Transcending Human-Centered Design by Service Sciences

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Abstract. Human-Centered Design (HCD), which emphasizes the user's point of view, has brought many good results to date. For instance, with detailed analysis of user's context of use, developers of products and services can make them easier to use. Despite such good results, some limitations of HCD have also been pointed out. For example, since most methods of HCD are qualitative, they require exhaustive work every time with small improvements in efficiency. Although many qualitative quick methods have been proposed and tried to solve the problem, their results have not brought big differences. On the other hand, in the area of Service Sciences (SS), quantitative methods that explicate details of human activities based on a large number of data have brought some good results in producing new added-values and higher efficiency. Methods in SS emphasize the users' point of view as with those in HCD, and have come to be associated with innovation theories. Considering these current situations, this research emphasizes the users' viewpoint and combines HCD, SS, and innovation theories to come up with new methods that lead to new added-values and higher efficiency. As an initial effort of the research, this paper first clarifies relations between HCD, SS, and innovation theories, and then discusses issues in transcending HCD.

Keywords: Human-Centered Design, Service Sciences, Innovation Theories, Optimal Design Loop, Persona, Field Studies (Ethnography).

1 Introduction

Recently, situations surrounding business organizations have been changing rapidly and extensively. Due to the wide availability of broadband Internet in many countries, international division of labor, namely offshoring, has become quite common, and global competition is growing intense [1]. As a result, business organizations must seek to produce added-values and higher efficiency to survive the competition.

At the same time, big changes can be seen in modern technologies such as IT equipment, consumer electronics and services. Not only have their prices dropped

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rapidly as they become commodity, but they come to be avoided more when the designs are technology-driven and do not meet user needs [2].

To summarize, business organizations are required to consider the user's viewpoint, namely context of use, and at the same time pursue competitive added-values and higher efficiency for survival.

2 Current Human-Centered Design

The development considering user's viewpoint with their way of use is called Human Centered design (HCD), and it has been applied in many developments [3-6].

HCD is a development method based on design activities as shown in Figure 1. First, it requires observing the situation in which users actually try to use the equipment or service (1) and then clarifying the requirements for the design (2) followed by development (3). After development, evaluation is performed preferably accompanied by the users (4).

HCD is a cyclic activity similar to PDCA (Plan, Do, Check, Action) used in the process of production or quality administration. However, HCD is quite different from PDCA in that HCD emphasizes user standpoint by observing them use products or makes them participate in activities. HCD not only covers electronic products and IT equipments but also services.

The effects of HCD are;

- Resolution of usability issues.
- Creation of new products and services through the understanding of actual usage. This eventually leads to products or services with higher degree of user satisfaction.

HCD brought an innovation in the sense that it focuses not on technology but on user manners. However, accepting too much user needs can have negative side effects like excess functionality or lack of consistency [2].

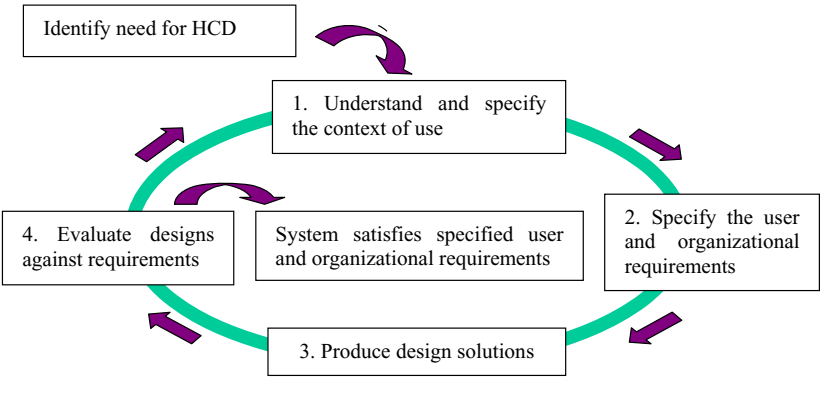

Fig. 1. Human-Centered Design activities [3]

Furthermore, the limitation in the efficiency of HCD has been pointed out due to the enormous labor required for its qualitative method such as field studies (Ethnography).

3 Optimal Design Loop in Service Sciences

Recently, an optimal design loop is gaining acceptance for its efficiency and effectiveness in the field of Service Sciences (SS) [7]. The loop is similar to HCD based on user's viewpoint and cyclic loop, and the method is much more quantitative and promises to solve many issues of HCD. SS and the optimal design loop are discussed in sequence below.

Tertiary industries are represented by immaterial services that bring benefits to its customers. There have been special emphases on the productivity improvement of these services in recent times [8, 9]. What was once dependent on experience or intuition, SS pursues approaches based on science and engineering [10].

SS is defined by the following formula. Service productivity is added-value divided by labor input.

$$\text{Service productivity} = \text{Added-value} / \text{Labor input} \quad (1)$$

Following the formula in (1), the improvement of service productivity requires improvement in the denominator, the numerator or both conditions. SS is expected as a way to bring significant progress by improving both the denominator and the numerator. Namely, service productivity will rise through less labor input by way of process improvement and cost cutting as well as higher added-values such as customer satisfactions.

A method called optimal design loop is in practice for a general approach to improve productivity (Figure 2) [7]. This design loop is rather general in design and consists of processes with data observation and accumulation, analysis, design, and application. It is not so much emphatic on users as HCD.

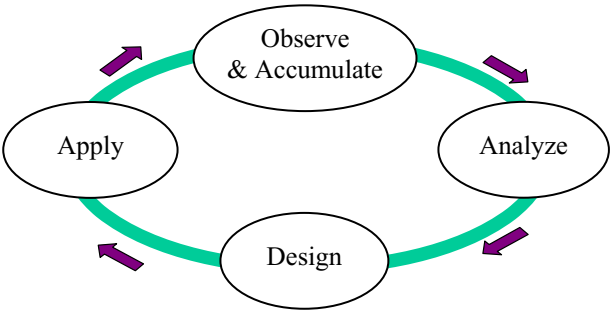

Fig. 2. Optimal Design Loop in Service Sciences (This is created based on Motomura [7]. The emphasized steps will be different depending on the types of objects and innovations explained in Figure 3.)

The advantage of the loop is that once the prediction model is built using the data relation analyzed from observation and accumulation, prediction of the entire data will be possible even if it is later given only partial observation data. By repeating the

loop in such a process, precision enhancement and expanded prediction area are eventually expected. An example is a scale with a body fat monitor found on the market today. Information about body weights, electric conductivities and body fat percentages from hundreds of people are observed and collected in a database. Then the analyzed data formulate the relations of body information. The manufacture designs a scale with a body fat monitor using the formula. The formula is applied when the scale is used to calculate body fat percentages, the skeletal muscle rate, and the basal metabolism based on the weight and the electric conductivities. At the same time, the observation data uploads to accumulate by means of the Internet. Then the analyzed data contribute to the next generation product with enhanced precision and expanded functions.

When accumulation and analysis of quantitative mass data clarify actual human activities, and prediction precision is improved by rotating the cyclic loop, creation of new added-value and efficiency improvement, which was a HCD weak point, can be expected.

4 Consideration of Market Lifecycle

The purpose of working on SS is the significant improvement of service productivity. The approach with such a purpose is generally called "Service-related Innovation" or simply "Service Innovation" [7, 10].

Geoffrey A. Moore, who proposed the "Chasm theory" on technical innovation, explains four types of innovation in a market lifecycle: Product & Service Leadership type, Customer Intimacy type, Operational Excellence type and Category Renewal type [11]. This innovation framework not only covers products but also services.

The four types of innovation proposed by Moore are shown in Figure 3. The four rotating arrows are Optimal Design Loops in Figure 2. * indicates the improvement of the numerator (added-value) in formula (1) whereas - indicates the denominator (labor input) improvement.

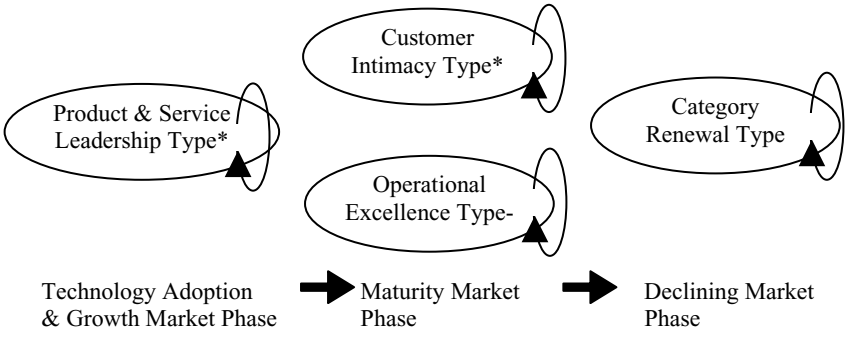

Fig. 3. Four types of innovation according to market lifecycle (This is created based on Moore [11])

In Figure 3, "Product & Service Leadership" type innovation is at the beginning stage or introduction and growing phase of the market. The innovation at this phase

requires mainly technical excellence and performance. There is less importance on customer satisfaction or marketing since it is positioned before the mature market phase where fundamental features of user requirements are fulfilled. The improvement of service productivity at this phase primarily focuses on its performance and added-value and requires a good deal of R&D investment.

"Customer Intimacy" type innovation is positioned after the period of market introduction or growth. It is a mature time where the performances required by users are primarily satisfied and less attention is paid to technical features. The innovation at this time is to concentrate on making the service even the slightest more attractive than the competitors [2].

"Operational Excellence" type innovation is to make cost-cuts by optimizing the operations of service providers. The previous two innovations are improvements of the numerator in formula (1), whereas this is of the denominator. At the time of maturity market, maintaining customer intimacy and improving operational excellence lead to improvements of both the numerator and the denominator in formula (1). Then significant service productivity improvement can be expected.

Finally, "Category Renewal" type innovation is located at the end of lifecycle where future value creation is no longer possible. Since improvement of service productivity cannot be expected, the innovation at this phase is to identify problems coming from important customers and connect to "Product Leadership" type innovation of the next generation.

Optimal design loop of Figure 2 can be applied to each of the four types of innovation in Figure 3. For example, in the case of the scale with body fat monitor mentioned before, the original scale without the body fat monitor was improved functionally taking user research and feedback into account in "Customer Intimacy" type innovation of "Mature Market" phase. Cost reduction effort was also conducted in "Operational Excellence" type innovation. In "Declining Market" phase, "Category Renewal" type innovation was conducted, which sought unknown fundamental issue of important customers. It was the body fat monitor in the example. Once such issue was found, "Product & Service Leadership" type innovation was started investing R&D expense to produce a new innovative product, namely the scale with body fat monitor.

As mentioned above, the major issues of the service productivity improvement are quite different depending on the lifecycle status of the market.

5 Discussion: Transcending HCD

So far, relations between HCD, SS, and innovation theories were clarified to some extent. Following the arguments above, future issues of HCD are discussed here; the first two are related to the optimal design loop and the next two are related to the category maturity life cycle.

1) Participation of users:
In HCD, participation of users in the four activities of Figure 1 is considered quite valuable. Now that the notion has been well accepted and executed, it is becoming harmful rather than useful. For example, Donald A. Norman claimed that too much attention not to user activities but to the users would lead to too much listening

resulting in confusion as mentioned in the second chapter [2]. In addition, innovation theorist Clayton M. Christensen points out that successful companies in "Maturity Market" phase tend to listen to the users too much and add too much functionality to their products or services, resulting in loss of their market. It is because of assault by new comers that provides "disruptive" products or services with low-price and limited functionality that are sufficient for the previous non-users [12].

In the optimal design loop, which applies to four types of innovation, the users become continual providers of valuable quantitative data that are indispensable for the prediction model. The users can save time attending interviews and user tests which is required in HCD. Furthermore, accumulating data according to predetermined parameters of the prediction model can prevent excessive user participation.

A new data acquisition and utilization method is required for HCD to save precious user time and to obtain more real-time and continual data.

2) Prediction model based on quantitative data:
In HCD, "conceptual model" which represents abstract structures and functionality of a product is often created [2]. Although a good conceptual model eases user understanding of a product, it requires many researches on the context of use to clarify important points for the understandings. Refining the conceptual model also requires almost the same amount of effort.

On the other hand, prediction model of the optimal design loop will be more accurate over time with more quantitative data from the users. It is often the case that the data is acquired almost automatically with advanced sensor technologies.

Since sensor technologies are so advanced to continually obtain various real-time data of user activities, such prediction model based on quantitative data should be used in HCD as well for more detailed tracking and understanding of user situations.

3) "Total Solution" which solves user problems completely:
Moore claimed that in "Technology Adoption & Growth Market" phase it is crucial to provide "Total Solution" for a niche market and repeat it until an enough size of the market is acquired [11].

For this purpose, HCD based on qualitative methods has two limitations: reusability of results of a niche market and situation-dependent solutions. In regard to reusability of results, since solutions derived from user's real goal and the context of use analyses are so specific to the situation that the solutions can not be applied to other niche markets. Same efforts are required for other niche markets. Meanwhile in the prediction model stated above, if relations between a setting, preferences, and activities are learned for instance, relations between preferences and activities will be reused to some extent in other settings as well. In this sense, the prediction model is superior to HCD in reusability of results resulting in better efficiency.

With respect to situation-dependent solutions, while solutions in HCD are usually static as stated above, the prediction model can usually simulate many combinations based on real-time data. Hence, the prediction model is superior to HCD in producing solutions in response to real-time situation changes.

Since HCD tends to concentrate on highest usability and highest user experience, it usually provides a partial solution rather than a "Total Solution". Although the

prediction model does not always provide a "Total Solution", HCD is required to see such broader issues.

4) Transcending elaboration-focused HCD:
In most HCD projects, elaboration of products or services is focused on taking the context of use and user's real goal into account since they were created with little care of such issues and do not meet user needs. Meanwhile, for innovation in SS where even definition of market is difficult, research efforts such as generating ideas before building a specific user profile ("Persona") and clarifying hidden logics are requisite rather than elaboration.

Although there were some research-oriented HCD efforts in Universal Design area, where common-sense guess does not work at all [13], more situation-oriented models which cover a huge number of situational variations are required. For this purpose, HCD specialists such as ergonomists need to cooperate more with researchers in a quantitative modeling area such as Bayesian Network in Artificial Intelligence and in the innovation theory area.

6 Concluding Remarks

In general, HCD has been applied firstly to usability improvement, and then to User Experience and Universal Design with the framework enhanced.

To cope with SS, HCD needs further enhancements. Cooperating with experts from different fields, promising services must be identified and their trial results must be shared to create new methods which transcend HCD.

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