Integrating Discount Usability in Scrum Development Process in Ethiopia

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Abstract—System design and development methods need to be contextualized to the specific needs. Most developing countries are characterized by low economies and infrastructure, complex and heterogeneous culture. In these countries software development is characterized by big differences in education and livelihood. Culture has impacts in ICT development and use. Discount usability methods are lightweight methods to be integrated with agile methods. The paper addresses research questions, what contextual factors in Ethiopia trigger tailoring usability practices, and how can discount usability methods be adapted and integrated into the Scrum-agile development with especial emphasis on the Ethiopian context. The research aims at adapting software engineering and ICT development methods to the specific situation and integrating user-centered design (UCD) and lightweight usability methods into agile development. Two projects have been considered for the empirical research. Cooperative Method Development (CMD) has been used as the research approach. Interview notes, observations and workshop results have been analyzed using thematic coding and qualitative data analysis. Local IT personnel bridged between end users and developers. Culturally adapted user pair testing and heuristic evaluation supported usability testing and supported developers in getting early feedback. Integrated approach of discount usability with the Scrum process has been developed and evaluated first with the involved practitioners and second with expert evaluation.

Keywords— Agile methods; Scrum; discount usability; culture; local IT personnel; heuristic evaluation; user pair testing

I. INTRODUCTION

Low-income developing countries are struggling with low infrastructure and low funds for projects and the heterogeneity in culture and complex socioeconomic situation impacts usability evaluation. ICT design and development in low-income and developing countries need the consideration of several factors including education and training, material and resource mobilization, localizing relevant applications and services as discussed in the real access and real impact (RA/RI) document [1]. Earlier research shows that software industries in Ethiopia lack trained manpower and skills and project management competence, where there is high demand of development projects [2].

In Ethiopia, a growing number of projects are seen to empower the people with respect to ICT especially related to e-government. ICT has been considered as an enabler at the government level for every sector, there are initiatives at ministry level dedicated to improving ICT usage, coordinating ICT industries and working in the area of e-health, e-education, e-agriculture, e-transport etc. However less attention is given to usability in the ICT development projects. As a developing country with low economy and less infrastructure, ICT is underused and the services are not integrated into the everyday life and daily routines of the individuals.

Ethiopia's ICT sector remains far behind the rest of the world. It sits at the bottom of the Information Development Index (IDI) of the International Telecommunications Union, scoring 0.97 and placing 154th out of 159 countries in 2010 [3]. Looking into the improvements, Ethiopia ranked better in 2016 than 2015 under the ITU's IDI as shown in table 1 which also shows the IDI for Kenya and Rwanda for reference purpose with other low-income developing countries. However, if we consider the penetration of mobile broadband service, its price is high at the local consumer level. The report of ITU that has ranked 175 countries [4] indicates improvements in the ICT access and use comparing from year to year, however, this improvement is not shown in the development of ICT skills.

Software is developed to satisfy the end user and increase productivity by making use of it. For interactive systems, usability is utterly important. In developing countries where ICT services are limited, in many cases IT services are leapfrogging paper-based administration [5].

TABLE I. IDI RANKINGS AND VALUES PER INDICES ON THE YEARS 2016 AND 2015 OF ETHIOPIA, KENYA AND RWANDA (ADAPTED FROM ITU 2016)

Country	Year	IDI access		IDI use		IDI skill	
		Rank	*IDI*	*Rank*	*IDI*	*Rank*	*IDI*
Ethiopia	*2015*	171	1.85	161	0.54	172	1.71
	2016	170	2.11	158	0.82	172	1.71
Kenya	*2015*	136	3.30	118	1.76	133	3.76
	2016	133	3.54	123	2.05	133	3.76
Rwanda	*2015*	158	2.54	151	0.73	161	2.42
	2016	159	2.65	136	1.47	161	2.42

So how software practitioners be supported to develop usable software within the available constraints. Ethiopia is a

home of over 80 ethnic groups who have their own language and culture. This diversity in culture and heterogeneities in language and socioeconomic circumstances need especial focus on Information and Communication Technology (ICT) and system development. Hofstede [6] on his empirical research characterized Ethiopian culture as high context (high power distance), high uncertainty avoidance and high collectivist society and it has been indicated that culture has impact in the design, development and use of ICT products [7]. So how does this cultural characteristic impact the software design and development? The next section discusses agile methods.

A. Agile Software Development Methods

Agile development approaches are iterative and incremental software engineering (SE) methods that focus on early delivery, marketing, project management and engineering aspects. The agile values: focus on 'customer collaboration' and 'working software' are important aspects of software development process. The focus in agile development is more on flexibility to requirements change and working software, however working software might not be usable software and usability requirements are not well addressed. However, agile methods have the potentiality to support the integration of UCD and usability. The question is then, do we need cultural appropriation of SE and usability methods when it is considered in a specific context. Scrum is one of the most popular agile methods and is a framework that is flexible and not prescriptive to be adapted to local practices [8]. The case organizations of this research also adapted the Scrum process. The next section discusses usability.

B. Usability

The ISO 25010:2010 [9] defines usability referring to the ISO 9241:210 [10] definition of usability that includes its definition given in ISO 9126, defining it as a subset of quality in use: "Quality in use is the degree to which a product or system can be used by specific users to meet their needs to achieve specific goals with effectiveness, efficiency, freedom from risk and satisfaction in specific contexts of use." Usability is the extent to which a product or service can be used by the specified user to achieve specified goals with effectiveness, efficiency and satisfaction [10].

The usability challenges identified in earlier works [5] [11], such as lack of usability professionals, lack of funds, less IT skills, user resistance and others like cultural constraints led to think how can UCD and usability methods and tools be introduced and integrated into a team with basic knowledge of usability but with no usability specialist and find a lightweight and systematic way for embedding usability evaluation in the development process.

There are a bunch of usability evaluation methods [12]. Towards the claim that usability evaluation is 'expensive', discount usability has been popularized. These are primarily based on the case of budget constraints and time pressures that more economical and simplified approaches recommended. It is based on this attempt to act on the challenge that Nielsen popularized the term "Discount Usability" [13]. His argumentation is that significant value can be gained by introducing low-cost and easily accessible usability testing methodologies over expensive test labs and sophisticated experimentation. Discount methods are deliberately informal and rely on simple observation and interpretation than a complex lab and statistical methods. In order to find inexpensively usability problems in a system, many lightweight, easy to learn and fast to conduct usability-testing techniques have been proposed by usability experts also. Even though it has been more than two decades since the term discount usability is popularized by Nielsen, it is still relevant and has been adapted by other researchers [14][15]. The three main discount usability methods are: prototypes, heuristic evaluation and simplified think-aloud protocol [12].

The paper addresses related research questions, what contextual factors in Ethiopia trigger tailoring usability practices, and how can discount usability methods be adapted and integrated into the Scrum-agile development with especial emphasis on the Ethiopian context. The objective of the research is to understanding the software development practice, identifying the challenges to develop an approach based on the context to support practitioners do better usability work. The paper 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

Usability and user experience study in agile development is an important area gaining the attention of several authors. In their examination of professional practice based on interviewing UCD practitioners involved in agile software development, the authors report that agile methods have a distinct culture that at initial looks seems to conflict with UCD [16]. However, the authors concluded that the use of agile methods can result in improved usability. Moreover, they did not find any interaction designers who preferred traditional approaches to agile processes.

There are trials by researchers and practitioners towards the integration of UCD and usability into agile development and there are few systematic reviews in the area. The recent systematic review in the area is by Brhel et al. [17]. In their literature review, Brhel et al. looked into the current state of user-centered agile software development (UCASD). In the studies they reviewed, usability work relies on the team members' experience and understanding, and user involvement is by and large takes place in an ad hoc manner. The open issue up until to date is who should be responsible for usability and quality requirements: usability specialist or a cross-functional team. The authors enquire a clear definition of who are the customers in the scrum agile method and to clearly place the responsibility for usability and for the quality of the products.

Brhel et al. [17] recommended the contextualization of UCASD in practice and further for empirically grounded research in the area. Furthermore, they recommended future research on the people/social aspect of the user-centered agile method which is a challenging area to set guidance especially on the organizational and cultural impacts to the user involvement and usability evaluation. However besides the people/social context, there are further challenges such as

project contexts, project funds, IT skills, cultural impacts and other contextual situations where the method is to be deployed. Furthermore, still the open issue is how the publicly available UCD and usability methods could be adapted and integrated by agile teams who have only basic knowledge of usability.

Moreover the SLR and other research in the area such as Choma *et al*. [18] recommend for more empirical investigations and working with inside software organizations to bring about changes and improvement. Neither the SLR nor the other studies referred to address the need to consider how each individual internal practices of a software organization and its configuration can help in producing usable software. Furthermore, they did not problematize how the socioeconomic, cultural heterogeneities and the low infrastructure situations that are more prevalent in the developing and low economic countries make the work of the integration as challenging. The important question is whether there is a need for cultural appropriation and adaptation of own method for software development and usability evaluation.

Singh criticized that the Agile-Scrum method is affected by lack of usability practices [19]. Singh identified that the product owner in Scrum is more focused on meeting minimum marketable features in just in time process and sales issues, user stories selected are not good enough from the usability perspective, lacks prioritizing user stories of high usability requirements, and the product owner lacks usability skills. Singh proposed a U-Scrum method in which a second product owner that has usability skill is included and this second product owner focuses on prioritizing usability requirements and user stories with usability requirements are prioritized. The usability product owner also works in coordination with the traditional product owner.

What lacks from the SLR reported here is consideration of what the actual practice undertakes in relation to the publicly available methods. It requires understanding the actual practice and its challenges and what the observed practice can contribute to method development. For example, Hansson *et al*. [20] reported from a qualitative study on how the team practices integrating usability works in their agile-like software development. Hansson *et al*. in their study, the team continuously consider users' feedback for a product that is continuously updated for the users. Even if the report by Hansson *et al*. is informal usability study, it shows the actual practice and it needs to see what this actual practice contributes to method development. This argumentation is in line with the report of Gould and Lewis [21] and Fitzgerald [22] and others.

A good approach for integrating usability practices and improving usability for agile projects has been proposed and could actually be achieved through the use of discount usability [14] [15]. Kane suggested due to the similarities between discount usability methods and agile methods as both values for lightweight methods, the need for user understanding and involvement for example in testing and quick iterations on both sides, integrating the two can result in better usability of the products developed. Sohaib and Khan [15], developed a theoretical framework solely from the literature review and interviewing practitioners in the area for integrating discount usability with agile-XP. Though the theoretical approach is an interesting finding, Sohaib and Khan did not show a proof of concept. Furthermore, apart from lightweight nature of traditional discount usability methods as propositions to integrate with XP practices, in actual practice, the context of users and their environment, project contexts and other important factors should drive tailoring the methods.

A report on a workshop on the integration of UCD and agile development by Gregory *et al*. [23] identified practices, people, culture and time as main elements of discussion from the workshop. The report categorized challenges of Agile-UCD integration as themes under people and roles, teams and communication, culture, methods and practice, time and synchronization and artifacts and tools. The workshop indicated the importance of industry-based empirical research to investigate challenges and innovate solutions and action research has been recommended in identifying obstacles in the integration of UCD and Agile development in practice.

A reflection on UCD by Maunder *et al*. [24], shows how traditional UCD methods fail to consider the broader and complex effects of the user's physical and social environments, especially in developing countries. As these methods are developed with the context of the western world, it may not be practical to be adopted and to be useful for the context of the developing world. Studies that account the use of UCD in the developing world context are limited [24]. The challenges of low economic and developing countries and how to cope with the digital divide has been documented in the RA/RI criteria [24] which are becoming visible as challenges in our study, for example the 'Trust in technology', 'human capacity and training' and the 'Integration into daily routines' criteria.

It has been researched that practitioners do not follow formalized method prescriptions [22], which is also supporting an earlier empirical finding in a survey of designing for usability by Gould and Lewis [21]. System design methodologies need to be adapted to the context of use and to the specific context required. Researchers and practitioners understood the importance of usability and, there is research and practice undertaken to integrate agile software development methods from the SE with usability and UCD aiming at improving usability and user experience. Most of the publicly known software development and usability methods emerged from and applied in developed countries. These methods are of little use if applied as they are in developing and low economic countries [2]. They need to be appropriated to the context.

As a design methodology, UCD includes a number of practices that are advantageous to the developing world context. In developing countries usually work and social processes are not structured around technological solutions and it is difficult to adapt to accommodate such changes that need re-engineering. The users are also in difficulty to visualize any technological solutions; to choose between design options or abstractly place a technology into their lives or work activities [24]. Methods need to be adapted to the context of design, development, and use.

The design and evaluation of IT systems need to be synchronized with the target community to design and develop usable systems. Communities in different areas have

established their own value systems (culture) which do not necessarily correlate with the application of technology in other contexts [25]. This accounts for localization of information technology. The diversity in culture and heterogeneities in language and socioeconomic circumstances in Ethiopia need especial focus on ICT and system development.

III. RESEARCH METHOD

The research approach employed is a form of action research structured and appropriated to the SE research by Dittrich *et al*. [26] known as Cooperative Method Development (CMD). CMD is an action research cycle consisting of three phases: understanding, deliberating change, implementation, and evaluation of improvements as shown in fig. 1.
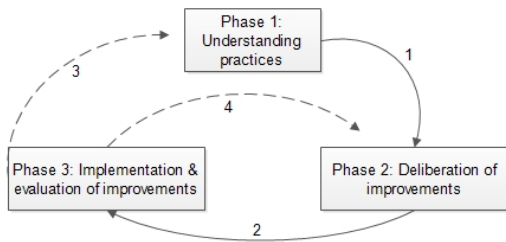

Fig. 1. The CMD research cycle

Phase 1 - *Understanding practice*: the CMD research cycle begins with qualitative empirical investigations into the problem domain. Understanding of practice took place both during participatory observation on frequent visits to the case organizations (the first author was physically placed in the case organizations three days per week supporting product owners, operational people and software engineers) and during planned participatory workshop and observations of particular issues.

Phase 2 - *Deliberate improvements*: The results of the first phase are used as input for the deliberation of possible improvements. These deliberations of improvements are done in cooperation with customer representatives such as product owners, operational people, users and SE practitioners involved in the development projects.

Phase 3 - *Implement and observe improvements*: During the implementation of the improvements the first author follows these method improvements as a participant observer. The results are evaluated together with the involved practitioners. The results of the evaluation help to summarize concrete results for the organization involved. The results of the evaluation are also used for researchers involved to build the base for the scientists' evaluation of the proposed improvement measures and also a base for the next action research cycle.

The adaptation made for the CMD research cycle in this research is the optional iteration from phase 3 to phase 2. Sometimes further understanding might not be important and the action may take for further deliberation improvements. The adaptation is also meant for keeping with the pace of agile iterations of fast delivery of prototypes for evaluation. From the outset, CMD was chosen because a structured methodological framework would help in identifying the practices and challenges and propose and deliberate

improvements followed by evaluating the improvements that take place iteratively.

Four case projects have been considered for the empirical study at two software organizations located in Addis Ababa, labeled org. A and org. B for anonymity. Three of the case projects labeled proj. A, proj. B and proj. C are from org. A and the fourth project is from org. B. Part of the action research and the result of CMD cycles of proj. A and proj. B of org. A and the Scrum process tailored to the internal practice in the case organizations is reported in the articles [5][27]. Here in this paper the focus will be made to proj. C of org. A and the project in org. B that have been used also as a means for evaluation of the integrated approach. The integrated approach that has been developed as a result of the empirical work on proj. A and proj. B is shown in fig. 2.
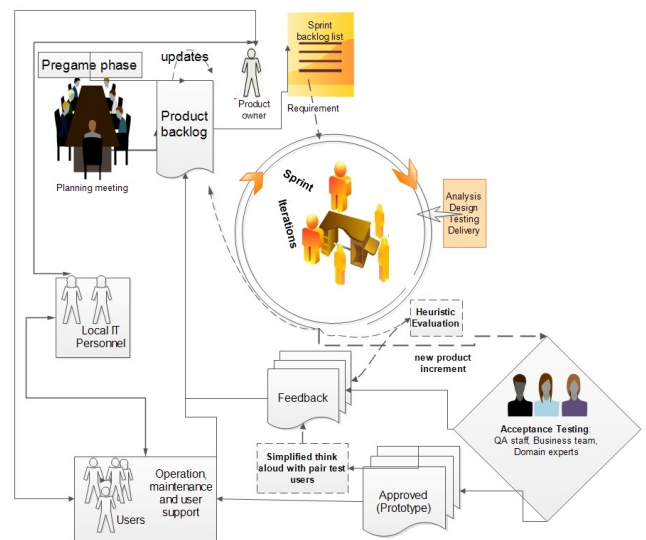

Fig. 2. Integrated approach of Discount usability and UCD with Scrum

Proj. C is a bus ticketing public project for collecting fares, recording passenger details and issuing tickets. The tariffs are set at the federal level and the federal level transportation office is one of the clients in addition to the association of bus owners. The software development team is composed of both local and globally distributed team i.e. the second-team mainly involved in the development of mobile front-end application is an offshore team involved also in the previous project, proj. B. The project team is therefore the same as that of proj. B plus two new hires of internal team members who are software engineers. The team composition with their assigned roles for project management is shown in Table II. For anonymity practitioners are named P1, P2, P3 …P6. Six practitioners were in the local team, however the project team also consists supporting teams for acceptance testing who are members of the business and marketing departments. The local development team is mainly involved in developing the backend web application of the product, integration of the mobile client and testing both systems. On table II the codes P1, P2, … P6 are all local team members.

TABLE II. TEAM COMPOSITION IN PROJ. C

Practitioners	Roles
P1	Software Architect
P2	Lead Software Engineer
P3	Senior Software Engineer
P4	Project Manager/Scrum Master
P5	Product Owner
P6	Quality Assurance
Offshore Team (two in number)	Mobile front-end application development
Customer Care and Business Teams	Acceptance testing, functional testing

The first author as a researcher has been supporting the team, sometimes playing the role of a usability lead by developing prototypes, evaluating the prototypes with the internal customer cares and users, usability testing with culturally adapted test user pairs, coordinating heuristic evaluation of prototypes and collecting feedback, coordinating workshops and meetings and documenting the results and feedback and other tasks focusing on usability including administering system usability scale (SUS) survey [28] for evaluating usability and end-user satisfaction.

Organization B (org. B) is a medium-sized software organization with about 25 employees located in Addis Ababa. It is one of the very few leading local software development companies established before 15 years. The organization develops various application software for a number of clients in both the government and private sectors. The project considered aimed at redesigning an existing program and adding new functionalities. The team for the project is composed of four members, a project manager, two software engineers and a junior programmer who also works for customer representation and user support. The team uses an adapted Scrum-like process, tailoring it to the project management activities to fit the call for tendering (CFT) documentation. Most of the projects in this organization are public projects. Scrum ceremonies and artifacts such as stand-up meeting have not been observed.

The client of the project in org. B is a large public organization managed at a federal level which has branches in all the regions of Ethiopia. However the current project targets at the 13 branch offices of the organization located in Addis Ababa that use Amharic as their working language. Among these 13 branches of the client office, 3 of them have been contacted for this research.

IV. RESEARCH PROCESS AND RESULTS

A. CMD Phases 1 and 2 in org. A and B

CMD Phase 1: The usability challenges that are encountered in proj. C are similar with that of proj. B [27] including the slow mobile network versus the high number of transactions to be processed due to the high number of passengers seeking tickets especially in the mornings of every days, the challenges related to scheduling and modifying buses allocations due to the high number of bus associations and change of buses required due to unpredicted situations. In org. B the challenges observed include the complexity of services in the client organization and understanding the situation by the

practitioners, less experienced users, user resistance and cultural influences to evaluate with users.

CMD phase 2: Deliberation of improvements in proj. C include prototyping, culturally adapted user pair testing with users as an alternative form of simplified think-aloud protocol and adaptation of heuristic evaluation guidelines. Deliberation in org. B include working with local IT personnel to approach the hierarchical culture and uncertainties while evaluating usability with the users and mediating between the software engineers and users for the low skills and resistances. Furthermore user pair testing for adapted simplified think-aloud protocol and heuristic evaluation have been agreed to be implemented by the practitioners.

B. CMD Phase 3 in org. A: Heuristic Evaluation

Heuristic evaluation guideline for android mobile application has been adapted from [29] and extended with new heuristics that have been evaluated for its appropriateness with two experienced android application developers and their feedback has been used to improve the list. The adapted heuristic evaluation checklists are given to four software engineers to evaluate and fill it using the options (Y, N, N/A). Furthermore an evaluation form is provided to each evaluator to fill in the problems, place of occurrence from the application that the problem arose and the violated heuristic. Here the aim is not to prepare a comprehensive list of the adapted heuristics. Furthermore, the main goal is not only to identify design flaws but to study the developers' motivation and courage towards its application. A sample result of the evaluation is shown in fig. 3

No	Function/Screen where the problem is found	Detail of problem	Violated heuristic	Suggested solution
1	Booking journey	When seat is full for all schedule buses, it says "No schedule available"	9.12 Do messages place users in control of the system?	The message should be "No seat available"(High priority)
2	Passengers Departure and Destination form	Virtual Keyboard covers the form and does not disappear to fill the lower part of the single page form; It seem as if I have completed filling the form on the page when I have to press done, or I feel it as it is quitting the app if I press the back button on the phone	3.7 Can user hide virtual keyboard when unused?	The virtual keyboard should disappear when the user touch like free area on the form (high priority)
3	Fetching schedules, Printing ticket	User waits longer until the system fetches schedule data from the server and process transactions from the server for ticket printing; Critical problem beyond programmers technical solutions	1.14 − 1.17, response time	Management decision required to solve the bandwidth problem with the telecom provider (high priority)
4	During transaction processing	User wants to change the age of a passenger as she is under 12 and pays half of adult travel fare instead of the full travel fare, there is no easy way of moving to the previous pages without losing the entered data, agent uses back button of the phone	3.3 If the system has multipage data entry screens, can users move backward and forward among all the pages in the set?	Application should provide moving to the previous pages without losing the already filled data (medium priority)
5	After transaction	No easy way of canceling once transaction is processed	3.13,3.14 Undo cancelation	Agent cannot cancel booked and processed transactions based on the business rule

Fig. 3. Sample heuristic evaluation result for proj. C

C. CMD Phase 3 in org. A: Usability Testing Using User Pairs

Before releasing to the customer site, the internal test team (the business team and customer representatives) and the quality assurance team performed acceptance and security tests. The user pair testing has been done on the first release. Pairwise usability testing is performed on this first release on

the customer site after the users and customers were trained on how to use the system by the PO and developers. The case has been used as the opportunity to pair the terminal users and distribute set of questions (tasks) that have been prepared together with the practitioners. The trainees are of similar age groups and it has been tried to pair similar genders together to make them have more focused discussions. Ten test users have been used, five pairs are each with two members. The terminal users (test pairs) are having qualifications minimum of diploma either in IT, accounting or marketing and employed to operate the application by the service provider (org. A).

A number of issues and important feedback have been collected. The result has been summarized and discussed with the practitioners to take actions on the critical feedback. One of the critical challenges observed from the pair test is the slow communication of the mobile application with the server due to the low network bandwidth. A reflection from one of the pairs is: "… it takes too much time when it fetches bus schedules…, see it also takes longer to print a receipt, what is the problem?" The application should sync with the backend app from the server and fetch scheduled buses to a trip and for making transactions. The problem has been observed in most of the pairs practicing. The performance is dependent on the network bandwidth. Sometimes the printing might take longer due to the Bluetooth connectivity issues of the touch phone and the Bluetooth enabled thermal printer. The other member of the pair related the same problem observed with her previous experience of getting a bus ticket, "There are too many passengers in the mornings, the system is slow, and passengers want to get their tickets quicker to get their seats". These are reflections that address the problem of the slow mobile data connection. From the second pair sample users challenge presented here is related to language localization and the slow ticket printing mechanism. "It could be better if the application is prepared in Amharic, most passengers do not read and understand English". The test subject claims that the receipt/ticket might have been printed in Amharic to be read by most of the passengers even if not by all as there are illiterates and other language users. The other important feedback from this same pair is: "The error message: 'Invalid session. Please relaunch the application and reset the device' is coming frequently as the device cannot quickly connect to our touch phones. Maybe the Bluetooth communication is not working". The problem occurs because the printing device could not connect to the touch phone at a responsible time and there is a session timeout for the printing device which should not be set as the first-hand solution. The third pair: "The system does not provide a report on the tasks, transactions made …there should be a facility to get a deposit, the transaction made and remaining balance per day, per week, per month …" The pairs were faster than others in this that they have predicted what they need in the future. Another challenge observed from the fourth pair: "tariff of children of age between 7 and 12 is half of the adults and do not pay if they are under 7. But when the ticket order is displayed it shows the total amount for adults only". As being one of the business rules and a requirement the issue has been considered initially, however the bug has happened for an issue of integration of latest update which has been addressed later.

These are sample high priority feedback that has been extracted from the test session. These important feedbacks are considered for the next release in a deliberation meeting with the development team. The test result/feedback considered at the lower priority area are documented for future reference by the team.

D. CMD Phase 3 in org. B

In org. B agreement has been reached with the client organization to hire IT professionals to support users and work with the software engineers communicating users challenge. These local IT personnel work in close collaboration with the software engineers to solve the challenges identified including uncertainties and hierarchies that have been observed during the first phases and to provide clear feedback to the developers. For example a local IT personnel in one of the branch office sent a request that "The visual Geez available on the application web page to be downloaded and installed on the PC of the officer to write in Amharic is for 32 bit systems. Those 64 bit systems cannot use it. The web application successfully works on Mozilla, however it is very problematic to work with other browsers". These are issues that are immediately addressed by the developers. A local IT personnel in another branch has been observed for example in capturing system related errors on his touch phone as a screenshot and send it to the developers. What he claimed and raised in our discussion is "… many bugs become visible when the officers are using the system, it could be good if the developers create log system that captures and send the errors encountered during operations internally to the developers". This argument of the local IT personnel is to reduce user frustrations and to make an effective way of fixing errors for developers.

Nielsen's [12] usability heuristics and Shneiderman's [30] general design principles have been studied. These usability heuristics and the heuristic evaluation from [31] has been adapted and used for the usability inspection of the web application in org. B. Based on the experience of web-based applications five new checkpoints have been added to the checklist and evaluated by two software engineers with experience in web page design and development.

The resulting checklist has been given to three computer science graduates who have experience in software development and web page design. They are given the application and have tried the application once and discussed on how to evaluate using the checklist using the yes, no and not applicable (Y, N, NA) choices and furthermore to fill in an evaluation form that asks which heuristic has been violated, detail of the problem and suggested solutions. The aim of the heuristic evaluation is to see its applicability by the software engineers for evaluation of UI who have only basic usability knowledge and how it is used to enhance application's UI.

The evaluators identified a long list of usability challenges, some of the identified issues but considered as most sensitive along with suggested solutions are shown in Table III. The page where the problem is identified is labeled as P1, P2, P3, and P4 on the sample shown in table III for anonymity. The issues identified are prioritized with the developers to take corrective measures and enhance the interface.

TABLE III. SAMPLE HEURISTIC EVALUATION RESULT

Page	Detail of problem	Violated heuristic	Suggested solution
P1	The small font sizes challenged to read and perform task	6.11. Appropriate font size	Following standards for the fonts
P2	System generated errors not understood by the user	9. Error messages be expressed in plain language	Control and make error messages understandable by the user
P1	Mandatory fields in the data entry interface are not emphasized	6.4. Are optional data entry fields marked?	Optional and mandatory fields should be clearly marked
P3	There are items not relevant in a list that slows down user performance in selecting items	1.7. Filters should be available 8. Minimalist design	A group should contain only necessary and important items
P4	too much typing and editing takes time (less efficient)	12. Pleasurable, respectful interaction	The system should simplify user's task

Usability testing with culturally adapted user pairs has been implemented in the real environment after deployment and user training. Three test pairs involved. The users are contacted based on their agreement to participate. While the users are processing their customer case, they are asked in pairs to discuss the issues they face. The first author has been shadowing users to observe with minimum interference to guide. The opportunity of the user paired arrangement between one officer and one authenticator who usually sit near each other has been used. The result is analyzed and then prioritized with the developers in a meeting. Table IV shows sample problems documented during the test. Some of the issues encountered such as the 'network failure' and 'chair discomfort for the user' are identified to the client organization. The test pairs also observed with the challenge to cope up with the typing speed required to serve customers as normally a large number of customers are visiting the office throughout the day.

TABLE IV. SAMPLE USER PAIR TESTING RESULT

S. No.	Problem	priority
1	Text entry box is not active to accept data	High
2	Date of Injunction is not correctly mapped from Gregorian calendar to Ethiopian calendar as the UI is in Amharic	High
3	The data entered on the form disappeared when a user accidentally pressed the 'Enter key'	intermediate
4	user observed screen flicker as a result of selection of an item from Drop down button	Intermediate
5	The attorney reversal does not permit to include second or more agents to be reversed.	High
6	Drop down field not flexible to accept new input	High

E. Evaluation

The evaluation of the approach has been done first with users using the system usability scale (SUS) survey, next with the practitioners in both organizations as interview-based evaluation and finally evaluated with experts in external software organizations.

The SUS survey result has been analyzed using a spreadsheet as indicated in table 7.8. SUS enables to get a measure of the perceived usability of a system (learnability and ease of use) with a small sample (say, 8-12 users) [28][32]. For proj. C 12 users selected based on convenience, the average score is 85.6 which is an 'A' score, with minimum score 72.5 and maximum score 97.5. [28] [32] details how to evaluate with SUS.

Evaluation with practitioners in org. A has been performed as interview-based evaluation with the project manager and a software engineer. It shows both positive feedback and limitations. As audio recording was not possible, the interview notes have been analysed using thematic coding [33]. The positive feedback includes: better involvement of users, less user support requests, satisfied customers and users, reduced rework, workshops enabled deliberating collective solutions and early identification of design flaws. The limitations include the need of strong management support and need of extra manpower and effort by developers.

Two experts evaluated the approach. One of the experts is a project manager having experience in Scrum and Kanban and the other expert is a software engineer having experience in Scrum. The experts have 8 and 7 years of experience in software development. A diagram showing the integrated approach, the implemented practices and the interview guiding questions have been first given to the evaluators some days before the interview. The expert evaluation has shown that the experts have not practiced discount usability. However they have worked with domain people as customer representatives. Their evaluation shows similar positive opinion as for the evaluation with the involved practitioners. Their critics lie in the local IT personnel to have the domain knowledge to better support developers and the need of management support to do the adapted usability methods. Their evaluation shows the adaptations are well investigated and could be also applied in their organizations and organizations with similar context.

V. DISCUSSION AND CONCLUSION

Close collaboration between the researchers and the industry practitioners and customer and user representatives created opportunities to understand the practice and challenges and deliberate improvements together with the involved practitioners. Adaptation of discount usability evaluation methods to the context has been effectively carried out and is based on the deliberation workshop with the practitioners to use checklists. Heuristic evaluation has been carried out by practitioners with basic usability knowledge and helped developers to get early feedback in addition to the acceptance testing by the support departments. In relation with [15] of integrating discount usability with XP, the difference here is that methods have been tailored to the context and its effectiveness have been evaluated. The local IT personnel bridged between end users and software developers. Fast delivery of working prototypes supported getting early feedback from users.

The empirical study of Hofstede [6] for the core characteristic of Ethiopian culture has been used to adapt the methods supported by the practical evidence from observation of the challenges in the empirical study in the case organizations. The collectivist culture helped in getting collective solutions for example in deliberation workshops. The cultural impacts that users were not open to technical developers due to the hierarchical cultural context and uncertainty issues have been bridged by the local IT personnel and furthermore user pair testing helped in doing systematic usability testing with users that have resulted in identifying usability challenges that are not identified in the other techniques. The integrated approach has been evaluated and the evaluations show positive results and the expert evaluation shows that it could be applied in organizations with similar context.

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