THE IMPACT OF USER EXPERIENCE WORK ON CLOUD SOFTWARE DEVELOPMENT

Kati Kuusinen
Tampere University of Technology
P.O. Box 553, FI-33101 Tampere, Finland
kati.kuusinen@tut.fi

Abstract

Cloud computing is getting more popular means to provide software to end users. However, little is known about how to develop Cloud software that provides good user experience. This paper introduces an agile software development model where a product owner and user experience specialist work closely together from the beginning. We followed a distributed project team consisting of a product owner, user experience specialist, technical specialist, scrum master, and five developers with a repeated survey for sixteen weeks. We observed that the project benefitted in several ways from the close cooperation between the product owner and user experience specialist. The project team was able to dramatically shorten their lead time, improve user satisfaction and decrease the amount of work in progress.

Keywords: Cloud, Software, Agile development, User experience (UX), Agile UX

1 Introduction

Users are expecting to be able to use Cloud based applications with numerous devices [1]. They expect efficient interaction flow and coherent inter-device user experience (UX) [1]. The most common user interfaces (UI) to Cloud services include web applications accessed via browsers and native mobile applications. With the latter method, the UI needs to be adapted to the device operating system, which may not be a trivial task in maintaining the consistency of UX between platforms and devices. UI elements and navigation (e.g. gestures on touch screen) should follow the operating system guidelines [14, 22]; and the consistency of the UX should be achieved on a higher level [14]. Another issue that may endanger the cross-platform consistency of UX within Cloud based systems is the fact that platform owners, service providers, and device manufacturers can be have conflicting business interests guiding their UX development [14].

Applications based on Cloud computing [2, 17] are in general smaller and more limited in features than traditional desktop software. The importance of UX work is in that sense emphasized in Cloud software development [11]; the software should fulfill the most essential user needs also via small screens and limited input methods [21, 22]. The fact that Cloud software differs from desktop software should be considered in the software development. The existing literature gives little guidance on Cloud software development. Guidance on mobile application development can be applied to some extent within Cloud software development. However, it is another less studied area [22].
We studied a software project team developing Cloud based mobile applications for enterprise use. The team was working in a large globally operating information technology service company which is a market leader in the Northern Europe. The team has been developing an agile [12] software engineering process for Cloud based mobile applications. The current process model, which is under continuous improvement, has already provided tremendous improvement compared to the earlier approach that was a less systematic mix of waterfall and Scrum. In this paper, we present a process model for developing Cloud software, the project team collaboration frequencies, and correlational study results over several practices the team had during the 16 weeks study period. The goal of the paper is to contribute to the understanding of the collaboration between UX specialist and others in a successful Cloud software project and to reveal correlations between the predicted success and the ways of working.

The paper is structured as follows: Next, in section two we shortly introduce the background and related research. Section three introduces the research method. After that, we begin the results section by a description of the studied project and development model and continue with the actual research results and limitations of the study. Finally, we discuss the results in section five while section six concludes the paper.

2 Background and Related Research

We understand user experience (UX) as the person’s perceived value that results from the use or anticipated use of software in a certain context of use [10, 13]. Basically, UX work can be considered as any task in software development that aims or results in creating UX. Any piece of software that is used by someone will result to user experience whether the UX design was consciously created or not. By agile UX we mean any UX work that is conducted in an agile manner or within agile software development. Agile UX aims to integrate UX work with other agile software development practices [20].

As the current agile development approaches, such as Scrum [19], do not include UX activities, the cooperation is not always straightforward [3]. Common problems in agile UX work include e.g. differences in timing, problems in communication, and compromising the UX of the outcome in decision making [3, 5].

One commonly recommended model for agile UX work is the ‘one sprint ahead’ approach by Sy [20] where a UX specialist works a bit ahead of implementation to deliver the design in time for development. Commonly recommended practices include some design upfront, close cooperation between UX specialists and developers, and doing user tests – each of these were recommended by over 20 papers analyzed in a recent systematic literature research [7]. Following these practices has been reported to not only improve user satisfaction and product consistency but also to lead to shorter development time and lower costs by increasing the accuracy of project estimation [8]. They have also helped to find defects faster [4].

3 Method

We used a mixed methods approach where the core of the data was gathered from the participants of one particular software project with a repeated web survey during 16 weeks. In addition, we interviewed four of the project participants before starting the 16 week follow-up period. We also studied project and process documentation to understand the way of working.
After the 16 week period, we validated the results with the product owner and UX specialist in an online meeting. The survey concentrated on how UX work was being conducted and who were contributing to it. The UX specialist was answering a separate survey, which provided more detailed information compared to the one the rest of the team was using.

We interviewed four project staff members individually via Microsoft Live Meeting; the product owner, UX specialist, scrum master and a developer. Each interview took 45-55 minutes. We recorded and transcribed the interviews and categorized the data into the following interview themes:

1. job and project description,
2. way of working (process model, tools),
3. collaboration between the UX specialist and the others,
4. challenges in communication and cooperation,
5. project goals, user needs and goals, verifying goal achievement,
6. gaining information about users and their needs, and
7. experienced success factors and needs for improvement in the current way of working.

In the survey, we asked on a seven-level semantic differential how clear the project is in general, how good the UX of the project outcome will be, the weekly amount of rework because of UX, and the level of understandability and implementability of the user interface (UI) design. We also had defined different development tasks from concept creation and requirements clarifying to reviewing implementation and having a demo session. Tasks were selected to cover the most relevant activities of UX specialists in software development projects. The task selection was based on our previous research where we, among other things, determined the typical tasks of UX specialists, and how UX staff is cooperating with others during development by surveying 143 and interviewing 34 persons from two international software companies (see [15, 16]). The task list was iterated based on a review by four UX specialists from two companies. The survey included two open fields for reporting tasks that were missing from the list.

The project staff reported each week if they had participated in the tasks and whether the UX specialist was also participating. In addition to filling the task list, the UX specialist reported the roles she cooperated with. The UX specialist’s survey also had a diary-like question for describing the week. Background information was collected from all the participants once.

The survey data was analyzed by calculating frequencies of cooperation between the UX specialist and the others and comparing the weekly variation of the frequencies with the task types and employee roles. We gathered weekly diary-like data from the UX specialist and combined it with the frequencies to explain the cooperation. In addition, we calculated Pearson’s product-moment correlations between the measured factors pairwise using SPSS.

4 Results

This section first characterizes the studied development project and the process model they utilized (subsections 4.1 and 4.2). The project and process description were collected with interviews and studying the project and process documentation. The rest of the section describes the actual results of the survey and interviews.
4.1 Studied Project

The project was developing Cloud based mobile applications for enterprise use. In general, those applications were additions to existing enterprise system software such as working time management or sales management. The goal of the project was to create small tools that would make the generally boring routine work more pleasant and time-saving. The idea was to enable employees to e.g. enter their work hours while sitting on a bus, or to enable salespersoons to view customer data graphs with a mobile phone during sales negotiations.

One challenge in the project was to identify those tasks that users would like to perform with a mobile hand-held device; tasks that it would make sense to develop for the mobile device. Other challenges included redesigning the selected tasks for small touch screen, and to make tasks that are routine and dull on desktop to be more appealing on a mobile device.

4.2 Development Model of the Project

The project team was distributed on two separate sites that located in Finland and in China. The team in Finland consisted of product owner (PO), user experience specialist (UXS), and technical specialist (Tech), and in China of scrum master (SM) and five developers (Dev) (Figure 1). The PO and UXS worked as a pair. They had the general responsibility over the product. Internal or external customer was located on a third site. The customer provided the first pilot users who were involved during the development and a sponsor authored to make high level decisions concerning the project. The roles of PO, SM and Dev were in accordance to the roles defined by Scrum [19].

PO and UXS created and maintained the ordered product backlog together. Whereas the PO was liable of clarifying and explaining the content of the release and the reasons behind it, the UXS was responsible for the way the application works. The technical specialist assisted especially during the concept creation to ensure the technical feasibility of the release.

Project success was followed by e.g. lead time (the latency between getting funding and shipping the application or feature to user) and user recommendation per cent. User recommendation per cent was measured with a repeated web survey with one question asking how likely the respondent was to recommend the service to their colleagues.

![Figure 1. The process model the studied project utilized.](image-url)
The process consists of the following phases:


Go means getting funding and live means that the user has the application in use. The other phases are illustrated in Figure 1 and are described below.

4.2.1 Concept and project plan

The application creation starts from concept creation where user needs are defined as design. The concept, which is owned by the UXS, is created in face-to-face workshops together with users and other stakeholders. The concept describes the expected outcome, intended user groups, user and business values, and means to realize the expected outcome.

The PO owns the project plan. It illustrates the business case, strategic grounds behind the project, purpose of the project, product roadmap, and development methods. The PO, UXS and Tech do release planning together. In general, the Tech has a consultant role.

4.2.2 App

Tasks are implemented during the app phase. UI design is communicated to the development team as an ordered list of usage scenarios. Work is continuous communication: “at the point where we get the (UI) pictures, then, the action flows are pretty clear as well, because we have lots of demos, and during these weekly demos we get a lots of feedback” (scrum master).

Development is conducted utilizing pair programming. During development, user and customer feedback is gathered via demos, usability tests, and piloting. Feedback is discussed and repossessed to the development team via product backlog. The project has a demo session once a week and before that, the UXS reviews the implementation “for example, we will both go to the same screen, then we share our screen. And then we can discuss” (scrum master about communicating with the UXS). The app phase ends separately for each task when the task passes certain definition of done and is accepted by the PO.

4.2.3 Pilot

In piloting, a set of users test the application to verify its usability and functionality before the actual launch. The length of the pilot phase varies from weeks to a month. During the pilot period, user feedback is gathered with a web survey. The project team implements adjustments and bug fixes in the application based on issues found during the pilot period.

4.3 Research Results

We followed a project developing Cloud based mobile enterprise applications for 16 weeks between April and July 2012. Next we present the findings of the survey and interviews. The findings are grouped into the following categories: cooperation between the UX specialist and others, differences between the site in China and in Finland, and results of a correlational analysis of the survey responses associated with the interview findings of experienced success factors. At the end of this section, we discuss the research limitations.
4.3.1 Tasks performed with the UX specialist

In the project, a UX specialist (UXS) was working full-time and from early on in close cooperation with the product owner (PO). The UXS was participating almost all the studied activities (Figure 2). The UXS was mostly working alone while creating user interface (UI) design, creating or grooming product backlog, making changes to the UI design, reviewing implementation and conducting other UX related activities such as working on styleguides, doing graphical design and analyzing user survey results. Most frequent tasks the UXS conducted with others included clarifying user requirements, reviewing the UI design, helping others to understand the UI design, having demo sessions, and changing the UI design. There was no significant variation over time in the performed tasks and cooperation.

![Figure 2. Frequency of tasks conducted with or without the UXS during the 16 weeks study period.](image)

The UXS reported on a weekly basis the roles with whom they had been cooperating during each task. The cooperation was the most frequent with the PO (41 notes mentioning the PO), with developers (23 notes), and with the customer (20 notes). Other stakeholders the UXS cooperated with included other UX specialists (10), the scrum master (8), managers (7), users (2), and salespersons (1). The UXS was cooperating with others the most during demo sessions (32 notes of other participants), when reviewing implementation (14 notes), helping others to understand the UI design (14 notes), and reviewing the UI design (13 notes).

4.3.2 Differences between the sites

The staff at the site in China reported more often that the UI design was not understandable or implementable, and they had to do more rework due to UX design than the staff at the Finnish site (Table 1). Interviewees from China reported more problems in communication than the Finnish ones. The majority of the problems were related to differences in working times and the communication means. The scrum master told that “we cannot have a proper discussion about UI because of the time difference ... the UX specialist and product owner take care of the UI, but they keep us in the loop”.

"dataset"
Table 1. Averages and standard deviations (in brackets) of survey responses in China and in Finland.

<table>
<thead>
<tr>
<th>Question</th>
<th>Chinese site</th>
<th>Finnish site</th>
</tr>
</thead>
<tbody>
<tr>
<td>The UI design was not understandable (0) – understandable (7)</td>
<td>5.42 (1.31)</td>
<td>7.00 (0.00)</td>
</tr>
<tr>
<td>The UI design was not implementable (0) – implementable (7)</td>
<td>5.40 (1.43)</td>
<td>7.00 (0.00)</td>
</tr>
<tr>
<td>I had to do rework because of UX (not at all 0 – very much 7)</td>
<td>3.53 (1.96)</td>
<td>2.60 (1.84)</td>
</tr>
</tbody>
</table>

Another difference was that the survey participants in China named no UX goals for the project, and the interviewed ones just described that the user should have “good user experience and to be happy”, or “it should be easy to use” while the PO and UXS gave detailed descriptions. It seems that UX goals are not communicated effectively enough to the developer site. Such general goals do not help developers in their work.

There were also differences in the preferred UI communication methods. The UI was first discussed and iterated with Power Point pictures. Later, the UXS sent the final design in detailed pictures to developers. The SM would have preferred to get the UI pictures as wireframes: “if you have these wireframes, it is a whole overview, and basically ... you simulate actually the application before you even get it, before you actually even start developing it ... I would like to avoid this explanation text (static Power Point pictures have arrows and explanation texts to communicate the user flow or navigation). I would just prefer to have these wireframes, where you can clearly see what happens at what point”.

On the other hand, the UXS stated that they have no time to draw wireframes “we reuse components when possible and that makes it quick just to modify the existing detailed images”, and continued: “part of the developers would prefer detailed UI pictures whereas others would like to get only measures and guidance to code the UI ... but developers understand finalized graphics better”.

4.3.3 Correlational analysis and experienced success factors

We conducted a correlational analysis for the survey data with Pearson’s product-moment correlation using SPSS. The most significant correlations are illustrated in Table 2.

Table 2. Correlations between the measured factors (22 < N < 39, within-subjects design with 9 subjects).

<table>
<thead>
<tr>
<th></th>
<th>Project clarity (low-high)</th>
<th>Predicted UX (bad-good)</th>
<th>Rework caused by UX (low-high)</th>
<th>UI design understandability (low-high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project clarity</td>
<td>1,000</td>
<td>.775***</td>
<td>-.523*</td>
<td>.503*</td>
</tr>
<tr>
<td>Predicted UX</td>
<td>.775***</td>
<td>1,000</td>
<td>-.729***</td>
<td>.743***</td>
</tr>
<tr>
<td>Rework caused by UX</td>
<td>-.523*</td>
<td>-.729***</td>
<td>1,000</td>
<td>-.710**</td>
</tr>
<tr>
<td>UI design understandability</td>
<td>.503*</td>
<td>.743***</td>
<td>-.710**</td>
<td>1,000</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.0001 level (2-tailed).
***. Correlation is significant at the 0.01 level (2-tailed).
* . Correlation is significant at the 0.05 level (2-tailed).

The predicted goodness of the output UX correlated positively (Table 2) with the experienced project clarity (r = 0.775, p < 0.0001) and the UI design understandability (r = 0.743, p < 0.0001), and negatively with the amount of rework caused by UX design (r = -0.729, p < 0.0001). In addition, we found a clear negative correlation between the understandability of
UI design and the amount of rework caused by UX work ($r = -0.710, p < 0.01$). On the other hand, there was no correlation between cooperating with the UXS and the other factors (e.g. cooperating with the UXS and the predicted UX: $r = 0.380, p = 0.120$, not significant).

The project success was measured by lead time and level of user recommendation. During the interview, the PO described that such a set of meters is simple enough to reveal the level and trend of the project success. User recommendation was measured constantly during the development and thus the project team was able to react immediately if the level was decreasing. The PO did not want to reveal the actual lead times, but they have decreased significantly since the process model was introduced and the close cooperation with the UXS started in January 2012. When asked about project success factors, both the PO and UXS were convinced that the close cooperation from early on is a key success factor in their project, and it makes the work more efficient. The emphasis of their work was in concept creation, scenario making and eliciting user needs. The UXS stated that one success factor is to include UXS into decision making; in many cases managers and POs are more experienced in estimating the amount of developer work whereas it is more difficult to them to estimate the amount of UX work needed in a project. Other experienced success factors included focusing on producing smaller applications in terms of scope and feature amount. The PO, UXS and Tech created concepts together to align business, customer, user and technical goals. The concepts were as lean as possible; nice to have features were excluded from the developed applications, which reduced the development time and costs and the amount of work in progress. It also seemed to make the project clearer to the participants.

4.4 Research Limitations

The study described in this paper was conducted within one project with nine project team members. We did not give any definitions in the questionnaire what kind of cooperation would count. The participants reported their activity once a week. Therefore, they might not remember every task or every occurrence of cooperation. There might also be differences in the tendency to report cooperation, e.g. some might have reported cooperation if the UXS was just present in a demo session while others may have reported only if they talked to the UXS. One means to improve the reliability of the study would be to observe the UXS. However, we got data via interviews and repeated survey both from the UXS and the others. We compared the reported cooperation between subjects and it was quite consistent. Both using repeated measures and multiple methods to gather data increased the reliability of the results. Thus, the approach we used gave detailed enough information of the cooperation for reporting cooperation frequencies and tasks of the UXS with decent reliability.

5 Discussion

The process model the project used was based on Scrum. The project basically utilized an approach similar to the ‘one sprint ahead’ model introduced by Sy [20]. In the Sy’s model a UX designer is working one sprint ahead of development. In the project’s approach a PO and UX specialist worked closely together to create features, tasks, user interaction model, and UX designs. They utilized a ‘some design upfront’ approach that has been widely recommended (31 papers analyzed in a recent systematic literature review recommend it [7]). The UX specialist cooperated with a technical specialist when needed which is recommended by e.g. Budwig et al. [4] and Petrovic et al. [18]. When the design was ready to be
implemented, it was communicated to the development team. The developer task list worked with a pull mechanism and the amount of work in process was limited.

The project staff predicted the UX of the outcome better when the amount of rework caused by UX was low, project was clear in general, and the UI design was understandable and implementable. These correlations might indicate that when the project goals and UI design are not communicated effectively, the project members might lose their motivation towards UX issues. In addition, we found a clear and significant correlation between the understandability of the UI design and the amount of rework caused by UX work. It would be quite evident to reason that making understandable and implementable UI design might lead to less rework. This would emphasize the impact of early and continuous cooperation between the UXS and other team members as commonly recommended (e.g. by [4, 6, 7, 9]).

The project managed to tackle many problems commonly faced in agile UX work. Such problems include compromising UX in decision making and differences in timing [3, 5]. However, some problems related to offshore communication and communicating UI design remained unsolved. However, these are common problems in agile development in general.

6 Conclusion

The role of user experience is emphasized in Cloud software because of high user expectations and more demanding devices and contexts of use [1, 21]. Therefore, a successful Cloud software development model should provide a central and early role for UX work. UX work helps in clarifying user needs and objectives and thus it helps to focus on developing only the essential features with functionality of user preference. That again leads into shorter development time, smaller project costs, better maintainability and user satisfaction.

We conducted a study where we followed a project developing Cloud software for sixteen weeks via a web survey and interviews. The project success was measured by lead time and user recommendation per cent. The cooperation between the UX specialist (UXS) and others was measured with a weekly survey. The UXS was involved from early on, in cooperation with others during the majority of activities.

The project was able to dramatically drop their lead time while getting high levels of user recommendation. The key success factors were considered to be the close cooperation between the PO and UXS, and the ability to focus on simplicity and leanness of the software being developed that was enabled by the cooperation.

The UXS cooperated with other project team members the most when clarifying user requirements, during demo sessions, helping the others to understand the UI design, and reviewing the design. Communication about the UI design was thus the main collaborative activity. However, the means to communicate the design in a distributed project had some problems. The preferred form of design was varying between wireframe, detailed pictures with explanations, and giving only dimensions and guidelines.

7 Acknowledgment

I want to thank the project team in Finland and in China for their active participation during the study, and the company contact person for enabling the study. I am grateful to Santtu Pakarinen and Marie-Elise Kontro for their help with the analysis and interviews, and Tommi
Mikkonen for good comments and support. The study was funded by the Finnish Funding Agency for Technology and Innovation (TEKES); it was part of the Cloud Software program.

References