Effective Practice of HCD by Usability Modeling and Standardization

Hideo Zempo

Software & Service Design Division, FUJITSU DESIGN LIMITED
1812-10, Shimonumabe, Nakahara-ku, Kawasaki, 211-8588, Japan
zempo@jp.fujitsu.com

Abstract. Human-centered design (HCD) is one possible approach to enhancing usability, and it is important to take the HCD method to the development process. However, there is a realistic problem with insufficient resource such as manpower and time for the HCD method. Then, in order to practice HCD and to use know-how concerning the usability available more easily, the template defined of nine basic screens based on current findings was made. As a result, system engineers and developers came to be able to develop systems with a certain level of usability by using the templates, and that leads to the efficiency of the systems development and the improvement of the design quality.

Keywords: Human-centered design, usability, screen template, system development.

1 Challenges for HCD Application in System Development

High usability, an established requirement for general consumer software applications, is also becoming an important requirement in business system applications for B2B use these days. In developing business systems, the tendency has been to give priority to functionality over user-friendliness, since system users and scope of use are largely limited. However, problems have arisen from little consideration for usability, such as human errors and additional development cost requirements for reworking. As a result, the importance of system development from the user's standpoint is now widely recognized even in the B2B context, as exemplified by the "Electronic Government Usability Guidelines"[1] issued by the Cabinet Office of Japan in 2009 regarding electronic administrative application systems. Human-centered design (HCD) is one possible approach to enhancing usability, but it must be applied to the entire process of development.

FUJITSU has a standard process called SDEM (Solution-oriented system Development Engineering Methodology) for system development mainly involving SI construction. As in general development processes, SDEM describes, comprehensively and systematically, such required work steps as planning, design, development, testing, operation and maintenance, as well as results expected from these steps, mainly to avoid omissions and ensure efficient project operation. HCD was integrated into SDEM in 2007.

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In SDEM, specific steps of usability improvement are summarized as follows: (1) integrate usability into information system strategy, (2) clarify usability requirements, (3) understand current status of use and record user and environmental attributes in requirement definition phase, (4) design and develop usability in development phase, (5) evaluate usability, (6) introduce and operate system and perform support activities in operational testing phase, (7) plan and implement HCD throughout entire development process .

It would be ideal to practice HCD as an integral part of a standard system development process, as in SDEM. In actual development, however, realistic challenges such as limited budget and insufficient expert resources often hinder HCD application, though its importance is well understood (still poorly understood, in some cases). As well, design departments charged with supporting development projects may have sufficient know-how for HCD process implementation, but lack the resources and time needed to handle the actual numbers of products and projects.

The most effective way to overcome these challenges in the long run is to get system engineers and developers working in the field to acquire knowledge and know-how relating to usability. Some organizations have already put educational programs in place to this effect. On the other hand, many extremely busy workplaces simply cannot afford to dedicate extra time, energy and labor to such an endeavor. For them, one immediately effective solution would be to convert usability-related know-how into tools. While this is difficult to do at the upper reaches of the HCD process, in the phases of (4) usability design and development and (5) usability evaluation, it is possible for system engineers and developers to secure, without the involvement of designers or HCD specialists, a certain level of usability by using standardized models such as a screen template or checklist. Furthermore, the use of standardized models can improve efficiency in system development.

To illustrate how a template for usability improvement can positively impact system development efficiency and design quality, this paper presents the FUJITSU GUI Design Platform, which we developed at FUJITSU DESIGN, along with the background to the creation of a template and its characteristics.

2 How Usability Models Can Be Standardized

2.1 Viewpoint of Usability Modeling and Standardization

FUJITSU's accumulated experience in usability evaluation, usability improvement design and so on, mainly concerning business system applications, enabled us to identify their common traits. This in turn led us to conclude that, in terms of user tasks as expressed on the display screen, most systems have a similar screen composition, which can be broken down into simple and typical screens and screen transitions.

Since user interface characteristics are in question, business systems discussed here are those linked with a database and mainly executed on a web browser, and not clerical software, whose principle purpose is document production, or creative software, such as Visual Studio and Photoshop. Clerical software, mainly for document production, involves creating a text with or without images on a blank screen; therefore, only

one task window is mainly used, necessitating few other screens or screen transitions. On the other hand, business systems mainly consists of adding new data to the database or editing registered data; screen types and transitions are required in accordance with functions, and are suited to standardization.

From the standpoint of software quality, the screen types and transitions that interest us here are system user interfaces, which influence the quality of use, that is, internal and external software quality. Focusing on usability at this level enables the formulation of models as concrete screens [2].

It is also effective to standardize UI at the component level, and there are cases in which standardized UI patterns are converted into tools [3]. However, screens, which are composed of combinations of component-level patterns, are more important as a unit that can determine the quality of use. This is why we conducted screen-level standardization.

2.2 Defining Nine Basic Screens and Incorporating Them in a Template

A typical operational flow of tasks that a user performs proceeds chronologically as follows (Figure 1): The user first logs in to use the system (1. log-in screen). In most cases, this is followed by transition to the screen on which an item can be selected from a menu (2. menu screen). The user then selects a task (function) to perform. If the system involves interaction with a database, following menu item selection, in most cases, the data retrieval function is proposed at the top of each function (3. data retrieval screen). The user then executes a search, and a list of data to be processed appears (4. retrieval result list screen). In some cases, the data retrieval function and list of results appear on the same screen (5. retrieval and result list screen). The user selects an item from the list to edit, update, delete or otherwise process (6. input screen). The user can also create new data on the same screen. Following new input or data update, the user confirms the content of the task (7. confirmation screen) and completes the operation.

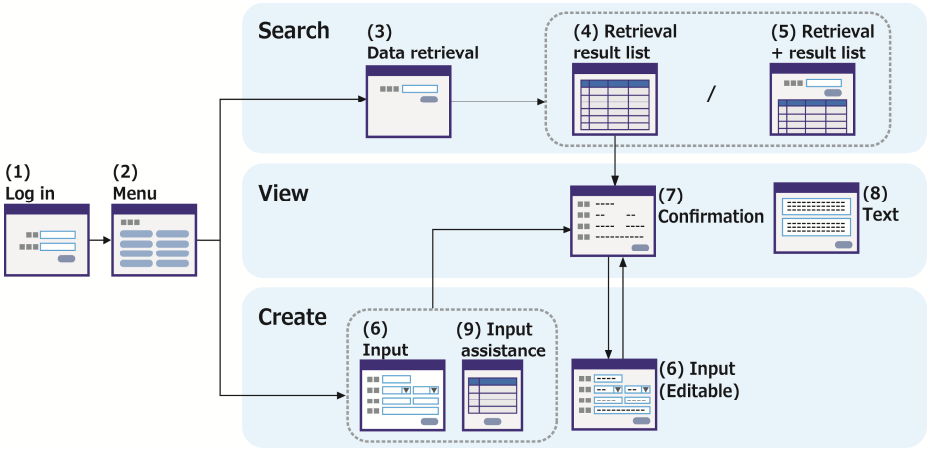

Fig. 1. A typical operational flow with nine basic screens

The above can be considered the most simplified typical sequence of screen types and transitions. A point to note regarding usability in processing is whether or not the sequence incorporates the two options of creating new data and editing already existing data, and whether this is done in an easy-to-follow manner. In terms of user intention, an important point for ensuring usability is the general division of tasks into three types: search, create and view, which respectively correspond to the functions of data retrieval, new input and confirmation. The fundamental key to usability improvement of a business system is to arrange screen types and transitions that take into account these points, together with functions offered.

To create a template of screens, we identified nine basic screens for a web-based business system application, that is, the seven screens described above, plus two additional screens: a text screen (8) that offers sample textual descriptions on the web browser, and an input assistance screen (9) that serves as an auxiliary screen for inputting date and other information items (Table1).

Table 1. Nine basic screens and their functions

Screen type	Function
(1) Log in	User inputs user ID and password via this screen, to log in to the system.
(2) Menu	This screen shows a menu summarizing functions, as the entry to the task.
(3) Data retrieval	The user inputs data retrieval conditions via this screen to execute a search.
(4) Retrieval result list	This screen shows a list of retrieval results. The user selects an item or items from the list and proceeds to the next task (confirmation or input).
(5) Retrieval + result list	The user inputs data retrieval conditions and views retrieval results via this same screen. This screen type is used when many searches are repeated.
(6) Input	The user inputs required information via this screen, which displays a task execution form. More than one screen (page) may be used if many items of information are required or the inputting procedure is lengthy.
(7) Confirmation	This screen shows the details of data already input (or already registered in the database).
(8) Text	This screen shows a group of sentences or paragraphs, which are notices, help tips etc.
(9) Input assistance	This screen assists the user in data entry during principal inputting tasks, such as calendar and address retrieval. In many cases, the screen takes the form of pop-up UI.

2.3 Providing Tools Readily Usable in the Field

With the nine basic screens, we created a template (Figure 2). In this process, in accordance with screen layout principles, we optimized and standardized header and footer placements for area division and role definition, and did same for the arrangement of controls and buttons that realize respective screen functions. We also prepared about 50 themes from which color scheme and other design particulars can be selected to accommodate various use settings. We gave sufficient consideration to ensuring accessibility by, for example, optimizing character visibility. In addition, we produced the template in HTML and CSS versions that conform to the widely applied web standards, enabling simple and efficient customization.

As a tool to complement the template, we prepared guidelines describing usability features on each screen. These features, which are incorporated into the screens in various aspects, range from such basic features as proximity of log-in ID and password input fields and log-in button on the menu screen, and clear indication of required items on the input screens, to more complex features such as buttons on the list screens by which an item is selected from a list of functions ("edit," "delete" etc.) for execution (that is, whether to provide both selection and execution buttons for each item on the list, or a selection button for each item and only one execution button). The usability features are summarized in a checklist at the end of the guidelines to serve as a quality assurance tool for verifying usability as part of application design and development.

The template thus created enables system engineers and developers to design and develop screens from the template according to the purpose of use. In this process, they can ensure a certain level of usability by limiting customization of screen layout, color adjustment etc. to the necessary minimum, while referring to the guidelines. They can also expect development efficiency to improve, since the template eliminates the need to create screens from scratch.

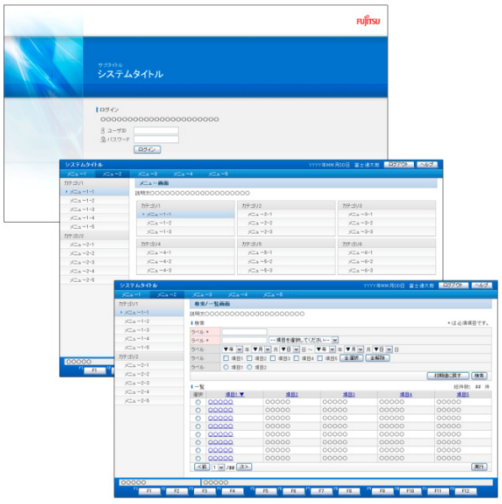

Fig. 2. Template sample

3 Actual Use and Effects

At FUJITSU DESIGN, in 2007 we created the intranet site FUJITSU GUI Design Platform from which FUJITSU Group personnel can download the template and other tools. The template was initially provided in HTML; versions such as ASP.NET and others corresponding to FUJITSU's development platform have been gradually added, in consideration of needs in and requests from the development field.

From the intranet site, developers typically download templates they need, together with accompanying guidelines. Currently, some 2,000 templates are downloaded per year for a wide range of purposes, from small in-house application development projects to business transactions with customers.

User feedback collected via questionnaire surveys and interviews points to the advantages of the tools, as summarized below:

- General advantages:
  - Members can share a color scheme and layout at the project outset, making it possible to proceed without deviation from the project orientation.
  - Less time is needed to arrive at well-balanced character and color arrangements.
  - The concreteness of lifelike simulated screens makes proposals more effective.
  - The idea of a web screen template is unique and excellent as a tool.
- Advantages relating to design and usability:
  - System developers need not be concerned about design.
  - Screens that are attractive in terms of character design and color scheme can be easily created.
  - Functions such as button placement unification enhance usability.

Although the template was initially conceived for use in developing actual systems, we soon learned that it was also used in the pre-development proposal phase, since it is useful in producing mockups that can be included in proposal documents as visual aids, or in presentations as demonstration samples. Such mockups are highly effective in rendering concrete images of systems proposed to customers. The template has come to be effectively used in this manner because it has an aesthetically attractive appearance perfected by designers, in addition to its primary function of screen standardization.

We also conducted a comparative study regarding screen production efficiency, in which the template enabled HTML/CSS beginners to create mock screens in about 40% fewer man-hours than when they did not use the template. This is a significant reduction in man-hours, even considering that template use generally improves efficiency, as compared to creation from scratch.

In view of the above, it can be said that template use is effective in enhancing system development efficiency and usability quality, as well as in communicating concepts in proposal and other early stages of system development. This indicates that HCD-based development, which actively incorporates the user's perspective, is an important element not only in actual manufacturing, but also in acquiring superiority in SI business.

4 Summary and Future Work

This paper has presented an example of HCD application to SI development, specifically in usability modeling and standardization that can be carried out in the design and evaluation phases-- that is, the latter part of the development process.

Other companies have conducted similar projects, identifying similar challenges in practicing HCD and proposing possible solutions. Some projects take a more research-oriented approach to examining screen design patterns in each of the system development phases, dealing with the characteristics and systems of screen design patterns. There are also similar reports on the effectiveness of screen design patterns in external design and on needs in the field in the planning and proposal-preparing phases [4].

In the future, it will be necessary to further advance our template development in response to new technologies and devices, aiming at, for example, tie-up with prototyping tools, templates for HTML5-based mounting and licensing-out of templates with new screen patterns compatible with smart devices. Moreover, when category classification in the style of the grade chart used in the Non-Functional Requirements Grades Usage Guide [5] become possible, and corresponding screen patterns and screen transition patterns are identified and sorted out, screen design modeling can be automated in a way adaptable to upper reaches of the system development process, rendering the template more effective and more widely adopted by those in the development field.

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