

# Environment-Centered Approach to ICT Service Design

Takehiko Ohno, Momoko Nakatani, and Yurika Katagiri

NTT Service Evolutions Laboratories, Kanagawa, Japan

{ohno.takehiko, nakatani.momoko, katagiri.yurika}@lab.ntt.co.jp

**Abstract.** One of the key factors we should consider in designing the new ICT services that provide high user experience is *environment*. In this paper, we show two example in which the use of ICT service strongly depends on the environment in which the service is provided. We then propose an environment-centered approach for designing ICT services. Traditional user-centered approaches like the persona-scenario method focus on the user domain, but environmental factors are considered in little while designing services. We found, however, that service use is diversified drastically in the different environments. We have started to examine the proposed approach for ICT service design. A preliminary finding is that we can focus on environmental factors, especially, the environmental difference at different times, which is not considered explicitly in the traditional user-centered approach.

**Keywords:** User experience design, user-centered design, ICT service design, environment-centered design, ethnography.

## 1 Introduction

Today's growing market for information-communication technology (ICT) service<sup>1</sup> for consumer users requires a new perspective far beyond the established concepts of functionality and performance, the traditional factors in service design. User experience (UX), the internal state of the user's mind during service use, has become a key concept in designing ICT services highly appreciated by the users [4]. User experience explores how a user feels about using a service, i.e., the experiential, affective, meaningful and valuable aspects of service use [11]. However, even though the importance of UX has been discussed in the field of human-computer interaction (HCI) [2,3,4] and marketing research [9,10], it is still not unclear what factors should be addressed when designing ICT service that provide good experience.

Our goal is to establish the service design process of ICT service that provides high user experience. In the last decade, a variety of ICT services and technologies used to implement the services has been emerged and diffused. For designing ICT services, those factors must be under the consideration carefully and definitely. For home use, various products including PC, smartphone, featurephone, tablet, game console, digital television, DVD recorder (DVR) and Blue-Ray Disk recorder (BDR)

---

<sup>1</sup> In this article, the word "service" refers to services, products and systems.

are available in commercial. Those products are connected on the broadband network, where various network technologies including fixed-line (e.g. ADSL and FTTH), wireless (e.g. WiFi) and also mobile network (e.g. LTE and WiMax) are supplied. Because ICT service has become popular in everyday life, diversified users from children to elderly persons now use ICT services. The service design process must deal in those factors in the unified perspective.

In this paper, we propose the environment-centered approach for designing ICT services that provide high user experience. In the approach, we focus on the environments that contain both users and services, and from the depiction of the environments, service specifications are derived. Because environment sometimes changes drastically when the context is changed, different environments in the different contexts are described.

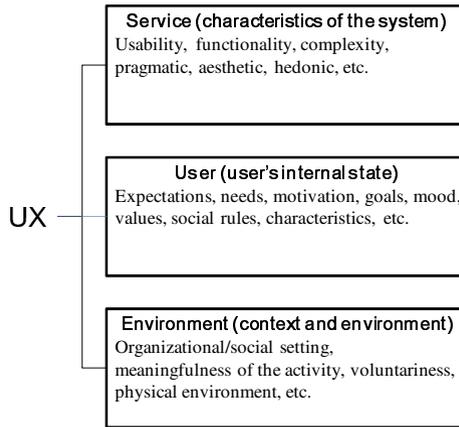
In the rest of the paper, we first overview the concept of environment-centered approach for ICT service design, and then we show two example in which the use of ICT services strongly depends on the environment. Next, we denote the detail of the proposed approach and discuss the strength and limitations. Finally, conclusion and future works are described.

## 2 Three Factors That Affect User Experience

As Hassenzahl noted in his article, UX is a consequence of the characteristics of the designed system, a user's internal state, and the context or environment within which the interaction occurs [4]. Here, as illustrated in Figure 1, we employ those three factors to understand what type of the elements we should consider for designing services. The first factor is "system", the characteristics of the designed system consisting of the performance side [7] including usability, functionality, complexity, pragmatic, and also the emotional side [8] including aesthetic and hedonic.

The second factor is "user", a user's internal state which is not limited to user's temporal aspects like expectation, needs, motivation, goal, mood, but also user's psychological characteristics and social rules. User's characteristics have been considered little for understanding UX, but in our research, it is sometimes the major factor for determining experience. For example, Nakatani figured out that absence of self-efficacy for ICT affects the inactive use of ICT service [5]. Another example is that implicit belief about one's ability, such as whether one's intelligence is fixed or malleable influences her/his experience [12]. For considering user's internal state, it is also important to focus on his/her social rules because interactions between users and services highly depend on the social rules. For example, Japanese high-school students prefer online chatting service on the smartphone, and would like to touch the smartphone for communication at any time. However, in our interview, we found that they often hide smartphone while talking with their friends because they think that touching smartphone during talking with their friends is a very bad manner. On the other hand, they think it is not a bad manner to use the smartphone while talking with their parents.

The last factor is “environment”, the context or environment within which the interaction occurs contains organizational and social setting, meaningfulness of the activity, voluntariness, and physical environment. Here, physical environment represents places, artifacts, and also the arrangement of the room in the house. Even though Hassenzahl did not mention the physical environment as the major factor for considering context and environment, we believe it is necessary to include it because it often determines the usage pattern of the ICT services. For example, various ICT services and other artifacts are located in the same place, and the arrangement of them affects ICT service use. In addition, in the mobile services, they are used in the different places in the different manner.



**Fig. 1.** Three factors that affect user experience

## 2.1 Example 1: ICT Service Use in the Home

Here, we show two examples in which the use of ICT services strongly depends on the environment. The first example is the use of ICT services in the home. Figure 2 illustrates a floor map of a family’s home created from our field study. They were living in an apartment, and the family consisted of husband, wife, and two elementary school children. In the family, we found that the husband used iPad mainly while sitting at the table in the living room. In the position, it is possible to watch the TV while interacting with the iPad. On the other hand, PC was placed in the children’s room locating next to the living room. The PC was used mainly by the wife, and she could not watch the TV while interacting with the PC. In our field study, we found that in various families, PCs were sometimes located near the printer and their position was determined if there was enough space to put the PC and the printer. Therefore, it is not convenient to use them while doing something else like watching TV. This phenomenon may reduce the frequency of PC use. iPad is different. There are little locational constraints to use the iPad. In the example illustrated in Figure 2, iPad was stored under the very narrow space of the counter, and the husband could pick it up while sitting at the table. For designing ICT services in the home, it is very important to consider accessibility to the service. If it requires more effort to use the service than competitive services, it is difficult to get the major position in the family.

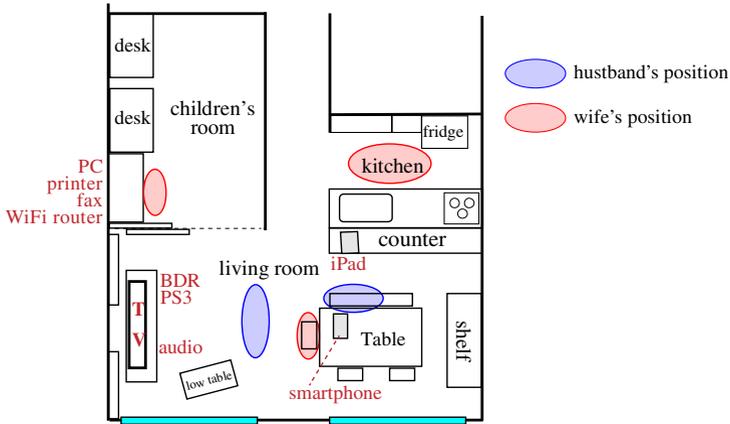


Fig. 2. An example of ICT use in the home

## 2.2 Example 2: Smartphone Use in the Everyday Life

Another example is the smartphone use in the everyday life. To understand everyday use of the smartphone, we conducted a group interview with seven university students and nine business persons. In the interview, we observed that their use of smartphone highly depended on the context and environment they occurred.

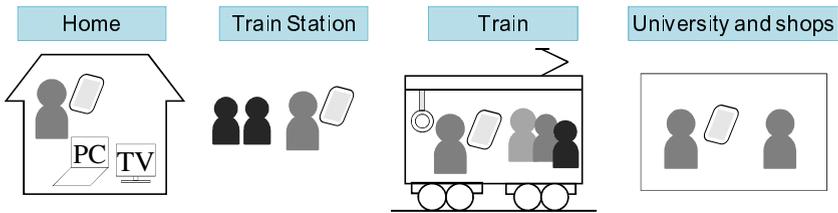


Fig. 3. An example of smartphone use in the everyday life

Figure 3 illustrates an example of smartphone use in their everyday life. Here, four different contexts, in the home, at the train station, on the train, and in the university and shops are described. In the interview, they reported that they used ICT services with different manners in the different contexts. In the home, there were different artifacts including PC and smartphone. All of them had both smartphone and PC, but their environment was different between users. They preferred the PC because it had large screen. However, they sometimes used the smartphone instead of the PC. It was because it took much time to start using PC. Some users kept their PC in the sleep mode, so it required short time (e.g. within 10 seconds) to start the PC, but they still thought that the smartphone was better because it was possible to use it

with no burden time to wait. When they thought they required large screen, e.g. browsing the Web sites with multiple windows or reading PDF documents, they switched to the PC.

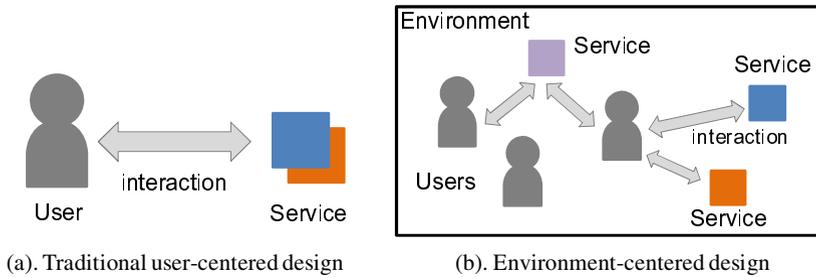
While riding on the train, their ICT service use was sometimes restricted due to the network condition. Some of them could not use the online services because network condition was not good on the train, so a contents prefetch service was preferred. Another example is the train condition. If they sat on the train, they could use the social network services (SNS) and the email but while standing on the crowded train, some of them hesitated to use them because the smartphone screen might be glanced by other persons.

In the university and the shops, the use of smartphone highly depends on whether they stayed with their friends or not. With their friends, they did not use the smartphone frequently, but if they had a time to become alone, i.e. in the toilet, they often checked SNS and email quickly.

For designing mobile services, it is necessary to consider how they use services in the different contexts and environments, and design the service to fit into the contexts. Especially, it is necessary to determine which context will be the major one, and the service should be designed to be used comfortably in the context.

### **3 From User-Centered Design to Environment-Centered Design**

The traditional user-centered design focuses on the user, and considers how the user interacts with the services. Figure 4(a) illustrates the interaction between the user and the service. For example, the persona-scenario method creates 'persona', a description of a fictitious user based on field data as well as statistical data for understanding interaction pattern, user needs and user values [1,6]. Traditional user-centered design assumes implicitly that there is only one user and she/he interacts with one service. It is because when the user-centered design was proposed in the end of '80s, most computers were large, and the user interacted with only one computer at the same time. It was difficult to consider mobile and ubiquitous services in the real-world. However, as described in Section 1, interaction between users and services is changed drastically in the last quarter of the century, and various interaction patterns are available today. Different services are supplied in the different artifacts, and users interact with different services simultaneously. In addition, two or more users sometimes interact with the one service. For example, the smart TV in the home can be shared by two or more users. For understanding interaction in the real-world, as illustrated in Figure 4(b), it is necessary to focus on the environment that contains both users and services. Based on the basic idea, we propose the environment-centered design where users and services existing in the environment are described simultaneously, and the service specification is derived from the description.



**Fig. 4.** From user-centered design to environment-centered design

In the environment-centered design, the fundamental process is to describe the environments in the different contexts at first, and then depict people and interaction pattern of the services available in the environment. Next, from the environmental description, service restrictions and opportunities are derived. By describing more environments in the different contexts, more service restrictions and opportunities can be derived. Those service restrictions and opportunities derived from the contexts become strong clue to determine the service scenario and specifications for designing new services.

In the rest of the section, the detail of the design process is described. Figure 5 illustrates the overview of the proposed method. In Step (1), the ‘real’ data is collected from field study and interview. For describing environment, it is highly important to use the real data. It is because when the service developers describe those factors just from their imagination, they might be different from the real-world. In addition, the detail of the environment description will be lacked. In addition, it is very difficult to describe the user’s internal state like their expectation, needs and social rules. The idea to create the description from the real data is taken from the persona-scenario method. However, the importance of using the real data is more essential because service restrictions and opportunities are derived from the contextual difference between different environments. If it is not possible to describe the prominent features that are unique in the context, it is difficult to extract the interesting and valuable restrictions and opportunities. Deep understanding of user’s internal state is also required in this approach. In addition, it is also necessary to select the target user group for collecting data because context might be absolutely different if you focus on the different user group instead of the target group. Therefore, it is necessary to determine the target user group before collecting the real data. If it is not possible to define the target user group when collecting the data, it is better to choose users from the different user groups, and by comparing environmental difference, target user group can be selected. In the interview, it is better to ask everyday life from the morning to the night. In general, one-day life consists of different contexts, e.g. meal time, commute time, working time, housekeeping, and so on. Therefore, by understanding the contexts in one-day life, it will become easy to understand the environment and service use for the each context.

In Step (2), contexts are determined from the collected data. It is not necessary to select all contexts appeared in the interview. However, it is necessary to select several important contexts that will be valuable in designing the new ICT services.

If there are unique environments and artifacts, prominent use style, and interesting values and experiences in some context, the context should be selected.

In Step (3), environment, people, and usage of existing ICT services are described in the each context. Like creating persona in the persona-scenario method, real data taken from different users are filtered and merged for creating fictitious environment. In the environment description, it is necessary to retain interesting, valuable and distinctive features found in the real data. People are not limited to the user of the service, but also other persons who may affect the user’s ICT service use. For example, in the commute time, users sometimes get on the crowded train where bunch of people are jammed every day. As mentioned before, some of them hesitate to user SNS in such environment. In this case, it is necessary to describe that the train is jammed with people and the user does not use SNS in the environment. While describing services, it is not necessary to mention the new service designing here, but taken from the interview and field study, write down what type of the existing services they used and how they interacted with the services in the each context. It is important because in our observation, the way to use the service highly depends on the context and the environment. Therefore, it is possible to estimate how to use the new service in the same context and environment. For example, in our interview, some people used weather forecast service on the smartphone in the busy morning, and rushed to get the latest forecast in the very short time. In the context, services must be designed as simple as possible, and required to get the answer quickly with a few or no operations.

In Step (4), write down the service restrictions and opportunities driven from the each context. For example, from the context ‘busy morning’, it is possible to describe that ‘service must be simple and requires no operation’ as the restriction, and if the existing services are not simple, ‘more simple than existing services and an user can obtain information just by glancing at or without looking at the screen’ will become the opportunity for the new service. In case of ‘crowded train’, privacy problem will become a restriction if the service is designed for young users.

Finally, in Step (5), service scenario and specifications are derived from the service restrictions and opportunities. For emerging new services, existing design process like the persona-scenario method can be applied in the step.

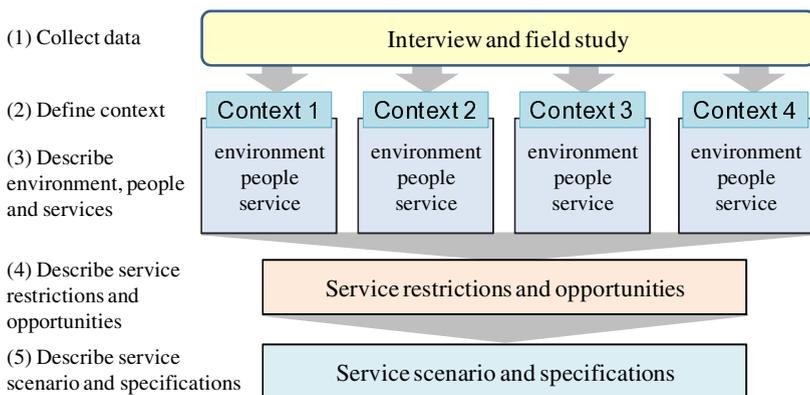
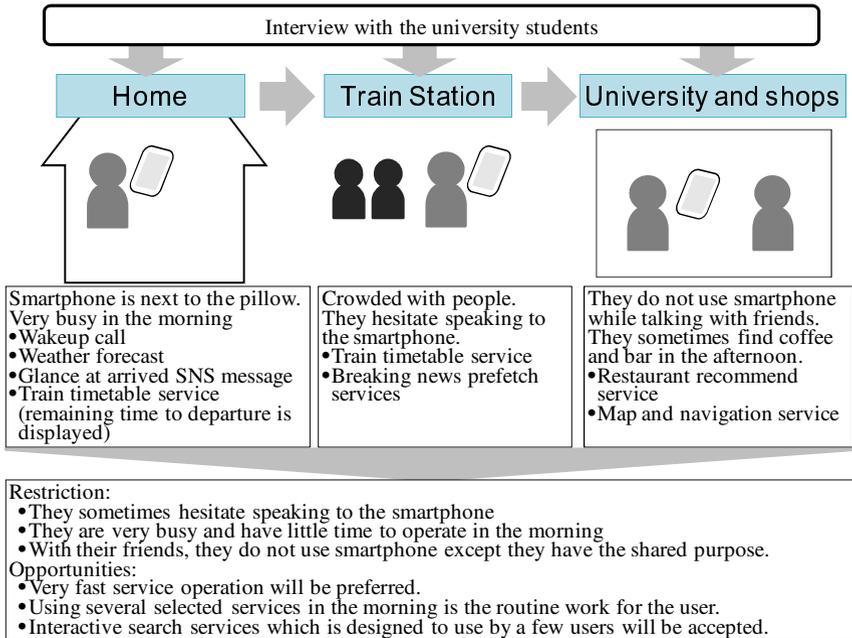


Fig. 5. Five steps of the environment-centered approach to design ICT services

## 4 Case Study: Designing Voice Agent System on Smartphone

Here, we show a case study that highlights the strength of the environment-centered approach. The goal in this case study is to design a new voice agent system on the smartphone for young people.



**Fig. 6.** Overview of the voice agent service design in the environment-centered approach

Figure 6 illustrates the overview of the voice agent service design in the environment-centered approach. In the example, three different contexts consist of ‘home’, ‘train station’, and ‘university and shop’ are selected. For the each context, several remarkable environmental features and user behaviors are derived from the interview data. Typical applications operated by the user are also presented. Based on the results, three restrictions and three opportunities for designing the new voice agent service are derived. With this process, it is possible to create the service scenario that satisfies both restrictions and opportunities. Here, it is necessary to note that detail description is required for the each step in the actual design. Contexts are not limited to three, but a lot of different contexts will be appeared in the actual service design. In addition, only the subset of the interview data was described here. It is also necessary to remark that it is not necessary to use all contexts for describing service restrictions and opportunities. Selecting several contexts that are not scoped by the competitive services will make the new service more attractive and superior. For example, in the case, just saying “Hello” in the morning to get the constant information required every morning will be preferred for the users.

## 5 Discussion

The strength of the proposed design approach is that it is possible to deal with the environment, the users and the services in the different context simultaneously. On the other hand, because the proposed design approach is based on the interview and field study, there are several limitations. The first limitation is the clarity of the target service at the beginning. If there are no conditions and restrictions in the new service, it might be difficult to conduct interview and field study for acquiring valuable data. Therefore, the approach may be difficult to use in the very early stage of the service design. However, in our case, there is rare case that there are no conceptual ideas in designing new ICT services.

The second limitation is the difficulty to innovate the completely novel service which is not available now. It is because we cannot estimate their usage pattern of the novel service from the existing social rules. In general, when a novel service is emerged, social rules are formed gradually in the long period, and it is difficult to estimate the rule before the service appearance in the society. We should examine how those two limitations will actually affect in the service design process in our future works.

## 6 Conclusion and Future Works

In the paper, we propose the environment-centered approach for ICT service design. We have started examining the proposed approach for ICT service design and confirmed the strength of the approach. However, we need a lot more case studies to determine what factors in the each step are the most important and how to derive them from the field study and interview data. For applying this approach to various services, we are planning to make the design process more explicit and easy to use for service designers and developers for designing high UX services.

## References

1. Cooper, A., Reimann, R., Cronin, D.: *About Face 3: The Essentials of Interaction Design*. Wiley Publishing (2007)
2. Fallman, D.: Design-oriented Human-Computer Interaction. In: *Proc. of the 2003 Annual Conference on Human Factors in Computing Systems (CHI 2003)*, pp. 225–232. ACM Press (2003)
3. Fallman, D.: The New Good: Exploring the Potential of Philosophy of Technology to Contribute to Human-Computer Interaction. In: *Proc. of the 2011 Annual Conference on Human Factors in Computing Systems (CHI 2011)*, pp. 1051–1060. ACM Press (2011)
4. Hassenzahl, M., Tractinsky, N.: User Experience - A Research Agenda. *Behaviour & Information Technology* 25(2), 91–97 (2006)
5. Nakatani, M., Ohno, T., Nakane, A., Komatsubara, A., Hashimoto, S.: How to Motivate People to Use Internet at Home: Understanding the Psychology of Non-Active Users. In: *Proc. on APCHI 2012*, pp. 259–268. ACM Press (2012)
6. Nielsen, L.: *Personas - User Focused Design*. Springer (2013)

7. Norman, D.: *The Psychology of Everyday Things*. Basic Books (1988)
8. Norman, D.: *Emotional Design: Why We Love (or Hate) Everyday Things*. Basic Books (2005)
9. Pine II, J., Gilmore, J.H.: *The Experience Economy: Work is Theater & Every Business a Stage*. Harvard Business School Press (1999)
10. Schmitt, B.H.: *Customer Experience Management*. John Wiley & Sons (2003)
11. Vermeeren, A.P., Law, E.L., Roto, V., Obrist, M., Hoonhout, J., Väänänen-Vainio-Mattila, K.: *User Experience Evaluation Methods: Current State and Development Needs*. In: *Proc. of NordiCHI 2010*, pp. 521–530. ACM Press (2010)
12. Yamauchi, T., Ohno, T., Nakatani, M., Kato, Y., Markman, A.: *Psychology of User Experience in a Collaborative Video-Conference System*. In: *Proc. of CSCW 2012*, pp. 187–196. ACM Press (2012)