Investigating Agile User-Centered Design in Practice: A Grounded Theory Perspective *

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Abstract. This paper investigates how the integration of agile methods and User-Centered Design (UCD) is carried out in practice. For this study we have applied grounded theory as a suitable qualitative approach to determine what is happening in actual practice. The data was collected by semi-structured interviews with the professionals who have already worked in the integrated agile UCD methodology. Further data was collected by observing the professionals in their working context, and studying their documents, where possible. The emerging themes that the study found show that in agile team members there is increasing realization for the importance of usability in software development. The requirements are emerging; and both low and high fidelity prototypes based usability tests are highly used in agile teams. There is the appreciation of the each other's work of both UCD professionals and developers and both sides learn from each other.

Keywords: Agile Methods, Extreme Programming, Scrum, Usability, User-Centered Design, Grounded Theory, Interviews.

1 Introduction

The adoption of agile software development methods is growing in the industry. However in their development lifecycles, these methods still lack the realization for the importance of usability and usable user interface. Both the agile methods and user-centered design methodologies have many similarities: both methodologies focus on delivering value, both focus on customers/users, and their iterative nature and continuous testing are the key similarities for integrating them easily [1]. However, there has not been much investigation regarding how these two

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methodologies are actually practiced in industry; and how to successfully integrate HCI/usability techniques into agile methods is the area worth to explore.

In this paper we report our findings, the emerging themes of our qualitative research conducted using grounded theory [2]. The data was collected by semi-structured interviews with the professionals who have already worked in the integrated agile UCD methodology. Further data was collected by observing the professionals in their working context, and studying their documents, where possible. All the interviews were conducted by the first author. We also confirm some of the previously identified themes by Ferreira et al. and Fox et al. [3][4][5].

The next section describes related literature studies. Section 3 provides details about the research method and participants' profiles. Section 4 describes the results – the emerging themes along with the quotes of the participants. Section 5 concludes the paper with future work.

2   Related Literature Studies

There have been studies present in the literature that report about the various aspects and efforts for the integration of agile methods and usability/user-centered design. Patton [6] reports about the way of combining interaction design into the agile process and emphasized for the participation of all the stakeholders into the design process. His team was responsible for the UCD practices as there was no dedicated UCD professional [3] present in the team. In his recent article, Patton [7] describes the twelve best practices for adding user experience (UX) work to agile development. Chamberlain et al. [8] propose a framework for integrating UCD into agile methods by presenting similarities between two methodologies. McInerney and Maurer [9] interviewed three UCD professionals for integrating UCD within agile methods and their report was positive. Meszaros and Aston [10] describe how they introduced paper prototypes based usability testing into agile process. Sy [11] reports the parallel tracks used at her company by both UCD professionals and developers to integrate UCD with agile methods. At every iteration called cycle, the coordination between UCD professionals and developers was smoothly done in that way that UCD professional were always one cycle ahead to gather requirements and design for the next cycles while testing the previous cycle's work. Ferreira et al. [3][4] have investigated four projects in four different countries for the integration of UI design and agile methods. They have used grounded theory qualitative method for their study where they have conducted semi-structured interviews from the two members of each project, one who concentrated on UCD and one who concentrated on programming. Some themes that emerged from their data they report, are: there is advantage in doing up-front interaction design; do most of up-front design; much part of interaction design consists studying clients and users; interaction design learns from implementation by developers; cost and time are constraints; both usability testing and development affect each other; and agile leads to change

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[3] We use the term UCD professional equivalent to usability engineer, interaction designer, UI designer, user experience designer, etc.

the relations of UCD professionals and developers. Using the same grounded theory qualitative approach, Fox et al. [5] also investigated the integration of UCD with agile methods. They conducted semi-structured interviews from ten participants, one member from each team, in North America and Europe where majority of the participants were UCD professionals and only few were developers. They describe three approaches taken by the participants to achieve the integration and term these approaches as generalist, specialist, and hybrid approach. In generalist approach there is no UCD professional present in a team but this role is performed by a developer having interest in usability/UCD. In specialist approach one UCD professional is present in the team; where as in hybrid approach a team member has both formal UCD training and also has experience in software development. Brown et al. [12] report that they use various artefacts, such as stories, sketches, and lists between UCD professionals and developer in their agile process. Ungar [13] reports the advantages of introducing a Design Studio, a collaborative workshop, into the agile UCD process. "The design studio is a rapid process that allows designers, developers and stakeholders to collaborate and explore design alternatives. Participants grow their skills by exchanging viewpoints with their peers and openly discussing the strengths and weaknesses of their work. The design is enriched and strengthened from the feedback" [13]. In their work, Wolkerstorfer et al. [14] and Hussain et al. [1], [15] report on the integration of various HCI techniques, e.g., field studies, usability tests, paper prototypes, usability expert evaluations, etc., into their agile process. Recently, Miller and Sy [16] discuss issues regarding agile user experience.

Except the work of few studies, many studies are anecdotal; albeit providing important information that how the UCD is integrated with agile methods at various levels and at various levels of efforts. Studying the various aspects of the integration of agile methods and usability/UCD is the area worth to explore for developing usable and quality software products. Our research aimed at enhancing this knowledge base to identify new themes, and supporting and confirming the existing empirical evidence by using grounded theory qualitative approach.

3   Method

Besides technical focus, software development is mainly a human activity carried out by team members; so qualitative approach is needed to study this human behavior; as with qualitative approach researcher is forced to delve into the problem's complexity thus making the richer and more informative results [17]. As we wanted to study how the integration of agile methods and user-centered design is carried out in practice; which and how team members are integrating and using usability/UCD techniques into agile methods; we chose to use grounded theory qualitative research method [2]. Grounded theory method is used to discover theory from data [18] - mostly from the 'voices' and 'experience' of the practitioners [19] but also from other form of data like observations and documents; and its application to human behavior is well-known [19]. Grounded theory is "useful for discovering behavioral patterns that shape social processes as people inter-

act together in groups" [18]. It is used to generate a mid-level substantial theory that is directly derived from the data rather than verifying prior hypotheses [18]. Coleman and O'Connor [19] describe the analytical process of grounded theory, "The analytical process involves coding strategies: the process of breaking down interviews, observations, and other forms of appropriate data, into distinct units of meaning, which are labelled to generate concepts. These concepts are initially clustered into descriptive categories. They are then re-evaluated for their interrelationships and, through a series of analytical steps, are gradually subsumed into higher-order categories, or one underlying core category, which suggests an emergent theory." Basically for social sciences and specifically in nursing, grounded theory has also been applied in information systems, software engineering as well as in agile software development [20][19][21][3][4][22][5][23].

Since the initial discovery of grounded theory by Glaser and Strauss [2], now there are at least three versions of grounded theory [18] but we employed the Strauss and Corbin approach [24] and [25], because they argue that "the researcher's personal or professional experience is supportive of theory building and contributes to theoretical sensitivity, the ability to understand the data's important elements and how they contribute to theory" [19]. We have the experience of both as the professionals as well as the researchers in the study area, i.e., agile usability/UCD; and are already familiar with the literature thus this knowledge supports the theoretical sensitivity. Another reason for selecting the version of Strauss and Corbin is that "they favour setting the research question in advance of commencing a grounded theory study, rather than it being allowed to emerge at the coding phase as advocated by Glaser" [19]. We also set few questions in advance: How the integration of agile methods and user-centered design is carried out in practice? Which HCI techniques are being used in agile methods? How the role of UCD professional is carried out in agile teams? Besides finding new themes, we also wanted to confirm the studies of Ferreira et al. [3][4] and Fox et al. [5].

Grounded theory consists of a set of established procedures and guidelines for the systematic collection and analysis of qualitative data [21]; of which constant comparison method is the heart of grounded theory [18] where data and concepts are constantly compared to each other during collecting and analyzing the data, to ensure that an integrative theory is developed which is grounded in the raw data [21]. In theoretical sampling, the sampling is continuously selected based on emerging categories and concepts [2]. So the interview questions are being changed according to these emerging categories as well as "the researcher may decide to interview certain types of individual or seek out other sources of data" [19]. We developed an initial interview protocol with the help from literature and from our own experience. Initially, we conducted a pilot interview from a project manager who is also certified scrum master and works in a software developing company on a project about social networking and employing scrum agile method. We then adjusted our interview protocol by getting feedback from his interview and it was slightly but continuously modified as the interviews were conducted and data was gathered. For the analysis we used Atlas TI software

tool which is suitable for grounded theory analysis. In grounded theory for the analysis first step is open coding, where codes or labels are allocated to data obtained from interview transcripts and from other sources if any [19]. The purpose is to identify important concepts in the data and then categorize it [5]. During our open coding analysis, codes were allotted to data which were then, constantly compared to subsequent data. At the end of open coding, initial concepts and categories are identified which are then used in axial coding to make relationships among categories and their sub-categories, and identifying core category/categories. We compared initial categories with subsequent categories and made relationships among them in the form of categories and subcategories. Finally in selective coding, core categories are used to find themes or high-level concepts that emerge from the data [5]; and that explain how the participants are carrying out their work and solving their problems. Another ongoing technique in grounded theory is memoing which is "the ongoing process of making notes and ideas and questions that occur to the analyst during the process of data collection and analysis" [26]. These memos have important role in identifying ideas or hypotheses and generating the themes or high-level concepts [19]. We continuously wrote memos during the interviews and during the analysis of the data which helped us in generating the themes during the all phases of analysis and those themes are described in the results section.

3.1   Participants

We denote the participants as P1, P2, P3, P4, and P5 because of their confidentiality. Based in Austria, P1 is a usability expert who provides consultancy to both agile and non agile projects ranging from banking sector to transport to typical web based applications whose durations vary from 6 months to 3 years. He also delivers lecture at a local university. He works with the companies whom either do not have expert UCD professionals or have certain knowledge of usability but they don't have resources to manage it, so they have to buy resources. Depending upon the projects, sometimes he is the only UCD professional and sometimes his two other colleagues also work as UCD professionals in the projects. In one of the companies which is employing XP process, he is working as a UCD professional, so according to the Fox et al. he is performing the role of specialist [5].

Based in Austria, P2 is a developer who has also interest in usability so he is performing the role of generalist [5]. . He works in a team with 3 team members, one project manager and two developers. They use combination of XP and Scrum and modified their practices according to their context. The web based product is for sales people who can optimize their sale process.

P3 is based in Finland, and works in a large mobile phone company. He is a program manager and works on multiple projects using scrum. They develop mobile phones and telecom applications and also configuration tools for internal use. After failure on a project using traditional waterfall process, he switched to agile methods and now he is continuously working on different projects by employing scrum agile method. In one of the projects, team size is about 6

persons, one person as tester, 3 to 4 developers, and UCD professional; so the role of specialist is being carried out in this team [5].

P4 is based in Germany who is an agile coach, a consultant and a certified scrum master. Mostly, he has been working as a project manager consultant with telecom sector and has been developing and leading teams for mobile phone applications. In one of the agile projects where he is working as a coach and project manager using scrum, there are 8 members who all are developers as well as having good background in usability as according to [P4], "In that team, most of the people are actually coming from user interface design for mobile phones, so they almost all have a feel of what is the good UI because they saw many of those... They already have quite a lot experience of developing UI and some of them are developing these types of things something like 14 years but, one even 15 years, even before working in agile process. Usability was a part of our job description since quite long time... The general concepts about usability are discussed together by the whole team including management; and the low level usability, so what happened when the user presses a button, how for example scrolling goes, those are mostly decided by the engineers themselves." The role of UCD professional in this case is carried out differently as all are both developers as well as having good experience in UI design, nevertheless, we would call this type of role as hybrid as described by Fox et al. [5].

Based in Austria, P5 is a developer and project manager who has also experience in usability. He works on products which are used in hospitals for the medical staff and he also develops software for clinical research. They are using agile process which has been adapted to their context where many agile practices have been taken from pragmatic programming, scrum and XP. The team consists of 3 to 4 persons, among them one is usability engineer who is not present in the team all the time but is accessible on demand. He is contacted for the formal usability tests, otherwise mostly the usability tests, i.e., low and high fidelity tests and thinking aloud tests are conducted by P5. Here again, the role of UCD professional is carried out differently as both the role of specialist as well as generalist is present in this project. So again, this is a new situation for the role of UCD professional than described by Fox et al. [5].

4   Results

This section describes some of the main themes, main concepts that emerged after the analysis of the data. The relevant passages from the interview participants are also presented.

In agile team members there is increasing realization for the importance of usability in software development where as agile methods also provide advantages to usability/UCD for its integration.

[P1] "This is also an indicator for me that it is good to use agile developments because then you have shorter cycles and then you have the possibility to integrate in the next cycle. If you use conventional project processes, you don't have the possibility, for example for half a year, to integrate. So agile development is

good in that the usability results can be easily integrated in its short cycles and end users become more satisfied."

[P2] " We have no usability engineers, but I have interest in usability... Usability fixes can be done because of agile development we always have a working software so it is easy to find usability changes which then can be fixed according to the priority."

[P3] "The usability guy has value for the project... He thinks how the process and one sitting proceeds; so which functions are more used, which should be more easily available, which is used, which is the harder way to access, how to jump in from one component to other, and that kinds of issues. He has better vision and intuition what is better and what is not."

[P4] "Usability testing and taking care of UI into agile process, it is beneficial...The usability tests and evaluating UI with users bring lot of feedback to be fixed, so it was easy for us to fix those usability results into small iterations of agile process."

[P5] "Being both a developer and having interest, experience in usability is a plus point. If your product is usable, the user acceptance is far better than if it is only functional but unusable... Usability is always a main feature of the software, so the good usability is really important."

Almost all the participants mentioned that integrating usability/UCD into agile process has enhanced the quality and the usability of the product and increased the satisfaction of the users. Some also pointed out that this integration has added value to their team and the process.

[P1] "We also have some numbers showing about the company that they compared page usage with user sessions and it doubled their usage and this was because of our usability work."

[P2] "Yes, we have good experience with that and customers, who are both customers and end users, are happy about that; they give us good feedback; they get what they want; and so we don't have bad experience about that."

[P3] "Yea, well, on this case I say, it's quite good proof because we tried on traditional way and it crashed and burned and nothing got. It was totally unusable, and this (using usability into agile process) we got...also the short iterations are good or the customer doesn't forget what he has asked for. Because in first case, they had changed their minds over the half year period, so that's why it wasn't any more what they expected and wanted. So now in agile, we can show the customer what he asks for immediately... The integration of usability techniques into agile method has added value to our team and the process. I definitely would like to use more."

[P4] "As the product is new and not yet public so we don't have real external users but it has increased the satisfaction of the internal users... Usability testing and taking care of UI into agile process, it is beneficial."

[P5] "Of course, yes."

Almost all the participants mentioned that they do some up-front design to understand users, their goals, and the project vision; and the requirements are emerging. This result is consistent with other studies [3][4][5].

[P2] "For the initial vision of the project we do paper prototyping with the customers (who are also end users) to understand their goals; and then we are getting continuously requirements from the customers during every cycle."

[P3] 'Initially, we (as a team) did prototyping with end users, we discussed it with them and said this is what you are and on which you are comfortable and then on demo when we went through and we sat after wards and asked does it work for you? How are your feelings? ....The requirements are gathered for about one sprint. The usability guy takes feedback from the team members, from customers and user representatives, and shows them and asks them how they feel it; and of course there is feedback that this design works very well and this does not work and then it as taken as a requirement for the next sprint and so then it is fixed.'"

[P4] "The requirements are emerging and they are not fixed up front. As the product is completely new, so the customer had no clear requirements, he just provided few requirements and the majority of the requirements are generated internally by us (the team and the internal users at the company); and there were few requirements also generated by technology. So the customer just had the vision of the product, a generic vision and we are putting meat into it (the features). There was informal feedback got from outside but no formal feedback because they wanted to keep their product secret...Initially, paper prototype was something used in brainstorming and even in product manifest period and were shown internally. So in visionary meetings we used drawing boards, and also simulated them using NetBeans with GUI designer with the screen shots and how you move."

[P5] ". The requirements are always emerging. The customer has only the vision. So only 20 to 30% requirements are already fixed and the rest are emerging. So the html mockup is the first version we implement and evaluate them to the customer to get more requirements."

There is the appreciation of the each other's work of both UCD professionals and developers and both sides learn from each other. This result is also consistent with [3][4][14][15].

[P1] "Because of different understanding, from developer perspective from usability perspectives, we are presenting the results in the form of workshop; so we try to invite developers and the other team members to discuss and to ask questions, because this is more efficient. During the discussion a developer pointed out technical, legal and security issues. And this was also an information for us; so we said ok we have to consider it in future."

[P3] "Of course we have to consider how it is difficult to implement. So we have the conversation that what is possible at technical level and in this way the usability guy also got feedback from the developers. For example, the usability guy is presenting something and saying this is good and then when it is tested for example, in a testing environment and then it came out that it's response time is too long and on paper it looks good but it is not usable."

Both low and high fidelity prototypes based usability tests are highly conducted in agile teams. The forms of prototypes vary and include paper proto-

types, screenshots, powerpoint presentations, html mockups, etc. This result is also consistent with [10] and [15]. Usability tests on working software are also conducted. Other HCI techniques that were mentioned by the participants and sometimes also conducted are heuristic evaluations and thinking aloud. Fixing of usability feedback depends upon how big the usability change is. If it is big then it is implemented in the next iteration cycle, otherwise it is fixed in the same iteration cycle.

5   Conclusion

This paper investigated how the integration of agile methods and user-centered design is carried out in practice using grounded theory. The emerging themes that the study found show that in agile team members there is increasing realization for the importance of usability in software development; whereas agile methods also provide advantages to usability/UCD for its integration. The participants also mentioned that integrating usability/UCD into agile process has enhanced the quality and the usability of the product and increased the satisfaction of the users. Some also pointed out that this integration has added value to their team and the process.

Some up-front design is carried out to understand users, their goals, and the project vision. The requirements are emerging. The usability changes are fixed in the same iteration cycle or in the next iteration cycle depending upon how much they are big. Both low and high fidelity prototypes based usability tests are highly used in agile teams. There is the appreciation of the each other's work of both UCD professionals and developers and both sides learn from each other. Almost all the results are consistent with the existing studies present in the literature. We also confirm some of the previously identified themes by Ferreira et al. and Fox et al. [3][4][5].

It should be noted that the sample data set of five participants for grounded theory research is small which may be the limitation of the study but we plan to conduct more interviews from various participants working on different projects to verify and extend the results found during the current study. The current qualifying core category is "the realization for the importance of usability in software development"; which will be verified by conducting further interviews and collecting various forms of data.

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