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# End-user data based requirements analysis and design in agile software development: An experience report

*Bachelor of Science Thesis in Software Engineering and Management*

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### **End-user data based requirements analysis and design in agile software development: An experience report**

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**Abstract**—The purpose of this thesis study is to investigate the effects of different end-user data collection methods. The main research question conducted in this study is: how can collection and analysis of data from end-users be used for requirements analysis and design of features in agile software development? To carry out the study, we implemented design science as our main research methodology. A user observation method, a survey method and an interview method were distributed in different regulative cycle iterations combined with scrum methodology. The user observation method was implemented primarily in the first iteration, followed up by the survey method in the second iteration and finally the interview method took place in the third iteration. The conclusion of this thesis work is that integrating design science methodology in agile software development process is a good way of carry out a research study. Furthermore, the result of our study shows that the survey method can provide a better effort for collecting both quantitative and qualitative data measurements.

**Keywords**—instant chatting message, design science, scrum methodology, agile software development, data collection, regulative cycle, user observation method, survey method, interview method.

## I. INTRODUCTION

Our main idea of this thesis study is to integrate and analyse the end-user data collections within agile software development. Our research paper contains the comparison and analyzation of multiple data sources, as well as data collection during agile requirement development. The result of this research study can contribute an experience to other similar software studies in agile software development area.

### *Research question*

**RQ1:** How can collection and analysis of data from end-users be used for requirements analysis and design of features in agile software development?

Specifically we are also interested in the following subquestions:

**RQ1.1:** How can the data analysis be integrated into an agile development process (i.e. Scrum sprints)?

**RQ1.2:** What are advantages and disadvantages of different data sources (i.e. interviews, surveys, end-user observation)?

We get better support to answer our main research question by adding these sub-questions. We created two sub-questions to cover the area of data analysis, agile development integration and data source usage to fully cover the main research question. Our research question is focusing on the data collecting and data analysing method used in the new feature implementing process in agile development.

The key finding of this research topic is that: implementing survey method for end-user data collection as requirements analysis works the best among all three methods. We adopted regulative cycle as researching method in agile software development process which works very well to carry out this research study.

We introduced the research questions in Section I, case company background and related work are introduced in Section II. Section III contains the main

research method, section IV shows our findings related to research questions, we discussed the research results and valid threats in section V and in section VI we concluded our research study for the main research question.

## II. BACKGROUND AND RELATED WORK

### *A. Related Works*

We found some related papers which are similar to our research topic; we selected a research paper written by Rangert from Uppsala University. Her research topic is based on the integration of quantitative user data into the agile website development process. The main research question is: “How can the work of collecting and analyzing quantitative user data from websites be integrated in the agile work process at Valtech?”, moreover, three sub-questions regarding to the main research question are “How should measurements be used between sprints?”, “How should the agile team be composed?” and “How could early release to production be achieved?” [1].

According to the research question, the result from this research paper described the website measurement should be included between every sprint by continuous data analysis and learning from analysing result [1]. In this research paper, the researcher has implemented Google Analytics as the statistics tool during development and testing, which provides us the experience and idea of choosing research methodology. However, we will use regulative cycle as a framework to solve our problems.

In Brill and Knauss's research paper [4], user observation and requirement elicitation methods are also related to our research paper, their main focus is on identifying or indicators pointing to new requirements. In Zirjawi, Kurtanovic and Maalej's study paper [6], they discussed how can survey method helps developers to get user requirement. Our approach is to check user action and use different methods to get data. We would like to learn from user behavior for our data collection methods and analyse different data sources.

The research paper is written by Rannikko, the research topic is based on user-centred design in agile software development [3]. The researcher has compared the traditional process model with user-centred design(UCD) in Agile software development and find out which way can lead better success in the project development. This paper is related to our study since we are also doing an user-centred implementation within agile development, it provides the experience of how UCD agile development works and why we should chose this method for project development.

Maalej and Nayebi [5] demonstrated the way of collecting usage data, and how does user feedback influence the decision of a feature. Their paper shows a clear vision about the importance of data for requirement engineering.

## B. Case Company

Peiliee AB is a Swedish company founded in September 2015. It is a newly started company cooperating with Chinese, Japanese and British suppliers. Peiliee AB is an internet-based retail company with three global shopping websites. This company is primarily established for the bachelor thesis research study, as well as for getting industry practice experience. During these six months, Peiliee AB's web shops received eighty orders in total, and around 400 - 800 visitors are visiting Peiliee AB's web shops every day.

In an E-commerce company such as Peiliee AB, end-user data analysis is very important for the goal-driven development. Recently Peiliee AB decided to implement a new chatting system on their website to improve customer service. Based on this new feature, we will analyse the data from the end-user and the different data collection methods.

This research paper introduces a case study of different end-user data collection methods based on new features implemented in the Peiliee AB's web shop. First we will develop an instant chatting system with a pop-up window on the website; then we will change the style of the chatting system or add new functions depending on the feedback received from users.

We will have enough information from this case company because our contact person for Peiliee AB is the same person conducting this research paper. Therefore, we do not plan to have any interviews with the case company.

## III. RESEARCH METHOD

### A. Design Science

March and Smith [6] have defined design science as attempts to create things that serve human purposes [7]. It is a solution-oriented study which brings design and investigation together for improving existing problems. In the area of design science, a logical structure such as Regulatory cycle should be used for solving a specific problem.

### B. Regulatory cycle

Our research method for this experience study is by using regulative cycle, which was presented by Strien [8]. The regulative cycle contains five steps, identification of a problem, diagnosis, plan of action, intervention and evaluation. Our research strategy is using this regulative cycle and two to three iterations through this process cycle for different data sources.

#### 1) Identification Of A Problem

In this phase, we identify the main problem which we would like to solve. Van Sterin suggested, "starts with something like a general idea, a particular objective which seems desirable to reach" [8].

The problem we need to solve is about comparing data collection methods. Therefore we suggested the

driven problem: which data collection method from an end-user can benefit our requirement analysis the most?

#### 2) Diagnosis

Diagnose is to suggest and specify the problem which we have identified. In this study we have the following data collection methods, end-users observation, survey, and interview.

In the first iteration, the suggestion for this problem is by using a suitable end-users observation analyzing tool, and analyse data during one sprint.

In the second iteration, the suggestion for the problem is by using a survey for collecting and analyzing end-user data.

In the third iteration, the idea of this iteration is to use the interview method to get necessary data directly from users.

#### 3) Plan Of Action

In this phase, we plan matching solutions to solve problems which we identified.

In the first iteration, we decide to implement a third party system on the web shop for chatting between users and customer service. In the dashboard of this system, we can see the total amount of users and the chat satisfaction rate. By reviewing this data, we can observe and frame the result of the end-user's behaviour. We can compare this result with the results we will get from the survey method and the interview method to analyse and evaluate which method provides the most accurate and suitable data for our research study.

In the second iteration, we plan to have a quantitative survey as the main research method for collecting data from users [Appendix A]. For data analysis, we will use Excel for general survey data analysis. Furthermore, we will implement R studio as a technological method for making different tests, such as T-test and chi-square test. Besides, before the analysis we will use R studio for data cleaning by detecting outliers. The tests given by R studio can help us to sort out the data from the answer we received from the survey. We can also notify users' viewpoints for this new implemented feature and improve this feature by the result of these tests.

We will apply interview method for the third iteration, to collect qualitative data, we choose the method of face-to-face interview. We plan to have five to ten face-to-face interviews with selected users. We select five to ten volunteered users who already had shopping experience with Peiliee AB and we created several questions for the interviews [Appendix B]. Besides, we will write observation sheets during interviews for taking notes if any further or additional questions are needed.

#### 4) Intervention

We will implement our solution to each matching iteration problem with a specific method. In this phase, we are going to plan the solution of each matching method in detail.

In the first iteration, we will implement the new chatting system on Peiliee Shop's website with a pop-

up styled chatting window. We will focus on observing the user data of how many total users have attended in the conversations, and how did these users rate for this new feature after they finished the conversation with customer service.

In the second iteration, we conducted a questionnaire for data collection to help us analyse and provide a better understanding for solving the second iteration problem. The instrumentation we used in this study is a questionnaire which contains ten questions. The questions are designed according to the related literature for the study. We used SurveyMonkey to create this questionnaire, which is an online survey creation tool. These questions will help us to gather informations of how people feel about the new implemented chatting system, and more importantly we can know if this new instant messaging system is an overall needed strategy, or it can not benefit the users.

In the detail of the questionnaire [Appendix A], we have divided population categories to age and gender by the first two questions, since Peiliee webshop has a specific target audience, they are focusing on selling products for females and teenagers. Besides, age and gender also provide important information to our study, we will talk more about this in the discussion section. The third question is to check the user interaction rate with Peiliee AB's online shop. The fourth question helps us to collect which type of questions users would like to ask the most; it means we might need to improve in this area. The fifth question helps us to build the automatic reply with key words. Then we follow up with two questions asking how well the users liked the new implemented chatting system. The ninth question is to check if the user service has any influence for the user purchase, and the last question is to let users input their own ideas for any questions, suggestions or complaints they have. We will encourage users to fill in this survey by giving each participant a five dollar gift card for shopping at Peiliee AB's online shop.

After we have received answers for the survey, we will arrange the collected data to a data table, and we will load this data table to Excel for making diagrams. Furthermore, we will also follow the guideline from Creswell's report for further data analyzing. After data analysis, the result will be used in the discussion part.

In the third iteration, we will collect data from user interviews. We used the first-degree data collection from Lethbridge's paper [2], which means the researcher contacts the interviewees directly. The reason for selecting this method is because the interviews with selected participants can provide reliable feedback about the new implemented chatting system to us, since they are one of the biggest beneficiaries of this system. We plan to gather information about whether this new feature has improved user's shopping experience or not. Besides, this method is a good combination of qualitative and quantitative data collections.

Researchers will hold five fully structured interviews with selected participants, which means a questionnaire is prepared for each interview. One researcher will ask these questionnaire selections in

order. At the same time during the interview, another researcher will write down observation sheets. As well as taking notes for each answers and any additional information.

After the interviews, researchers will transcribe the interview answers to a easier arrangeable data table. Data analysis will be taken question by question from each participant's individual answer and then link with other participants' answers to see if this is a common issue that most participants have. The result from data analysis will be used in comparison with other two data collection methods, and will also be used in the future discussion and evaluation part.

### 5) Evaluation

In the evaluation stage, we will use observation sheet and reflection checklist for each iteration process. The reflection that we are going to take is a checklist form from Lightweight Document [9]. By using this checklist, we can clearly evaluate the work done in the previous stage. This method provides the most suitable practice which we can evaluate ourselves and guide us to the next iteration. We will use the observation package which propounded by Stapel, Knauss, and Scheider [10] as a checklist to check all the phases of each iteration. The observation package contains three parts: observation, emotion and conclusion.

Our result of the evaluation for which data collection method benefits our requirement the most will be discussed in the discussion section.

### C. Scrum Methodology

Scrum is the most used process framework in agile development. Scrum methodology contains many aspects: scrum roles, product backlog, sprint backlog, product increment, scrum sprint, daily scrum, scrum review, scrum retrospective and burndown charts.

Scrum roles usually refer to the product owner, the development team and the scrum master. Together they build a scrum team with three roles. Product Backlog is a list of requirements for the system or work being developed and processed. The Sprint Backlog specifies each task in the product backlog which must be addressed during the next coming sprint. Product increment is the sum of requirement complication of product backlog items for all sprints. Scrum sprint is a set time period for each specific task's duration, normally each sprint is around two weeks. Daily scrum is a fifteen-minute meeting for development team members to track tasks and plan for what to do the next day. Scrum review usually will be held after each sprint, team members will go through the process and review each other's work. Scrum retrospective is to analyse the finished sprint in order to make improvement for next sprint. Burndown charts is a chart diagram which shows the process speed of how fast the development team works through the user's user stories, which are the requirements for the project that the development team is making [11].

We decide to implement scrum methodology in our team as our development process framework. Since we only have two developers in our team, therefore we

need to find the most suitable way for applying scrum methodology. We are going to use trello for making product backlogs and sprint backlogs for specific tasks to be done for each sprint, we also use trello to keep tracking of our process. We have a daily scrum meeting for few minutes to talk about what we have done in the sprint backlog and what we should do today. Our sprint length is seven days instead of traditional two weeks, since this way suits our regulative cycle experiment the best.

*D. Observation Sheet*

Our observation sheet [Appendix H] contains three different parts: observation, emotion, and conclusion. In observation part, we record user behaviours. We have several type of behaviours for our instant message, survey, and interview. Emotion is to describe how we feel about this behaviour. We divide emotion into more specific parts, such as problem, typical distributed, interesting, and good idea. Conclusion and suggestion provide suggested solutions for the behaviour (Shown in figure 1).

<b>Observation Package</b>	<b>ID:</b>
<b>Observation:</b>	about...
	<input type="checkbox"/> instant message <input type="checkbox"/> Survey <input type="checkbox"/> Interview <input type="checkbox"/> Data analysis
<b>Why noteworthy? / Emotion:</b>	<b>Type</b>
	<input type="checkbox"/> Problem <input type="checkbox"/> Typical Distributed <input type="checkbox"/> Interesting <input type="checkbox"/> Good Idea
<b>Conclusion/ Suggestion:</b>	

(Figure 1)

*E. Reflection Checklist*

Our reflection evaluation will follow these questions as a checklist by using the guideline from Lightweight Document [9]. This checklist (shown in figure 2) helps us to evaluate the process of each

iteration, and also provide an outline of ourselves to check for each iteration.

<p><b>Checklist:</b></p> <ol style="list-style-type: none"> <li>1. What was the purpose for this cycle?</li> <li>2. Does the activities occur as we expect?</li> <li>3. Was it a success?</li> <li>4. What are the risks for this cycle?</li> <li>5. How is the process?             <ul style="list-style-type: none"> <li>5.1 overview</li> <li>5.2 preparation</li> </ul> </li> <li>6. Conclusion for this iteration</li> </ol>
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(Figure 2)

IV. FINDING

*A. First Iteration End-user observation*

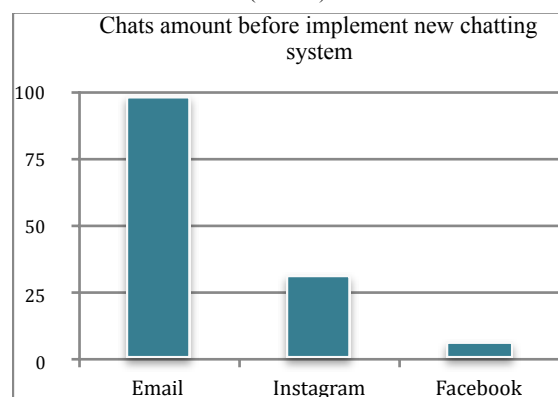
Each iteration of our regulative cycle is a scrum sprint, the length of each iteration is seven days.

In the first iteration, we implemented a third party tool named LiveChat for developing the instant messaging system. LiveChat dashboard provides several data types which we can collect and use in our analyse for Observation method. These data types are: user information, user page view information system, user IP address, user operating system information, user browser information and chatting service quality rating system.

In the first iteration, we focused on comparing the difference between before and after implementing the instant message system. Before implementing the instant message system, users can only contact the shop owner by sending emails, private message via Instagram message and Facebook messenger. We collected data of these three methods from 16th March 2016 to 18th April 2016, which are shown in table 1 and figure 3.

CONTACT TYPE	NUMBER
Email	98
Instagram	32
Facebook	7

(Table 1)



(Figure 3)

1) Data Analysis

During the first seven days after the instant message system was implemented, we gathered data of total chatting numbers, chat engagement, chat availability and chat satisfaction.

Total chat numbers presents the number of chats that we received during these seven days. The total amount of chats created is 21.

Total satisfaction shows the number of users who rated their chat, and how they are satisfied with the chatting quality.

Chat engagement shows which side the chat started. There are three different methods to start a chat, it can be started by agent, by user or from greeting. Greeting is an automatic message sending from the system by asking if users needs any help.

Chat availability determines whether the agent is available for accepting chats or not. All the elements are listed in the Figure 4 and Figure 5.

The data we have received from the instant messaging system shows us that there are many people

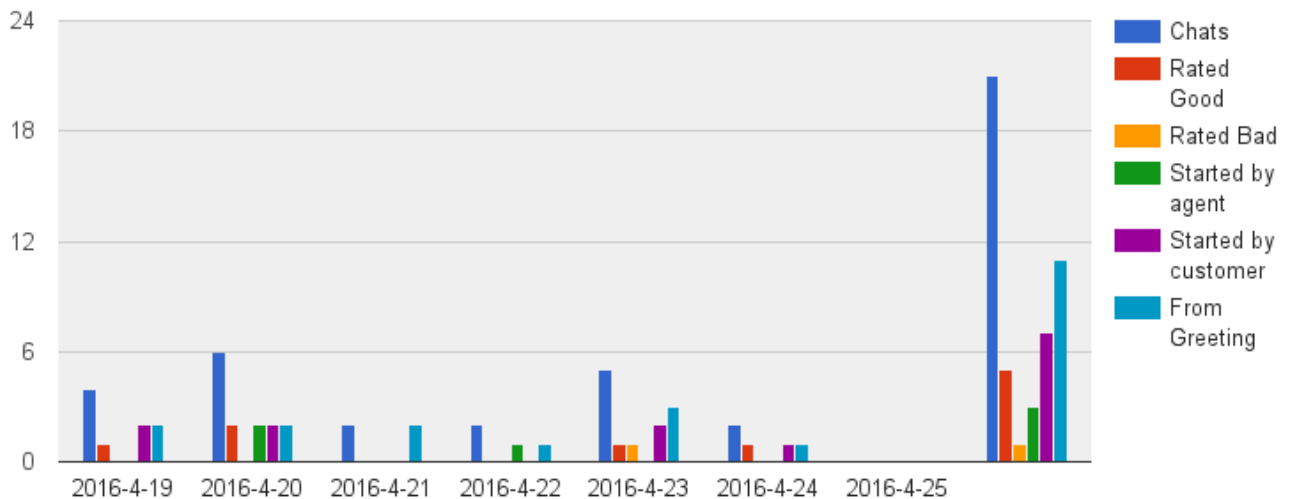
willing to contact us by chatting. There are three different ways of starting a chat. Users can start the chat themselves by sending a message, the agent can also start a chat by sending a message to the user, and lastly the chat can be started after the automatic greeting message. Start by user means user sent the chat first, start by agent means agent started the conversation first and from greeting means user started after the greeting message. From figure 5, there are eleven users started the chats after greeting message was sent. In the old data, the conversation can only be started by users, therefore the interaction with users is improved after implementing this instant message system. After we implemented this system, we received less emails than before during this experiment period.

2) Evaluation

a) Observation Sheet

During the first iteration, we filled in five observation package sheets in total. In general, our

Observation result



(Figure 4)

DATE	CHATS	RELATED GOOD	RATED BAD	STARTED BY AGENT	STARTED BY CUSTOMER	FROM GREETING	AVAILABILITY
2016-04-19	4	1	0	0	2	2	24
2016-04-20	6	2	0	2	2	2	24
2016-04-21	2	0	0	0	0	2	22.35
2016-04-22	2	0	0	1	0	1	14.66
2016-04-23	5	1	1	0	2	3	24
2016-04-24	2	1	0	0	1	1	24
2016-04-25	0	0	0	0	0	0	24
<b>SUM</b>	<b>21</b>	<b>5</b>	<b>1</b>	<b>3</b>	<b>7</b>	<b>11</b>	<b>157.01</b>

(Figure 5)

observations are after the instant message was implemented. Our observation part indicates three major behaviors. First of all, the response time from users took longer time than we expected. Secondly, users did not like to leave their personal information in the online chat. Finally, users who were using mobile phones are willing to use other chatting applications to talk with us. In the emotion part, we generally felt confused about the participants observation for the instant messaging system. In conclusion parts for every observation, we suggested to avoid or improve the problem.

### b) Reflection Checklist

Our reflection will follow by these questions as a checklist by using the guideline from Lightweight Document [9].

This iteration helped us to get basic information for the observation method with the newly implemented instant messaging system. All the data collected from this new system will be used for comparison with old time email system as we mentioned above, to analyse if this newly implemented instant messaging system has improved the user needs or not. This iteration also provided important data for further comparison and evaluation with second and third iteration.

We collected many data types as we expected, however one week is too short to collect all needed data with the observation method. This iteration can be considered as a successful process, it works very well with the system, but we estimate that we could get more data with other methods.

The biggest risk for this iteration is the difficulty acquiring necessary information. Without enough chats available, this method may lead to failure.

Overall this implemented system works well and we received many encouragements from regular customers. Before implementing this system, we did a lot of research and studies on different instant messaging systems. We also prepared observation sheets for collecting experimental data during this iteration.

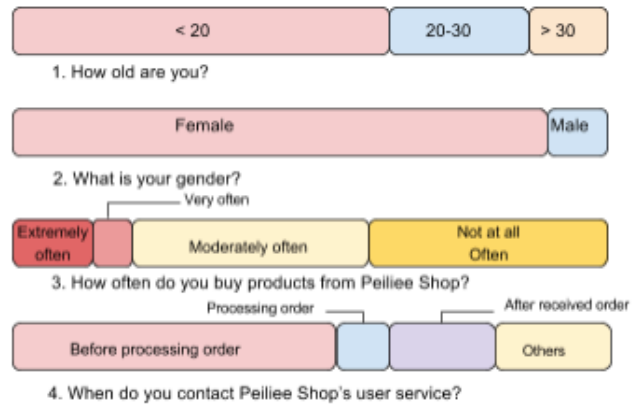
In conclusion, this observation method works well for data collection, the result from this method will be useful for further evaluation and comparison with second and third iteration. However, we cannot get users' feedback from this type of method just by looking at users passively. We assume that the survey method might help us to get more feedback from users.

### B. Second Iteration- Survey

In this second iteration, we made a survey via SurveyMonkey. We have then launched the survey and advertised it on Peiliee Shop's official site. We encouraged customers to enter this survey by providing a five US dollar gift card.

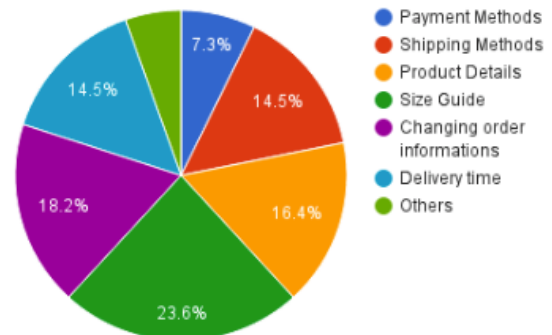
#### 1) Data Analysis

From all the response we gathered from survey, we realised that our questions are more tend to be closed-end questions. Which is better to use general statistical analysis method for our data analysis. From Linåker and Sulamanä's guideline for Survey, we decided to use Microsoft Excel for our data analysis [15].

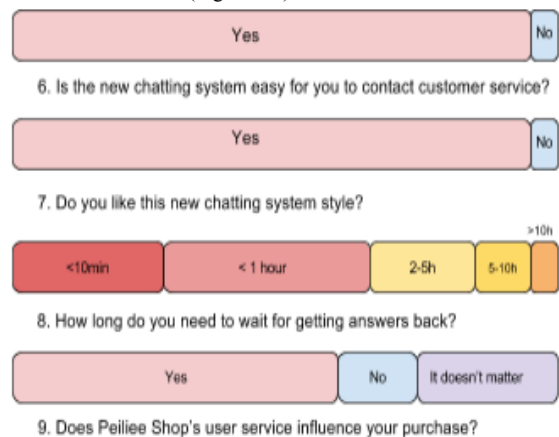


(Figure 6.1)

#### Percentage



(Figure 6.2)



(Figure 6.3)

According to the result [Appendix D], we can see that over half of the participants are younger than twenty years old and most of them are females. It shows that Peiliee AB's webshop targets teenager group, this target audience is more likely to use internet for chatting and online shopping compare to other age groups.

The result shows that more than half of the participants already have shopping experience with Peiliee AB's webshop, and the most question that users asked is before processing orders about size guide. Asking for product details and changing order information are the second and third common questions that users ask for. Maybe we should implement an automatic reply system for some popular searched keywords.

Over 98% users thought that the new chatting system is easy to find and use. Fifty-four out of fifty-



five users were satisfied with the instant message system. User feedback says the chat response time was within one hour. There is only one exception which was more than ten hours. Thirty-one users thought customer service is important for their purchases, seventeen users were indifferent to it, and seven people did not think customer service will influence their purchase at all. (answer shown in figure 6.1, figure 6.2 and figure 6.3)

## 2) Evaluation

### a) Observation Sheet

During the second iteration, it is difficult to use the observation package sheet for evaluation, therefore we only have three observation sheets for this iteration [shown in Appendix E]. We received more than twenty responses in one day after the survey was published, this showed that we need to keep the advertisement. The amount of responses decreased after two days, we felt depressed with less responses. We published a new advertisement with a clear give away gift card, and received more responses after that.

### b) Reflection Checklist

The second iteration helped us to get more information about users feedback for new implemented instant messaging system. The data we collected from the survey are used to compare with the observation data. Moreover, this survey data will use for further comparison with third iteration.

Duration of the second iteration is also seven days. In total we received fifty five responses which is more than what we expected, we encouraged customer to fill in the questionnaire with a five dollar gift card giveaway for Peiliee.com. 13 out of 55 users did not leave their email address for getting the five US dollar gift card.

From all the responses we received from this survey, this iteration was considered as successful. We got the most important feedback matching our expectations, the answers also show that users are satisfied with our new instant messaging system.

The risk of this iteration is that it might be difficult to arrange and analyse data if there are not enough responses. From this iteration, the most valuable experience is how to encourage people to participate in a survey experimentation.

We used SurveyMonkey which is an online tool for publishing surveys, and we advertised our survey on Facebook, Instagram and the homepage of Peiliee.com. The process of this iteration followed our Scrum plan and sprint backlogs, importantly we learnt the importance of announcing advertisements for encouraging users to participate in surveys.

Compare with observation method, survey method provides participate more options for user interaction with Peiliee shop, and users can leave their opinions in the answer options. We can receive more subjective opinions from participants than the observation method. However, the answers from participants are still limited by the survey method. For example, if participants want to leave more individual response from their perspective point, they are limited by given

options. In conclusion, using a survey method can gather more information than observation method, the result of this method will discuss with the third iteration.

## C. Third Iteration - Interview

In the third iteration, we get more feedback from users about our new instant chatting system by using the interviews. Customer interviews were held either with a face-to-face video chat using Skype or through phone call. Customers were able to decide how they preferred to do the interview. The reason we use video interview is because interviewees are from different countries. The interview time period is around fifteen minutes. Ten to fourteen questions were asked depending on whether users were just visiting the web shop or purchasing an item. For evaluation, we use the same method as the previous iteration, observation package sheets and reflection checklist.

### 1) Data Analysis

There are two participants that already had shopping experience with Peiliee Shop, three of them have no shopping experience with Peiliee Shop, therefore, they might not be as familiar to the system as the other customers. For participants who have no shopping experience with Peiliee Shop, we do not ask the first three questions. For participants who already had shopping experience, one participant likes to use the new instant chatting system for getting fast replies when she needs to contact customer service for size suggestions. Another participant likes to use Facebook or Instagram private message for contacting customer service, since she uses social media very often.

For the other three participants who have no shopping experience with Peiliee Shop, they all like to use Instagram private message for chatting, because they use their phone for chatting more than chatting on a website, and Instagram message can push notifications. These answers show that chatting on social media is very important to most participants, it might be good if we can implement social media connections into the chatting system.

Among all the participants who are living in different time zones, one of our questions is focusing on time difference. We considered if users have difficulties contacting customer service or if this live chat will be useless for users who are living in different time zones, However all the answers received from the survey shows that it wasn't a problem. All of the participants liked our new chatting system, especially the interface design and the position where we placed the pop up window. Besides, all the participants want us to keep the same style with the pop up window as we have it now, since they prefer to talk to customer service while they are browsing websites.

Another important part we are focusing on is the privacy aspect when users enter their name and email address before starting the chat. Customers need to enter their name and email address in order to join the chat, this is a really good way for us to know who to contact if we lose connections to the users or if customers need further help. In another way, customers

might think this is too much work for them to enter their information and they might want to keep privacy. From the answers we collected, some participants think this does not matter for them by entering their name and email address. Especially some of them even think this is also important for customers who join the chat, because they might want customer service to answer them back. There is one participant who thinks that customers need privacy and many people who shop online often do not want to leave their personal information. We can improve this option by changing the enter information option to optional, so customers can choose whether to enter their name and email address or not. They can also choose to enter their information with Facebook or other social media login, which will be faster and easier for them.[Shown in Appendix F]

## 2) Evaluation

### a) Observation Sheet

During the third iteration, we filled in ten observation package sheets in total. In general, our observation sheets are about participant's behaviors during the interviews. First of all, the internet connection of some interviews are not good enough; sometimes the connection got lost so that we think the face-to-face interview in real life will be better. Secondly, we asked an open-ended question to find out which part of the instant messaging system we should improve. Customers had difficulty answering the open ended questions until we started asking closed-ended questions.. This kind of question is better to have in the interview, but for customers who do not have enough experience with software developing, it might be a little bit difficult to answer. Finally, participants gave us some advice not only from their viewpoint but also others customer's viewpoint. It is really good to get those answer with two viewpoints. In emotion part, most of the advice as interesting or good ideas. In the conclusion parts for every observation, we give the feedback for every observation. [shown in Appendix G]

### b) Reflection Checklist

The purpose of this iteration is to implement the interview method for collecting required data. The interview went as we expected. We think this iteration can be considered as a success. There are a few risks with this iteration: first of all, we chose three participants who had no shopping experience with Peiliee Shop, they might not as familiar as the other two participants who already have shopping experience with Peiliee Shop. We selected five participants who live in different time zones, with different ages and different shopping experiences. We sent invitations to each participant for inviting them to join the interview experiment, after they agreed to join the meeting by choosing their preferred method with either face-to-face talking via Skype or through a phone call, we let them choose a suitable time for themselves to do the interview. We have interview meetings one by one with each participant, during the meeting we record the whole process after getting their permission. One of us asks the interview questions and

one of us is writing down the notes and observation sheet during the meeting. After we finish the interview, we send a free gift to all the participants who joined the interview.

We have selected twelve questions for the interview, some of the basic questions are the same as we have asked in the survey for getting a basic idea from the participants. We care about age and education background because we think it might influence the result of the interview. We will talk more about this part in valid and threads. Besides the question list, we also prepared observation list and papers for taking notes.

All the interviews were successfully finished, we received all the data as we expected. All the participants are active and open-mind for talking and sharing their thoughts and suggestions.

## V.

## DISCUSSION

### A. Research Question

#### ***RQ 1.1: How can the data analysis be integrated into an agile development process (i.e. Scrum sprints)?***

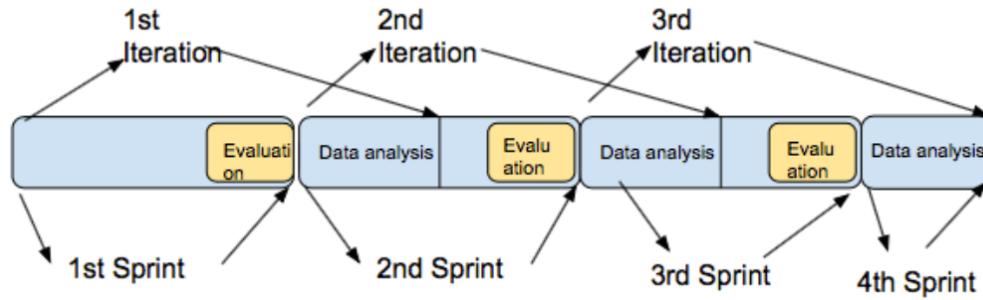
In this study, we planned to have data analysis at the end of every sprint, however, because of the limited time for our bachelor thesis, we decided to have data analysis in every second sprint.(shown in figure 7)

In the first sprint, we did observation preparation, implemented the chatting system and data collection. To save time, we did data analysis for observation method, regulative cycle evaluation and published the survey at the second sprint. In the third sprint, we did data analysis for the survey data, second iteration assessment, we have also prepared and started interviews with the customers for the third iteration. In the last sprint, we did the data analysis for the interview and third regulative cycle evaluation.

During each sprint, we realised that we did not have enough time for managing both data collection and data analyse in one sprint as we planned. The reason for this might be that we are a small group with only two members, if we have a larger group and each sprint time is two weeks instead of one week, we think we can manage it better than we planned, but still some delay may happens.

We implemented both Scrum sprints and Regular cycle iterations during the process as research methods. There are few differences in our implementation process between these two methods, the sprint time period for us is one week, but the iteration time period for us is around one and half weeks.

In our study, we used Scrum to find the way of integrating data analysis to agile development method, and regulative cycle to compare three different data types.



(Figure 7)

**RQ1.2: What are advantages and disadvantages of different data sources (i.e. interviews, surveys, end-user observation)?**

**End-user observation**

From our experience, this method is easier to use for getting specific numeric quantity data, as well as getting more data types and a larger range of data.

There are few disadvantages of using this method. Firstly, this method provide only history data from chats, like chat numbers, chat period, and customer information. However, this method can not provide useful data for getting to know what customers think about this new chatting system. We can see from the increase of customers view amount and chat amount, but it might be that customers are curious about this new system, since many customers entered the chat but never really chat with customer service.

Many research paper shows that many researchers apply user observation research method on human behavior study. It means that they use this observation research method for watching what people do for carrying on their study. Generally, in most of the study of the observation method, researchers filled in a observation sheet every 15min to take notes during the experiment [12]. The experience study shows that the strength of this observation method is to generate new ideas [12], which means that many times the researchers can get new information from the observation method which they did not expect to get before. On the other hand, there are few limitations of this method, this method is usually conducted on a smaller sample and therefore there is a lack of reliability. Furthermore, in this study they mentioned that this method does not have manipulations of variables [12] which is the same disadvantage we are facing when we were implementing this method.

**Survey**

Firstly, surveys can get the information from many people. In Amy Blackstone's study, she had a survey through mail with around 500 people, and she realized that having the interview with 500 people will double or even quadruple their cost for data collection[13]. Amy Blackstone's study shows us that using survey for data collection is relatively cost effective in comparison. Secondly, one of the benefits of the survey method is generalizability, because surveys allows researchers to collect data from large samples. Thirdly, Amy Blackstone mentioned that reliability was also an asset of survey research. Because surveys

are set in the same questions and phrased in the same way, surveys lead to produce reliable results with well-constructed question and questionnaire design [13]. Finally, the versatility of survey research is also a strength. Amy Blackstone mentioned that surveys could be used by all kinds of people and professions.

On the other hand, surveys also have some disadvantages. They can be inflexible because researcher are usually stuck with a single instrument for collecting data [13]. For example, it is difficult to change the survey after it is published. Surveys can also prove to be invalid. If the person's answer is not a yes or no answer this can cause the response to be invalid.

During this study, data collection by using the survey method has been cost effective. We published the survey using social media and gave away a five US dollar gift card to use in Peiliee Shop. In the end, 55 people filled in our survey, this cost us 275 US dollar in total. We tried just to ask people to answer the questionnaire in the beginning, but we did not get many responses. We decided to give the gift card to people who answered the questionnaire. After the giveaway was posted on social media, we received 55 responses and felt it is necessary to reward survey participants. Moreover, we felt that using the survey can get enough valid responses within a short time period. Also, the large amount of data made the result from survey is reliable. However, we think the interview method is inflexible, we cannot make any change from survey if it was published. We also need to consider about the validity of all the answers, there can be some chance that people filled in the survey just for the gift card. For more information about validity of the response, we describe more details in Threats to Validity section.

**Interviews**

From the Fretchling's handbook, there are several strengths and weaknesses with the interview method. By interviewing we can collect detailed data and gather new insights compared to using other data collecting methods. During the interview, an interviewer can explain and help interviewee to understand questions to avoid useless responses. Interviewers can manage interviews to suit particular individuals or situations. That way interviews are more flexible than other data types[14]. On the other hand, conducting interviews is generally time-consuming and expensive. The interviewer needs to be experienced and well-qualified. There were also

situation where interviewees were uncomfortable answering the questions truthfully. Fretchling's handbook also mentions that when you have too much information from interviews it can be difficult to transcribe and reduce the received data.

In this study, the interview has helped us to get more detailed information about our five customers. We had interviews with people that shopped in Peiliee.com and hadn't shopped in Peiliee.com. During the interview, we had some changes about questions to the matching participants without any problems. We used Skype to video chat and the phone call to have our interviews, and give a small gift which is worth around 80 sek. In total, the interviews cost around 400 sek and took 7 days to get complete data. In some cases, we can explain the questions to participants so that they can have a better understanding and give useful answers.

The disadvantage of using interviews in our study is time-consuming, we need to interview with people individually and also we need to make the appointment with a customer at begin. Each interview took around 10 to 15 minutes, in total we spent most 75 minutes for five interviews.

	END-USERS OBSERVATION	SURVEY	INTERVIEWS
advantages	1. Generate new ideas	1. Cost-effective 2. Generalize 3. Reliable 4. Versatile	1. Details answer 2. Flexible 3. Useful response
From our experience	1. Easy data collection	1. Cost-effective 2. Time saving 3. Generalize 4. reliable	1. Flexible 2. Details answers 3. Useful response
Disadvantages	1. Lack of reliability 2. Small data scale	1. Inflexibility 2. Invalidity	1. Expensive and time-consuming 2. Well trained interviewers 3. Interviewee may distort answer to please interviewers 4. Large information, difficult to transcribe data.
From our experience	1. Lack of multi variables	1. Inflexibility 2. Invalidity	1. time-consuming

(Figure 8)

## B. Threats to Validity

### a) Internal Validity

In survey method, we give out five dollar gift card for each participant to use in Peiliee Shop, this might influence the survey answer's quality. Since

participants might only want to get the gift card and thus fill in unreliable information.

Most of the participants for both survey method and interview method are aged below twenty years old, and from the interview answers we realized that many participants that are under twenty years old did not understand our questions as well as the participants that are over twenty years old. Therefore, the younger age group participants may not provide as usable information as the older age group participants.

### b) External Validity

Our research is based on our personal experience experiment for the new implemented chatting system on a shopping website, the result from our report may not be fully applicable for other studies.

## VI.

## CONCLUSION

The summary of evaluated results to our sub-question RQ1.1 and RQ1.2 provide an answer for our main research question. Our main research question is: How can collection and data analysis from end-users be used for requirement analysis and design of features in agile software development?

Observation method, survey method and interview method performed different strength and weakness of each data collection method. End-user observation can not provide us with as much information as we expected, as well as it is limited for getting individual thoughts. The reason why this method did not work out as well as we expected may due to the limitation of our bachelor thesis working time. If we had more time, we would like to change the order of these three methods. We would like to do observation method in the last iteration, since observation method needs longer time when we do not have enough user data. From this change, we estimate the observation result would be greater with more user data presented. For the future work, we would like to insert keywords research function and make customer information input optional

In conclusion from our research, implementing survey method to gather user data for data analyse of a new system works better than using the observation method and interview method. In reference to the result of our three method evaluation, survey method did provide larger range of data types than other methods and this method combined qualitative and quantitative data collections for easier data acquisition.

## ACKNOWLEDGMENT

First of all, we would like to offer our sincerest gratitude to our supervisor Eric Knauss. Thank you for your guidance and advices, for all the weekly meetings, encourages and feedbacks. We would also like to thank all the participants who took part in the survey and interview experiment, without your help we could not complete our study.

VII. APPENDICES

A. Appendix A- Survey Questions

1. How old are you?
  - A. Under 20 years old
  - B. 20 - 30 years old
  - C. Over 30 years old
  
2. What is your gender?
  - A. Female
  - B. Male
  
3. How often do you buy products from Peiliee Shop?
  - A. Extremely often
  - B. Very often
  - C. Moderately often
  - D. Slightly often
  - E. Not at all often
  
4. When do you contact Peiliee Shop's user service?
  - A. Before processing order
  - B. Processing order
  - C. After received order
  - D. Other (Please specify)\_\_\_\_\_
  
5. What would you like to contact Peiliee Shop's user service for?
  - A. Payment methods
  - B. Shipping methods
  - C. Product details
  - D. Size guide
  - E. Changing order information
  - F. Delivery time
  - G. Dispatch time
  - H. Other (Please specify)\_\_\_\_\_
  
6. Is the new chatting system easy for you to contact user service?
  - A. Yes, It is easy to find and use
  - B. No, It is difficult to use
  
7. Do you like this new chatting system style?
  - A. Yes, it is a suitable style
  - B. Not really, I would like to suggest another style \_\_\_\_\_
  
8. How long do you need to wait for getting answers back from Peiliee Shop's user service?
  - A. Within 1 hour
  - B. Within 2-5 hours
  - C. Within 5-10 hours
  - D. More than 10 hours
  
9. Does Peiliee Shop's user service influence your purchase?
  - A. Yes
  - B. No
  - C. It doesn't matter
  
10. If you have any further questions please write down(write your email to get 5 USD gift card): \_\_\_\_\_

B. Appendix B- Interview Questions

For customer who has shopped in Peiliee.com:

1. How many times have you been shop with Peiliee.com?
2. Did you contact peili before? times/method
3. Are you satisfied with your last shopping experience with Peiliee.com?
4. Which way do you like to contact Peiliee Shop's user service?/Why?
  - Emails
  - Facebook chatting system
  - Instant chatting on website
  - Calling
  - Others
  
5. How long does it take before you receive your answer back from them?
6. For difference of the time zone, sometimes it might be hard for your to use instant chatting messaging talking to our customer service, would you then change a contact method?
7. How do you like our new instant chatting system on our website?
8. Do you feel easier to talk to customer service now by this chatting system?
9. Are you willing to type in your name and email address before chatting with us?  
If not why?
  
10. The style of pop-up window live chat system and a chat room in a new-opened tab, which one do you prefer?
  - Pop-up window live chat
  - New-opened tab live chat
  - Other model
  
11. Which part do you think should be improved with this chatting system?
12. Do you have any other questions for us?

C. Appendix C- Observation package sheet from first iteration

ID	Observation	Emotion	Conclusion
1	No customer chat with us right now	Worried. Is the dashboard of instant message can help us to get enough feedback?	We need to encourage customer to use our new instant message.
2	People entered chat with a made up name and email address	People need privacy and it might be too much work for customers to enter informations.	We can remove the enter information requirement
3	New chat	Annoyed. Take too much time to get the answer from customer.	Maybe is better to talk in person
4	People join the chat but do not talk	Wasting time waiting for customer to write but they do not write anything	Should have an automatic tips jumping up to customers or close the chatting window after few mins or secs
5	Checking website online with mobile but still use instagram for chatting	Confused, is it not convenient to chat on mobile?	Test more on mobile version if it works good for chatting on each page
6	Losing connections for 3 times	Annoying, I need to right with same message for 3 times and the customer still cannot receive it	When losing connection, live chat is not convenient anymore, this time we might can write a message for customers to contract us by email or other methods.
7	Have to be online most of the day	Tired. Feel like waste most of time for waiting	We might can write a message for customers to contract us by email or other methods.

D. Appendix D- Survey answer

Nn.	1. Age	2. Gender	3. Frequency	4. When	5. What	6. Difficulty	7. Style	8. Waiting	9. Influence	10. Other
1	B	A	E	A	F	A	A	C	B	
2	A	A	D	C	F	A	A	B	C	
3	A	A	B	B	E	A	A	A	C	
4	A	A	B	C	E	A	A	C	C	YES
5	B	A	D	A	D	A	A	D	B	YES
6	C	B	E	A	H	A	A	C	B	YES
7	A	A	D	C	F	A	A	B	A	YES
8	B	A	E	D	H	A	A	E	C	YES
9	B	A	E	A	E	A	A	A	B	
10	B	A	D	A	D	A	A	A	A	YES
11	A	A	D	C	D	A	A	C	A	
12	A	A	D	A	D	A	A	B	C	YES
13	C	A	D	A	B	B	A	B	A	
14	A	A	D	B	E	A	A	C	A	YES
15	C	A	E	D	H	A	A	B	B	
16	B	B	E	D	F	A	A	B	C	
17	B	A	B	A	B	A	A	A	A	
18	A	A	E	A	B	A	A	A	C	YES
19	A	A	B	A	E	A	A	A	A	YES
20	A	A	D	A	B	A	A	B	A	YES
21	A	A	D	A	A	A	A	A	A	YES
22	A	A	C	A	A	A	A	A	A	YES
23	A	A	D	A	E	A	A	A	A	YES
24	A	A	E	B	D	A	A	A	A	YES
25	A	A	E	A	D	A	A	B	A	YES
26	A	A	E	D	D	A	A	B	C	YES
27	A	A	D	A	F	A	A	B	A	YES
28	A	A	C	A	D	A	A	B	A	YES
29	A	B	D	A	F	A	A	C	C	YES
30	A	A	D	A	C	A	A	B	A	YES
31	A	A	D	C	C	A	A	C	A	YES
32	C	B	E	D	E	A	A	A	B	
33	A	A	D	A	C	A	A	C	A	YES
34	A	A	E	D	B	A	A	A	C	YES
35	A	A	C	A	C	A	A	B	A	YES
36	A	A	D	C	C	A	A		C	YES
37	B	A	E	D	B	A	A	B	C	
38	A	A	D	A	D	A	A	A	A	YES
39	A	A	B	C	D	A	A	C	A	YES
40	B	A	E	B	F	A	A	B	A	YES
41	A	A	D	C	C	A	A	C	C	YES
42	C	A	D	C	E	A	A	E	C	YES
43	A	A	E	D	B	A	A	C	C	YES
44	A	A	D	B	E	A	A	C	A	YES
45	A		E	D	B	A	A	D	A	YES
46	B	A	E	A	D	A	A	B	A	YES
47	A	A	D	D	D	A	A	A	A	YES
48	A	A	D	D	C	A	A	A	C	YES
49	A	A	E	A	C	A	A	B	A	YES
50	B	A	E	A	B	A	A	B	A	YES
51	A	A	E	C	F	A	A	B	C	
52	B	A	B	A	C	A	A	A	A	YES
53	B	A	D	C	D	A	A	C	A	YES
54	A	A	E	B	A	A		B	B	
55	A	A	E	A	E	A	A	A	A	YES

Question	A	B	C	E	F	G	H	I
1	36	14	5	—	—	—	—	—
2	50	4		—	—	—	—	—
3	0	6	3	23	23	—	—	—
4	27	6	11	11		—	—	—
5	4	8	9	13	10	8	0	3
6	54	1	—	—	—	—	—	—
7	54	—	—	—	—	—	—	—
8	17	20	13	3	1	—	—	—
9	31	7	17	—	—	—	—	—

*E. Appendix E- Observation package sheet from second iteration*

ID	Observation	Emotion	Conclusion
1	First day with announcement received many responses	Feeling good with fast response and participation amount	Keep the advertisement
2	Less and less responses after 2 days	Feeling depressed with less responses	Should more clear that each participant can get gift cards and announce new advertisement
3	More responses after new advertisement	Feeling good with more partitions	Should launch advertisement about this survey and giveaway constantly

*F. Appendix F- Interview answers*

*1) Participant 1*

She prefer contact customer service by Instagram. The reason why is she use her phone really often, and she can get notification on her phone.

It's usually take less than 10 minutes to get the answer back from Peiliee.com.

It's not the problem with time different.

Really like the new instant chatting system, for example, color, size and profile picture.

It's easier to talk to customer service by chatting system. Specially for new customers.

It's fine for herself. She suggested us to make the email and name as optional, because there are some people who doesn't want to identified on internet.

She thought pop-up window is better.

It's look better.

User can look at the product and also talk to customer service.

She suggested us do not have automatic reply, because she think talking with real person is much better. Also, she suggested us to add agent rate,

however, we already have the agent rate after end the chat. In her case, none of the agent or users end the chat that why this user didn't know.

*2) Participant 2*

She didn't shop on Peiliee.com before, but she's planing to order something.

She preferred using Instagram, because she uses Instagram more often.

It's take few minutes to get the answer back from customer service.

It's not the problem with time different.

She think our new chatting system is very good and looks cute. She likes the layout on the website.

It's easier to talk with customer service after implemented instant chatting system.

It's fine to enter the email and name.

The pop-up window is fine.

Maybe change the color, because she like some other color.

*3) Participant 3*

She haven't shop on Peiliee.com before.

She likes using Instagram, instant chatting system and facebook.

It's take 1 hour to get the answer back from customer service.

No problem with time difference.

She thinks the new chatting system is good.

She likes the new chatting system. It's make the conversation easier than before, because customer can check the product while talking with customer service.

She thinks is not the problem to enter the name and email address, and also it's important for customer to contact back.

Pop-up is better.

*4) Participant 4*

She shopped two times in Peiliee.com.

About the size, by using instant message.

She's satisfied with the last shopping.



She likes using instant chatting system, because she can get answer back really quick.

It takes 5 minutes and sometimes it takes 1 hour.

No problem with time difference.

She likes new chatting system very much.

It doesn't matter about name and email.

Pop-up window is better. User can look at the product and also talk to customer service.

She suggest to add automatic reply for some questions.

5) *Participant 5*

She have shopped at Peiliee.com for three times.

She used messenger via facebook and instagram.

She's satisfied with last shopping experience.

She preferred to using messenger via facebook and instagram, because she spend more time on facebook and instagram.

It takes few minutes to get the answer back from Peiliee.com.

The new chatting system looks alright, but she haven't use the new chatting system yet.

It easier for people who visit the website at the first time. User can look at the product and also talk to customer service.

It easier to talk with customer service with new chatting system.

It's fine to enter name and email.

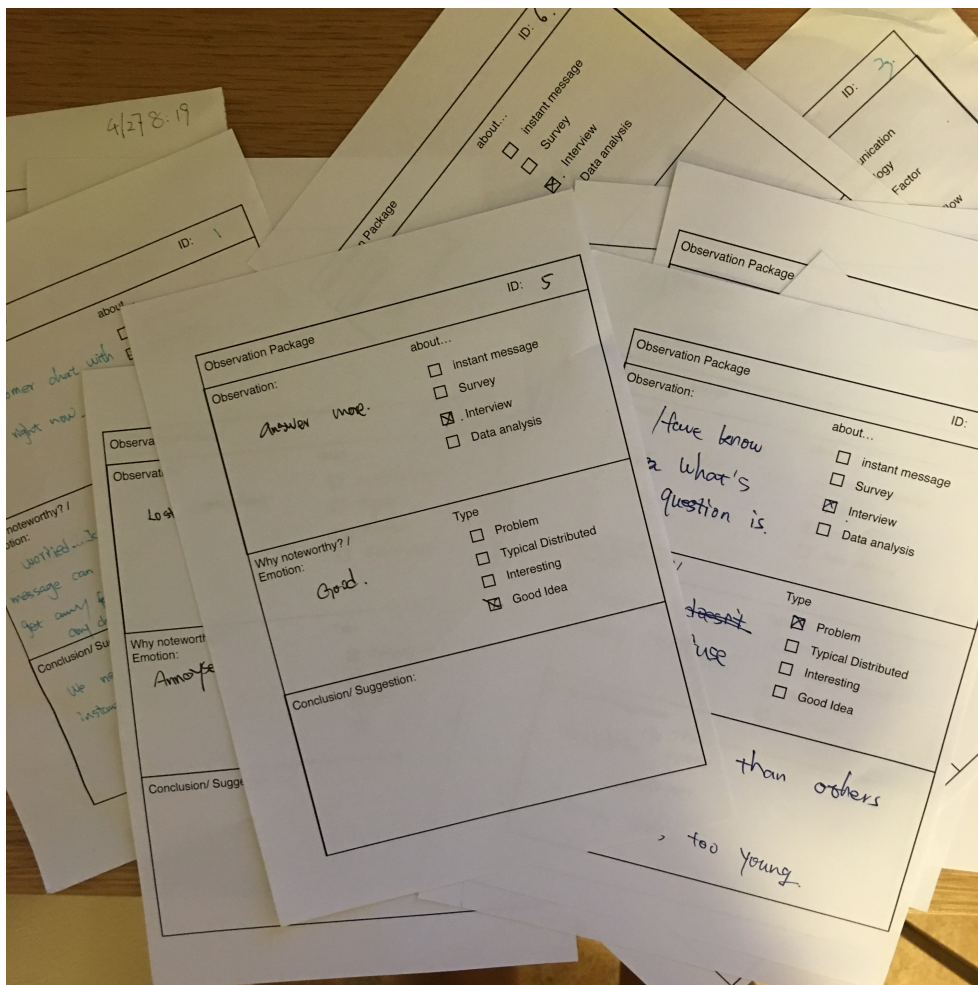
Pop-up window is good.

She suggested to add automatic reply for some questions people ask more often.

G. Appendix G- Observation sheet from third iteration

ID	Observation	Emotion	Conclusion
1	The connection is really weak	Problem. The interview can't be continue	Face-to-face interview is better, however, customer lives in other country. It's difficult to have a face-to-face interview
2	The question is not related to customer	Typical distributed. It is wast time for those question	Need to understand the customer first.
3	Customer can't give any advice for instant message	Problem. Nervous, we wont's get any answer about this question	We added some choices for this question
4	lost connection during video chat	Annoy	Face-to-face interview is better, however, customer lives in other country. It's difficult to have a face-to-face interview
5	Customer gave a lot advices	Interesting. It's good	Give us more advice and also helped us to improve new instant message
6	Customer get scared from the sound by instant message	Interesting. It is the first time we heard this advice.	We need to turn down a little bit the volume.
7	customer doesn't know how to answer the question	Problem. Worried.	We added some choice according to the advice from other customers. We think the question maybe is too difficult for customer who doesn't have any knowledge in SE filed.
8	Email optional	good idea.	It's help us for improve instant message.
9	real person to reply	Interesting. Maybe some people think in this way	We also need to consider this idea.
10	Customer doesn't understand what the question is.	Problem. We might can't get the answer from this customer	We explained to this customer more than others. Maybe her experience is not enough.

H. Appendix H- Observation sheet pictures



## REFERENCES

1. Rangert Emma, Integration of quantitative user data into the agile website development process, Uppsala, September 2014.
2. TC Lethbridge, SE Sim, J Singer, Studying software engineers: data collection techniques for software field studies. *Empir Softw Eng* 10(3):311–341 see also Chapter 1 in Shull et al, 2008.
3. Rannikko Pirkka, User-centred design in agile software development. Tampere, April 2011.
4. Brill Olesia, Knauss Eric, Structured and Unobtrusive Observation of Anonymous Users and their Context for Requirements Elicitation. ISBN: pp: 175-184, Hanover, 2013
5. Maalej Walid, Nayebi Malekanz, Johann Timo, and Ruhe Gunther, Towards Data-Driven Requirements Engineering, Hamburg, 2015
6. March A.T. and Smith G.F. Design and natural science research on information technology. *Decision Support Systems*, 15(4):251–266, December 1995.
7. Roel Wieringa, Design Science as Nested Problem Solving, Twente, May 2009.
8. Pieter J. van Strien. Towards a Methodology of Psychological Practice. pp 689-691.1997.
9. Bomarius Frank, Oivo Markku. Product Focused Software Process Improvement. pp 419. Oulu, Finland. June 2000.
10. Stapel Kai, Knauss Eric, and Schneider Kurt. Using FLOW to Improve Communication of Requirements in Globally Distributed Software Projects. pp 4. Leibniz Universitat Hannover, 2009.
11. J Rasmusson, Agile in a nutshell, Retrieved from: <http://www.agilenutshell.com/burndown>, 2015.
12. McLeod Saul. Observation Methods in Research | Simply Psychology, Retrieved from <http://www.simplypsychology.org/observation.html>, 2015.
13. Blackstone Amy. Sociological Inquiry Principles: Qualitative and Quantitative Methods. pp 194,195,196. University of Maine.
14. Frechtling Joy, and Sharp Laure. User-Friendly Handbook for Mixed Method Evaluations. pp23. Directorate for Education and Human Resources. 1997.
15. Linåker Johan, Sulaman Muhammmad Sardar. Guidelines for Conducting Surveys in Software Engineering v. 1.1, pp40. Lund University, 2015.