Applying Human-Centered Design Process to SystemDirector Enterprise Development Methodology

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Abstract

Human-centered design process is specified in ISO13407 international standard, where policies are prescribed regarding the development of systems offering high usability. The NEC Human Interface Center takes these human-centered design process policies and systemizes them as specific development procedures applicable to system development projects, integrated as SI development standards within our company. By incorporating systemized usability-enhancing activities into our SI development standards, it is possible even for non-specialists to design and develop systems that emphasize usability.

1. Introduction

Conventionally, improvements in usability have been made by evaluating a final product or system and then applying those results to the next version. However, this meant that even if a problem was discovered, solving it would have to wait until the next version, and in cases of a major problem, reworking would take lots of time and cost.

To overcome such problems and to create products and systems offering high usability, it has been common for Human Interface (abbreviated as "HI" hereinafter) specialists be involved in the development project while it is in early stage of development process, and offered consulting on how to improve usability. However, the fact that the number of HI specialists is limited, thereby also limiting the number of projects for which consulting can be applied, is a serious issue.

For some time, NEC's Human Interface Center (HI Center) has offered HI consultancy vis-a-vis our company's internal projects, and the HI design know-how was gathered there. Together with the principles of the Human-Centered Design Process, we systemized specific development procedures to be implemented in system development projects. They were incorporated as the "User Interface (hereinafter abbreviated as "UI") Design Guide" as part of NEC's SI development standards, based on the integrated development environment afforded by SystemDirector Enterprise. By incorporating activities to enhance usability into our SI development standards as specific procedures, it has become possible to design and develop high-usability systems even if an HI expert is not on hand. This paper will explain our thoughts in formulating the "UI Design Guide."

2. What is a "Human-Centered Design Process"?

Human-centered design is a method of developing interactive systems that emphasize ease of use from the viewpoint of the user. In contrast to the conventional design process which was function-centered, this new way of thinking puts the user at the center and designs the system from that perspective.

The human-centered design process was established in 1999 as ISO 13407 international standard, and in Japan it was established in 2000 as JIS Z8530, a translated version of the same standard.

The basic principles of human-centered design as specified by ISO 13407 are: (1) to actively seek user involvement in the design process, and to fully understand the user and his or her task; (2) to appropriate allocate tasks between the jobs done by the user and the functions handled by the system; (3) to perform repetitive design and evaluation; and (4) to incorporate users of various type of skill and perspectives into the design process. Based on these basic principles, it defines the following four activities as the human-centered design process.
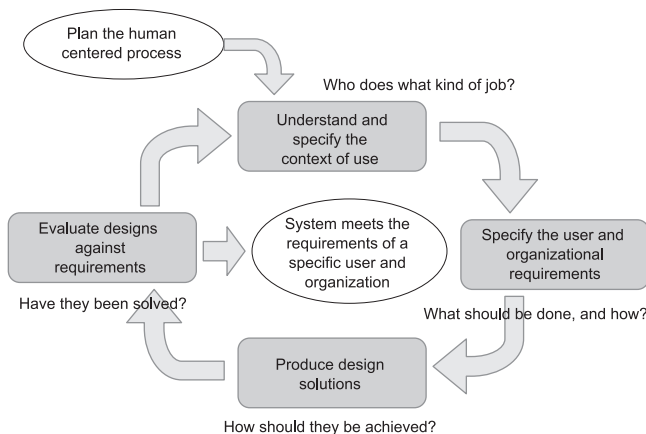
Fig. 1   Interdependency of human-centered design process activities.

(1) Understand and specify the context of use (of the system users)
(2) Specify the user and organizational requirements
(3) Produce design solutions
(4) Evaluate designs against requirements

Fig. 1 shows their relationship in the human-centered design process.

By implementing these activities at an early stage of the development process, such as the system planning phase, repeating these processes again and again with improvements, it is possible to create systems that are truly easy for the user.

3. Formulation Policy for "UI Design Guide"

3.1 Incorporation into SystemDirector Enterprise Development Methodology

The designated target of SystemDirector Enterprise development methodology is business system development in an open environment. As such, it systematically sets specific procedures and outputs per each role of the developer within the development process, and is used as the SI development standard within our company as well. By incorporating the ideas of the human-centered design process into the development process of our SI development standards, we aimed at improving usability in our SI project.

What's more, this development methodology was created based on the fundamental policy that it "should be capable being implemented in the field of development easily, and should not require any specialized expertise to the developer." Therefore, it specifically defines the "Who" (Role), "When" (Phase), "How" (Activity/Task), and "What" (Outputs)" needs to be done, in each phase of the development process such as "Requirement definition" or "Outline design."

Based on the above, we drew up the "UI Design Guide" by systematizing activities/tasks required to implement a human-centered design process, and refined them into specific procedures that developers could use as-is in the field.

Furthermore, we also decided that the four activities involved in the human-centered design process should be fully completed at least once before outline design is completed. Based on these policies, in preparation for requirement definition we "organized the context of use" (understand and specify the context of use), and while extracting non-functional requirements we "organized the UI requirements" (specify the user and organizational requirements), thereby integrating human-centered design process activities into a pre-existing development flow.

3.2 Illustrating Our HI Design Know–how

In the past, member of HI Center has been involved in various NEC development projects, offering HI consulting aimed at improving usability. We analyzed target users and task requirements to formulate specific usability-related requirements based on the concept of the human-centered design process. We made it our policy to illustrate our accumulated HI design know-how numerous times in the "UI Design Guide."

ISO 13407 stipulates that when performing the step "understand and specify the context of use," it is necessary to analyze the characteristics of the user, the task, and the environment. As a way to perform these analyses, field surveillance and task analysis exist. But these methods require the expertise of a usability specialist. As a way to enable any on-site developer to effectively perform analysis, we decided the system should provide a large number of specific examples, categorized so that the developer can easily select those with similar, relevant characteristics.

3.3 Use of Screen UI Standard

Development of "produce design solutions" in keeping with the human-centered design process can be done more efficiently by preparing beforehand and using design standards such as "UI guidelines" or "screen UI standards." Especially in cases

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where numerous members or teams are involved in system development, the use of "screen UI standards" helps to achieve a consistent UI for the entire system. And by unifying the design and developing common parts, it helps to increase development efficiency.

In "UI design guide," we added the new step to specify the "screen UI standards" as the procedure following "specify the user and organizational requirements." And we decided to use the "screen UI standards" when actually designing the screen UI (Produce design solutions). Moreover, we prepared a "screen UI standard creation guide" to assist in formulating the "screen UI standards," and clarified the types of factors that needed to be standardized as the items of those standards. And we also prepared document samples as specific examples for screen UI standards, as well as "UI design basic guidelines" to act as a versatile set of UI guidelines.

4. Architecture of "UI Design Guide"

4.1 Document System

The "UI design guide" consists of a three-part main text plus reference documentation (See **Fig. 2**). The document showing the procedure for the human-centered design process that
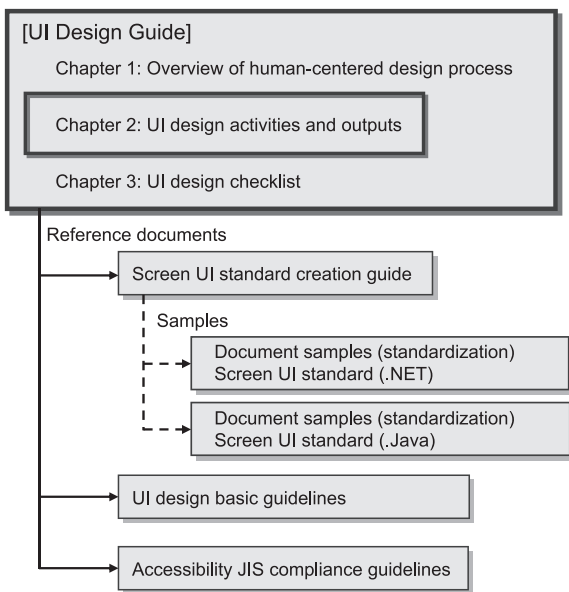
developers will be referring to is the "UI Design Guide, Chapter 2: Activities and outputs of UI design." Chapter 2 of the "UI design guide" explains the detailed procedures and outputs for analyzing the context of use and specifies the requirements based on the human-centered design process, and how to perform designing and evaluations accordingly.

In the "screen UI standard creation guide" we explain the items that need to be decided on for screen UI standardization, as well as the thinking process behind it. For example, it includes formulation of screen transition methods, screen layout (title, common header, common footer, etc.), the data display method (grouping method, display format, etc.), the help and guidance display methods, and so on.

The "UI design basic guidelines" explain the fundamental principles involved in performing UI design. Here we discuss the do's and don'ts of UI design from the standpoint of usability (ease of use, ease of understanding, efficiency, etc.) and human characteristics.

The "accessibility JIS compliance guidelines" explains the criteria for the building of systems that are compliant with Web accessibility JIS (JIS Z8341-3) and the operational model prescribed by the Japanese Ministry of Internal Affairs and Communications. Implementation of JIS standards pertaining to accessibility has resulted in compliance to those JIS regulations becoming a prerequisite for procurement, especially for public systems such as those used by local governments.

4.2 Process of UI Design

Chapter 2 of the "UI design guide" explains the procedures and outputs involved with implementing the human-centered design process. Those UI design procedures are defined as

Fig. 2   Document Configuration.

Table 1   UI design procedure.

UI Design Procedure	HCD Process

1. Defining the UI requirements
     - Organizing UI concept
     - Organizing the context of use
	Understand and specify the context of use

- Organizing UI requirements	Specify the user and organizational requirements

2. Screen UI design creation
     - Develop and evaluate screen prototype
     - Operational simulation by users
     - Screen UI standard creation
	(Small scale repetition of design work and user evaluation)

3. Screen UI design - Individual screen UI design	Produce design solutions

4. Screen UI evaluation
     - Screen UI standard conformity check
     - UI requirements list conformity check
     - Usability evaluation
	Evaluate designs against requirements

Table 2　Specific examples of user characteristics.

Attributes of User	Specific User Characteristics
Age, Gender, Profession	• Civil servants, from college graduate through 40's • Females in late teens, usually students • Females in 20's through 40's, work at call center • No age limitation, includes elderly
Linguistic ability	• Assuming user is a foreigner (speaker of English, Spanish, Chinese, Korean) • Middle school level Japanese capability • College graduate level English comprehension
Computer literacy	• Barely even touched a PC • Use PC at work on a daily basis

shown in **Table 1** .

The UI design procedures start with "organizing the UI concept." This involves extracting the overall policies and common concepts that characterize the system to be developed and organizing them as the UI concept. Organizing the UI concept is not specified in ISO 13407, however we decided it was important to clarify them early stage in the system development process because this information is critical to deciding on the initial design and policy of the UI, and also can affect the functional requirements.

To "organize the context of use," we analyze the characteristics of the user, the task, and the environment where the system is used. Here, possible comprehensive analysis and classification are performed on the attributions of user, task and environment, and numerous examples are provided for each depending on their particular characteristics. As for the attribution classification method, we refer to JIS Z 8521 (Guide on Usability) to formulate the characteristic criteria (**Table 2**).

Based on the user, task and environment characteristics gained in "organizing the context of use," specific UI requirements are derived in "organizing UI requirements." In this procedure, a list of UI requirement items that need to be extracted is displayed along with examples of concrete UI requirements so that the developer can easily derive UI requirements. Ultimately, this results in the creation of a "List of UI requirements" to decide on priority for development.

We added the step of creating a screen prototype in "screen UI standard creation" so that we can gather user feedback regarding operability, design and visibility, and come to an agreement at this stage. This aims to reduce changes or revisions to the common specifications occurring after the screen UI standards are created because of the prohibitive loss of efficiency that would be involved.

In "screen UI evaluation," we confirm the continuity of the various screens developed through screen UI design against the

"screen UI standards" and "UI requirements list," and also evaluate usability of them. For usability evaluation, we have provided a checklist. But as for the specific procedure, we only provide overviews and reference materials as attachments.

5. Conclusion

This paper is a report on the policies involved in drawing up, as well as its architecture and contents the "UI design guide," which we formulated in order to integrate the human-centered design process into our SI development standards. By utilizing this "UI design guide," it will be possible for developers to design and develop systems that emphasize usability even if they are not usability experts.

Currently the "UI design guide" has been released internally within our company, but we have yet to sufficiently analyze its effects. We intend to continue analyzing those effects, as well as repeatedly apply improvements, to ultimately realize a development and design guide that will be easy for developers to use.

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