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How Do Designers Deal With Uncertainty

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Abstract:

Uncertainty touches most aspects of life and cannot be avoided, anybody is frequently presented with situations wherein a decision must be made when he/she is uncertain of exactly how to proceed. Narrow down into Information Systems (IS) field, uncertainty could be regarded as a basic but difficult problem that every HCI designer need to deal with within their design process. The purpose of this thesis is to find out how do human-computer interaction (HCI) practitioners deal with the uncertainty in their daily work. Based on this purpose, we assume that design approaches could be the methods for the designers to deal with uncertainty. There is however very few existing research on how to deal with uncertainty. In this study, we firstly categorized the uncertainty into a logical taxonomy, also ranked four design approaches by the extent of user involvement. We interviewed five HCI practitioners in different organizations that are or were working as designers. We found that most uncertainties are resulted from their customers, which can also be the most difficult to handle by them. In order to solve uncertainty, the designers need to make a good communication with others in specific situation, and some of them also proposed other practical solutions, such as “Role Play” and “Instinct Follower”. Additionally, the designers all proposed that the relationship between uncertainty and design approaches can be weak or inexistent. Interestingly, modest user involvement can be a helper for designers to solve or avoid uncertainty in the design process.

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1 Introduction

At the beginning of the IT development, the composition of this industry was very simple and monotonous. As suggested by Grudin (1990), most computer systems engineers and programmers were self-sufficient until 1975, when there were very few difference and diversity sharing between system use environment and system development environment. However, according to Reed (2000), the popularization of personal computer had brought a considerable alteration for the whole civilized society, popularized human-computer interaction (HCI) into a utterly hot topic as well, by enabling more and more stakeholders participated in the role of end users. Furthermore, it also totally differentiates the system use environment and system development environment. The dramatic change also brought problems to the “designers”, Maria (2001) state that there are many high-tech products, including computer-based systems as well as electronic equipment and everyday appliances, are so hard to use is that during the development of a product, the emphasis and focus have been on the system, not on the people who will be the ultimate end users. Facing the alteration of end users, the designers need to deal with the uncertainty in their daily work.

The general definition of uncertainty comes from the Oxford Dictionary, which states that uncertainty is about ‘a state of being’ or (not) knowing. According to Simonović (2012), who expresses that the concept of “uncertainty” from “certainty” within a opposite way, which claimed that “uncertainty” refers to “lack of certainty”, a state of having limited knowledge where it is impossible to describe exactly the existing state, a future outcome, or more than one possible outcome. The definitions point out that decision makers are always only working with part of the picture, that there is always information missing, and that therefore there are lots of things that practitioners do not and could not know when they make judgments and decisions about the appropriate course of action and its outcome (Streatfield, 2001). However, the decision makers or practitioners refer to HCI practitioners or general designers in this study.

The uncertainty could be regarded as a basic but difficult problem that every HCI practitioner or designer needs to deal with in their daily design work. Nevertheless, there is very few existing research work on how to deal with uncertainty. Furthermore, there are several design approaches have been developed from which the designers could utilized to guide the overall goal of the design or the tendencies of the designer.

Gaver *et al.* (2004) probed the value of uncertainty and perceived uncertainty as positive values. Designers should understand their users empathetically, not intellectually. Asking unambiguous questions tend to give you what you already know which means constraints to some extent. Posing open or absurd tasks, in contrast, ensures the freedom of design and allows more possibilities. Gaver, Beaver and Benford (2003) also claimed that although ambiguity is usually avoided in HCI design, there is a growing number of interactive designs which using to good effect. Ambiguity enables designers to go beyond limits of technologies and engage users with fewer constraints while with more active.

We focus on possible ways of how do designers deal with uncertainty based on the several design approaches that are available to the designers. Within comparison among different approaches in this area, which provide a specific approach or model of dealing with

uncertainty. These definitions and theories play a major role in the exploration because of the ability to approach the area in all possible aspects. With this, we strive to give the readers a fair understanding of uncertainty within HCI field and how it could be dealt by these approaches.

1.1 Problem area

At the empirical level, uncertainty is an inseparable companion of almost any measurement, resulting from a combination of inevitable measurement errors and resolution limits of measuring instruments. At the cognitive level, it emerges from the vagueness and ambiguity inherent in natural language. At the social level, uncertainty has even strategic uses, and it is often created and maintained by people for different purposes (privacy, secrecy, proprietary) (Klir and Wierman, 1999, pp.2).

According to Tannert, Elvers and Jandrig (2007), uncertainty touches most aspects of life and cannot be avoided, anybody is frequently presented with situations where in a decision must be made when he/she is uncertain of exactly how to proceed. Uncertainty is a term used subtly in different ways. It has been used in a number of fields, such as philosophy, economics, finance, insurance, psychology, sociology, and information science.

Madsen and Pries-Heje (2009) claim that uncertainty has been widely discussed as a fundamental characteristic of information systems (IS) projects. We intend to discuss them in a narrower domain, for instance in HCI.

The field of HCI is a significant subset of IS (Agrawal, Boese and Sarker, 2010). A long-term goal of HCI is to design systems that minimize the barrier between human's mental model of what they want to accomplish and the computers' support of the users' task. Researchers study the design and usage of computer technology, investigate particularly at the interfaces between human beings and computers. The impact of problematic HCI designs is magnified greatly by the advent of desktop computers, employed mainly by professionals for enhancing their work productivity (Gerlach and Kuo, 1991). More and more non-technical end users connected to the Information Technology (IT) world. For those who are non-technical end users, HCI designers/ researchers have to combine the knowledge from computer science, ergonomics, linguistics, psychology and social science to build an easy use IS. Therefore, HCI is an interdisciplinary. However, according to Borchers (2001), in order to design systems that fulfil today's high expectations concerning usability, HCI experts need to work together very closely with team members from other disciplines, such as user interface (UI) designers, software programmers, project managers and production managers. Most notably, they need to cooperate with application domain experts to identify the concepts, tasks and terminology of the product environment, and with the development team to make sure the internal system design supports the interaction techniques required (Borchers, 2001). From which we can easily find out that there may be very few differences between the roles of UI designers or software designers, as the teammates for each other, they may all have to deal with the same problem and challenge in the same time. Therefore, as a software designer, who may share plenty of similarities with UI designers, also need to handle the uncertainty during the design process.

1.2 Research purpose and questions:

The purpose of this study is to find out how do HCI practitioners deal with the uncertainty in their daily work. In order to find out the answer, firstly we plan to look at HCI practitioners' perception of uncertainty and exemplify uncertainty according to their design experience. And then, we intend to summarize what methods do they utilized to solve or utilize the uncertainty.

As argued in the introduction, there is very few research attention paid to the uncertainty in HCI domain. Therefore, in order to achieve the research purpose, the authors of this paper intend to analyze and summarize the definition of uncertainty in HCI domain based on the previous literatures within general and IS definition. Besides, the HCI practitioners' perceptions of uncertainty are also considered and utilized to identify the concept of uncertainty in HCI domain. Additionally, the methods and approaches for HCI practitioners to deal with the uncertainty are also investigated and discussed. Keeping these in mind we have developed the following research questions:

1. What is uncertainty in HCI domain and how do designers perceive uncertainty?
2. What approaches or strategies do the designers utilize to deal with uncertainty?

In this thesis, we want to investigate the perception of uncertainty in the domain of HCI, and how HCI practitioners are dealing with uncertainty in their work.

1.3 Delimitations

As we have clarified the aim of this thesis, it is understood that the authors are going to summarize the concept of uncertainty in HCI domain. Thus, this study is limited to the HCI domain, instead of other branches in IS field nor outside of IS field.

Additionally, the research is limited to the designers' perspective, and we will not only focus on the designers in particular country. Our study will not analyze the technical details that exist in terms of characteristics, implementation of various tools that are being used in designers' design process.

1.4 Target group

This study is mainly aimed towards other students and researchers that have an interest in the HCI domain, the specific definition and other difficulties regarding uncertainty that this field may involve. Practically, this study may be helpful for the HCI beginners, who lack experiences to handling uncertainty within their works.

1.5 Structure of the thesis

The rest of the thesis is organized as followed:

Chapter 2 -Frame of reference discusses the relevant knowledge and information that have been raised in existing literature regarding designers, uncertainty, and different design approaches. Thus, the first part of this chapter is to address the definition of designers, in order to specify our discussion into a tangible domain. The second task is to collect and summarize the uncertainty as a general notion, meant to conclude a systematic definition of uncertainty within a non-specific area. Next, we will further elaborate on the notion of uncertainty expressed in literature, and narrow down the concept from non-specific to specific IS field. Furthermore, some literature review that related to the uncertainty within HCI field has been presented. The third part of this chapter includes collect different sort of design approaches, categorize them into different groups and discuss the differences among them.

Chapter 3 is an exposition of the approach of the study and the methods that have been used. It states how we conducted the literature review and interviews with HCI practitioners. It also includes reflections regarding quality and ethical issues. We will present the research methodology and how we are writing this report.

In chapter 4 we will present the findings and result of the empirical research, including a simple analysis of the result. We have five interviewees and four sections of interview questions. The result of the empirical research will be presented in order.

Chapter 5 will consist of a discussion regarding the empirical findings proposed in chapter 4. Here we will highlight interesting topics and questions in the findings of the empirical research. Furthermore, we will analysis these interesting topics and connect them with the result of the literature review.

In chapter 6 we will present a conclusion of the research and state an answer to the research questions.

2 Literature review

Frame of reference discusses the relevant knowledge and information that have been raised in existing literature regarding designers, uncertainty, and different design approaches. Thus, the first part of this chapter is to address the definition of designers, in order to specify our discussion into a tangible domain. The second task is to collect and summarize the uncertainty as a general notion, meant to conclude a systematic definition of uncertainty within a non-specific area. Next, we will further elaborate on the notion of uncertainty expressed in literature, and narrow down the concept from non-specific to specific IS field. Furthermore, some literature review that related to the uncertainty within HCI field has been presented. The third part of this chapter includes collect different sort of design approaches, categorize them into different groups and discuss the differences among them.

2.1 Designers

Until 1975, most computer system users were engineers and programmers. The system use environment was very similar to the system development environment (Grudin, 1990). HCI is not such a big issue during that time. Engineers and programmers produced computer systems for themselves, they are the user representatives and main end users. Along with the popularization of the personal computer, more and more stakeholders have been integrated into the targeted end users. HCI design had gradually become important. However, until 2005, Tognazzini (2005) still stated that the design practitioners still work in obscurity. Because so few companies in that time employed interaction designers, instead leaving engineers with no design training in charge of design, this obscurity comes with a penalty for society through lowered productivity. Since the development of information technology, hardware has become cheaper, personal computers and smart phone have been worldwide spread. More and more ordinary people use computer systems for work improvement, entertainment, and daily social contact. They may use personal computers, tablets, smart phones and other smart wearable devices in anywhere at anytime. The system use environment is very different to the system development environment now. Therefore, HCI has becoming an extreme significant issue, we should pay more attention to the interaction design process. And designers are the keys who take the responsibility of system design and UI design.

2.1.1 Who is the designer?

Park and Boland (2012) concluded that “design is an activity of action aimed at changing existing situations into preferred ones” (Simon cited in Park and Boland, 2012), and designers look for opportunities to innovate from various angles. In IS field, we referred to definition from Clausen (1994):

The designer is an individual who is acting actively; is creative and through his activities expresses a will to influence and change into the better some existing situations by developing a computer system.

In this paper, we mainly focus on the HCI designers such as the system designers (such as software engineering) and UI designers (graphic designers). The designer is a man of actions,

who are working within the practice, which he wishes to change according to his conceptions and attitudes (Clausen, 1994).

2.1.2 What is the designer's task?

The designer is aiming at implementing a computer system as part of a larger whole. Generally, he/she has a vision of changing the situation to the IS stakeholders and it is his task to formulate and express his vision in such a way that it could be understood, discussed and evaluated by other people (Clausen, 1994). Interaction design is a creative activity, a decision-making activity to balance trade-offs. Furthermore, pervasive technologies present new challenges for designers to facilitate the interaction between human beings and computer systems (Lim and Rogers, 2008). The system use environment is much more complicated nowadays, variety of devices that have been used in multifarious situations by distinct people. The possibilities of uncertainty for the design processes and results are highly increased in this perspective.

2.1.3 How do the designers communicate?

As we mentioned above, more and more stakeholders are integrated into the IS development, the end users formed by different people from all over the world for distinct purposes. It is important how the involved persons communicate with each other. The designers should use different forms of language through the development process dependent on what he is communicating about and with whom he is communicating (Clausen, 1994). We conclude there are four different groups which designers have to communicate with: programmers (or software engineers), project managers (or product managers), end users (or customers), and the third parties in the development. Programmers and software engineers communicate in a technical way, and the communication should be accurate. Consequently, a certain kind of formalism is appropriate. When the project managers and the product managers communicate about the system, they focus on the develop process and final product, working schedule, delivery date, technical functions and the communication between different departments within or even out of the company. They pay attention to the quality and deadline. When the designer communicates with end users, he either wishes to learn something from the users about the domain or get the users' reaction on the system to come (Clausen, 1994). Sometimes, end users are hard to be targeted. Even if the end users are found, it is still a challenge to communicate with them (Grudin, 1990; Tuovila and Iivari, 2007; Huang *et al.*, 2008; Clausen, 1994). Sometimes, there are external stakeholders (who are not in the design group, design department or even in the design company) integrating into the design process. For instance, consultants, independent or third-party software developers and vendors, domain experts hired by development companies, internal market research or development groups and so forth (Grudin, 1990). Flexible or multi-stage system development contracts may involve a lot of stakeholders from different working processes and perspectives. The communication with those external stakeholders requires extension knowledge and more tactics.

2.2 Uncertainty

As stated previously, uncertainty is a term used subtly in a number of fields, such as philosophy, economics, finance, insurance, psychology, sociology, and information science.

In this paper, we single-minded focus on uncertainty in HCI field. Madsen and Pries-Heje (2009) claim that uncertainty has been widely discussed as a fundamental characteristic of IS projects, but it is often mixed with risk and treated solely through risk management. Nevertheless, there is few study attention has been paid to the concept of uncertainty in IS projects. Therefore, Madsen and Pries-Heje (2009) push forward and take a closer look at the uncertainty, they described and derived an understanding of uncertainty from the existing literature from three different perspectives.

Understanding from the the existing literatures, the concept of uncertainty in IS project could be regarded as: “the individual’s and/or group of individuals” perceived level of not knowing the appropriate course of action and/or its outcome at a given point in time (Madsen and Pries-Heje, 2009). Furthermore, Madsen and Pries-Heje (2009) identify four different types of uncertainty based on in-depth analysis of qualitative interviews with experienced IS project managers, which are task uncertainty, collaborative uncertainty, process uncertainty, and individual uncertainty. This paper will narrow down the concept of uncertainty from the general field, and then constraint it in the HCI field and relate it to designers’ daily work.

2.2.1 The taxonomy of uncertainties in general

Generally, uncertainty touches most aspects of life, especially when we make decisions that have consequences that we cannot predict. Uncertainty is an inherent attribute of a situation (Tannert, Elvers and Jandrig, 2007). We found two taxonomy of uncertainty in general. One is proposed by Tannert, Elvers and Jandrig (2007), this taxonomy for uncertainty that recognizes two fundamental forms of uncertainty: objective and subjective uncertainty, both of which are divided into two further subforms (as shown in figure 2.1). The other taxonomy is according to Sharma (2010), there are three main types of uncertainties: 1. Fuzziness (vagueness), 2. Imprecision (non-specificity) and 3. Discord (strife). In the following part, we will introduce both of these taxonomies.

Uncertainty taxonomy (Tannert, Elvers and Jandrig, 2007)

The first form of uncertainty in this scheme is objective uncertainty, which can be further divided into epistemological uncertainty and ontological uncertainty (Asselt and Rotmans cited in Tannert, Elvers and Jandrig, 2007). Epistemological uncertainty is caused by gaps in knowledge that can be closed by research. In this case, research becomes a moral duty that is required to avoid dangers or risks, to realize possible benefits, or to balance risks and benefits in a rational and responsible way (Tannert, Elvers and Jandrig, 2007). This is up to individual designers’ professional expertise and interpersonal communication skills. Sometimes, the designers might have extensive knowledge on some approaches they frequently used, but at the same time very poor knowledge on others, even some commonly used in the industry (Liu *et al.*, 2008). Therefore, it is necessary for designers to improve their personal capabilities to handle this type of uncertainties. Furthermore, Norman (2010) claimed that there is an immense gap between research and practice. This gap brings additional difficulties for designers to gain more knowledge about design. Conversely, ontological uncertainty is caused by the stochastic features of a situation, which will usually involve complex technical, biological and/or social systems. Such complex systems are often characterized by nonlinear behavior, which makes it impossible to resolve uncertainties by deterministic reasoning and/or research (Shrader-Frechette cited in Tannert, Elvers and Jandrig, 2007). In such cases, it is impossible to make rational decisions. This type of uncertainty is more like the general

uncertainty in our cognition: random, unpredictable, emergence. Nevertheless, past experience and probabilistic reasoning at least provide some guidance and help for designers. Zimmerman (2011) emphasized the importance of experience as well. He proposed that designers use their experience and their sensitivity to design conventions to search for a balance between the comforts of convention and the stimulation of novelty. Instead of blindly following a process, they need to be more pragmatic. Clausen (1994) also stated the system designers do their job the best they can, the system is implemented whereupon the designers learn from their mistakes and make adjustments to the system.

The second main form of uncertainty in their taxonomy is subjective uncertainty, which is characterized by an inability to apply appropriate moral rules (Tannert, Elvers and Jandrig, 2007). It can be distinguished between two sub-forms of subjective uncertainty. The first is uncertainty with respect to rule-guided decisions. This is caused by a lack of applicable moral rules, and Tannert, Elvers and Jandrig (2007) called these situations “moral uncertainties.” We claim since more and more stakeholders involved in the IS development and the composition of end users become utterly complicated, the moral uncertainty may be an issue for designers. Tannert, Elvers and Jandrig (2007) analyzed that, in this case, decision-makers (here refer to the designers) have to fall back on more general moral rules and use them to deduce guidance for the special situation in question. Unfortunately, decisions guided by general moral rules often give only poor satisfaction to the designers.

The second subform is uncertainty with respect to intuition-guided decisions—that is, uncertainty about moral rules. In specific situations, we can make decisions only by relying on our intuition rather than knowledge, or explicit or implicit moral rules. This means that we act on the basis of fundamental pre-formed moral convictions in addition to experiential and internalized moral models (Tannert, Elvers and Jandrig, 2007). Similar to the ontological uncertainty, this type of uncertainty required the sensitivity and experience as well. The design is different to coding; it combines the knowledge of social science, ergonomics, psychology and IS. For designers, HCI should be seen as a part of the broader context of human via computer to human interaction (HCHI), rather than simple HCI. This complicated interdiscipline increases the uncertainty for design, requires designers to gain more knowledge on different subjects, and emphasize the importance of sensitive and experience.

When dealing with real-world problems, we can rarely avoid uncertainty. Klir and Wierman (1999) describe uncertainty in “at the empirical level, uncertainty is an inseparable companion of almost any measurement, resulting from a combination of inevitable measurement errors and resolution limits of measuring instruments”. At the cognitive level, it emerges from the vagueness and ambiguity inherent in natural language. It is easy to understand the language confusion. At the social level, uncertainty has strategic uses, and it is often created and maintained by people for different purposes (privacy, secrecy, propriety). We assume that during the design process, there may be deliberate uncertainty made by designers themselves.

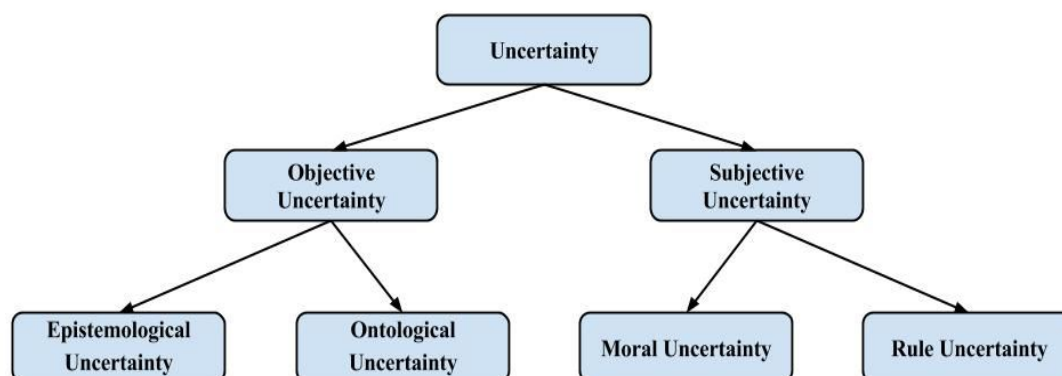


Figure 2.1: The taxonomy of uncertainties and decisions(Tannert, Elvers and Jandrig, 2007).

Uncertainty taxonomy (Sharma, 2010)

The next taxonomy of uncertainties in the general field is according to Sharma (2010)'s study, there are three main types of uncertainties: 1. Fuzziness (vagueness): uncertainty due to imprecise boundaries (fuzzy set instead of the crisp set). 2. Imprecision (non-specificity): uncertainty due to the size of relevant sets of alternatives. 3. Discord (strife): uncertainty due to conflicts among various sets of alternatives. We will discuss them separately.

Fuzziness

For the HCI designers, there are two main imprecise boundaries. One is the imprecise boundary within the HCI practitioners. HCI practitioners include UI designers, product managers, project managers, software engineers and may involve with external consultants. The imprecise boundaries between them may lead to confusion. Designers need clear task division and working process. The other imprecise boundary is between the designers and end users. The importance of understanding the intended users when designing interactive computer systems is widely enough acknowledged in 1990 (Grudin, 1990). The traditional software development model is waterfall model. Boehm (cited in Grudin, 1990) stated that the dominant waterfall model of development does not work well for many classes of software, particularly interactive end-user applications. At that time, the end users normally mean a stack of user specifications or requirements. Since the spiral model and incremental model have been developed, incorporates user involvement, prototyping, and iterative design became more possible, acceptable and popular. We understand the importance of multiple stakeholders' interactions and highlight the designeruser interaction as the core of design and IT innovation process (Park and Boland, 2012). Recent years, the user-centered design and user experience have been brought a hot wave in the HCI field. With the advent of this user-centered trend, the relationship between designers and users changed.

For the traditional software development, there is a "wall" between designers and users: the reliance on specifications documents. Since the end users involved in the develop process, the wall is broken but an imprecise boundary left because of general communication obstacles and the way how designers target and involve the users. The boundary between the designers and the end users should be clear: one is a producer and one is a consumer. But the cooperative development between designers and user representatives dim the boundary. How

center should the users be? Schweikardt (2009) criticized the user-centered design always focus on users (users' demands such as comfortable and convenient) and ignore the environment and sustainability. To what extent shall designers involve the users? How designers involve the users and get their real cognitions? There are interviews, questionnaires, personas (Miaskiewicz, Grant, and Kozar, 2009), narratives (Clausen, 1994) and so many techniques, methods to study users' needs. But we still need to explore the approaches of integrating users to clear the fuzziness between designers and users.

Imprecision

The HCI design has become more and more complicated. From limited and comparable simple end users to a large number of end users from different background. From computers to cross-platform such as computer, tablet and mobile phone (Miaskiewicz, Grant, and Kozar, 2009). New methods of passing and sharing information have been developed; information shall be transferred between computers and distinct devices, such as from a laptop to an interactive tabletop screen and a large public display. The imprecision uncertainty increased due to the large size of relevant sets of alternatives: various end users (the targeted users are imprecise) and cross platforms (the systems usage environments are imprecise). Additionally, the requirements that proposed by the users or customers are usually imprecise, they have no idea about their real demands (Grudin, 1990; Tuovila and Iivari, 2007; Huang *et al.*, 2008; Clausen, 1994).

Discord

Uncertainty arises from conflicts among various sets of alternatives. In this paper, we transfer this uncertainty into the conflict between different requirements. Huang *et al.* (2008) claimed that very limited insights were offered to explain how different requirements should be managed and settled. How to handle situations when contradictory requirements occurred? The contradictory requirements may come from different end users, or between the end-users and the customers, or there are some conflicts due to the third parties. Designers have to balance and make the decision of this uncertainty. Furthermore, even within the design groups, different designers may hold different or contradictory ideas, the discord uncertainty is almost everywhere in the design process.

2.2.2 The taxonomy of uncertainties in IS field

Madsen and Pries-Heje (2009) concluded many “messiness” in IS field such as communication pitfalls; resistance to change; unclear tasks and plan; changing system requirements; conflicting stakeholder demands; individual career concerns; difficulties in achieving deadline and information from future end users; time and budget constraints; pressure to delivery; rapid technological change in the marketplace; organizational changes which may influence the design; and difficult and unexpected technical problems at the project level. Madsen and Pries-Heje (2009) identified four types of uncertainty included task uncertainty, collaborative uncertainty, process uncertainty and individual uncertainty. We will go deep into them one by one.

Task uncertainty

Task uncertainty addresses the uncertainty that arises due to a lack of understanding or doubts about the project, its end result, as well as major and minor tasks within the project (Madsen and Pries-Heje, 2009). When designers have no idea or unclear understanding of the task, it

will lead to the task uncertainty. If designers are certain then they know what the next action is, when they are uncertain then they just muddle through. This is a general uncertainty in IS field and even in organization management. One way of dealing with it is trying to get back in control via project planning, lists, and templates. Designers should have a whole picture of the project, have the final goal and short-term objectives in mind. Madsen and Pries-Heje (2009) proposed that the IS project managers should ask questions and engage in reflective, and conduct participative conversations which including (in)formal reviews to understand expectations and to deal with doubt. The review and validity will improve designers' task understanding and reduce the task uncertainty.

Collaborative uncertainty

Collaborative uncertainty addresses the uncertainty that arises due to (a lack of knowledge about) the individuals in the group, and their different expectations, preferences, abilities, and actions (Madsen and Pries-Heje, 2009). Designers do not yet know what to expect with regard to the different group members' interest in and ability to participate and deliver. If different stakeholders cannot agree with one commitment, or HCI practitioners cannot work on the same goal, a bad working climate may arise. While it is extremely important for the designers to feel comfortable in the group. Collaborative uncertainty may be managed in several ways such as participation and communication, formal and informal distribution of roles (Madsen and Pries-Heje, 2009). Good working climate will improve the quality of collaborative and reduce the possibility of uncertainty.

Process uncertainty

Process uncertainty arises at different points in time during the IS development process, namely in the beginning, middle, and when deliverables have to be handed in along the process or in the end (Madsen and Pries-Heje, 2009). These type of uncertainty focus on the process such as "startup uncertainty", "midway crisis", and "deliverable-uncertainty". In the different design stage, designers may have distinct anxiety. In the startup section, designers may confused with their tasks, final goals, and roles. While, in the midway of the process, designers may feel tired with the tasks but it is still half away from the end of the project. They may not sure about what they have done and what they are going to do. When the deadline is coming, they are deeply troubled with the product delivery. For startup uncertainty, designers shall well understand the project scope and foundation. In the midway of the project, re-negotiate is a strategy to control the design process. Before the deadline, everyone shall only focus on the project.

Individual uncertainty

The individual uncertainty concerns the individual experience of the task, collaborative, and process uncertainty and the reaction to or 'management' of that experience. Thus, when the level of task, collaborative, and process uncertainty increases the level of individual uncertainty is also likely to increase (Madsen and Pries-Heje, 2009). This uncertainty is due to the designer's personal skill and experience. Madsen and Pries-Heje (2009) proposed project planning, mental risk, and worst case scenario analysis as a solution for reducing this kind of uncertainty.

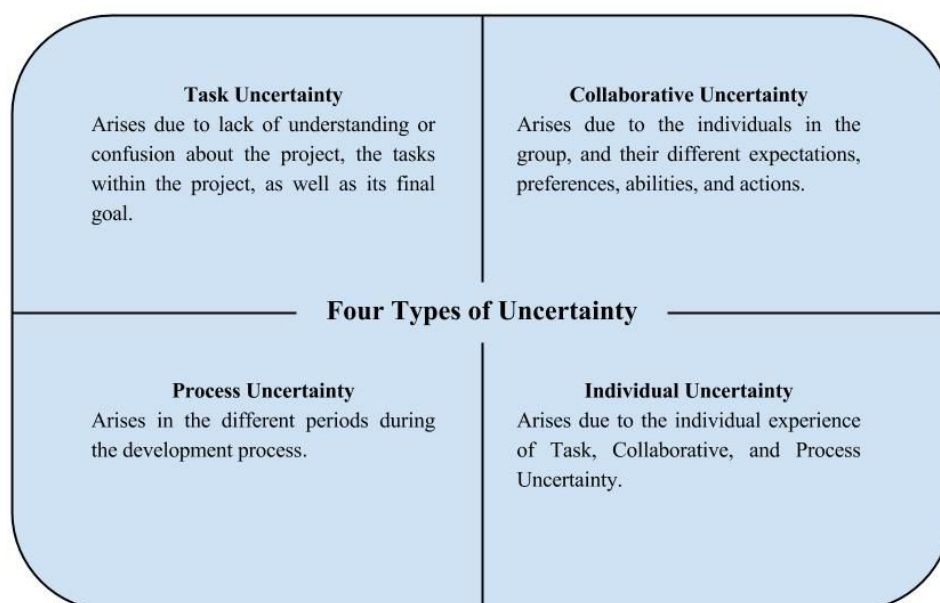


Figure 2.2: Framework of uncertainty(Madsen and Pries-Heje, 2009).

Based on these taxonomies or framework of uncertainty that under a wide definition, we will propose a framework specific focus on the uncertainty in HCI field.

2.2.3 The taxonomy of uncertainties in HCI field

There are very limited studies focus on the uncertainty in HCI field, and that is the primary motivation of this thesis. In IS field, system requirements or software specification are classified into two categories: Functional and Nonfunctional requirements (Khatter and Kalia, 2013). As a basic definition, a functional requirement defines a function of a system. It may be technical details, data processing, and other specific functionality that define what a system is supposed to accomplish. While in contrast, a nonfunctional requirement is a constraint or a restriction on the operation of a system that must be considered during the design of the solution rather than specific behaviors, such as usability, stability and security. Nonfunctional requirements are much more abstract and conceptual compared with functional requirements. Since HCI emphasizes the importance of “experience”. Therefore, the fuzziness and imprecision of nonfunctional requirements may lead to more uncertainty.

Gaver, Beaver and Benford (2003) stated “ambiguity” as a resource for design and distinguish three broad classes of ambiguity according to where uncertainty is located in the interpretative relationship linking person and artifact. Ambiguity is a similar concept to uncertainty. This ambiguity mainly focuses on the interaction between designers-artifacts-users rather than uncertainty straightforward between designers and users. And Gaver, Beaver and Benford (2003) highly appreciated the value of ambiguity in HCI design. This is the different voice that against other studies we have mentioned above, it claimed the value of uncertainty. They distinguish ambiguity from related concepts such as fuzziness or inconsistencies: “these are

attributes of things, whereas ambiguity is an attribute of our interpretation of them” (Gaver, Beaver and Benford, 2003, pp. 233). The three type of ambiguities is: ambiguity of information, ambiguity of context, and ambiguity of relationship.

Ambiguity of information

Ambiguity of information finds its source in the artifact itself, arises in the way that information is presented. Just as Mona Lisa’s smile, the attraction comes from the ambiguity of information, why she smiled like this, who was she? Designers may implement this tactic to engage users to be more active while they respond to the systems rather than passively accept information and react based on common sense.

Ambiguity of context

Ambiguity sometimes arises not because things are themselves unclear, but because they may be understood in different contexts, each suggesting different meaning (Gaver, Beaver and Benford, 2003). Since the development of technologies, IS is no longer used solely by programmers, its users are becoming ever more varied and its uses ever more flexible. Ubiquitous computing, IoT (Internet of Things), cloud computing, all of those new technologies allow distinct users deal with IS in various context. Contextual ambiguity can question the discussion surrounding technologies, allowing users to expand, bridge, or reject them as they see fit.

Ambiguity of relationship

Relational ambiguity can lead users to consider new beliefs and values, and ultimately their own attitudes. It evokes a projection of our subjective experiences and attitudes onto new situations. It allows the designer’s point of view to be expressed while enabling users of different socio cultural backgrounds to find their own interpretations (Gaver, Beaver and Benford, 2003).

In section 2.2, we collected and summarized the uncertainty as a general notion, meant to conclude a systematic definition of uncertainty within a non-specific area. And further elaborated it on the notion of uncertainty expressed in literature, narrowed down the concept from non-specific to specific IS field. Furthermore, some literature review that related to the uncertainty within HCI field have been presented.

2.3 Approaches to design

The field of human-computer interaction is rapidly expanding (Rogers, 2004). The HCI literatures have outlined several approaches designers can use when working on a project (Huenerfauth, 2002). Its mission, goals, and methodologies, which were well established in the 80s, have all greatly expanded to the point that “HCI is now effectively a boundless domain” (Barnard *et al.*, 2000, pp. 221). As suggested by Rogers (2004), with the investigation and development in HCI field, a number of design approaches are new and much of what is being designed significantly different.

2.3.1 Four design approaches

Saffer (2010) suggests four main approaches to interaction design, each of which is based on a distinct underlying philosophy. He acknowledges that the purest form of any of these is unlikely to be realized and takes an extreme view of each in order to distinguish between

them.

1. **User-centered design**, the user knows best and is the only guide to the designer; the designer's role is to translate the users' need and goals into a design solution. In the ideal UCD approach, designers should involve users in every stage of the product development. Designers move away from their preferences and instead focus on needs and goals of users. This is more appropriate for the software development in now days since the system use environment is very different with the system development environment as we mentioned above. However, there are still some potential problems of UCD: such as it narrow focus on end users and may overlook the other aspects of development, designers may focus on the wrong users' types, and when designers service for a large (segmented) audience, UCD may be impractical.

2. **Activity-centered design (ACD)** focuses on the behavior surrounding particular tasks. Users still play a significant role, but it is their behavior rather than their goals and needs that are important. Designers collect cluster of actions and decisions done for a purpose. Designers observe and interview users for insights about their behavior design solutions to help users accomplish a task. Compared with UCD, ACD is simple and time efficiency. While, ACD fix tasks at the same time, designer don't look for solutions for the problem as a whole.

3. **System design** is structured, rigorous, and holistic design approach that focuses on context and environment. It is particularly appropriate for complex problems and useful for seeing the whole picture of the project. In systems design, it is the system that are the center of attention while the users' role is to set the goals of the system. In system design users are de-emphasized in favor of context.

4. **Genius design (Rapid expert design)** is different from the other three approaches because it relies solely on the experience and creative flair of a designer. In this approach, the users' role is to validate ideas generated by the designer, and users are not involved in the design process itself. User involvement (if it occurs at all) comes at the end of the process when users test what the designers have made. It relies on the wisdom and experience of the designer and is widely used today. This fast and personal way of work, flexible approach allowing designers to focus their efforts where they see fit. The creative work result may gain huge success or nothing at all.

Approach	Overview	User Involvement	Designer Role
User-Centered Design	Focus on users needs and goals	High. Users participate the whole design process	Translator of users needs and goals
Activity-Centered Design	Focus on the activities that need to be accomplished	Less high. Users' behaviors are investigated	Collector of user behaviors and activities
Systems Design	Focus on the systems	Low. Users set the goals of the system	Makes sure all the parts of the system are in place
Genius Design	Design based on designer's experience, talent and skill	Lower. Users just test what the designers has made	The source of inspiration

Figure 2.3: Design approaches (Saffer, 2010).

Nevertheless, often a mixture of approaches is applied—best designers are those who can move between different approaches. Different design approaches will better solve different design problems, and different designers will tend to gravitate towards using the approach that suits them best. Although an individual designer may prefer a particular approach, it is important that the approach for any one design problem is chosen with that design problem in mind.

2.3.2 User-centered design and non-user-centered design

In Human-Computer Interaction research, designing with the user in mind has become a generally agreed principle (Bekker and Long 2000). Obviously, the role of the users has been become increasingly essential to the whole design process. In general, specialists agree that users should be involved in the design process to ensure the development of usable systems (Bekker and Long, 2000). Inspired by Bekker and Long (2000) and Maria (2001), the design approaches is differentiated from others by considering the involvement of users in the design process. Design approaches differ in the rationale they propose for user involvement and how such involvement should be implemented, a main difference between approaches is the role envisaged for the user in the design process (Bekker and Long, 2000).

User-centered design: is a broad term to describe design processes in which end-users influence how a design takes shape. It is both a broad philosophy and variety of methods (Abrams, Maloney-Krichmar and Preece, 2004). User-centered design implies that final users are involved from the very beginning of the planning stage, and identifying user requirements becomes a crucial phase (Maria, 2001). As for the roles of designers and researchers in UCD are distinct and interdependent, as suggested by Abrams, Maloney-Krichmar and Preece (2004), the role of the designer is to facilitate the task for the user and to make sure that the user is able to make use of the product as intended and with a minimum effort to learn how to use it.

Non-user-centered design: can be regarded as an opposite term to user-centered design, as suggested by Herstad and Stuedahl (2002), since there has not been a clear definition of non-user. Analogizing to the definition from Maria (2001), non-user-centered design can be seen as a kind of design approach that contain few user involvement instead of the whole design process. Learned from Saffer (2010) and Maria (2001), systems design can be categorized as non-user-centered design, in which the designers put the systems in the center place instead of users, and count on the fact that users are flexible and adaptable. And looking into the genius design approaches from Saffer (2010), which can be regarded as designer-centered design. It relies solely on the experience and creativity of designers, and there is no user involvement within the entire design process (except the evaluation section/).

Concluding both ways of categorizing four design approaches that we have discussed above, we secondarily categorized and summarized a new taxonomy these four design approaches from Saffer (2010) based on the user involvement during the whole design process.

2.3.3 Importance of user involvement

User-centered Design: since we have mentioned above, this kind of design approach focus solely on users, the users is the guide to the design as a whole, while the designers take the role as a translator who create the whole design project by following the expectancy from the users. And the users participate every step during the whole design process, so user involvement lies on the highest level in this design approach.

Activity-centered Design: in this design approaches, the users' needs and goals are less important than user-centered design. Most attentions are paid to the tasks and activities that need to be accomplished, but the users still play the role as the performers of activities. Comparatively, the designers take the role to create the tools for actions. Therefore, the user involvement was degraded in activity-centered design.

System-centered Design: the components of the system is the focus of the design, the users are only involved in to set the goals of the systems, and the designers just responsible for place the different components in the right positions. Obviously, the users just involve in the initial stage of the design process to identify the task and goal.

Designer-centered Design: differentiated from other three approaches, this kind of design approach relies solely on designers' experience and wisdom. The users play the role as a validator, from which we could conclude that there is very few users involvement here and sometimes even not involved during the whole design process.

Regarding to the increasing importance of the role of the users supported by Abras, Maloney-Krichmar and Preece (2004), the new taxonomy of these four design approaches we summarized could offer a clearer perspective for the designers. It enables the designersto choose the most suitable design approacheasilyand balance the user's role in the whole design process.

2.4 Summary

This chapter introduced related theories of “designer”, “uncertainty” and “design approaches”. We clarify the domain of designers and present their work process. The definition and taxonomy of uncertainty was narrowed down from the general area to IS field and further narrowed down into HCI section. Furthermore, we focused on the taxonomy of uncertainty from Madsen and Pries-Heje (2009), and deeply discussed it in our following sections. However, as for the four design approaches, we decided to group them by two understandable concepts, in order to make them clear to some designers who are not familiar with them and the design beginners as well. Based on the general concept user-centered, these four approaches are divided into user-centered and non-user centered design; according to the depth of user involvement, four design approaches have been ranked clearly. Expand those theoretical backgrounds, we designed the interview framework that the main sections are designers, uncertainty, design approaches and the relationship between uncertainty, user involvement and design approaches.

3 Methodology

The methodology chapter attempts to present the chosen approaches and methods for our research study. We will initially show how we conduct this research study step by step, introduce the research process and explain the reason for the decisions made.

3.1 Research approach

The term “interpretive research” is often used loosely and synonymously with “qualitative research”, even though the two concepts are quite different. Normally, “qualitative” means text, and words, while interpretive research is a research paradigm that is based on the assumption that social reality is not singular or objective but is rather shaped by human experiences and social contexts (Bhattacharjee, 2012). It is, therefore, best studied within its socio-historic context. The interpretive researchers “interpret” the reality through a “sense-making” process rather than a hypothesis testing process (Bhattacharjee, 2012). According to interpretive research, we can analyze the holistic and contextual data with a comprehensive view of the designers' perspective. Integrate our cognitions into the study and iterate the study process from the literature review to data collection, since the data collection and analysis can proceed simultaneously and iteratively in interpretive research (Bhattacharjee, 2012). The reason why a qualitative approach is more suited than a quantitative, and why we believe that the data required is of a qualitative model, is that the notion of uncertainty is not really measurable. Depending on the purpose of research, scientific research projects can be grouped into three types: exploratory, descriptive, and explanatory (Bhattacharjee, 2012). This research paper will record the perspectives from designers and explain how they perceive uncertainty in HCI field and why they practice like that.

We decide to implement the qualitative research that use of standardized interviews to collect data about designers and their preferences, thoughts, and behaviors in a systematic manner. It is a formal and mature research method that has a quite long history. The motivations of why we want to conduct the qualitative research include:

- This method is best suited for studies that have individual people as the unit of analysis. The unit of analysis refers to the person, collective, or object that is the target of the investigation (individuals, groups, organizations, countries and so forth) (Bhattacharjee, 2012). Since we will interview individual designer and probe his cognition, so the qualitative research is suitable.
- Qualitative research is an excellent vehicle for measuring a wide variety of unobservable data. Based on the qualitative research we can figure out designer's preferences (e.g., user-centered design or user-off-centered design), attitudes (e.g., how do designers perceive the uncertainty in HCI field), behaviors (e.g., designers' daily work and design practices), or factual information (e.g., designers' education background).
- Qualitative research is also ideally suited for remotely collecting data. For the interview candidates, we prefer to interview designers mainly from China and Sweden, and we are in Sweden now, so we have to conduct remote data collection by online interview.

3.2 Data collection

The data collection section based on two ways: literature review and interview. The literature review is the start point of this research paper. We generated the research question from research gap spotting. Alvesson and Sandberg (2011) introduced the gap-spotting as a prevalent way of generating research questions. It created opportunities for contribution by arguing that existing literature was either incomplete or had overlooked in important perspective and that those were gaps that needed to be filled. In the literature review section, we assumed the connection between uncertainty and design approaches, which the design approaches could be regarded as the answer to uncertainty in HCI field. There would be several iteration between the literature review and data collection.

3.2.1 Literature review

Recker (2013) discussed the role of literature in the research process. Before we start research, we need at least three types of knowledge:

1. Knowledge about the domain and topic of interest;
2. Knowledge about relevant theories that help you frame questions and phenomena;
3. Knowledge about relevant research methods that you can apply to develop new knowledge, build innovative artifacts or articulate new questions.

To acquire the essential knowledge, the first step of data collection shall be the literature review. We need the knowledge from the literature review to generate and shape our research question, conduct and reinforce our interview questions, guide and strengthen our paper content.

In order to gather as many data as possible, we have tried several websites that targeting scholars and especially focus on the IS/ HCI scholars. We selected some academic search engines and database such as Google Scholar, LUBsearch, IEEE (The Institute of Electrical and Electronics Engineers), ACM Digital Lab, and AIS Electronic Library. Specifically, in MIS Quarter (The top journal in IS field) and International Journal of HCI, we have found many inspirations for our arguments.

We filtered every information by some keywords, such as uncertainty, design approach, HCI practitioners, designers, user involvement and the combination of them. We looked through every relevant article firstly with their topics and downloaded them into different categories. Secondly, we would double-check their abstract and conclusion to narrow our reading scale. Finally, we plan to categorize them into different levels, give the priority to the articles that come from the top journals and top universities, in order to fully utilize these articles, we also digged into depths on their references to find the most original materials.

3.2.2 Interview

Interviews are a traditional but popular form of data collection method. The interviewer has the opportunity to clarify any issues raised by the respondent or ask probing or follow-up questions. We prefer to conduct the semi-structured or unstructured interview. We designed around 20 questions in advance and listed some possible directions. At the very start of the

interview, we will follow the interview questions and in the later interview we may discuss some open-end questions or some related topics that the interviewees prefer to.

3.3 Development of interview

Bhattacharjee (2012) suggested some useful probing techniques to overcome the silence, awkward scenes and get better understanding of the interviewees by pausing, waiting, using overt encouragement, asking for elaboration, repeating what the respondent said.

3.3.1 Design of interview questions

We categorized our interview questions into six parts: 1. introduction (warming section), 2. designers, 3. uncertainty, 4. design approaches, 5. the relation between design approaches and uncertainty and 6. ending question. In the warming section, we collected the basic information of the interviewees such as occupation and work experience. Then we moved to the uncertainty section; first we would introduce the concept of uncertainty in a general way (instead of academic definition) to the interviewees and then discuss the pre-prepared questions. Similarly, for the third section, we would explain the different design approaches first. The fourth section focused on the relation between design approaches and uncertainty, and we focus on if the design approaches would reducing uncertainty for designers.

Table 3.1: Interview questions (See more details in Appendix 1).

Interview Section	Interview Questions
Introduction	Occupation, education background, basic information about the company and work experience.
The designers	• How do you characterize a designer?
	• How do you describe your design process?
	• How do you perceive the difference among programmers, project managers, product managers, and designers?
The uncertainty	• Have you ever felt "I am not sure..." situations in your design process? Can you give us one example?
	• We assume that your example of uncertainty could be resulted from work itself, which means it has nothing to do with persons. Could you elaborate your uncertainty, is it result from lack of understanding of the task or lack of experience of how to deal with the task?
	• How do you deal with this at that time?
	• We assume that your example of uncertainty could be resulted from other professional roles or customers, which

	<p>means it has nothing to do with work. Could you elaborate your uncertainty, is it result from lack of experiences of yourself or difference among different people in your team?</p> <ul style="list-style-type: none"> • How do you deal with this at that time?
	<ul style="list-style-type: none"> • You said this problem was the uncertainty with your colleagues, apart of that, have you ever contacted with end users in your work?
	<ul style="list-style-type: none"> • Have you ever meet any problems or uncertainties with the end user (user representatives)? Could you give us one example?
	<ul style="list-style-type: none"> • How do you deal with that?
The design approaches	<ul style="list-style-type: none"> • How do you perceive the role of user involvement in your design process?
	<ul style="list-style-type: none"> • Have the user involvement brought you any benefits or obstacles? Could you give us one example?
	<ul style="list-style-type: none"> • Based on the benefits/obstacles you have mentioned in your story, do you think the user involvement would bring you more uncertainty or help you solve it?
The relation between design approaches and uncertainty	<ul style="list-style-type: none"> • Do you think these design approaches are useful to deal with uncertainty? Why?
Ending question	<ul style="list-style-type: none"> • Is there anything that you would like to add?

3.3.2 Interviewee selection

Regarding the selection of interviewees for this study, we can target our interviewees who mainly work within HCI field based on our research questions and purpose. We intend to find interviewees who had been involved in HCI for some years and thereby had experience in that line of work, and hopefully could elaborate on our topics. In order to maintain the objectivity of our interview, we planned to interview designers in different companies and countries, by which we could avoid reducing the risk of resulting in similar answers. We targeted at organizations which work with systems development of IS and IT, therefore, have people working with HCI to find possible interviewees for the interviews. Since our research target in the Chinese context, we would conduct our interview via online video call. And we also preferred to find the Chinese interviewees working in Sweden so that we could interview them face-to-face if possible. Furthermore, we chose to pick interviewees that were involved in HCI work, but that had different roles and professional labels, such as software designers, in that way getting a clearer understanding of uncertainty in the sector. In Figure 3.1 below is a

presentation of the interviewees, including the scale of the organization, working experience, the position of our interviewee, the duration of the interview, the date of when it was conducted, and how it was conducted.

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Organization Scale	Medium	Small	Small	Large	Medium
Working Experience	4 years	2 years	1 years	4 years	5 years
Position of Informant	Project manager	UI designer	UI designer	Software designer	Product manager
Duration	40 mins	40 mins	45 mins	30 mins	40 mins
Day	2015-05-03	2015-05-05	2015-05-05	2015-05-07	2015-05-09
Type of interview	Online	Face-to-face (Lund)	Online	Face-to-face (Lund)	Online

Figure 3.1: Basic information of interviewees.

The first interviewee is Jialou Zhang (Appendix 2). He leads the software development team, which means that he copes with issues of interaction design and software engineering as it is also called on a daily basis. The main duty of his team is to secondary software development, which means that his daily assignment is to improve existing software based on users' need. So he usually conducts some researches with customers, in order to get their insight and feedback of the company's prototypical software. And fulfill their extra demand with the secondary development of the existing software. He needs to lead his whole team and deal with every problems and uncertainty so as to strive for excellent performance applications and customer satisfaction. The interview was recorded.

Interviewee 2 is anonymous (Appendix 3), he works in Sweden, and so we conducted a face to face interview at Lund. He has limited work experience as UI designer. But he was graduated from HCI subject in master degree. He had asked for the interview question before the interview, and we send it to him. The interview was recorded.

The third interviewee is Luona Xiao (Appendix 4); she works in China. As a student who graduated from University last year, she has only one-year work experience. She is a UI designer and primarily responsible for website UI design. She refused the record request, so the interview was not recorded. So we documented the conversation. During the interview, one conductor took notes of the interview process and one wrote down the key words. After the interview we transferred the documents to the interviewee and made a validation.

Interviewee 4's name is Xin Zhang (Appendix 5). He works in Sweden, in an international enterprise as a software designer or software engineering. In his enterprise, the tasks are quite clear, and they have a standard working process and hierarchy. We conducted a face to face interview with him. He refused the record request as well. So we documented the conversation in the same way as the third interview.

The last interview is anonymous (Appendix 6). He is a Chinese product manager. He focuses on the product design and user requirement specification. His daily work is to transform and collect user demands and communicate with technical leaders. We recorded this interview.

3.3.3 Pre-interview

We conducted a pre-interview to test and validity our interview questions before the formal interviews. The interviewee who contributed to the pre-interview is Qingyou Wang, a Chinese UI designer. We got inspired from the pre-interview as well. This pre-interview helped us to check:

- The interview questions are easy to understand: the pre-interview mainly addressed cognitive and syntax problems of words and language.
- The interviewers could control the interview process: during the pre-interview, we motivated interviewees and paid attention to the time arrangement, tried to get a better understanding of the interview process.

After this pre-interview, we found some problems:

- The interviewee in the pre-interview was not familiar with the concept of “uncertainty”. Since he usually paying more attention to the technical problems during the design process, uncertainty may always be ignored by him.
- The length of the interview was comparatively longer than 1 hour as we planned. It took most of time to explain the concept of different design approaches, which he was not familiar.

According to these problems we addressed in our pre-interview, we have tried to make some improvement for our interview.

- Before each of the interview, we send the detailed definition of every concept that we are going to discuss during the interview one day before. Such as the explanation of “uncertainty”, different kinds of design approach (While, in fact, some of the interviewees still had no idea about those concepts during the interview).
- We transform the question about “uncertainty” into a more general way as: " Have you ever felt 'I am not sure...' situations in your design process?".
- Since the interviewee may have very limited knowledge about design approaches, we rank them based on the level of user involvement and introduce the concepts in a more general way.
- We redesigned the order of our interview questions, in order to avoid the same

answers from every single interviewee.

- We re-selected our interview candidates, who work with different roles, professions, and organizations. In order to maintain the diversity of the context of the interview.

3.3.4 Interviewing

We have five interviewees, and we made appointments with these HCI practitioners in advance according to their time arrangement. The first interview was a pre-interview that in order to improve the quality of the following formal interviews. Since the first edition of interview questions are based on the literature review, we have to conduct the pre-interview to validate the operability of the interview questions. There may be unexpected results or new topics emerge during the interview. So the pre-interview as the pilot is necessary.

According to our interview plan, we will control the whole interview under 1-hour long for each, design interview questions elaborately in advance with a clear structure. Two of the interviewees are in Sweden; we conducted the face-to-face interview with them. Since we have three interviewees who are working in China, so three of the interviews was conducted online. Two of the interviewees required for anonymous. Furthermore, two of them reject the interview record request, so we have three interview records in total.

3.4 Data analysis

Qualitative analysis is heavily dependent on the researcher's analytic and integrative skills and personal knowledge of the social context where the data is collected (Bhattacharjee, 2012). So we will keep reviewing literature to refresh and enrich our HCI knowledge. We prefer to implement the content analysis and hermeneutic analysis. Content analysis is the systematic analysis of the content of a text (Bhattacharjee, 2012), it is a good technique used to capture designer's opinion or attitude toward user involvement and how they perceive user-centered design or non-user-centered design. The hermeneutic analysis is a special type of content analysis where the researcher tries to "interpret" the subjective meaning of a given text within its socio-historic context (Bhattacharjee, 2012). We will try to interpret or explain why the designers perceive the uncertainty in that way, and how they deal with uncertainty based on different design approaches.

We asked the interviewees if it is okay for us to record the conversation. After the conversation has been recorded, we converted the conversation into a text file (transcript). All of the interviews were conducted in Chinese, so we have to translate the interview results into English first. As recommended, NVivo is a powerful qualitative data analysis software, it can effectively analyze a wide variety of data. We utilized it to do the data coding. Generally speaking, there are three coding techniques: open coding, axial coding, and selective coding. Open coding is a process aimed at identifying concepts or key ideas that are hidden within textual data, which is suitable for this research (Bhattacharjee, 2012). It would allow us to get a better overview of what was said, and thereby ease our analysis. It is a suitable data categorizing method for qualitative interviews (Creswell, 2007).

Based on the design of interview sections which we have mentioned in part 3.3.1, the coding was performed by different categories. The coding was made in our interview transcripts; we used acronyms to represent the categories, seen in the right column of Table 3.2. For instance,

the “DHP” is the code for the question that related to the HCI practitioners in designers section.

Table 3.2: Data analysis coding scheme.

Interview Section	Categories	Code
Introduction	Occupation, education background, basic information about the company and work experience.	IN
Designers	Characterize a designer	DC
	Describe your design process	DD
	Perceive the difference among HCI practitioners?	DHP
Uncertainty	"I am not sure..." situations	UI
	Work uncertainty	UW
	How do you deal with work uncertainty	UHW
	Colleague uncertainty	UC
	How do you deal with colleague uncertainty	UHC
	End users uncertainty	UE
	How do you deal with end user uncertainty	UHE
Design approaches	Perceive the role of users involvement	DUI
	User involvement brings you any benefits or obstacles	DU
	User involvement and uncertainty	DUU
Relation between design approaches and uncertainty	Design approaches and uncertainty	RDU
Ending question	Anything else	EA

3.5 Research quality and ethics

There is not an explicit definition of quality or a method to measure quality in qualitative research, but according to Seale (1999): explicit discussions of quality in social research, though, began with concerns designated with words such as validity and reliability, developed within the quantitative or scientific tradition, and then moved on under the pressure of critique from the qualitative research community. So in the following part we will present will explain how we have worked with aspects of quality and discuss the ethics issue in this research study.

3.5.1 Reliability

Recker(2013) analyzed that reliability is similar to independent, it concerns the extent to which the research conduct is impartial and freed from any subjective judgment or other bias stemming from the researcher or research team itself. In another word, reliability emphasizes whether a result is reproducible or not if another researcher would give the same output as a previous one. To ensure the reliability we conducted five interviews with people within HCI but in different organizations that distributed in Sweden and China. And thus get a broader view on the topic.

3.5.2 Validity

Some qualitative researchers have argued that the term validity is not applicable to qualitative research, but at the same time, they have realised the need for some qualifying check or measure for their research(Golafshani, 2003). According to Cho and Trent (2006), there are two general approaches to validity: transactional validity and transformational validity. Cho and Trent (2006) define transactional validity in qualitative research as an interactive process between the researcher, the researched, and the collected data that is aimed at achieving a relatively higher level of accuracy and consensus by means of revisiting facts, feelings, experiences, and values or beliefs collected and interpreted. On the other hand, Cho and Trent (2006) define transformational validity in qualitative research as a progressive, emancipatory process leading toward social change that is to be achieved by the research endeavor itself.

To improve the accuracy of our research, we drew up a plan, followed by scientific research methods, keep contact with the interviewees even after the interview in order to have a better interpretation of our data analysis.

3.5.4 Research ethics

Ethics forms a branch of philosophy that seeks to address questions of morality. Ethics define the principles of right and wrong conduct in a community or profession, and can be used by individuals acting as free moral agents to make choices to guide their behavior (Recker, 2013). Generally speaking, IS research in most cases does not present potential harm to participants in the same way that biological or medical studies may, so we pay more attention to the "voluntary". Before we contacted to the potential interviewees, we had prepared the interview plan adequately. We would try to inspire them to participate the research interview voluntarily, make them interested in the topic. This an opportunity for the designers to talk about their work and give some reflection of the research results.

As Recker (2013) proposed, we have the responsibility to secure the actual permission and interests of all those involved in the study. We could send them the basic interview questions if they want them. And respect their time arrangement and personal preference. The data of interviewees will be protected in terms of anonymity or confidentiality. In the final report, there is only some basic and simple personal information about the designers such as age, education background, their title and firm size. We have a duty to protect the rights of people in the study as well as their privacy and sensitivity. After the interview is completed, we thank respondents for their time, tell them when to expect the results, and not leave hastily as Bhattacharjee (2012) suggested. Immediately after leaving, we wrote down every note and key observations that might help interpret the respondent's comments better.

Ethical issues in writing up the study such as plagiarism are not something new. We followed the Harvard Referencing System to avoid plagiarism issue and refused academic misconduct or academic cheating. Even if the research result is unexpected, we will present it in the final report. The unexpected research result is interesting and valuable.

4 Empirical findings

In this chapter, we will present the information that was collected through the interviews. We will go through each of the themes that we presented in our research model, explaining the discussion that each of the interviewees has had within that theme. We have decided to keep the interviewees answers separate when there are differences in their answers, in that way giving a better overview of who said what and how their perspectives differentiate from the others.

4.1 Based on the designers

Initially, we will begin with the theme concerning their individual understanding of the role of the designer. Their explanation of what the notion means and how the design process proceeds will be presented, often related to their experiences, but also the difference between the positions revolve around the designers connected with their work.

4.1.1 Characterization of designers and design process

Interviewee 1 defines the designer with three nouns, researcher, integrator and deliverer. And he believes that the design process could be also described by these three characters. At the beginning of each design, the designers should fully understand what are the requirements and demands of the target group. But it is not an easy work to do because not all the users or customers could cooperate your research, and sometimes they do not tell the truth. Nevertheless, in order to get the demanding information. The designers should be a researcher who needs to find out the real requirements by all means. Secondly, after the designers being aware of the requirements of the target group, the designers need to verify and integrate these information, because sometimes the users have no idea about their requirements or preference even the end users may be not your customers. Finally, the designers need to deliver the requirements in a fully structured and detailed blueprint to the programmers or engineers to develop the project.

While the second interviewee does not have a systematic view of a designer, he believes that the designer is a professional with freedom and it is not necessary to have a clear definition of a designer. He characterizes the designers with accumulation, inspiration, and visualization. As for designers, you need to be qualified with all three abilities, that why not everyone is capable to be a designer. These three words concerts with the design process, which can be easily understood as the designers absorb and accumulate the information and knowledge from daily life. And then, they can be inspired by the details and form idea in their mind. Eventually, the designers are capable to express the value of his/her idea by visualizing the idea into an understandable reification.

Interviewee 3 likens the designer as a guide whose role is to offer the tourists several strategic approaches so as to bring them to their destination. And she also describes her design process as a guided process, the designer take the role of a guide, the customers or users can be the part of the tourists. Most interestingly, interviewee 3 easily likens the users' or customers'

requirements as a description of the destination from the tourists. With the help of this metaphor, we could simply understand and visualize the role of the designers and design process. In order to offer a systematic description of the design process, interviewee 3 shares some similarities with interviewee 1 and states that the designers should collect the information from the customers initially. Afterward, the designers unscramble the inputs from the customers and reforms them into a sequence of logic requirements. Based on the work in the stage 2, the designers eventually could offer the customers a specific object that perfectly represent the requirements from the customers.

Interviewee 4 has a comparatively open mind about the designers and the design process, he states that the designer is a kind of person who is capable to use their imagination to create something that could make the world a better place. And he also divides the design process into two categories, one can be easily understood as a word “inspiration”, which compresses whole design process into a mere moment. Another one is a more traditional and academic way, which contains several steps, such as problem definition, requirements collection, goal setting, and visualization. The former method sounds like a shortcut, but it contains a considerably long period of accumulation and experience, and designers’ luck should also be considered on this occasion. Therefore, “inspiration” is something can only be found by accident, and not through seeking. The latter method is more complicated and effort needed, but it includes the fundamental abilities for designers. Therefore, it is the way must be passed for every designer’s development.

Interviewee 5 describes the designer within three adjectives: creative, aesthetic and practical. The interviewee gives us his explanation based on his individual awareness development of the role of designers. As for the whole design process, it is a create process where the designers need to build a new thing by utilizing the old things. Nevertheless, not every creation can be called as a design because the design process is always accompanied by aesthetics and practice. A good design is a creation of aesthetics and practicality, none of these three words can be excluded.

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
How do you characterize a designer?	Researcher, integrator and deliverer	Accumulation, inspiration and visualization	A guide	Imagination and creation	Creative, aesthetic and practical
How do you describe your design process?	Research, integrate and deliver	Visualizing the idea	A guide process	The design process include: inspiration way and academic way	The design process accompanied with aesthetics and practice

Figure 4.1: Interview result about characterize a designer and describe the design process.

4.1.2 Difference between the positions which around designers

Interviewee 1 maintains that he does not have a clear and structured view of the difference between these positions. Although he has been worked for several years, but he think that there is few companies in China has a structured hierarchy, especially in some small and medium companies, where there is only one manager take both business and technical roles in one position. Nevertheless, turning towards his customers, there are two managers: project manager, and research and development (R&D) manager, the role and responsibility are assigned clear and detailed. Project manager operate several projects, supervise the progress of each project and take the accountability of equitable resource distribution among every project. While R&D manager is responsible for one project, manage one team, dealing with technical problems during the project workflow. Referring to the difference between designer and programmer, Interviewee 1 believe that there are a number of design works are taken by the programmers, even if they have no background as designers. From which he reveals that sometimes the programmers take the designers work based on their own understanding. Based on the standard workflow, design and programming are two separate aspects. The design work should be as detailed as possible in the beginning stage of a project, giving a structured and elaborate description of the customers' requirements. By this way, the uncertainties could be avoided at the programming stage. Therefore, the difference between designer and programmer could be analogized as the difference between architect and builder.

Interviewee 2 states that the difference between these positions is too academic, and it is not necessary to have such many positions in a project team. Based on his personal experience, he used to work in an IT company with a big scale where the workflow is utterly agile. Once he worked on a project with three software programmers as his team members but none product or project manager. So he claims that the differences among the positions are not practical at all since most of company shares an agile workflow, they usually organize a project team based on specific requirements instead of standard team composition.

Interviewee 3 argues that the difference between these positions may be blur and boundary less in some small companies, which share the similar view with interviewee 1. As for most small and medium companies in China, cost saving always be taken as the priority in the companies with such small scale, where there is only one person takes both roles of product manager and project manager. The interviewee means that these positions always share lots of similarities rather than differences with each other and complement each other with the specialties of themselves. In some cases, there is only one team leader and team members in a project group, the team leader allocate the work based on individual specialty and everyone shares mere one goal to complete the project. Such kind of working environment ensure the full engagement of every team member, facilitate the cooperation and efficiency of the team. Besides, it also reduces the cost of personnel management. It is a good working module for small companies.

Interview 4 has a standard design process; there is a clear function definition for every position in his companies. Therefore, everyone takes a specific responsibility in his company. From his personal story, the product manager is mainly business-oriented, the project manager mainly focuses on the resources allocation and progression of each project. And there are some system architect in his department who can be helpful for technical problems.

Interviewee 5 holds a distinct opinion and argues that the difference in these positions is significant and should be clear and well-structured in a company. As a product manager, he thinks the biggest difference of product manager, compared with other three positions, is business-oriented. Specifically, the primary task of a product manager is to deliver the business value of the product by explaining the product strategy, product direction and product feature to the target market. A qualified product manager can express the business value of the product with accurate figures and suitable methodology module, in which he/she could bring the customers into a well-designed scenario. Interviewee 5 means the feature of a product manager is full of persuasion and business-oriented. Apart from the role of product manager, there is a detailed description of the primary work for each position in the departmental manual, although there would be some small changes when conducting some special projects. Furthermore, Interviewee 5 maintains that the standard regulation enables the employees to have a tangible awareness of their main tasks and increase their working efficiency rather than limiting their workspace.

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Difference among the positions revolve around designers.	He does not have a clear and structured view of the difference among these positions	Not necessary to have a such many position in a project team	Blur and boundaryless in some small companies	A clear function definition for every position in his company	The difference among these position is significant and should be clear

Figure 4.2: Interview result about the difference between the positions.

4.2 Based on uncertainty

Once having the understanding of how do the interviewees characterize the designers and design process but also what the difference among other professionals revolve around designers meant for our interviewee, we lead them to think about the “uncertainty” and tell us some detailed story from appearance of uncertainty to how do they solve it.

In order to enable our interviewees to have a clear understanding about what the notion of uncertainty we discuss, we categorize the four types of uncertainty into two groups, which lies upon the person (Individual and Collaborative) and work (Task and Process). We will discuss both possibilities separately. In this section, we will present an instantiation of uncertainty with structured categories and the reaction from our interviewees.

4.2.1 Uncertainty from work itself

Interviewee 1 has been worked in this domain for several years, and he is always assigned to take the role as a mentor or guide for the new employees in his companies. Most of guidance and supervision are given in the first two or three months because they are lack of familiarity and experience at the beginning. While after this period the new employees would form a comprehensive individual understanding of their business. He also holds an optimistic attitude towards uncertainty and believes that every problem and uncertainty is a chance of study for them, so he always encourages them to have a close communication and ask questions.

Interviewee 2 states that work uncertainty troubles him when there is something new come in his daily work sometimes. As for a UI designer, you have to communicate with different kind of customers from distinct areas, which means that you always need to process your design within a different context. It is easily to understand that if you conduct your design with medical context, then you may need to absorb some basic knowledge about medicine so as to complement your design work. Therefore, you may encounter the uncertainty during your studying process because this is an utterly strange domain. Nevertheless, it could be easy for you to solve this kind of uncertainty. He concludes two methods to solve this uncertainty: one is to refer to other design within the same context, which means you can be inspired by some examples online. Another one is to have an affinity with other professions, which means that you can learn the new knowledge by doing some researches with the professionals in that specific domain.

The third interviewee argues that the work uncertainty mainly happens to the beginners who just enter a new business. Based on her personal situation, she says that she always bothered by work uncertainty in the first three months of her profession. Since you have very few practical knowledge and experience, everything could be your obstacles in the initial stage. She means that the work uncertainty is mainly resulted from lack of experiences. She recommends a simple solution to work uncertainty is to ask experienced colleagues.

Work uncertainty often happens and disappears, according to our fourth interviewee. As a software engineer, most of his work uncertainty comes from the technical problem, such as a bug inside a specific function. He holds the opinion that you are never the first one who encounter this uncertainty, all you have to do is to seek help from the Internet or other colleagues. Apart of that, he also has a very active attitude to work uncertainty, because it is easy for you to handle it but also you could accumulate knowledge and experience from it.

Our fifth informant agrees that the work uncertainty usually bothers an inexperienced person. And he provides his understanding on an organizational level, he believes that it is important for an organization to have a clear and structured system or regulation which be made to help every new employee solve their common troubles when they are the beginners. There is a mature system in his company called “Newbie Trace System,” which is utilized to trace the new employees who just recruited. With the help of this system, the company establishes a win-win situation inside the company. On the one hand, the system offer the new employees instant help to solve every kind of uncertainty and problem which could appears to them. On the other hand it is also capable to update the newest information of every employees which could help the managers to know and evaluate their new stuff.

4.2.2 Uncertainty from persons

Apart from work uncertainty, another kind of uncertainty results from the difference among different people. According to our interviewees, such kind of uncertainty is comparatively more often and need more efforts to handle. Therefore, we decide to present the uncertainty from person within two categories, one focuses on their colleagues in other professions, another one focuses on their customers or end users.

The first interviewee provides a unique opinion towards the uncertainty with the person. From

his personal view, he maintains that is utterly delighting to see if there is uncertainty among different designers. In order to solve this uncertainty and proof themselves, the designers are encouraged to consider more about their idea that could be regarded as a process of reflection and brainstorming. By doing this, the uncertainty offers the designers another chance to improve their ideas by learn from other designers. Thus it naturally improves the quality of the project. Therefore, sometimes, as a manager, he always allocates different persons working in one single team, in order to create the uncertainty for them. As for the uncertainty with customers, he also holds a comparatively optimistic and active attitude towards it. With the prevalence of the computer in the society, he believes the customers or end users are not merely take one single role anymore. Even the some amateurs of IT grasp more professional knowledge than IT professions, and some of them are really willing to engaging to find the bugs and mistakes of projects. By thinking the uncertainty in that way, he also believes that it is good to leave some uncertainties to the customers or end users, which enable them to deeply engage in the project or software. Thus, as for the company, we can get more data and information about their preference to improve our further projects, but also obtain more potential end users or customers who can be cooperated to spread our business.

Interviewee 2 partly agrees that the uncertainty with colleagues is easier to be solved than with customers. He concludes the reasons are that communicating with colleagues is comparatively easily both geographically and psychologically. Besides, the relationship between your colleagues and yourself always keeps a longer duration than your customers. And he also provides a new method to solve the uncertainty with colleagues based on his example. When there is an uncertainty about whose idea is better, he and his colleague used to make a prototype of their idea and show their prototype to their customers, leave the decision to their customers. Regarding to the uncertainty with customers, he offers another approach as well. He believes that the uncertainty with customers sometimes resulted from lack of understanding, as a designer, she think it is necessary for you even to spend a few days with your customers if allowed.

Our third interviewee continues what the previous interviewees have said, she also utilizes the metaphor that likens the designer as a guide, and the customer as a tourist. So the uncertainty with colleagues could be simplified into the different plan from A to B if there is no mistake in each plan. Then it is easily to be resolved by asking the tourists. However, if there is an uncertainty between guide and tourists, sometimes the tourists may propose unrealistic requirements or make the requirements that they do not need actually. For example, the former one can be seen as the tourists want to go Antarctic mainland by train, the latter one can be seen as the tourists want to go London for the great wall. Nevertheless, as a designer, sometimes you need to explain to your customers or end users about this problem with patience. And she maintains that there are no better approaches than a close and patient communication.

Our fourth interviewee underlines the uncertainty from customers rather than his colleagues. He works in a flexible environment where there are plenty of communications and cooperation internal and external departments. He believes that the uncertainty is easily to handle among his colleagues, the reason is that there is always more or less intersection among you and your colleagues and all share one single goal. So the uncertainty is often about to whose solution should be taken to solve the problem, the only thing you need to do is do more researches to convince your colleagues that your solution is a better one. However, when it comes to the uncertainty with customers, which would be more difficult to handle. He elaborate his opinion with his personal experience, sometimes the customers give you a

complicated project that needs to be done in a rush time. You pretty sure that the project cannot be done in such limited time, so you do not know whether you should finish the project as fast as you can without quality or ask for an extension of time. “Quality or efficiency, this is a most common uncertainty my department have with customers.” While he also provides his solution to solve the uncertainty with customers, in most cases, he usually elaborates the problem to the customers and offer them several strategic proposals, so as to reach an agreement with customers. Thus, the uncertainty with customers could be solved.

The view from interviewee 5 is built upon an organizational level again. Being a role in a management level, he believes the certainty with colleague or customers could be minimized by appropriate management. As a project managers, he always assigns the task to cooperatively stuff within careful consideration, and then some of the uncertainty is naturally avoided or minimized. Regarding to the uncertainty with customers, he does not advocate user-centered design, whereas he believes that the designer should follow their ability and experience. Furthermore, he maintains that the appearance of certainty is connected to designers’ ability and experience. He used to work as a designer, he means a capable and experienced designer can understand customers’ real requirements and discuss the potential uncertainty may appear during the design process beforehand. To some extent, it facilitates the efficiency and avoids the obstacles, thus earning more time for the whole project. In a word, interviewee 5 maintains that the uncertainty all can be avoided or handled by a qualified manager, the effective and efficient resource allocation is the most suitable method to solve with uncertainty.

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
How do you perceive work uncertainty?	It is a problem to new employees	It troubles him when there is something new come in his daily work	It mainly happens to the beginners who just enter a new business	Most of his work uncertainty comes from technical problem	It usually bothers inexperienced person
How do you perceive end user uncertainty?	It is delighting to see if there is uncertainty among different designers	Communicating with colleagues is easily both geographically and psychologically	It is easily to be resolved by asking the tourists	Easily to handle among his colleagues	Could be minimized by appropriate management
How do you perceive customer uncertainty?	Hold an optimistic and active attitude towards it	Sometimes it resulted from lack of understanding	A close and patient communication could be useful	More difficult to handle	Could be minimized by appropriate management

Figure 4.3: Work uncertainty user uncertainty and customer uncertainty.

4.3 Design approaches

There are so many different design approaches and categories of these design approaches; the design approaches in this paper primary refer to four design strategies: user-centered design, activity-centered design, system design and genius design. But during the pre-interview, interviewees were confused about these four design approaches. To make a better understanding of these design approaches, we introduced the concept of user involvement and ranked these approaches according to the level of user involvement. Five interviewees have distinct education backgrounds, occupation, and work experience, so in the feedback their

design preferences are quite different. Two of them have some knowledge about these four design approaches, and the rest three almost have no idea of the design approaches before this interview. According to our introduction, they talk about their work experience and cognition of the design approaches as well.

4.3.1 Design approaches preference and the role of user involvement

Interviewee 1 prefers the activity centered design and regards it as the most used design approached in small and medium companies in China. Based on his work experience, his customers (normally are the end users as well) always have no idea about what they really desire. Customers say what they want but in a confused way. Professional designers have to translate the activities and behaviors of customers to a better understanding technical language. Designers produce an initial model for customers to validity the design. Interviewee 1 proposes that normally their initial model works well which generally means they successfully catch the real desire of their customers. However, sometimes customers think the initial model is not what they want then project managers, or designers have to communicate with customers and make modifications. The design process always means validation and modification. Interviewee 1 is familiar with the activity centered design and never used the other three design approaches. Furthermore, he says that he has hardly ever seen his colleagues used the other design approaches either. He proposes that the system design and genius design is not such accord with common sense. He works as a project manager and recommends the activity centered design for small and medium companies.

However, even interviewee 1 recommends the activity centered design that is good for his company; it does not mean the activity centered design is the best approach. Actually, interviewee 1 considers the user-centered design is the best design approach which fully involved users into the design process. But there are so many constraints in small and medium companies to implement the user-centered design. In big IS development enterprises, there are so many professional and experienced project managers and designers, they can comfortably involve the customer (or end users) into the project, and better fulfill the customers. While in the customer company that is running a big business, they may have the technical department and can send technical staff to communicate with the designers and settle down the specifications. It is much easier to reach a strictly standard specification. The user-centered design requires high-level professional skill on both sides of the design company and the customer company.

Interviewee 2 knows about these four design approaches very well. He enjoys the genius design more since design means art, creation and freedom to him. He divided the design approaches into two big categories: genius approach and other approaches. Genius design approach is a rush of inspiration which means precious and limited. When it comes, designers may produce amazing creation in a short time with passion. They have to catch the light of inspiration and realize it. Even the second interviewee regards the genius design as his favorite design approach, but unfortunately it is not the most used one. Normally, he has to contact the end users via different ways. Sometimes, he interviews the end users, sometimes he observes them, and sometimes experiments are necessary. He proposes that generally the end users have no idea about what they really want. This perspective is same as the first interviewee. Interviewee 2 says he is usually implementing the "role play" strategy to collect the user demands when needed. He is not restricted to design approaches, from user-centered

design, activity centered design to system design. The most significant thing is about how to collect user requirements. Except the genius design, other design approaches are all academic, principle, regular and respect the users.

The third interviewee has not provided her preference of the design approaches. As a UI designer, she regards the user involvement more like testers, and asks them for validity. Designers collect user experience of software and websites, and analysis the collected results. During the design process, they utilize the advantages of the design and modify the disadvantages. There are no obvious design approaches in her daily work. She concludes that they may implement the mixed design approaches of activity centered design and system design as their work approaches. Since every design approach has different value, it requires designers to keep a balance between their workload and user involvement.

Interviewee 4 works in an international enterprise; he takes an articulate work role of software engineering and his work process is standard defined. During his design process, he has limited opportunities to contact with end users directly. Normally, he gets the data about the end users and specifications of the project from other departments or project managers. He has never heard about these four design approaches before this interview. And after some comparison, he thinks he may implement the system approach in his design work. The users are the ones who identify the task and final goals for the project. We assume that his enterprise may involve the users in other design links by other departments that are invisible to interviewee 4. So even he designs and follows the system approach, it does not mean his enterprise or departments always work with the system design approach. "Under this clear hierarchy and process, the software engineering has limited design space," interviewee 4 says so.

The fifth interviewee has an overall perspective of all these four design approaches, he compares and analyzes them separately during the interview. He prefers the activity centered design as the first interviewee. User involvement will bring a better understanding for both designers and users (normally their customers are the end users). Designers get a good chance to collect the information from users. And their customers can really go into the system design. Sometimes, the customers have a quite poor understanding of the system development. Higher user involvement provides an opportunity for the customers to integrated their real demands and requirements into the final product. Furthermore, higher user involvement means flexible and human-centered design, designers can get a convenient communication precondition and make modifications according to users' needs. But there are two problems for the activity centered design as well, one is unclear goal, and the other is inefficiency. Activity centered design implies collecting users' activities and behaviors, it always takes a lot of efforts which following with numerous modifications and multiple replications. Additionally, flexibility brings uncertainty. During the design process, users may deny the previous design, or lead to inconsistent, contradictory design thoughts.

Interviewee 5 comments the other three design approaches as well. The user-centered design provides a clear goal, follow the requirements of users, so it is more efficiency in this perspective. But it may overlook the technical feasibility thereby increasing the difficulties in the implementation phase. He thinks the system design is more "software developer friendly" since the technical issues always under control. While, the user almost excluded in the developing process. Therefore, this design approach means poor human-centered design and poor usability. He also mentioned about the genius design, this design approach is efficiency but the final product is more like imposing designer's view of the customers. So personally he

prefers the activity centered design and denotes it is the most used approach in his work.

4.3.2 The relation between user involvement and uncertainty

The first interviewee believes that the high user involvement can reduce uncertainty between designers and end users, but it requires a lot of efforts. He really encourages their customers (normally customers are their end users) to participate the design process. But he perceives the high-level user involvement as a challenge for small and medium companies. As mentioned above, high-level user involvement requires technical knowledge from the customer side and good corporate willing from the designers' side. For small and medium IS development companies, their customers may not have the technical departments so that the customer representatives may have no technique knowledge, and they communicate in a fairly ordinary way. While in small and medium IS development companies, they may focus on product fast delivery and sometimes project managers have to lead the customers to make decisions. Work in this way they can save time but may not really integrate the demands of customers into the products.

Interviewee 2 regards user involvement as a positive power while sometimes it brings obstacles. It is useful for reducing the uncertainty during the design process. User involvement means more constraints, in other words, users will propose more ideas, requirements, principles for the design. These constraints are good things for the designers because designers can get a clear and comprehensive picture of what are the user's' demands. But it increases the degree of difficulty of design. Designers may feel confused and contradictory among the requirements and suggestions from users. Interviewee 2 concludes that the user involvement is good for the final results but hard for the design implementation.

Interviewee 3 also holds the positive attitude of user involvement. Based on her work experience, the user involvement can figure out the problems in the project and optimize the final product. She says the user involvement will lead to more uncertainties, but it fixes much more uncertainties at the same time. She claims that the user involvement is valuable.

The fourth interviewee is a software engineering, he has very limited experience of user involvement, and he is satisfied with his work process. He says: "to be honest, I have no idea about how to involve users in the design process, of course, I will take consider of them into the design... I have sufficient information about the users, or I have a sufficient specification, that is enough" (Interviewee 4, Appendix 5, R52, translated). He is not such active about the user involvement, and kind of reject it. When the conversation went into the relationship of user involvement and uncertainty, he believes that the user involvement must bring more uncertainty for his work, and he is not sure about the improvement of the final product.

Interviewee 5 perceives user involvement as a necessary design strategy but need to consider the degree of involvement. If the users involve the whole design process, it is a large project that will take a lot of efforts and hard to handle. It is not a smart choice for small and fast delivery product development. While if the user involvement is not sufficient then it is hard to collect user requirements, or hard to collect the real user demands. Designers may hold a stack of requirement documents that are not such useful.

Four of the interviewees have a positive attitude about the user involvement and declare it is

useful for reducing the uncertainty between designers and users (or customers). They want to probe the user demands by getting closer to the end users. Only one interviewee suspect that the user involvement could benefit from the uncertainty.

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
Design approaches preference	Usually use activity centered design, but considers user-centered design is the best design approach	Genius design	Mixed design approaches of activity centered design and system design	System design approach	Activity centered design
User involvement and uncertainty	High user involvement can reduce uncertainty, but it requires a lot of efforts.	Regards user involvement as a positive power	HoldS the positive attitude of user involvement	Not such active about the user involvement	Perceives user involvement as a necessary design strategy

Figure 4.4: Design approaches preference, user involvement and uncertainty.

4.4 The relation between design approaches and uncertainty

The first interviewee suggests that the activity centered approach is helpful for reducing uncertainty between designers and customers. He gives this answer mainly based on his work experience and design sensitivity. He states the activity centered design is the most comfortable design approach. And according to his cognition, the rest three design approaches are not such practical.

Interviewee 2 prefers the genius design as his favorite one but he acknowledge this design approach would do nothing with reducing uncertainty. Since the final products normally lead to an extreme result: attract most of the end users or abandoned by all of the end users. The third interviewee proposes that the other three design approaches are useful for reducing the uncertainty. The user involvement will improve the communication and cooperation between designers and users. But at the end of the interview conversation he emphasizes the importance of uncertainty. He says: “I would like to say that you need to have a positive attitude to uncertainty, since it would bring you some surprise sometimes” (Interviewee 2, Appendix 3, R96, translated). Uncertainty is necessary for design. Because it is impossible for designers to fix all of the uncertainties. If you really fix all of the uncertainties it always means more problems. He gives us one example, a user interface with only one option. If the designers eliminate all of the uncertainties, then only one possibility left. The designer constraints the end users with an exclusive choice which means no choice for them. This is not the design. So he has a quite positive and open mind about uncertainty. And he gives us some new perspective: do not always be negative to uncertainty, try to get benefits from uncertainty. He still wants to solve uncertainty, but he always leaves some uncertainty in his design for art, creation and freedom.

The third interviewee suspects the direct relationship between design approaches and

uncertainty. She proposes that the HCI design including three aspects: product, development and design. These design approaches may reduce the uncertainty between designers and users, but probably increase uncertainty in the development process since a high level of user involvement lead to complicated work process.

While the fourth interviewee holds the similar viewpoint as the third interviewee. He is not sure about these design approaches would benefit the uncertainties in his work. Furthermore, he thinks the user involvement may introduce more uncertainties. From this perspective, the user-centered design and activity design are not smart choices.

The last interviewee appreciates user involvement in the design process but concerns about the uncertainty which may accompany with the involvement. His answer for this topic is: “it depends”. It is hard to say these design approaches could really fix the uncertainties, it depends on the designers, the customers, the cooperation between them, the scale of the project and so many factors. Designers could propose these design approaches are the prescription of uncertainty, but at the same time, these approaches may be the uncertainty as well. There is no best choice and designers always have to balance the project, users, and design.

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5
The relation between design approaches and uncertainty	Activity centered approach is helpful for reducing uncertainty	Genius design would do nothing with reducing uncertainty. The other three design approaches are useful for reducing the uncertainty.	Suspects the direct relation between design approaches and uncertainty	Not sure about these design approaches would benefit the uncertainties in his work	It depends on the designers, the customers, the cooperation between them, the scale of the project and so many factors.

Figure 4.5: The relation between design approaches and uncertainty.

5 Discussion

This chapter discusses the findings from the empirical research compared to the information obtained in other literature. According to the result of this study, we will divide the discussion into the four themes that were identified in our research model and have been used throughout the report: 1. designers, 2. uncertainty, 3. design approaches and 4. the relation between design approaches and uncertainty.

5.1 Based on the designers

By comparing the interviewees' characterization of the role of designers, we can summarize that they share both similarities and differences in their characterization of the designers. The differences may result from they all work in different organizations and take different positions inside the organization. Nevertheless all of them have the experiences being designers, so they may share agreements upon the characterization, connected with the opinion from Clausen (1994) in Chapter 2, there are some keywords both utilized by our interviewees and academic authors, such as "creative", "deliverer" and "practical". Obviously, most interviewees characterize the role of designers based on their design process, all of them agree that the design process can be regarded as a create process, and this process is roughly divided into three steps. According to interviewee 1 and 2, the design process can be described as a sequence of step like collecting information from outside, like users, customers, organizing and integrating the information into logical requirements and translating and realizing the abstract context into practical project. Comparing with the opinion from interviewee 1 and 2, other informants provide a rougher and more abstract version of the design process. Our third interviewee likens the design process as a guided process, which makes the design process easily understandable. According to Simon cited in Park and Boland (2012) in our literature review, he summarize the design process as a process of improvement so as to make the existing situation a better one. While interviewee 5 seems share agreement with Simon cited in Park and Boland (2012), he believes that design is an activity of creation that would facilitate and improve existing object.

Apart of these, the differences can also be seen obviously from the answer of our interviewees and the context of our literature review. Most our interviewees pay more attention to the design process itself and user's requirements but ignore the computer system side, except our fourth interviewee mentions the importance of computer's side, and states the HCI designers are more like the bridge connect computer and human, so the technical skills are significant for them to update their understanding from computer's side. Connecting to the context in our literature review, Clausen (1994) provides a more systematic definition for the role as a designers based on both sides of designers and computer system.

As a summary of how the interviewees describe their design process you could say that design process never should be seen as linear but circular process where lies customer or end user as the starting point and termination as well, whereas the computer system takes the role as the intermediary. While the designers take the part as a bridge that connects the customers or end users with computers. An interesting aspect of this perspective, if you relate it to the thought of designer's task from Clausen (1994), seen in Chapter 2.1.2. From the academic

researcher's perspective, since pervasive technologies present new challenges for designers to facilitate the interaction between human beings and computer systems, the designers should pay more attention to the computer system side. However, as a matter of fact, the designers actually focus on the customer and end user instead.

Something that was expressed in 2.1.3 was that the communication is necessary for designers to use different forms of languages through the development process. By analyzing our empirical findings of the difference among the professions revolve around designers, most of our interviewees express that communication is important, but some of them share distinct opinions towards the difference among the other professions. Responder 2 has an essential point to the discussion when talking differences, maintaining that the differences are too academic, and it is unnecessary for the designer to distinguish the differences. He advocates an agile working environment where everyone is working with a same goal and enable more communication among these people. That is probably a unique angle to look at the differences in which the communication would be facilitated.

However, there are two interviewees consider that the differences among the other professions revolve around designers may be blurry and unclear inside their organizations. Interviewee 1 maintains that the reasons are the scale of the organization, because cost saving always be taken as the priority in the companies in small or medium scale. Some small or medium companies may make one capable employee take upon himself/herself several posts so as to saving the cost. By this way, the boundary among different positions is unclear, whereas blur the differences among the different positions. Another interesting point was presented by our third interviewee, who claims that even though the differences may not be perceived clearly by some employees in some small companies, they yet clarify the role and function of their employees to their customers, which may suggest that the small companies give their customers a clearer perspective of the functions of their employees so as to form a long relationship with their customers.

By comparing the opinions among our interviewees, Interviewee 4 holds a distinct opinion that the difference among these position is significant and should be clear and well-structured in a company and the function and role for each position has been well-described. It suggests that in the organization with large scale establish a clear and structured hierarchy inside the organization, it is important for the employees to clarify their responsibility.

5.2 Uncertainty

According to the taxonomy of uncertainties in general in 2.2.1, the uncertainty is categorized into objective and subjective both kinds. And it can be simply connected with the taxonomy in our interview where we divide the uncertainty into work and person such two categories.

When talking about the work uncertainty in our empirical findings, interviewee 2 and interviewee 4 agree that the work uncertainty always bothers the beginners. During our fifth interviewee directly connect the work uncertainty with inexperience. According to Zimmerman (2011) who emphasized the importance of experience, it is easily for us to see that the sufficient experience determines the appearance of work uncertainty for the designers. Apart from experience, there is another factor has been mentioned by several interviewees is knowledge gap. Our first interviewee maintains that the work uncertainty may result from

lack of knowledge in other domain, which can be connected to the author Liu *et al.* (2008), who also mentioned the out-balanced knowledge for the designers. In order to solve the knowledge gap, the designers need to gain more knowledge from several fields. However, according to Norman (2010) there is another kind of gap between researches and practice, which would bring an additional problem for the designers during the process of gaining new knowledge. Our fourth interviewee mentions a method like the experienced employees take the role as the mentor for the new ones, giving guidance and supervision that would be a potential solution to the gap between research and practice.

One special interviewee of us, the fifth interviewee offers us an understanding of uncertainty upon a management level. He believes the quality of management is an effective method to avoid the work uncertainty to some extent. More interestingly, the “Newbie Trace System” that has been utilized in his company provides a clear perspective of how to deal with work uncertainty for the new employees. Connected to the statement of Madsen and Pries-Heje (2009), who mentioned about task and process uncertainty, this “Newbie Trace System” would be a valuable approach to handling these two kinds of uncertainty.

If we instead look at what the interviewees considered as person uncertainty which can be connected to collaborative uncertainty what Madsen and Pries-Heje (2009) mentioned, communication, cooperation, understanding were mentioned. These keywords all go pretty much goes line with what was presented in section 2.1.3 and 2.2. When talking about person uncertainty, most of our interviewees have pretty much story to tell within their experiences. We asked them about person experience based on two categories, such as your colleagues and your users/customers. Not surprisingly, all of them agree that the uncertainty with colleagues is easily to handle than the uncertainty with customers. The common solution for them to solve the person uncertainty can be summarized by one word “communication”. That probably what Clausen (1994) meant as an effective method to solve uncertainty but also an essential ability for designers.

In addition to this single approach to person uncertainty, interviewee 2 and interviewee 3 provide another approach to solving the uncertainty with colleagues instead of communication. They both are two UI designers and work in the companies with agility and flexibility. When facing the uncertainty with their colleagues, they will let the user or customer to make the decision. Comparing with the opinions from other interviewees, they seem more user-oriented and bring more user involve their design process. This is connecting to what Park and Boland (2012) emphasized the importance of designer-user interaction.

Apart from designers’ perspective, our fifth interviewee presents his method to solve person uncertainty based on his individual experience from the management level. As a product manager, he personally advocates the designer should trust their ability and experience rather than following the requirements from the customer or user. That is what Schweikardt (2009) criticized the user-centered design always focus on the users and ignore the environment and sustainability.

Most interestingly, our first interviewee offers us an angle to think outside of the box, who look at the beneficial side of the person uncertainty. Interviewee 1 takes the rapid progression of technology into consideration, which can be connected to (Lim and Rogers, 2008 Shuang 1). Based on this background, he sometimes even intend to create collaborative uncertainty for his employees. Take the role as a manager, he believes the collaborative uncertainty could provide the employees more chances to communicate with others and learn from others. On

the other hand, he also believes that uncertainty can be utilized by the designers to bring more users involve your design process, the end users sometimes even qualified more professional knowledge, so they may offer you some constructive suggestions beyond your mind. According to Huang *et al.* (2008), who claimed that very limited insights were offered to explain how different requirements should be managed and settled. This kind of problem can be regarded as one type of uncertainty called “discord” presented by Sharma (2010). However, the uncertainty in “discord” type probably can be solved by the method from the context of interviewee 1.

Based on the literature review and interview result, we categorize the uncertainty into two big types: work uncertainty and collaborative uncertainty. The work uncertainty is referred to Madsen and Pries-Heje (2009) which including task uncertainty and process uncertainty. When designers have no idea or unclear understanding of the task, it will lead to the task uncertainty. Process uncertainty arises at different points in time during the IS development process, namely in the beginning, middle, and when deliverables have to be handed in along the process or in the end (Madsen and Pries-Heje, 2009). In the different design stage, designers may have distinguished anxiety. The work uncertainty has nothing to do with human beings. This uncertainty may result from designers lack of experience or related knowledge, or because the task specification and work process are not sufficient defined.

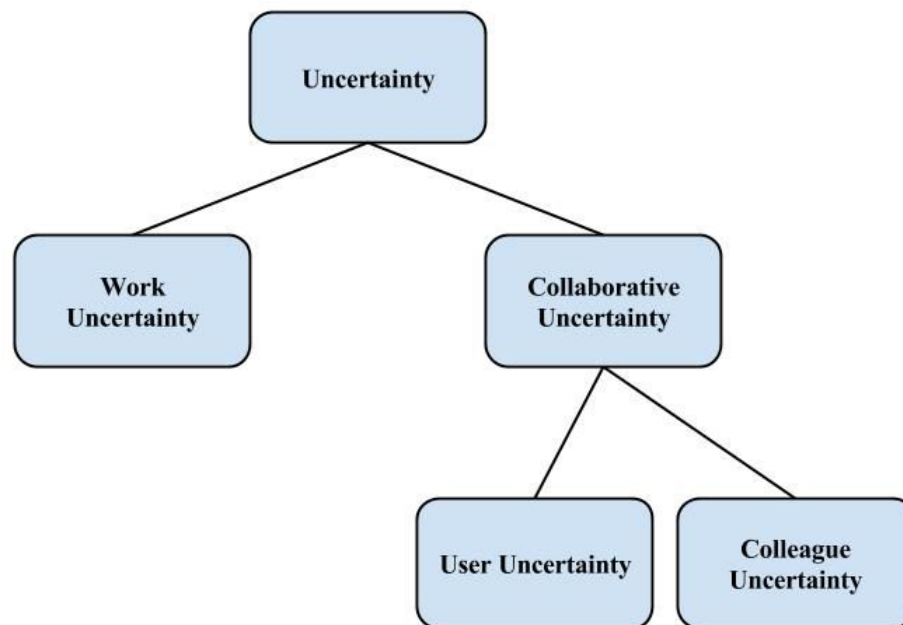


Figure 5.1: Classification of uncertainty in HCI field.

The second type of uncertainty is collaborative uncertainty. We further divided it into user uncertainty and colleague uncertainty. The uncertainty between designers and users are the user uncertainty which have been investigated by many scholars (Grudin, 1990; Tuovila and Iivari, 2007; Lim and Rogers, 2008; Miaskiewicz, Grant, and Kozar, 2009; Huang *et al.*, 2008; Park and Boland, 2012). In this research topic, there are two issues, the first one is about how to transfer, study and collect user needs. Users have very limited cognition about what they do want. This limited cognition lead to poor product specification and development process. Many uncertainties may arise from the repetition of model validation. When designers try to explore the real desire of users and involve them in the design process the other issue growing.

During the user involvement, the collaborative between designers and users is an uncertainty (Clausen, 1994; Clausen, 1994; Madsen and Pries-Heje, 2009). They always have different expectations and professional, the communication is not such simple. The uncertainty between designers and their colleague is the colleague uncertainty. Even they are all HCI practitioners and share the same work goal, but they still have different expectations, preferences, abilities, and actions (Madsen and Pries-Heje, 2009). Designers do not yet know what to expect with regard to the different group members' interest in and ability to participate and deliver. Furthermore, the colleagues may include different stakeholders such as consultants from external company and third party partners.

5.3 Design approaches

Based on Saffer (2010)'s category of design approaches, this paper introduces four design approaches: user-centered design, activity-centered design, system design and genius design. Two of the interviewees have some knowledge about these four design approaches, and the rest three almost have no idea of the design approaches before this interview. The first interviewee has experience of the activity centered design but has no idea about the other design approaches. This is confirmed to the viewpoint of Liu *et al.*, (2008), he argued that the designers might have extensive knowledge on some approaches they frequently used, but at the same time very poor knowledge of others, even some commonly used in the industry.

Both of the project manager and product manager are recommended the activity centered design and propose this design approach is the most used one based on their work experience. One UI designer enjoys the genius design, but this design approach is not such practical. It requires a rush of inspiration. Normally he would not restrict to the design approaches, which is similar to the other UI designers. The point is about how to collect user requirements, they would not always pay attention to the design approaches. They balance their workload and may use any of approaches or the mixed one. The software engineering has very limited knowledge about the design approaches. He infers he may implement the system design as his work approach. As mentioned in the literature review part, Tognazzini (2005) claimed that until 2005, the design practitioners still work in obscurity. Because so few companies employ interaction designers, instead leaving engineers with no design training in charge of design. But for this software engineering who works in an international enterprise, there is no such obscurity. The software engineering always gets detailed specifications and user information. He only needs to consider the software design instead of interaction design. Even Miaskiewicz, Grant, and Kozar (2009) criticized that the information about the user needs is typically summarized and distributed to designers in the form of a "user requirements" document. These user requirements summarize the findings of user research in a lengthy spreadsheet, table, or as bullet points, however, this potentially very useful information about the users has proved not to be useful (Pruitt and Adlin cited in Miaskiewicz, Grant and Kozar, 2009). But if the user requirements are elaborately prepared by UI departments or project managers, then the user requirements may improve the efficiency of IS development since the other HCI practitioners have transformed the user needs to the more technical language that is much easier to understand for the engineerings.

Four of the interviewees admit the user involvement would reduce uncertainty from users side, in that designers can get a clear and comprehensive picture of what are the user's' demands.

Good communication and cooperation will improve the quality of final product and reduce the repetition of product validation. Even Clausen (1994), Tuovila and Iivari (2007) mentioned about that designers are not such willing to contact with end users, but the interview results indicate that today the HCI practitioners are performing more active to involve users into their design process. User involvement could reduce the uncertainty that often exists between designers and the target users. However, both the project manager and product manager worry about the efficiency issue. High level of user involvement is hard to control and not all of the projects worth such efforts. This is consistent with the literature review results. Project managers and product managers always pay attention to the workload and delivery. They have to consider about the deadline and how to control the development process.

5.4 The relation between design approaches and uncertainty

There is an interesting interview result. Four of the interviewees appreciate the user involvement in the design process, and believe the involvement would reduce the uncertainty between designers and users. But their attitude is not such positive, they doubt about the design approaches would be helpful to fix uncertainty. Only two of the interviewees confirm the design approaches would reduce the uncertainty. One project manager claims the activity centered design is a good choice that could collect real user demands and easy to control. One UI designer points out the genius design has nothing to do with reducing uncertainty but the other three design approaches are useful. The other UI designer and one software engineering suspect the relation between design approaches and uncertainty. They focus on the practical purpose of these design approaches. They do not need to classify all of these design approaches in detail. These design approaches may be mixed implemented. One product manager holds a similar perspective, since the design approaches may be the uncertainty or lead to new uncertainties.

None of the interviewees mentioned about the user involvement or design approaches would reduce the uncertainty which coming from the colleagues. When we discussing about the uncertainty between person, these HCI practitioners always directing to the communication with their customers or users. The language game, the user's tacit knowing, and the psychological and cultural distances between users and designers are more critical issues to designers. But two of the interviewees mentioned about when designers hold different idea about one case, it could be solved by producing a prototype or a model, and refine their idea based on customers' suggestions. Therefore, user involvement could reduce the colleague uncertainty in this way.

One UI designer emphasizes the value of uncertainty. Designers should try to get benefits from the uncertainty instead of removing it blindly. It seems that the ability to deal effectively with changes in uncertain situations is an important skill in IS projects. Sometimes more uncertainty means more design space. It is a double-edged sword that should be handled with wisdom. Designers should be more positive and active when they face uncertainty. Uncertainty is an inherent attribute of a situation, you cannot escape, avoid it, or kill it. We can do no more than try, try to learn from it, get some benefits.

6 Conclusion

According to the results of empirical findings and discussion, this chapter firstly summarizes the main findings attempting to answer the research questions we posed from the beginning of our study. Further to this, a guideline to implications to this study, our contribution to the IS sphere will follow up. Concluding thus with short outlines of limitations in our study and proposed further research.

6.1 Research questions

In response to the purpose of this study, the main goal was to find out how do designers deal with uncertainty. In order to achieve this goal, the task was divided into two research questions, which were designed to gain the designers' perception of uncertainty in their daily work and find out what kind of methods or strategies do designers utilize to deal with uncertainty. Through our empirical findings and analysis, presented in Chapter 5, the authors have summarized the following conclusions for these two research questions.

Research question 1:

What is uncertainty in HCI domain and how do the HCI practitioners perceive uncertainty?

Generally, uncertainty is a term used subtly different ways in a number of fields. Every designer faces uncertainty during their design process. As we categorize the uncertainty into two type, collaborative uncertainty troubles the designers more often than work uncertainty.

Work uncertainty mainly lies in the technical side or unfamiliar to your daily work. Work uncertainty usually bring problems and troubles to the beginners as designers, and the frequency of occurrences will reduce by the accumulation of the designers' experiences and the improvement of the design abilities.

However, when talking about collaborative uncertainty, designers are always bothered by the uncertainty from their customers. Since the customers have a totally different background and have few knowledge of technology, so the customers always present their requirements without the consideration on the technical side, which is the main reason lead to collaborative uncertainty. While another reason is that sometimes the customers even have no idea of what do they need. This brings a problem to the designers, because they need to spend plenty of time on conducting researches to find out the customers' real requirements. Further on, regarding the collaborative uncertainty to designers' colleagues, designers find it comparatively easier to deal with than their customers. Dividing into two cases, in the organization in small or medium scale where share an agile and boundaryless hierarchy, the differences among different positions are less and unclear. And there are more cooperation and communication in-department and inter-departments. Therefore, there are more uncertainties may appear but it is easier for the employees to handle uncertainty with other colleagues. While in the organization with a large scale where lies a structured and clear hierarchy, the differences among different positions are obvious. In such organization, the

appearance of uncertainty among colleagues is hardly, while it may be more difficult for designers to handle the uncertainty with colleagues in such organization.

Even in the literature review section, we proposed the communication issue between designers and third party stakeholders such as external consultants that may involve into the design process (Grudin, 1990). But none of the interviewees mentioned about that. We assume the designers may regard the those third party stakeholders as colleagues or customers.

Research question 2:

What approaches or strategies do the designers utilize to deal with uncertainty?

In order to answer this research question, we split the answer into three parts based on the categories of uncertainty.

Work uncertainty is a common problem for beginners, since this kind of uncertainty is resulted from alack of experiences and professional abilities. The most effective method is to get the opinion from experienced people. In order to get the help, the designers could ask their experienced colleagues or superiors or search the question online to find other experts. However, if you work in a company with some special regulations to help the new employees, the work uncertainty would be solved in a moment.

Collaborative uncertainty from the other professions is also easily handled. Since you and your colleagues always shares intersection, such as similar background, same goal and same working environment, the uncertainty can be handled effectively by good communication. Designers should get benefits from colleague uncertainty. When designers hold different ideas about one case, they can communicate and discuss, share information and inspired by each other, make further improvement of the IS. Or it could be solved by producing a prototype or a model, and refine their idea based on customers' suggestions. Therefore user involvement could reduce the colleague uncertainty in this way.

Collaborative uncertainty from the customers or users side is the key aspect in this question, to solve this uncertainty, we presented four design approaches and ranked them with the element of "user involvement". The language game, the user's tacit knowing, and the psychological and cultural distances between users and designers are more critical issues to designers. While the interview results are different with our expectation. Interviewees appreciate the user involvement in the design process, and believe the involvement would reduce the uncertainty between designers and users. However, they doubt the design approaches would be helpful to fix uncertainty, and suspect the relationship between design approaches and uncertainty. They focus on the practical purpose of these design approaches and do not need to classify all of these design approaches in detail. These design approaches may be mixed implemented.

Even many research criticize the designers are not such willing to communicate with end users (Grudin, 1990; Tuovila and Iivari, 2007; Huang *et al.*, 2008; Clausen, 1994), but today designers hold a quite positive attitude with user involvement. They perceive themselves as researchers or tourists and study users' demands actively. Our interviewees listed some strategies which they have implemented in their design process:

- Designers may implement "role play" strategy to experience end users' world.

Designers need to absorb some basic knowledge about specific domain so as to complement their design work. And role play strategy could help designers familiar with end users' usage context.

- Since designers are aware that end users sometimes have no idea about their demands, so designers make decisions for users based on their instinct and experience directly. Experienced designers could better guide users and grab users' preference. They unscramble the inputs from end users and reforms them into a sequence of logic requirements.
- Prototypes and models are useful strategies that could help users understand the IS, therefore refine their real needs.
- User involvement could effectively solve many uncertainties between designers and users, while the depth of involvement may depend on specific situation.
- Last but not the least, communication is the thumb tip for designers to reduce uncertainty with end users.

On the other hand, designers still remember they are art oriented, who are inspired by freedom and creative. Genius design approach may not reduce the uncertainty between designers and users, but it still valuable. One success creation would reduce uncertainty from a brand new perspective.

We also emphasize the value of uncertainty. Designers should try to get benefits from the uncertainty instead of removing it blindly. It seems the ability to deal effectively with changes in uncertain situations is an important skill in IS projects. Sometimes more uncertainty means more design space. It is a double-edged sword that should be handled with wisdom. Designers should be more positive and active when they face uncertainty. Uncertainty is an inherent attribute of a situation, you cannot escape, avoid it, or kill it.

6.2 Contribution

By exploring how designers perceive uncertainty, this study has served to broaden the understanding of uncertainty in HCI field. Since there are very few empirical findings regarding the practical methods or strategies to solve uncertainty for designers, the main contribution of this study is narrow down the knowledge gap between HCI researchers and HCI practitioners.

Additionally, the result including designers' perceptions of uncertainty during their process and identified effective methods or strategies to deal with uncertainty in practical situation. The indirect relationship between design approaches and design uncertainty would help the researchers to find a more practical version of design approaches.

6.3 Implication

The implication of this study is mainly for HCI designers, give them suggestions and

recommendations of how to deal with practical issues in their design work, especially for the beginners in the HCI field, this study may enable them to connect their theoretical knowledge with their practical design work. HCI researchers may get inspiration from HCI practitioners' cognitions to investigate related design approaches that will improve the quality of design process.

6.4 Limitations and further research

Due to practical and conditional limitations, the study we conducted has space for improvements. One of the limitations of our study findings is that there is only an utterly small number of designers in our study and additionally we could expect that all of them have a clear view of uncertainty and design approaches in their design process. Furthermore, it is impossible to find the interviewees with all kinds of background, we can just find the designers in Sweden and China these two countries, which may make the context biased. Finally, due to the geographical problem and time difference, some interviews are conducted via the internet which may influence the quality of the interview.

However, we tried to connect the design approaches based on the academical level to effective methods to solve practical uncertainty for designers. Although the result suggests that the relation is indirect, we believe that the results could help both researchers and designers. Apart of that, there is also space in our research can be further developed. Based on the practical limitation or the time condition we suggest that this study can be further improved. Thus, further research can involve a mixed research, substituting the qualitative research of consumers with quantitative one. A larger and randomized number of respondents worldwide can be included in the sampling. Finally, this study mainly built on the hypothesis that the designers need to deal with uncertainty, but as we inspired by one of our interviewee, uncertainty could be utilized for the designers to gain more chances to improve themselves or bring more users involve their design process to obtain more valuable suggestions. So the further research could be conducted to find out how to utilize uncertainty or the necessity to solve uncertainty.

Appendix 1

Interview Questions

Introduction

Occupation, basic information about the company and work experience.

Based on the designers

- How do you characterize a designer?
- How do you describe your design process?
- How do you perceive the difference among programmers, project managers, product managers, designers?

Based on the uncertainty

- Have you ever felt "I am not sure..." situations in your design process? Can you give us one example?

We categorize the four types of uncertainty into two groups, which lies upon the person (Individual and Collaborative) and work (Task and Process). We will discuss both possibilities separately.

Possible Answer 1:

- According to the example, which could exemplify uncertainty. And we assume that your example of uncertainty could be resulted from work itself, which means it has nothing to do with persons. Could you elaborate your uncertainty, is it result from lack of understanding of the task or lack of experience of how to deal with the task?
- How do you deal with this at that time?

Possible Answer 2:

- According to the example, which could exemplify uncertainty. And we assume that your example of uncertainty could be resulted from other professional roles or customers, which means it has nothing to do with work. Could you elaborate your uncertainty, is it result from lack of experiences of yourself or difference among different people in your team?
- How do you deal with this at that time?
- You said this problem was the uncertainty with your colleagues, apart of that, have you ever contacted with end users in your work?
- Have you ever meet any problems or uncertainties with the end user (user representatives)? Could you give us one example?
- How do you deal with that?

Based on the design approaches

Academically, there are four design approaches, which are User-centered, Activity-centered, System approach and Genius approach:

1. User-centered design, means the user knows best and is the only guide to the designer; the designer's role is to translate the users' need and goals into a design solution.
 2. Activity centered design focuses on the behavior surrounding particular tasks rather than their goals and needs. Since sometimes the users do not know what exactly do they need.
 3. System design is structured, rigorous, and holistic design approach that focuses on context, while the users' role is to set the goals of the system.
 4. Genius design relies solely on the experience and creative flair of a designer. In this approach the users' role is to validate ideas generated by the designer, and users are not involved during the design process itself.
- (These four design approaches could be ranked by the involvement of the users, so it would be a better way for the interviewees to understand the different approaches. From User-centered design to Non-user-centered design (Genius design))

- How do you perceive the role of user involvement in your design process?
- Have the user involvement brought you any benefits or obstacles? Could you give us one example?
- Based on the benefits/obstacles you have mentioned in your story, do you think the user involvement would bring you more uncertainty or help you solve it?

Based on the relation between design approaches and uncertainty

- Do you think these design approaches are useful to deal with uncertainty? Why?

Ending question

- Is there anything that you would like to add?

Appendix 2

Transcript of interview 1 (the interview was conducted in Chinese)

M= Minglei Cheng

J= Jialou Zhang

Date: 2015-05-03

Row	Conversation	Code
R1	M: Could we record this interview?	
R2	J: You want to record?	
R3	M: Ye, but we can do it anonym. The record is primarily used for later data analysis. If you do not want us to mention your name, we will not do that.	
R4	J: Ok.	
Introduction section		
R5	M: First, we need some basic information about you. What is your occupation?	
R6	J: I am responsible for a project now, as the project manager. But this occupation is not fixed. Sometimes I take the role of the programmer as well, sometimes I am the software designer.	IN IN
R7	M: How about the company scale, small, medium, or large?	
R8	J: I suppose it is medium. Our company develop so fast. We had 600 employees half a year or one year ago, but now we have 1000 employees.	IN
R9	M: How long time you work at this company?	
R10	J: Four years. From internship to now.	IN
Designer section		
R11	M: The first question is: as a software design, from this perspective, how do you define and describe "designers", which words do you prefer to use?	
R12	J: Adjective?	
R13	M: You decide it.	
R14	J: I will describe the work of designers.	
R15	M: Ok.	
R16	J: First is about the researcher. Research is the beginning of requirements. If you want to design something, first you need to understand what users want. The	DC DD

	research requires experience of designers. After several years of work, you know what questions you should ask about the specified software. Communication with customers, different designers would get various results in different depth. Experienced designers know more about what customers want. Sometimes, customers have no idea of what they do want. So we have to organize thoughts for them, and then we validate it with customers. Requirements mean communication, talking, speaking, organizing, validation, modification, and repeat all of these steps again and again. That is how we get the early requirements.	
R17	M: This is the requirement, what is more?	
R18	J: Designers organize those requirements. Then design based on the requirements. According to the software architecture, but this is more related to techniques. Anyway, designers have to archive different goals, collect requirements to detailed design, concept design, and then develop.	DD
R19	M: You just mentioned about detailed design, can we refer it to “integrate”?	
R20	J: Yes. We have to integrate all of the information, user data.	DD
R21	M: Ok. So the last phase is development, right?	
R22	J: Actually the last phase is delivery. We are the researcher, integrator and deliverer.	DD DC
R23	M:Ok. This is your definition and description about “designers”?	
R24	J: Yes, about their work.	
R25	M: Good. Next question. How do you perceive the difference among programmers, project managers, product managers, and designers?	
R26	J: This classification is so detailed. Actually, I am not quite sure about that. Since in China, in small and medium enterprises, we would not divide the work in such clear way. Generally, the research and develop(R&D) managers take several roles.	
R27	M: R&D managers? You mean project managers or product managers? Both or neither? Or the integration of them?	
R28	J: Actually we only have project managers in our company. We do not have R&D managers and product managers. But in some of our customers they do have(R&D managers and product managers). The project managers mainly responsible for the business, and R&D managers mainly responsible for technique. I heard about those from our customers. The project managers take a lot of tasks, pay attention to the process of every project, the left workload, how to deploy employees. But the R&D managers only focus on one project, one group, fix technical problems. That it is.	DHP
R29	M: you mean project managers responsible for resource allocation, and R&D managers focus on technical problems, right?	
R30	J: Yes.	
R31	M: How do you perceive the difference among programmers and them(project managers, product managers, and designers)?	

R32	J: In China, programmers really work hard. Since they have to do a lot of design work. If we follow the formally develop process, programming and requirements should be separated totally. Designers should take the work of requirements. Projects are divided into several phases, at the beginning of design, we need detailed design, detailed requirements. Such as some Japanese outsourcing enterprise, when the design the project, they could design and give the name of one specific class and method. In China, we have not do it in details, but we should. It will reduce uncertainty since every detail has been considered and designed, we only have to code and implement. We have the design of the building and only need to brick.	DHP
R33	M: Good. You mean the designers are the architects, they responsible for the design work of a building in the beginning, design a blueprint. Programmers implement the building in details according to the blueprint. From the entirety to details, right?	DHP
R34	J: Yes.	
R35	M: The next question, in your work team, how do you communicate with your colleagues?	
R36	J: Most of my colleagues are programmers. In my company, programmers would do some design. Sometimes, the customer requirements are not such clear, that is very annoy.	UE
R37	M: How do you define “the customer requirements are not such clear”? Could you give us an example?	
R38	J: Sure. Once we had a project in a hurry, it required us finish it in two months. Additionally, at the beginning of the project there was no requirements, no detailed design, and no standard workflow. The customer told us what they want, oral. At that time, project manager went to communicate with customers and recorded. Then he threw the records to us and asked us to finish it. How to do that? We were thinking hard. How to do that?	UE
R39	M: They gave you a very abstract description, and you transferred those abstract description into concrete requirements based on your understanding, right?	
R40	J: Yes. Then we had to make validation with the customer. If they disagreed with the requirements, we had to modify them. Validation and modification, again and again. It took quite a long time to do that.	UHE DD
R41	M: Ok. Let us back to the former question, how do you communicate with your colleagues? As a project manager, or a software designer, how do you cooperate with others, such as programmers, project managers, R&D managers?	
R42	J: Generally speaking, we have one person to handle the whole project. He has a well understanding of the business, know all of the business. The programmers are workers. First of all, we need a meeting. The person who takes responsibility of this project has to divide the tasks. To those experienced programmers, you do not need to tell them in details. You just need to give them requirement, and they can finish the functions. But for anewbie, you have to explain the requirements indetails,so that they can finish the job.	DD DHP
R43	M: Do you mean you have a simple structure in your group? One leader who responsible for allocating tasks, and the rest of you work together to implement the requirements?	
R44	J: Yes. Actually, except one leader in the group, we have an assistant. Since if	

	only one person decide all of the projects it is too arbitrary.	
R45	M: Individual has limited thoughts.	
R46	J: Sure. So there must be someone who provides counter views.	
Uncertainty section		
R47	M: Ok, let us move to the next section and talk about “uncertainty”. Have you ever felt "I am not sure..." situations in your design process?	
R48	J: A lot of experiences.	
R49	M: Could you give us one example?	
R50	J: In details? If we go in details then we have to talk about the technique things.	
R51	M: No, not in such details.	
R52	J: Still the problem of uncertain customer requirements. I just said, the customers want some function, but they only give you one sentence(such as I want this...), then you have to consider about their demands. Once in a while, they need those functions in a hurry, and urge on the process, push you a lot, you must submit something. The customers are not merely take one single role anymore. Perhaps it is good to leave some uncertainties to them, which enable them to deeply engage into the project. Thus, as for the company, we can get more data and information about their preference to improve our further projects, but also obtain more potential customers.	UI UE
R53	M: Could you give us an example? What do the customers say?	
R54	J: For instance, he wanted one specific function. We had a hotspot map in this project. This map needs to display some data of every province. That was what the customer told me: “Some data of every province, I want this function. First, you need to display one map for me, and I want it in next week.” Then we went back and discussed. In the beginning, we thought this requirement was quite clear: clear business things, we knew where we could get the data. But we had to figure out how to implement. It seemed like customer told us the requirements articulately. But when we really went into the implementation, we found a lot of details, not such easy to handle.	
R55	M: For example?	
R56	J: Such as the hotspot map, the data resource was ok, and we knew what he wanted. Theoretically, it could be done. We could provide the map with data display. But when you click one province on the map, then you should get the detailed penetration data of that province. While during the development process, we found that we could not get penetration data of every province that the customer need this penetration function. It might be the data structure problem or other technical obstacle. If we want to implement it, we need a lot of time. We could finish it, it was not impossible.	
R57	M: Good. We found a lot of articles about the uncertainty, basically, we categorize the four types of uncertainty into two groups. One lies upon the persons, for example, you and your colleagues, you have a different experience, or you and your customers, and you have different background and angle. The other uncertainty is work uncertainty, it is more about the working process. Such as, at	

	the beginning of one project you have some trouble with the requirements individually. We categorize the uncertainty into this two groups. You just mentioned about the uncertainty is related to the person uncertainty, right?	
R58	J: Yes, it is between customers and us.	
R59	M: How do you deal with this at that time?	
R60	J: Normally, we handle it in one pattern. If the customers want some function, we could make it for them. But we will declare it in advance: "we are so stressed in time, so we are not capable for that". If they could give me more time, we can do it. If they could not give us sufficient time, we will say we cannot do that. But we could negotiate, maybe not put the function in such details, some small functions will be ignored, we only focus on the main functional part.	UHE
R61	M: how do you perceive the uncertainty between your customers and you? It primary because of the designers lack of communication experience or caused by the difference with human beings? For example, the experienced designers may find and solve problems in a short time when they communicate with customers. But the second reason has nothing to do with designer's experience. It roots in the difference between person, designers and customers stand on totally distinct standpoint, customers have no idea about the difficulty of software development and implementation. How do you perceive the reason which leading to uncertainty between designers and customers?	
R62	J: Both. Experienced designers or project managers could consider about every detail of the project when they communicate with customers. Then they could coordinate with customers about time, requirements, so we will meet less obstacle during the project. But even experienced designers or project managers, it is impossible for them to consider of everything. We will still meet problems. If the designers or project managers are a lack of experience, then we will meet thousands of problems, it is a challenging.	UE
R63	M: Have you ever experienced some uncertainties within your design group, or teammates?	
R64	J: Yes. The uncertainty among different designers, normally it means "funny". Designer in the same group prefer to prove themselves, they need to consider more idea and present it. Just like a brainstorming. We shall provide the best solution for the customers. And some uncertainty or some conflicts are the opportunities for us to improve our ideas by learn from other designers, thus it naturally improves the quality of the project. Sometimes, I push them to the uncertainty, put different persons working in one single team.	UC UHC
R65	M: Have you ever experienced the other uncertainty? We just talked about the uncertainty between human beings, how about the work uncertainty? Have you ever felt you are not sure about the requirements? For example, project leader gives you one task, actually, the task requirement is quite clear, but you have no idea about how to figure out some parts of the task.	
R66	J: Of course. In fact, because of personal reason, lack of experience or something, different people have different understanding of one same sentence. The project manager wants a function, but you misunderstand it. You make something and present it to the project manager, he says: "This is not what I want." These are of common occurrence.	
R67	M: As a newbie?	

R68	J: En, normally, newbie. I have to take the role as a mentor for the new employees these years. In their first two or three months, you know, they have no idea about this company and the develop process. But it is not bad, every problem and uncertainty is a chance of study for them, if they prefer to communicate with and ask questions to experienced employees.	UW UHW
R69	M: Do you still have this kind of problem(not sure about the requirements)?	
R70	J: Seldom.	UW
Design approaches section		
R71	M: Great. The third section is the design approaches section. Academically, we found there are four design approaches. First is the user-centered design, the user knows best and is the only guide to the designer; the designer's role is to translate the users' need and goals into a design solution. The second design approach is anactivity centered design that focuses on the behavior surrounding particular tasks rather than their goals and needs. Since sometimes the users do not know what exactly they need. Compared with the user-centered design, activity centered design involvesfewer users in into the develop process since in the user-centered design the users are involved from the beginning to the end of the project. But the activity centered design involve users that focus on their behaviors. Designers get user information from their activities. The third strategy is system design, which is structured, rigorous. It focuses on the project, software, and context. While the users' role is to set the goals for the system. Do you understand?	
R72	J: Yes.	
	M: The user involvement further reduced. Customers only give you the requirements and goals, nothing else. And then designers design for the whole project. The fourth approach is sort of extreme. The genius design relies solely on the experience and creative flair of a designer. You got me?	
R73	J: Yes.	
R74	M: In the fourth approach, the user involvement is the lowest since the users' role is only to validate ideas generated by the designer, and users are not involvedin the design process itself. These four design approaches could be ranked by the involvement of the users, from User-centered design, the highest user involvement, to activity centered design that the user involvement is less high. The third is software design, and the last is anon-user-centered design which is genius design. So which one is the most used one in your work?	
R75	J: The second one.	
R76	M: You mean you would not ask the customer what do they want, but infer their demands from their feedback?	
R77	J: Right.	
R78	M: Most of the designers work in this way?	
R79	J: Most of us. But it depends on the scale of the company. In small and medium companies(customer companies), if they need some software and they do not have technical staff, so they have to send people who know the business to communicate with our technical staff. Then it is the second design approach. But	DUI

	in large companies(design companies), they have professional staff who know business and technique, then it is the first design approach. But for our company, the second one is the most used one.	
R80	M: You mean, in large companies, they have a lot of professional project managers and designers, so they could involve the users more comfortable. So you prefer the first design approach could better fulfill the customers?	
R81	J: Yes, but this approach has high expectation to the customers.	DUI
R82	M: And high expectation the project managers and designers as well, because they shall understand customers' desire and guide them.	
R83	J: Yes.	
R84	M: During the communication with customers, how do you perceive the role of user involvement in your design process?	
R85	J: Normally, our customers conform to the second approach. Customers say something, but not articulately. Our experienced worker will transfer the content to better understanding functions. We will make a model that could be presented to the customers. Generally speaking, the model works well. If the customers are not satisfied with the models, then we make some modification. A project is the process of validation and modification, again and again.	DUI
R86	M: Ok. We just talked about four design approaches; you said you always using the second one. Have you ever used the other three approaches?	
R87	J: No, I have not.	
R88	M: How about your colleagues?	
R89	J: No. And I think the third one and the fourth one are not such accords with common sense.	
Relation between design approaches and uncertainty section		
R90	M: Great, the fourth section! You perceive the uncertainty mainly comes from human beings?	
R91	J: Yes.	
R92	M: And the uncertainties are primary between you and your customers, right?	
R93	J: Yes.	
R94	M: Do you think these design approaches are useful to deal with uncertainty? Why?	
R95	J: The second one is helpful. It is the most comfortable one. The other three are not such practical.	RDU
R96	M: Not such practical?	
R97	J: Yes.	
Ending question section		

R98	M: Is there anything that you would like to add? Anything?	
R99	J: Some of your questions are not such accord with our company, such as product managers. Normally in small and medium company, there is no such detailed role divided. Except the large companies.	DHP
R100	M: You mean one person hold several posts simultaneously?	
R101	J: Yes. Saving cost.	
R102	M: Great, thank you for your participation!	
R103	J: No problem.	

Appendix 3

Transcript of interview 2 (the interview was conducted in Chinese)

M= Minglei Cheng

A2= Anonymous Interviewee 2

Date: 2015-05-05

Row	Conversation	Code
Introduction section		
R1	M: Well, what do you do, I mean your work in your company at this moment.	
R2	A2: UI designers.	IN
R3	M: Alright, then How long have you been work as a UI designer?	
R4	A2: Two years long, times goes fast.	IN
R5	M: Certainly it is. And how about your employer? Is it a big company?	
R6	A2: Not really, it is a small one.	IN
Designer section		
R7	M: Got it. Coming to our formal questions, can you characterize a designer?	
R8	A2: What do you mean about characterize?	
R9	M: Give us some opinion about a designer in your understanding.	
R10	A2: So you mean define a designer?	
R11	M: Yes, you understand in that way.	
R12	A2: Ok, I really do not want to say so, since you do not need to define everything in your life. As a designer, personally I am afraid that I do not have a very clear definition about it.	DC
R13	M: How about you just tell me what makes you a designer? Is that more answerable?	
R14	A2: Fine, I would like to describe a designer with some words. Personally, I believe there are three abilities that make a people into a designer.	
R15	M: Perfect, what are they?	

R16	A2: They are accumulation, inspiration and visualization.	DC
R17	M: Can you explain your answer?	
R18	A2: Yes, the first one is mainly about absorbing and accumulating information and knowledge from the outside world, I mean ordinary life. It is a way of learning. Inspiration is something that are built on your accumulation; you translate others knowledge into your words by your understanding. Visualization is about visualizing the idea into an understandable reification, in order to express the value.	DC DD
R19	M: Good point, then how do you describe your design process?	
R20	A2: Come on, I think what I said just now could be the answer to this question, actually I just describe my design process to you.	
R21	M: OK, so you mean these three abilities can define your design process also?	
R22	A2: Yes, I like it.	
R23	M: Fair enough, something about your colleagues right now, how do you perceive the difference between programmers, project managers, product managers, designers?	
R24	A2: Oh, another academic things again. I am not very into the difference between these positions actually. And it is not necessary to have such many positions in a project team.	DHP
R25	M: Why do you think that?	
R26	A2: My experience told me that. I remember I used to work in a project with three software programmers as my team members but none product or project manager, I was kindly surprised at that time.	DHP
R27	M: So do I, how could it happen?	
R28	A2: Yes, but I figure that out later. You know I used to work for a large IT company at that time where the workflow is utterly agile.	DHP
R29	M: You mean there is no standard working process for each position?	
R30	A2: No, it has. But it is very flexible. I learned from the experience with my previous employer, which is the difference we talk about here is too academic. Some big companies share an agile workflow, they usually organize a project team based on specific requirements instead of standard team composition.	
Uncertainty section		
R31	M: OK, that is interesting. Let us talk about uncertainty right now, have you ever felt "I am not sure..." situations in your design process? Can you give us one example?	
R32	A2: I can give you a list of it if you really need that.	
R33	M: Just one or two example would be ok.	
R34	A2: As a matter of fact, I just enter this company for nearly two months,	UI

	personally I still have some problems with my new business. I mean uncertainty usually bothers me these days. Such as, I am not sure about how to design the framework of the front page, which is one of my routines in my position. But right now, I need to ask my colleagues to help me about it.	UW UHW
R35	M: So you mean the uncertainty is resulted from the unfamiliarity to your business?	
R36	A2: Yes, this uncertainty usually troubles you when there is something new come in your daily work. The new thing for me in this position is you need to contact with real customers right now, which is the business I never met before. Based on that your design work may contain some element of the other context.	
R37	M: Could you elaborate that?	
R38	A2: Look at my project right now, It is easily to understand that if you conduct your design with medical context, then you may need to absorb some basic knowledge about medicine so as to complement your design work. Therefore, you may encounter the uncertainty during your studying process because this is an utterly strange domain.	UE UHE
R39	M: So how would you deal with it?	
R40	A2: Although it sounds difficult, but you could solve this uncertainty easily. I can give you my approaches, one is about learn the new knowledge by yourself online, it is a hard time for you if you do not interest. Another one is to ask help from the professional person which means that you can learn the new knowledge by doing some researches with the professionals in that specific domain.	UHE
R41	M: Alright, According to the example, which could exemplify uncertainty. And we assume that your example of uncertainty could stem from work itself, which means it has nothing to do with persons. Could you elaborate your uncertainty, is it result from lack of experiences of yourself or difference among different people in your team?	
R42	A2: In my team? Do you mean uncertainty with my colleagues?	
R43	M: It could be, but also your customers maybe.	
R44	A2: The uncertainty with colleagues is easier to handle I suppose.	UC
R45	M: Why do you say that?	
R46	A2: While it is a simple question over here, the reason is the communication with colleagues is easier, both geographically and psychologically.	UC
R47	M: Interesting answer.	
R48	A2: Just imagine that you and your colleagues both share one place in your company, which make you both geographically close to each other. But it is not available for you and your customers, sometimes the distance could be utterly remote. Psychologically means that you and your colleagues must have something in common even outside of your bare work, some internally relationship could make you both more understandable by the other one.	UC
R49	M: Great point.	
R50	A2: Besides, the relationship between your colleagues and yourself always keeps	UC

	a longer duration than your customers.	
R51	M: So there are three reasons over here.	
R52	A2: At this moment at least.	
R53	M: Sounds like you usually have some disagreements with your colleagues.	
R54	A2: Well, I think the uncertainty with colleagues is mainly about whose idea is better, we always handle that in an effective way which make a prototype of our ideas separately and show their prototype to their customers, leave the decision to their customers.	UC UHC
R55	M: How about customers? Have you had uncertainty with your customers?	
R56	A2: Yes, I am. It seems more complicated.	UE
R57	M: How do you deal with that?	
R58	A2: I do not have much experience on that, but I used to be told by one of my experienced colleague, he said that spending some days with your customers is a good way to solve this uncertainty.	UHE
R59	M: Do you mean “Role Play”?	
R60	A2: Yes, good word. But it needs much time to do that, you need to find a balance if time allowed.	
Design approach section		
R61	M: Fair enough, then we coming to the design approaches, have you heard about the design approaches?	
R62	A2: Yes, I think I have. But can you give me some examples?	
R63	M: Of course, we have found out four design approaches academically, which are User-centered, Activity-centered, System approach and Genius approach. Do you need me to elaborate them?	
R64	A2: It is ok, I can remember them since I just graduate no longer than two years.	
R65	M: Great, a great student are you!	
R66	A2: Haha, I just have a kindly good memory.	
R67	M: Then let us talk about these design approaches, how do you think of them?	
R68	A2: Well, my favorite one is thegenius approach. This is one of the easiest approaches here for a designer since you just need to follow your instinct. I think UCD has been overloaded these days, I do not trust much on users. And the other two approaches are not that familiar to me. So I would like to divide them into two big categories: genius approach and other approaches.	DUI
R69	M: Sounds you are very confident.	
R70	A2: I just believe designers should be the center of the design, not the users. The genius approach is a rush of inspiration which means precious and limited. When	DUI

	it comes, designers may produce amazing creation in a short time with passion. Nevertheless, I also need to contact with customers or users very often, so I should admit that the other three approaches are more often to use.	
R71	M: So you also use other three approaches in your design process?	
R72	A2: Yes, I do interview the end users, sometimes I need observe them, and sometimes even experiments are necessary.	
R73	M: Have you find out any uncertainties or problems in your researches?	
R74	A2: The biggest problem is even the end users have no idea about what they really want.	DUU
R75	M: This can be serious, how do you deal with it?	
R76	A2: Like what I said just now, the “role play” is a good method to this problem which can be really useful to find out the end user’s real need.	
R77	M: Can you describe the “Role Play” should belong to which design approach?	
R78	A2: From the four approaches?	
R79	M: Yes.	
R80	A2: I think it is a mixture. As a designer, you cannot be restricted to design approaches. To be honest, I do not into other three non-genius approaches. The most significant thing is about how to collect user requirements. Except the genius design, other design approaches are all academic, principle, regular and respect the users.	DUI
R81	M: Actually, we have ranked these four approaches by user involvement, if you could understand me about it. Then we are going to talk about user involvement.	
R82	A2: Alright, just move forward.	
R83	M: How do you perceive the role of user involvement in your design process?	
R84	A2: Well, I think it depends, the role can be different if you involve the users in different stages.	DUI
R85	M: Then Have the user involvement bring you any benefits or obstacles? Could you give us one example?	
R86	A2: Personally, I believe there is more benefits but obstacles sometimes. User involvement means more constraints, in other words, users will propose more ideas, requirements, principles for the design. These constraints are good things for the designers, because designers can get a clear and comprehensive picture of what are the user's' demands. But it increases the degree of difficulty of design. Designers may feel confused and contradictory among the requirements and suggestions from users.	DU
R87	M: So you mean both benefits and obstacles?	
R88	A2: I prefer that, since I think it is useful to involve users to test your design in the final stage but not for the stage before.	DU

Relation between design approaches and uncertainty section		
R89	M: Then the last question, do you think these design approaches are useful to deal with uncertainty? Why?	
R90	A2: Mum, I would like to talk about it separately. I believe my favorite genius approach is useless to deal with certainty. Since the final products normally lead to an extreme result: attract most of the end users or abandon by all of the end users. But other three approaches may be useful.	RDU
Ending question section		
R91	M: Something to add in the end?	
R92	A2: Yes, I think uncertainty is necessary for design.	DUU
R93	M: Oh, how does this come?	
R94	A2: While it is impossible for designers to fix all of the uncertainties. If you really fix all of the uncertainties it always means more problems. As one example over here, a user interface with only one option. If the designers eliminate all of the uncertainties, then only one possibility left. The designer constraints the end users with an exclusive choice which means no choice for them. It is not the design.	EA
R95	M: This is a very interesting opinion.	
R96	A2: I would like to say that you need to have a positive attitude to uncertainty since it would bring you some surprise sometimes. But I still want to solve uncertainty, but I always like to leave some uncertainty in my design for art, creation and freedom.	EA
R97	M: Excellent. Anything more want to add?	
R98	A2: No more for now.	
R99	M: Ok, thank you for giving us your time and efforts.	
R100	A2: No problem.	

Appendix 4

Transcript of interview 3(the interview was conducted in Chinese)

M= Minglei Cheng

L= Luona Xiao

Date: 2015-05-05

Row	Conversation	Code
R1	M: At the beginning of the interview, we would like to ask do you mind if we make a record of the whole interview?	
R2	L: No problems.	
R3	M: Ok, then we would like to ask you some personal information. Do you want to be anonymous? We shall keep your personal information confidentially.	
R4	L: You do not need to do that.	
Introduction section		
R5	M: Alright, what do you work with your companies right now?	
R6	L: I am a UI designer.	IN
R7	M: What is your academic background? I mean your major for your degree.	
R8	L: My major is industrial design.	IN
R9	M: How long have you been work as a UI designer?	
R10	L: Mum, I have been worked for about two and a half years, as a UI designer for one year.	IN
R11	M: How about your company scale?	
R12	L: I believe it is a small company. But it covers plenty of IT program and have lots of partnership outside.	IN
R13	M: Perfect, then I would like to ask how you characterize a designer.	
R14	L: Can I just describe that metaphorically? I mean I could give you a more specific metaphor for your question.	
R15	M: That would be great.	
R16	L: Personally, I would like to describe the role of the designer as the role of	DC

	guide.	
R17	M: Sorry, do you mean the guide for the tourists?	
R18	L: Yes, you got me. I think it is a great way for the professions to perceive the role of the designer.	
R19	M: Could you explain it specifically?	
R20	L: Certainly, the role of the designer is likely to offer some plans to the customers, I mean the tourists. These plans all could bring the tourists to their destination but with different ways.	DC
R21	M: So you also liken the customers for the designers as the tourists for guides?	
R22	L: Yes, and design process could be regarded as the guide process.	
R23	M: Interesting, how do you describe the design process then?	
R24	L: No, there is nothing quite different from others, just some routine like doing research to collect information from outside, and unscrambling and translating them into logical requirements. Based on the requirements, the designer could offer the customers an object that could fulfill their requirements.	DD
R25	M: So how do you make the analogy to guide the process?	
R26	L: You could see the guide process could be also described as so. The guide needs to know what does the tourists want to see or visit since the tourists usually do not know where do they want to visit. Then the guide should ask the tourists or maybe make a research for that. And then, the guide find out the destination based on the research. Finally, the guide needs to figure out some routes that could bring the tourists to their destination.	DD
R27	M: Alright, I understand that. Next question, how do you perceive the difference between programmers, project managers, product managers, designers?	
R28	L: I do not have many ideas for this question actually, I will just give you my answer within my company.	
R29	M: That is good enough.	
R30	L: I do believe that the difference could be unclear even boundaryless in many small companies, at least in my company. As for a small company without a large number of resources, saving cost always be taken as the priority. Look at the human resources aspect, the positions of product manager and project manager are taken by mere one person in my company, because these positions always share same requirements.	DHP
R31	M: Could you describe your opinion with your personal experience since you have been worked in your company for a while.	
R32	L: Of course I can, personally I used to have experience within a team for a medium project. There are no any managers, like project or product; we had only one team leader for everything. The role of team leader is to allocate the task to every team member clearly and handle every problem during the working process. I prefer we do not dig into the details of it because it has been a long time backward. This working module I suppose could be a good module for every small company because it is really effective and cost saving.	DHP

Uncertainty section		
R33	M: Very well, then let us talk something about uncertainty right now, have you ever felt "I am not sure..." situations in your design process? Can you give us one example?	
R34	L: There is a large number of uncertainties happening in my working experience, mum, I think mostly the uncertainty is from my customers. One of my customers used to give me his requirements elaborately, but some of them cannot be fulfilled because of the technical limitation. This was an uncertainty for me at that time.	UI UE
R35	M: How do you deal with that?	
R36	L: While even it sounds difficult, but it really easily to handle, you just need to explain this problem to your customers, but of course you need to have some alternatives to fulfill this unrealistic requirement. After a communication, the uncertainty would be perfectly solved.	UHE
R37	M: So you mean the solution is listening to your customers?	
R38	L: Yes and no, of course, listen to your customer is a definite solution for that. But you cannot just listen to them since they usually have very limited knowledge regarding the project.	UE
R39	M: Alright, so you mean a communication within double ways.	
R40	L: You can understand it by what I mentioned above, the metaphor that liken the designer as a guide and the customer as a tourist. Sometimes the tourists could propose unrealistic requirements or make the requirements which they do not actually need. Something like the tourists want to go Antarctic mainland by train or want to go London for the great wall. As a profession in this field, the designer can easily find out the problem while they need to explain this to their customers with patience.	UE
R41	M: Good explanation, but how do you think the uncertainty from your colleagues?	
R42	L: It is easy, as two guides with two ideas, you can just leave the decision to their tourists.	UCE
R43	M: Great! According to the example, which could exemplify uncertainty. And we assume that your example of uncertainty could stem from other professional roles or customers, which means it has nothing to do with work. Could you elaborate your uncertainty, is it result from lack of understanding of the task or lack of experience of how to deal with the task?	
R44	L: You mean barely from work?	
R45	M: Yes, work itself.	
R46	L: While, I do not think this uncertainty is a serious problem. As a matter of fact, I believe that this kind of uncertainty mainly happens to the beginners who just enter a new business. Just like me, it was a hard time for me in the beginning three months as a UI designer since there were lots of problems or uncertainties bothered me.	UW

R47	M: What are the reasons for your poor experience at the beginning?	
R48	L: I think it is common for everyone when you enter a new area, you have very few knowledge or experience about it.	UW
R49	M: So you mean the reason is lack of knowledge and experience?	
R50	L: Yes, I am. Because it just kept for several months.	
R51	M: What did you do to solve this at that time?	
R52	L: I have to admit that the solution sounds easy, which ask help from your colleagues with experiences.	UHW
R53	M: Well done, let us move to design approaches, how many design approaches do you know?	
R54	L: I am sorry, what do you mean design approaches?	
R55	M: It is ok, I have found out four design approaches academically, which are User-centered, Activity-centered, System approach and Genius approach.	
R56	L: Can you explain to me in details?	
R57	M: No problem, user-centered design, means the user knows best and is the only guide to the designer; the designer's role is to translate the users' need and goals into a design solution. The second one is anactivity centered design that focuses on the behavior surrounding particular tasks rather than their goals and needs. Since sometimes the users do not know what exactly do they need. Next is system design, it is structured, rigorous, and holistic design approach that focuses on context, while the users' role is to set the goals of the system. The genius design relies solely on the experience and creative flair of a designer. In this approach, the users' role is to validate ideas generated by the designer, and users are not involvedin the design process itself.	
R58	L: Alright, I need to admit that I only heard about the first one UCD, I do not have much impression on the others.	
R59	M: No worry, we have ranked them by the involvement of the users, which would be a better way for you to understand the different approaches.	
R60	L: Great, user involvement is a familiar word to me.	
R61	M: Perfect, then the question is: how do you perceive the role of user involvement in your design process?	
R62	L: Personally, I think the role of user or user involvement is more likely a tester who is to make validity. As a UI designer, I always collect user experience of software and websites, and analysis the collected results, during the whole design process, I need to utilize the advantages of the design and modify the disadvantages. So the role of theuser is simply like telling me which is good or bad.	DUI DU
R63	M: Based on that, could you give us an opinion regarding these design approaches?	
R64	L: Yes, I mean these approaches may not be single used, in most situation. I think activity-centered design and system design as a mixture could be my	

	choice in my design process. However, the selection of design approaches should also be connected to designer him or herself. The designer need to select the approaches to keep abalance between their workload and user involvement.	
R65	M: Have the user involvement bring you any benefits or obstacles?	
R66	L: Both I think, but more benefits.	DU
R67	M: So it helps you more than troubles you?	
R68	L: Yeah, it helps me to figure out the problems in the project and optimize the final product to achieve the goal in the end. But sometimes, it also would bring me uncertainty but it fixes more than it brings. Personally, I would like to more user involvement in my design process since as a designer you can learn a lot from your customers.	DU DUU
Relation between design approaches and uncertainty section		
R69	M: Got it. Come to our final part, Do you think these design approaches are useful to deal with uncertainty? And Why?	
R70	L: Oh, I suspect that there is a direct relationship between them, but there may be anindirect one. In the HCI design field, I believe there are three aspects product, development, and design. These design approaches may reduce the uncertainty between designers and users, but probably increase uncertainty in the development process since ahigh level of user involvement lead to complicated work process.	RDU
Ending question section		
R71	M: Fair enough, nice opinion. As the end of our interview, do you have something want to add?	
R72	L: Nope, there is nothing coming to my mind.	
R73	M: Alright, thank you for giving us your time and efforts.	
R74	L: No problem.	

Appendix 5

Transcript of interview 4 (the interview was conducted in Chinese)

M= Minglei Cheng

X= Xin Zhang

Date: 2015-05-07

Row	Conversation	Code
R1	M: At the beginning of the interview, we would like to ask do you mind if we make a record during the whole interview.	
R2	X: It is ok, I used to make some interviews for my bachelor thesis as well.	
R3	M: Great, so you must know that we will ask you some personal information. Do you want to be anonymous?	
R4	X: Nope.	
Introduction section		
R5	M: Alright, what do you work with your companies right now?	
R6	X: I am a software engineer right now.	IN
R7	M: What is your academic background? Your major for your degree.	
R8	X: Computer Science and Software Engineering.	IN
R9	M: Sounds like you made a nice chance with your graduation. How long have you been work as a software engineer?	
R10	X: This is my fifth year. So I have been worked for four years.	IN
R11	M: Wow, you must be interested in programming.	
R12	X: Not that much, but I need that to feed myself.	
R13	M: Next question is about your company scale, but as we all know, Sony is a definitely large company.	IN
R14	X: Yes, it is.	
Designer section		

R15	M: Well, here we go to our formal interview question. Since you could be called as software design as well, I would like to ask how you characterize a designer.	
R16	X: Characterizing could be difficult to me, but based on my understanding, I suppose that the designer is a kind of person with creativity and imagination who could create something that could make the world a better place. I do not know if this is a good answer.	DC
R17	M: Yeah, very understandable. How do you describe your design process?	
R18	X: Another difficult question for me. Mum, let me think a minute. From my personal experience, I think it can be divided into two kinds. The first one can be easily called as "inspiration," everyone had an experience with such thing. Another one is more traditional, as a master student you may hear of it. It contains several steps, such as problem definition, requirements collection, goal setting, and visualization. Inspiration sounds like a shortcut, but it a considerably long period of accumulation and experience, and designers' luck should also be considered on this occasion. Therefore, "inspiration" is something can only be found by accident, and not through seeking.	DD
R19	M: It seems like you always have inspiration in your experience. Thus, you have a deep understanding of it.	
R20	X: Not really, I think the traditional one is more often for me. It is the way must be passed for every designer's development.	DD
R21	M: OK, next question, how do you perceive the difference between programmers, project managers, product managers, designers?	
R22	X: This difference is really obvious in Sony. Everything has a standard routine here, and there is a clear function definition for every position in my company. We can simply call it "responsibility code," every employee in Sony has a specific responsibility to take.	DHP
R23	M: Could you elaborate the difference?	
R24	X: I would like to try, I can offer an opinion based on my position. The product manager is mainly business-oriented, somehow more about external business. While, the project manager is mainly focused on the resources allocation and progression of each project, the resources could be seen in person and cost. And there are also some system architect in my department as an expert in technology who can be helpful for technical problems.	DHP
Uncertainty section		
R25	M: Sounds clearer right now. Then let us talk something about uncertainty right now, have you ever felt "I am not sure..." situations in your design process? Can you give us one example?	
R26	X: It is easy to answer, everyone has this situation. As a software engineer, I used to have lots of technical problems. Some small bugs which you have no ideas how to deal. Do you want me describe this with some coding knowledge?	UI UW
R27	M: It is good enough, I am afraid that I do not have much programming experience. Could you tell me how do you deal with uncertainty in your story?	
R28	X: As for this kind of uncertainty with technical stuff, it is easily to handle. I believe that you are never the first one who encounter this problem or	UHW

	uncertainty, so all you have to do is to seek help from the Internet or other colleagues. I prefer surfing the Internet to find the solution by myself. There is usually some windfall during your seeking process since sometimes you could find out more interesting things connected to your solution. And you could learn more than to ask others.	
R29	M: So you mean the uncertainty from your work could bring you more chances to learn?	
R30	X: Yes, it is. I really enjoy that.	
R31	M: Got it, According to the example, which could exemplify uncertainty. And we assume that your example of uncertainty could stem from work itself, which means it has nothing to do with persons. Could you elaborate your uncertainty, is it result from lack of experiences of yourself or difference among different people in your team?	
R32	X: Do you mean the uncertainty with my colleagues?	
R33	M: Not only colleagues, but also another group of people, like your customers.	
R34	X: OK, I understand you. I believe the uncertainty from my colleagues is easier to handle than my customers. Thanks to my work environment are really flexible and agile; there are plenty of communications and cooperation internal and external departments. This enables the uncertainty is easily to handle among his colleagues. The uncertainty is often about to whose solution should be taken to solve the problem, the only thing you need to do is do more researches to convince your colleagues that your solution is a better one. Additionally, there is always more or less intersection among you and your colleagues and all share one single goal.	UC UE UHC
R35	M: Sounds like you have pretty much experience in teamwork. But do you have some connection with your customers?	
R36	X: I prefer not elaborate my poor experience with my customers since I am the kind of person without patience.	
R37	M: Just a brief example.	
R38	X: Alright, let us see. One of the stories about customers could be useful here. Like one customer give you a quite complicated project that contains lots of functions and details. This usually needs a long period to finish. However, the customer always asks you to finish this project in a rush time. From the professional perspective you pretty sure that the project cannot be done in such long time, so you have no idea whether you should finish the project as fast as you can without quality or ask for an extension of time which would down your trust.	UE
R39	M: This was a hard problem for you at that time, was not it.	
R40	X: Well, actually not that hard as you imagine. This kind of uncertainty can be solved with a well-prepared communication. You need to explain your problem to your customers, meanwhile, also offer some strategic solutions to them. Hopefully, both of you can arrive an agreement in the end.	UHE
R41	M: That sounds reasonable, from the customer perspective, I would be delighted if you could offer me another solution.	

R42	X: Yes, this must be done to earn your trust.	
Design approach section		
R43	M: Then we would like to offer you some design approaches, to see if they are familiar to you. They are User-centered, Activity-centered, System approach and Genius approach.	
R44	X: Wow, what are they? I have never heard of them, except the first one, is it the user-centered design?	
R45	M: Yes, it is. No worries, I can explain to you since they are sort of academic.	
R46	X: I appreciate that.	
R47	M: User-centered design, means the user knows best and is the only guide to the designer; the designer's role is to translate the users' need and goals into a design solution. Activity centered design focuses on the behavior surrounding particular tasks rather than their goals and needs. Since sometimes the users do not know what exactly do they need. System design is structured, rigorous, and holistic design approach that focuses on context, while the users' role is to set the goals of the system. The genius design relies solely on the experience and creative flair of a designer. In this approach, the users' role is to validate ideas generated by the designer, and users are not involved in the design process itself.	
R48	X: Your explanation helps a lot then, but I need to admit that I only heard about the user-centered design approach.	
R49	M: It is Ok, you have heard all four of them right now, and in order to make it simple, we have ranked them by the involvement of the users, which would be a better way for you to understand the different approaches. Have you understood everyone of them?	
R50	X: Yes, I suppose.	
R51	M: Great. Then the question is: how do you perceive the role of user involvement in your design process?	
R52	X: I need to make it clear at first, to be honest, I have no idea about how to involve users in the design process, of course, I will take consider of them in the design. Because of my position, I do not have many chances to get to our end users. Then user involvement may not always available for me during my design process. Normally, I could get the data about the end users and specifications of the project from other departments or project managers, which could help a lot for evaluation. I have sufficient information about the users, or I have a sufficient specification, that is enough.	DUI
R53	M: Alright, but which one of the design approaches do you use most often?	
R54	X: Mum, if I understand it right I would say system design approach. The end users just identify the task and final goals for the project. As the person in my position, I could get more information about users from my colleagues whom may have the responsibility to users.	DUI
R55	M: You mean there is a department in Sony, which is specifically for your customers or end users.	

R56	X: Yeah, I guess so.	
R57	M: How do you think of the work of that department?	
R58	X: Well, they are helpful really. But as a software engineering, under this clear hierarchy and process, the software engineering has limited design space.	
R59	M: So do you want to do the research by yourself? Or you mean you want more user involvement in your design process?	
R60	X: I mean I am ok with my work right now, and I believe my colleagues do a better job regarding the customers or end users side. They have offered me much useful data. To be honest, I have no idea about how to involve users into the design process, of course, I will take it into my consideration further.	DUI
R61	M: Then how do you perceive user involvement? Is it a benefit or obstacle for you?	
R62	X: Generally, I believe it could bring the designers more benefits rather than obstacles. But as for me who is not that good at customers or end users side, I am afraid that I am not interested in that right now.	DU
R63	M: So you reject user involvement?	
R64	X: I think I have done a good job right now, I will consider deeply if I intend to make some changes.	
R65	M: Based on that you mean the user involvement would bring more uncertainty to you.	
R66	X: For the designers like me, yes.	DUU
Relation between design approaches and uncertainty section		
R67	M: Well, finally coming to the final part, do you think these design approaches are useful to deal with uncertainty? Why?	
R68	X: I prefer say no for this question, I cannot see much connection between them. And I do not have much experience with these design approaches you just mentioned. Therefore, I would rather insist on my old path, as a software engineer, I have concluded something along these years, I suggest that do not get much user involvement in your design process, like UCD or activity-centered design, sometimes you need to listen to yourself.	RDU
Ending question section		
R69	M: Great, as the end of our interview, do you have something want to add?	
R70	X: I think this is enough.	
R71	M: Fine, thank you so much for the help.	
R72	X: Do not mention it.	

Appendix 6

Transcript of interview 5 (the interview was conducted in Chinese)

M= Minglei Cheng

A5= Anonymous Interviewee 5

Date: 2015-05-09

Row	Conversation	Code
Introduction section		
R1	M: What do you work with your companies right now?	
R2	A5: I am a product manager.	IN
R3	M: How long about your work experience?	
R4	A5: This is my sixth year, so I have been worked for five years.	IN
Design section		
R5	M: How do you characterize a designer? As the first question.	
R6	A5: While, I have some words to describe designers. They are creative, aesthetic and practical.	DC
R7	M: Could you explain these?	
R8	A5: Yes, creative is the core feature for a designer. You need to have something that others cannot achieve, right here means creativity. While other two words could be regarded as a revolution for a designer. As the beginning of my design career, I pay many efforts in aesthetic aspect, simply I want to make it good looking. However, I realized that the practicability is more important for a designer, especially for HCI designers.	DC
R9	M: Then how do you describe your design process?	
R10	A5: Keep it simple, understandable, I prefer to talk about this in a more optional way. It is a create process where the designers need to build a new thing by utilizing the old things. Nevertheless, not every creation can be called as a design because the design process is always accompanied by aesthetics and practice. A good design is a creation of aesthetics and practicality, none of these three words can be excluded.	DD
R11	M: As a product manager in the management level, you must have some idea about the difference among programmers, project managers, product managers, designers? Do you think the difference is necessary?	
R12	A5: Of course it is. I have been worked in three companies, this is my fourth	DHP

	employer right now, all of them have a clear hierarchy, the difference among these position is significant and should be clear and well-structured in a company.	
R13	M: While your opinion is really distinct from other interviewees.	
R14	A5: I do not know their experience, and I just tell with my perspective.	
R15	M: This is what we want you to.	
R16	A5: Alright, from a management level, as a product manager, I suppose that the biggest difference of product manager, compares with other three positions you just mentioned, is business-oriented. More specifically, the primary task of a product manager is to deliver the business value of the product by explaining the product strategy, product direction and product feature to the target market. A qualified product manager can express the business value of the product with accurate figures and suitable methodology module, in which he/she could bring the customers into a well-designed scenario.	DHP
R17	M: You have made yourself clear about the role of a product manager, then how about the other three position?	
R18	A5: They are all on the employee manual in a very detail, I cannot remember others description specifically. But I can ensure that the difference in these positions should be clear, and they are clear in my company.	DHP
R19	M: How does the difference help?	
R20	A5: In fact, I think the standard regulation enable the employees to have a tangible awareness of their main tasks and increase their working efficiency rather than limiting their workspace.	DHP
Uncertainty section		
R21	M: Let us move to uncertainty, Have you ever felt "I am not sure..." situations in your design process? Can you give us one example?	
R22	A5: It is one of my friendly guest along with my design career, but I could give you an idea of a management level.	
R23	M: You mean there is a difference in management level, how do you perceive that as your position?	
R24	A5: From my perspective, an effective method to solve uncertainty would be a good management inside an organization.	
R25	M: Do you mean that the uncertainty could be effectively solved by a good manager?	
R26	A5: Well, yes I would say.	
R27	M: Can you give us an example?	
R28	A5: As the most susceptible group of uncertainty, most of our new employees would come across uncertainty at the beginning of their work. They are inexperienced in a new business where you could see how important for an organization to have a clear and structured system or regulation. There is an	UW

	example in my company that is called as “Newbie Trace System,” which is utilized to trace the new employees who just recruited. With the help of this system, the company establishes a win-win situation inside the company.	UHW
R29	M: How does this “Newbie Trace System” actually work for new employees?	
R30	A5: While, the system offers the new employees instant help to solve every kind of uncertainty and problem which could appear to them. Of course, it also could help the new employees to avoid uncertainty.	UHW
R31	M: I guess the system also could serve the management level some extra information, is not it?	
R32	A5: Yes, it is also capable to update the newest information of every employee that could help the managers to know and evaluate their new stuff.	
R33	M: How about the uncertainty with person?	
R34	A5: What do you mean by person?	
R35	M: I mean the uncertainty may come from your colleagues or customers.	
R36	A5: Alright, but I think it is kindly same question, which could also be solved by good management.	UHC UHE
R37	M: An example, please?	
R38	A5: For the uncertainty with colleagues, personally I would it is also capable to update the newest information of every employees which could help the managers to know and evaluate their new stuff. However, regarding to the uncertainty with customers, it is more related to designers’ capability and experience. A capable and experienced designer can understand customers’ real requirements and discuss the potential uncertainty may appear during the design process beforehand.	UHC UHE
R39	M: Do you suggest that the designers should more rely on themselves instead of users?	
R40	A5: While, if you mention user-centered design, I should say I am not into that kind of thing, I think it sometimes could be misunderstanding.	
R41	M: So as for the customers’ side, you always let the capable designer do the work?	
R42	A5: Yes, sometimes I will also allow the beginners to follow.	
R43	M: Alright, then we will talk about design approaches, we have found out four design approaches academically, which are User-centered, Activity-centered, System approach, and Genius approach. Have you heard of them?	
R44	A5: Yes, I used to have courses about the design theory.	
R45	M: That would be great, could you give us an overview of these four design approaches?	
R46	A5: Certainly, I prefer the activity-centered design since some of our customers may have no idea about what are they really need. Then the activity-centered design is an effective method to this problem. As for the most popular one, UCD	

	provides a clear goal, follow the requirements of users, so it is more efficiency in this perspective. But it may overlook the technical feasibility thereby increasing the difficulties in the implementation phase. However, system design approach focus on the technical problem, especially for the software engineer, which could enable them have a better control of the whole system. The last one, genius approach is efficient, but the final product is more like imposing designer's view on the customers.	
R47	M: Very clear, so you always use activity-centered approach during your design process?	
R48	A5: Yes, it always helps.	
R49	M: In fact, we have ranked them by the involvement of the users, from UCD to non-UCD, so we are going to talk about user involvement right now.	
R50	A5: Sure, smart choice.	
R51	M: How do you perceive the role of user involvement in your design process?	
R52	A5: It is always helpful to involve the user in the design process. User involvement will bring a better understanding for both designers and users.	DUI DU
R53	M: What do you mean by users? Are they customers or users?	
R54	A5: As for our company, our customers are end users.	
R55	M: Alright, please continue.	
R56	A5: Higher user involvement provides an opportunity for the customers to integrated their real demands and requirements into the final product. Furthermore, higher user involvement means flexible and human-centered design, designers can get a convenient communication precondition and make modifications according to users' needs.	DUI DU
R57	M: So you suggest that the user involvement could bring you benefits, but is there any obstacles from it?	
R58	A5: Every coin has two sides, although user involvement as a necessary design strategy, it also needs to consider the degree of involvement. If the users involve the whole design process, it is a large project that will take a lot of efforts and hard to handle. While if the user involvement is not sufficient then it is hard to collect user requirements, or hard to collect the real user demands. Therefore, the designer should measure this by aspecific situation.	DU
Relation between design approaches and uncertainty section		
R59	M: Got it, here comes to the final section of this interview, Do you think these design approaches are useful to deal with uncertainty? Why?	
R60	A5: I really cannot answer this question, or I would say it depends. There are so many factors to consider for this question; it depends on the designers, the customers, the cooperation between them, and the scale of the project and so on. Therefore, it is hard to say these design approaches could handle the uncertainty since these approaches may be the uncertainty for the designers as well.	RDU
Ending question section		

R61	M: Fair enough. As the end of our interview, do you have something want to add?	
R62	A5: Nothing left I guess.	
R63	M: Alright, thank you for giving us your time and efforts.	
R64	A5: Good luck to your thesis.	
R65	M: Thank you!	

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