

User-Centered Design Practices in Scrum Development Process: A Distinctive Advantage?

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Abstract—Agile methodology lacks in usability and most of the time issues like usability do not lead the software toward success. User-Centered Design supports usability and according to UCD, the client should be a part of the process from planning to handover phase. Integration of these two areas is a difficult and challenging task w.r.t its applicability for collocated and distributed level. This research focuses on Agile and UCD integration, providing a few practices and artifacts to guide designer's and Agile teams to overcome the challenges. How UCD techniques can support Agile in order to deal with usability issues. In this paper, we have demonstrated that which are the levels and phases where stakeholders, especially the user involvement and interaction are required. Case study and observation method have been followed. The result of this research is a framework.

I. INTRODUCTION

These days Agile methodology is very popular in the software industry for software development. There are some issues in traditional software development for example, lack of user input, incomplete and changing requirements that can cause problems in projects. According to [1] Agile helps to manage changing priorities, productivity and project visibility. Scrum is the most popular Agile methodology which has been used in the industry.

Agile is an iterative and incremental development approach that takes small steps toward defining a product or service. Fewer challenges and barriers are taken from industry annual reports. Those challenges may affect the usability directly or indirectly. The thing which makes Agile attractive is the possibility of a quicker return on investment for the development effort, because a company can deliver software as soon as possible. Known agile issues are present in Figure 1.

Version One Report	Customer collaboration
	Lack of upfront planning
	Loss of management control
	Lack of documentation
	Development team opposed to change
	Reduced software quality

Fig. 1. Issues in Agile

But still the usability issues need to be addressed in Agile. According to [2] [4] User-Centered Design was launched in

1986 by Donald Norman and Stephen Draper. UCD is an ISO standard which was previously known as ISO 13407 (1999) but later on it was updated as ISO 9241-210 (2010) to improve usability.

Several stages of UCD proposed by ISO 13407 present in Figure 2. UCD has been an iterative process just like Agile [6]. Eun-OK Baek et al. has defined two types of UCD approaches: Product Oriented and Process Oriented [3]. According to Redish and Dumas (1993) usability means people who use the product can quickly and easily accomplish their own tasks (p. 4). Usability is an ingredient of UCD that enables the user to find the solution easily and guides us how to use the things [2] [3] [4].

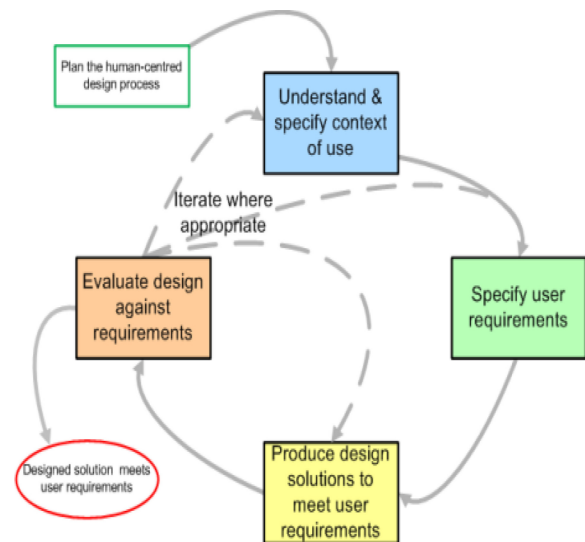


Fig. 2. UCD Process

It seems that UCD and Experience Design are the new instrument for industry and helps to build many successful applications and websites such as Facebook, NFC technology, Singing Shower and Dance Pad [14].

Based on available research, we can classify literature work into five sections. 1. Take Initiative, 2. Proposal, 3. Lesson learned 4. Recommendations and 5. UCD practices in Agile.

A. Take Initiative

According to [4], Agile is a light weight perspective and do not pay attention to the usability or any specific process. End users are not always involved in the development process, sometimes they are domain expert. Both Agile and UCD are user focused and customer focused. Communication between

the developer and designer is an important ingredient [9]. Agile software development methods lack user centric perspectives and create usability issues.

B. Proposal

According to [3], a user may participate at the minimal level, it means limited time during the project design or full inclusion level means users may involve in the design process by cooperating with researchers and developers. In UCD process designer face effective incorporation of user participation and control over resource problems like cost, time, money and space. According to [5] in UCD approach, by reducing the amount of rework and redesign the cost and time factor can be handled. According to [6] continuous evaluation and refinement may take a long time or even fail in UCD.

C. Lesson Learned

According to [8], to achieve the integration of both methodologies in terms of usability research work defined three approaches known as generalist, specialist and generalist specialist (Hybrid) approach. A generalist approach means that all team members should do the UCD work. A UCD specialist is required for specialist approach and in hybrid approach which is a combination of both approaches is used in which some UCD work can be done by the developers.

H. Williams and A. Ferguson [12] believed that along with development team one UCD person faces the challenge of prototype development and UI specification writing activities, so responsibilities should be divided among more than one UCD person. Integration of UCD and Agile is a successful outcome. According to [14] the teams working in Agile contexts do not use any techniques from HCI or user-centered development in order to maximize the interactions. In [21] authors said that most of the organizations do not follow the instructions of the books so certain practices should be followed according to the context of the project.

D. Recommendations

According to [7] common goals can be achieved if UI designers and software developers work closely together. They conducted interviews with team members at several different companies and then presented a summary of results. One study showed that it is unreliable if we left the usability testing over the developer.

In [10] authors tried to incorporate usability techniques such as contextual design with Agile methods. They also suggested that large projects can be handled by combining these methods. According to [11] UCD methods /techniques empower developers to understand the users' needs.

Author designed an organizational structure known as AUCDI as a scale for identifying the maturity level for a project. This helps the organization to evaluate organization's AUCDI strengths and weaknesses after analysis. AUCDI CMM includes five components which are Reference model, Assessment process, Performance scale, Assessment guidelines and Level improvement guidance. In paper [13], the authors asserted that the emphasis of Agile on communication and collaboration helps to accomplish a purpose, but there is a need to bring the UX in this communication and collaboration.

E. UCD Practices in Agile

After collecting the information w.r.t practices from industry reports, we have distributed all these practices into three main levels. Planning, Development and Design and Testing. Identified Practices are present in Table I.

TABLE I
UCD PRACTICES

Phase	Practices
Planning	Contextual Inquiry/Ethnography (Field studies) [15] [16] [17] User Requirements Analysis [15] [17] Iterative Design [15] [18] User Interviews [15] [17] Task Analysis [15] [17] Focus Groups [15] [17] Surveys [15] [17] Personas/User Profile [16] [17]
Design And Development	Prototype without User Testing [15] Low Fidelity Prototyping [15] [16] [18] High Fidelity prototyping [17] Card Sorting [15] [17] Interface/Interaction Design [17] Visual Design [17] Experimental Design [17] Conceptual Design [16]
Testing	Informal Expert Review [18] [15] Usability Expert Evaluation [16] / Heuristic or Expert Review [17] Rapid Iterative Testing [16] Usability Testing [16] [17] Cognitive Walk-through [17] Formal Heuristic Evaluation [15] [18] Usability Evaluation [15] Scenario [17]

1) *Planning*: In person communication with the users and participants is an important factor during the planning phase. Tools like Personas, Scenario, Sketches, Wireframes and User's journey or prototypes are more effective and efficient. He also suggested that in Sprint zero or iteration zero, two weeks can be too short due to the complexity of the desired product [13]. In paper [9] authors recommended for user interviews and contextual inquiry and during sprint zero personas should be created.

Contextual inquiry/research (Field Study), usability investigation activities should be taken place at the start of the project [10] [18] [19]. Develop the hand drawn sketches on flip chart paper to streamline and transform the work user will make [10]. After development of storyboarding, prototypes help to develop a user interface that can be tested by the actual user and also builds user stories. LDUF should be done at sprint Zero. A particular usability product owner should be created for usability aspect [11]. According to [13] two weeks would be too short for the iteration or sprint zero. It should be four weeks.

2) *Development and Design*: In paper [9], authors suggested in their framework that there should be two teams as interaction team and development team. They should work

together in parallel and provide their feedback. According to [13], for communication and collaboration personas, sketches, wireframes or prototype should be used for in person communication. Collected requirements can be turned into user stories. There should be a prototype who creates high fidelity prototypes [12]. Feedback is an important factor.

3) *Testing*: According to paper [19] automated usability evaluation with extended unit tests and conduct usability testing of prototypes directly with the user or remotely [12]. Also for usability testing and usability expert evaluation. [20] Suggests for three usability sessions as an In-house usability test with internal users, in-house usability test with external user and last usability investigation at design partner site. The goal of usability evaluation of paper prototypes is to refine the User interface for the next iteration [9]. The main target of usability testing is to identify and correct the usability issues related to the initial user interface design to handover to the development team [8]. According to [9] light weight evaluation methods should be adapted like user and expert reviews, collaborative usability inspection and Attrak Diff (questionnaire).

II. PROPOSED WORK

In order to integrate scrum and UCD practices, trying to minimize the costs, risks, timing and late changing, we propose a framework with usability and scrum artifacts by keeping in mind the usability principles and practices for the improvement of the developed product's usability and at the same time trying to minimally impact on the activities of Agile development. First of all classification of software project in terms of client interaction is needed.

1) *Ordinary Individual*: where the client has less information w.r.t software project, which client intend to develop. Following artifacts must be followed in this case for User Research such as: Task analysis, Scenario, Online Survey, Persona development, individual interview, Focus groups, Contextual interview and System usability scale.

2) *Special individual*: Client, who has sufficient knowledge about his/her software project, can easily dictate his/her requirements.

The proposed work will be discussed according to three main key aspects user/client satisfaction, less changing requirements, design and development team collaboration and communication. For small project there is no need to develop prototypes in the sprint. Iteration zero is enough for the design team to develop the prototypes and the rest of the design. However for large projects design and development can progress in parallel and for that matter there is a condition that if code is complete of the previous prototype given to the development then next prototype would be given to the developers. Currently our proposed work focus is on design work completion in iteration 0.

A. Planning

During the planning phase, after identification of all stakeholders a detailed session with user must be performed, where the product owner dictates all the requirements which he/she want to see in the software. For this matter design and

development teams can perform the following activities: Task analysis, Scenario, Online Survey, Persona development, Individual interview, Focus groups, Contextual interview and System usability scale.

This will help the team to prioritize the product backlog. After that a sprint planning meeting will help to plan and identify the work for the first sprint, and decide what should and should not be done.

B. Design Sprint

During Sprint zero, team uses these artifacts: paper prototype, design cards and user stories. The design team will perform the following activities: UI design, Interaction Design and Visual design by using these artifacts, initial design and UI prototype. UI prototyping and architectural prototyping are also involved in it. The duration of Sprint one should be seven weeks to evaluate the sprint and gather feedback.

Verification of initial design is very important from the usability aspect, especially by using practices like first click testing, plan usability testing, recruiting usability testing, running a usability test and reporting a usability test.

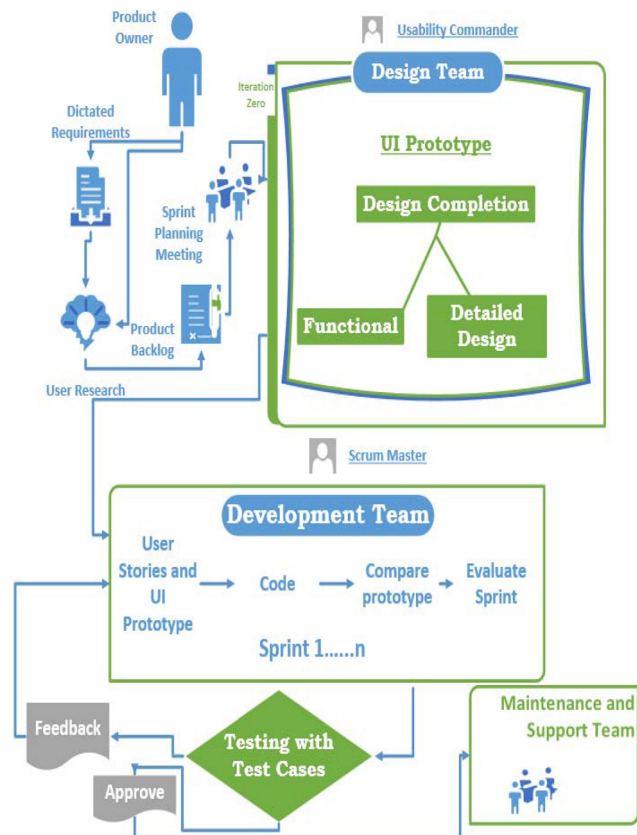


Fig. 3. UCD Proposed Framework

C. Development Sprint 1.... n

During sprint two, interaction designers can redesign after usability testing if it is needed and forward it to the development team. The development team is responsible for all functional requirements. With the help of user stories, low and high fidelity prototype development team may code. A development team can incorporate correctness which are reported by the designers as a feedback. In sprint n, cards are

allocated to describe the problems. Usability is evaluated by using the following: heuristic evaluation, experts review, eye tracking, contextual interview, focus groups, remote testing, mobile device testing and scenarios. Finally, results are compared with the dictated requirements. In the end, when software is finished, then performing a complete testing with test cases. After approval from client, hand over to the maintenance team. Further, we present a more detailed description of the four-State usability Agile framework as described in Figure 3.

III. CASE STUDY METHOD

The criteria of case selection is based on two main arguments: I) companies using scrum methodology for at least two years and II) where companies main concern should be users/client satisfaction. Furthermore, projects, data collection and data analysis are also described.

This study is concerned about how a specific company deals with an assortment of scrum, user experience and its practices. The field study was conducted in two SMEs (small and medium enterprise) that develops software products primarily websites. To understand the software process we try to get answers on following questions from the company:

- Does Integration of scrum and User-Centered Design is convenient for the company?
- How can a company deals with UCD and Scrum practices simultaneously?
- What works and does not work with particular process?

For further discussion, we take project and describe our study in main sections as The People (such as teams), The Software Project (name such as A, B, C), The Research site and methodology. Later on, we elaborate our findings in terms of key aspects observed in review.

A. The People

This study includes a team of individuals commissioned to complete project. Two designers were part of the design team (having worked over three months iteratively). The developers were part of the development team (having experience of two years). Selection of developers was according to their area and skills in the team. The rest of the team and their respective roles are given in Table II.

TABLE II
TEAM FORMATION

Sr.No	Role	Case A	Case B
1	Project Manager/ Scrum Master	1	1
2	Product Owner	1	1
3	Usability Commander	1	0
4	Technical Leader	1	1
5	Developers	3	2
6	UI Designers	2	2(distributed)
7	Test Engineer	1	1

B. Software Projects

Due to reasons of confidentiality, information about software systems had to be concealed. Hence, software projects were named case A and case B. In case of project-A design team was distributed at on shore level and in case of project B design teams are collocated.

Project A consists of the development of new features of a website and Project-B consist of developing mobile application. Main features of the website and the application are: Reading lessons, Memorization, Translation lessons and teaching of rules of recitation. It was the Product owner's wish that process of learning must be as simple and facilitating as possible.

TABLE III
UCD TEAM ROLES AND PRACTICES

Role	Software Project A	Software Project B
Designers	Develop Prototype, Design UI	Support System Engineer
Developers	Code User Interface	Code
Scrum Master	Monitor developers and overall team	Monitor developers and overall team
Usability Commander	Check over the Designing Team and their monitoring	No usability Commander

Project B consist of the website development of an existing product with new interface and new features, it was a large project. Being an educational website, the target of building that site was clear, concise, efficient and prefect from the usability perspective because various people from all fields and background try to access this website. The role of designers on Project A was to help software engineers to support new features of this software product. In Project B, Designer's role was to prototype and design UI, and monitor the design process without usability commander due to the distributed nature of the team. UCD practices used by the project A task analysis, personas, focus groups, usability testing, heuristic evaluation, mobile device testing, prototyping, parallel design and wireframing, whereas project B used contextual Interview, usability Testing, Scenarios, wireframing, prototyping and card sorting.

C. The Research Site and Methodology

Different roles in studies are mentioned in Table IV.

TABLE IV
TEAM USABILITY POLICY AND FORMATION

Study A	Study B
Separate Design Team	Separate Design Team, but distributed
Separate Development Team	Separate Development Team
Separate Usability Commander	No Usability Commander
Develop Prototype in Sprints	Develop Prototype in Ssprint 0 only

IV. RESULTS

The results of observations made, are separated into three main parts as the Planning (Client and little design up front), Designing and development (prototype, designer and developer interaction), Testing and Evaluation (Usability testing and Evaluation).

A. Planning

In one of our studies, we noticed that inclusion of a usability commander was an excellent decision. In case of project B, without usability commander it was difficult to retain the usability, communication and collaboration among the developers team. It was noticed that Product backlog helped the team to identify and resolve external dependencies, however, one drawback of backlog we observed was that it was not user friendly especially in client/product owner case. Several studies suggested that Persona is an effective practice, but we noticed in our study Persona wasn't very helpful for the design team.

B. Design and Development

In our study, we notice the inclusion of User Stories, which is suggested by several authors, is not a good practice used in both cases. This practice wasn't efficient, whether it was combined with the prototypes because designed Prototypes by the designers were enough for the developers to eliminate ambiguities and improve accuracy of the software project requirements and functionality. Due to the prototype, a developer could understand what and how he is supposed to work. The role of Interaction Designer for the development team was very favorable and extremely important, especially in clarifying the developer's need to have a better understanding of the system. Prototyping and user testing artifacts, frequently help communication among development and design team. It is very difficult to accommodate both development and design teams at distributed level.

C. Testing and Evaluation

In one of the studies (Project-B), team conducted comparative usability testing, it is helpful and easy to plan, conduct and analyze. On the other hand, actual user testing is somehow difficult because it took time, to perform and analyze. In project A, team conducted usability evaluation, which provided a positive user experience. Usability testing helps to achieve learnability, efficiency and early error identification. Throughout project life, role of Usability commander of a design team is productive to ensure usability. The UCD design team does not participate in the release planning, Sprints and Scrums, they made only initial plans.

D. Summary of Results

In our research, we have shown results of two case studies of scrum projects involving UCD practice. In case A, the development of a website and mobile application is performed with main features such as Reading lessons, Memorization, Translation lessons and teaching of the rules of recitation, successfully integrated user-centered design practices into the scrum methodology. In case B, improvement in the design of an existing educational website, utilized few UCD practices, but excluded the usability commander and interaction designer individuals from participating in Sprint planning and Scrums.

In both circumstances, we noticed that involvement of the separate Design teams and UCD practices into Agile increase collaboration with cross-functional team and user satisfaction. Increase in usability had a clear impact on the success of the projects. Although it is a challenging task to deal with distributed teams to ensure usability. Inclusion of user stories was not an effective practice and completion of design in first iteration helped the organization to reduce cost and time of project. We also noticed that by adopting usability tests, client and development team interaction, there was a lesser need to back track the requirements which prove the fact less changing requirement also helped the team to complete the requirements in time.

V. CONCLUSION AND FUTURE WORK

Client satisfaction, usability, close interaction between designers and developers, cost, reduction in time, less changing requirements can be achieved by integrating agile and scrum practices. We have applied our proposed framework to two case studies and received promising results. Our framework is applicable to collocated development, with subject to the conditions it is applicable to the distributed environment. Primarily our proposed framework is applicable mainly to websites and mobile applications.

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