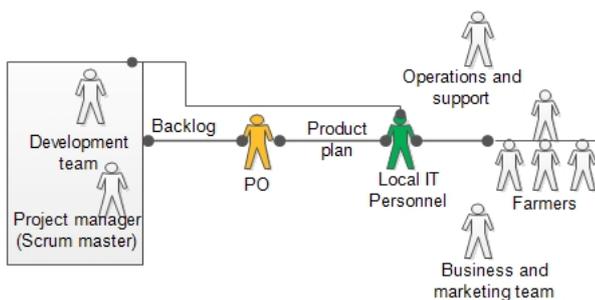


Fig. 3: Project A stakeholders and their interactions

The research process has been supported with the usability workshops which led to the decision to support the teams with the design of personas and local IT personnel and the discussion on how the challenges could be addressed. Here in this paper the description is CMD phases 2 & 3 of proj. A besides that of proj. B.

A. Project A: Exploring personas to communicate user needs

Deliberation meetings and workshops led to the development of personas during CMD phase 2 of the cycle. CMD phase 3, implementation: Based on the concept of pragmatic personas [29], 3 personas have been developed iteratively from user profiles, observation of users and their tasks in collaboration with users, customer representatives and the development team. During the successive agile iterations, the personas have been improved and updated using the data from usability testing and up to date feedback from users and user research. A sample persona is shown in figure 4.

The usability practices introduced here were not used in the previous projects in the company. UCD practices started as a result of the cooperation in the PhD research from which this paper has been extracted.

CMD phase 3: An evaluation meeting with the development team was organized including the PO and operational support to evaluate use of personas. The positive statements included ‘personas improved developers understanding of users and their needs’, ‘developers and the PO got better way of communicating user needs’, ‘internal test teams able to use persona descriptions to test against personas needs’ ‘rural users have been supported by local IT personnel that know their language

and culture’. On the challenge side, the participants mentioned: ‘It needs the support of management’, ‘personas need continuous update that has to be done by a dedicated person’, ‘personas need to be supported by other UCD methods’



Debela (user persona)

Occupation: IT Operator

Gender: Male

Age: 24 years

Education: Debela has Diploma (12 + 3) in accounting. He is a young graduate and has no professional experience.

Language: less skills in using English and Amharic languages but fluent in Afan Oromo which is a working languages of Ethiopia and Oromia region.

Technology: Debela is slow learner. He is eager to know technology but has less experience of using touch phones and has less IT skills. He has learnt basic computer application from a common course in his college. He used to ask his friends for support in operating IT products and for some internet services from the touch phone.

• Debela does not have prior touch phone exposure.

Debela is new to the product (supply chain) and digital payment system. He is to use the application in rural market setting for 4 to 6 hours especially on Tuesday and Saturday (local market days).

Motivation:

The main motivation of using the specific product is in getting salary but also supporting farmers in his area who are illiterate and semi-literate where they have problem of utilizing IT services.

Fig. 4: Sample persona.

The project setup and interaction with the local IT personnel enabled understanding the rural context better. Local IT personnel bridged the gap between users and developers. The intermittent electricity and mobile network led to the development of store and forward mechanism by the software engineers that has helped the application users to record data offline and send it when they came to the town with better mobile network. The evaluation shows that the usability challenges raised by developers during the workshop and documented in [3] such as ‘problems in requirement communication’ and ‘long chain of user representations’ have been relieved.

B. Project B: Culturally adapted usability testing

Proj. B was implemented by the same local team as proj. A with further additional offshore team. Therefore CMD phase 1 confirmed the findings in [3], though the users were situated in the capital. In phase 2 of the CMD, it was decided to implement personas. In CMD phase 3, personas have been developed using user research based on interviews at the users’ work places and further enhanced with usability testing methods. Three personas have been created and posted at the development room, shared to customer representatives and the offshore team. Their usage improved the requirements development and user representation to the development team and customer representatives in the organization. Persona usage effects has been evaluated and analyzed at CMD phase 3.

On the CMD phase 2 of proj. B, culturally adapted usability testing has been explored. Think-aloud protocol as light usability method to be carried out by Scrum teams with basic usability knowledge has been proposed. However as discussed in the literature review section (section II), these methods are based on equality between users and developers. Based on the cultural context, users consider criticizing practitioners as unethical and users are not comfortable for voice criticism to developers as observed. As a result, in CMD phase 3, grouping and pairing users with their colleagues has been implemented to give better feedback. The pairs were given set of tasks to carryout using the application while asking them to discuss their thoughts and results. At the same time, observation and intervention was minimized to allow users to freely discuss their criticism and feedback

A number of issues became visible that have been addressed in the next versions and some parts are deferred for future developments when there is no funding like for users request for instance, “*I prefer to have its laptop version to work from my Internet café so that I can use the broadband Internet service available without extra cost and instead of working on the slow mobile data network*”. Issues that are identified from the test and addressed on the next sprint include: A subject (an agent) from the pairs described the situation, “*on the way I was thinking whether we gave it incorrect input. It became late to respond*”. The error message displayed later is not descriptive either as it says “*FAILED*” without describing it. Figure 5 shows the test subjects during the test. There were two pairs each with two members and two groups each with three members. The pairing has been based on their equivalent ages aiming at active discussion in the pairs.

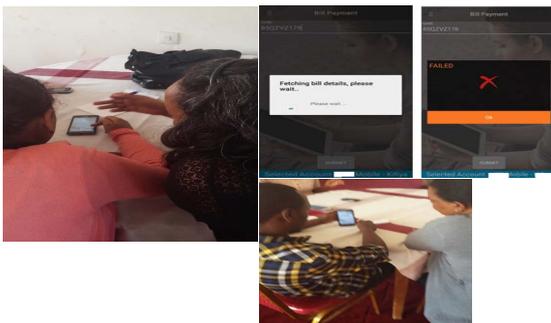


Fig. 5. Test pairs on Proj. B

CMD phase 3. The evaluation took place in form of interviews with the PO and project manager and then in a workshop with the whole team. In the workshop, the team was asked to write their views on sticky-notes and posted on board as shown in figure 6 for grouping to help for the analysis and for identifying themes. The analysis shows both positive and negative impacts of personas. The evaluation also includes own observation.

The personas aided project participants to share a perception of the users that is built on field data and not on preconceived ideas (avoid self-referencing). Practically the observed challenge of long chain of user representation has been addressed using the personas. The positive impacts include: “personas assisted in clearly understanding users and their critical requirements”, “Creates common understanding about users among the team members”, “Provide clear picture of user needs for design decision; Management gets an understanding to take decisions like infrastructure requirements”, “New employees easily understood our users and quickly familiarize with the personas”, “to create stable system design”, “Personas aided the offshore team to understand the users better” and “Personas aided to recruit users/agents”

Evaluation of pairwise usability testing shows both advantages and limitations. There has been a general agreement between the team that important feedback surfaced that might not be possible to attain using the traditional think-aloud protocol in the context. Criticism as cited above would usually not been told directly to the technical personnel as it would be considered unethical.



Fig. 6. Post-it notes for persona evaluation: green positive impacts and orange for negative impacts

The teams reflected however that ‘it requires expert personnel to facilitate and perform such tasks with users’, ‘it needs management support as we have already specified task’ and ‘users need to be incentivized to be motivated and involved’. In this particular situation, the test has been performed during user workshops and training organized by the service provider and client organizations. Furthermore, more feedback might be obtained if the facilitator is familiar to the user. Better results could also be achieved if the pairs are similar age groups and same gender.

V. DISCUSSION

In this research personas have been continuously updated and light weight for the Scrum team. Personas have been used by several authors [10, 22, 21] and are able to help bridge the heterogeneity between software developers and users in low and medium income countries. However, because of the heterogeneity and the distance, they have to be developed carefully and early, so that they can influence already the requirements formulation (in form of user stories and backlog items).

Deliberation meetings and workshops resulted in the implementation of proposed solutions together with the practitioners. Personas and local IT personnel effectively mediated between the developers and the users. This might also be associated with the research by Singh [17] to support the product owner (PO) in a Scrum project. Singh used a usability expert. The problem in our case is approached with a different setting to support and study users using local IT personnel for the obvious reason of lack of usability professionals. The deliberation has been backed up by the cultural studies [23, 24] and a survey [2]. Having local IT personnel in proj. A is also motivated by the difference in language and culture between the rural users and urban developers as discussed in [24]. Personas were not only used locally to support needs elicitation, design and testing but also by the offshore team to understand the users and their needs.

Discount usability methods that has been proposed by both Kane [11] and Sohaib and Khan [12] has been appropriated to local context. Pairwise usability tests adapt the think-aloud usability testing to the specific cultural context.

With respect to the research approach, appropriateness of workshops has been discussed in recent works like that of Jia et al. [30] and found that practitioners are usually using informal methods, and next to workshops the most widely used usability techniques are interviews and meeting with users. Workshop is

a dynamic approach as it allows customization to different purposes and contexts of a method, tool, ideas and concepts. Workshops are deliberated as a method to gain important feedbacks and design ideas as the high collectivist culture of Ethiopian society [23], is also a means to gain more from workshops. In the research process in this study, workshops have been used heavily at the CMD phases.

VI. CONCLUSION

We started with the research question, “How to adapt UCD methods, usability testing and agile development to bridge the heterogeneities?” and resulted in using personas and local IT personnel to mediate between rural users and urban developers. Personas has been adapted to Scrum team to be light and lean and continuously updated based on usability testing and experience from early deployment. User pair testing resulted in identification of unseen problems. User pair testing helped in minimizing cultural influence and workshops have been observed to assist in collaborative design and learning.

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