The Role of Design in UCD (User-Centered Design)

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Abstract

This paper describes the role of design in order to apply user-centered design (UCD) concepts to the various workflow processes. It also discusses the roles of designers and their effectiveness by focusing on the three main functions of designer activity: imagination, visualization and materialization. The reader also will be introduced to usability evaluations, universal design approaches and other activities as practiced in actual projects by the Design Department of NEC Design & Promotion.

Keywords

universal design, accessibility, usability, innovation, user-centered design (UCD)

1. Introduction

The NEC Group designers are involved in two major fields. One of these is the product design field that supports hardware design, and the other is the solutions design field that is a vital component of software design. In both of these fields, our designers are involved not only in the visual aspects of the design of products and services but also in various other design aspects by sharing projects with staff from the Planning and Development Depts.

In the product design process, designers are involved in a wide range of production processes. These stretch from the product specification evaluation stage to the finishing stage that examines basic configurations in order to achieve better usability and product appearance. In the solution design process, designers examine software operability including operation flows and screen layouts, create visual images and produce image data to be incorporated into the software. User-Centered Design (UCD) is employed in each process and is reflected in the design workflow.

Photo 1 Departure floor (3rd floor) of Haneda International Airport.

One of our latest projects is the flight information system (FIS) at Haneda International Airport (**Photo 1**), which opened in October, 2010. All kinds of travelers use the airport, including business people, the elderly, children and people from various countries. Friendly, state of the art designs as well as ones that have a traditional Japanese ambiance are expected and a UCD conceptual approach was employed in order to achieve them.

This paper describes the role of design and the approach that NEC Design & Promotion has made in applying UCD in the design workflow of the various fields.

2. Design Workflow Activities in UCD

The workflow process established in the NEC Group has adopted the steps shown in **Fig.** as its established workflow process for application of UCD principles in design and development. Development is advanced by repeating these steps.

2.1 Understand and Specify the Context of Use

At this stage we specify one of our customers in order to define their system usage environment. User research, field observations and questionnaire surveys are our main methods of inquiry at this stage. Suggesting some ideas or discussing related subjects at the planning stage are effective methods for understanding the issues and needs that users are facing. By employing such methods, underlying issues and needs of users

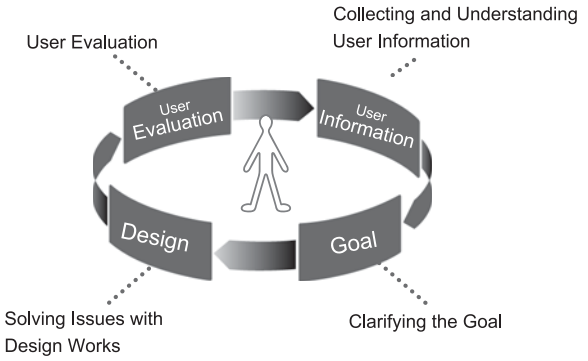

Fig. UCD process.

Photo 2 A scene at a user interview.

can be found. Conducting interviews with individual users and groups at the planning stage can be effective (**Photo 2**).

With the help of such methods user environments can be studied and it is important to share such acquired information among the related staff. Designers are expected to be familiar with these processes so that they can visualize the user environments and thereby develop a suitable project scenario by characterizing the user in the chosen scenario. It is easier for staff to share information via detailed images than with texts alone. Designers are involved from such an early stage of the process and understand the environments of users, which will be of great advantage to designers for solving issues occurring at the design process stage.

2.2 Specify the User Requirements

At this stage goals should be planned and set by clarifying the needs of users and requirements specifications should be prepared. The specifications prepared at this stage are mainly for the technical and functional requirements. However, considerations regarding operability and psychological aspects are also important. When considering operability, it is an essential premise to design a product or a service that ordinary people can operate easily. However, it is sometimes useful to plan for people to operate them with enjoyment, or even for them to operate devices in a crisis situation. Requirements for user interfaces should also be examined and prepared at this stage. Including such requirements in the project concepts and achieving agreement among staff for the planned direction of the entire process from design to development stages will reduce workloads and time loss in future work processes.

The role of a designer at this stage is to indicate the goal with as much detail as possible. At this stage it is effective to prepare an operations scenario supported by examples of how the product or service should be operated. For this reason it is useful to create sample images or simple prototypes to help visualize the working concepts. Such preparation will result in a smooth transition to the next stage.

Taking the care of FIS at Haneda International Airport as an example of this step, we set the following three design concepts as goals: 1) achievement of an attractive and delightful design, 2) providing users with the ability to intuitively acquire required information, and 3) realization of Universally Design principles, and from this point, we begin consideration of related sample images.

2.3 Produce Design Solutions to Meet User Requirements

In this stage we approach the goal proposed above helped by design work. For a projected process that does not employ the UCD concept, a designer is expected only to prepare a draft plan that satisfies requirements based on the product or service specification. Relevant diagrams and display design data are then generated in consultation with the appropriate engineers. On the other hand, when the process employs the UCD concept, a designer is expected to prepare a superior draft plan that satisfies not only the specification requirements but also user-centered solutions. A designer has to: 1) examine a wide range of solutions and 2) choose the best solutions among them. These are the two indispensable tasks in conducting processes employing the UCD concept.

Firstly, a designer can prepare solutions for users based on criteria arrived at from different perspectives that are linked to those of engineers and developers. A designer examines solutions together with the staff of the Planning and Design Depts.

while conducting various techniques such as brain storming and the KJ method, etc. that may generate new ideas to assist the project staff. A draft illustration produced by a designer during a meeting may induce more ideas among the staff.

To narrow down the choices of solutions, it is important to examine the necessary functions and their effectiveness. However, it is also effective to produce mock-ups of products or services, which is important work for a designer. In the Product Design section, for example, a mock-up made of paper is sometimes prepared just to give an idea of the size of a product. In the Solution Design section, some wireframe models indicating only screen configuration elements, or prototype displays to give a rough idea of screen transitions are prepared. During the stage of solving issues of the design workflow, the project planning can be improved gradually by discussing issues among the related staff while using such mock-ups or draft prototypes. By employing UCD activities for designers' tasks at this stage, it is expected that the entire project will progress more suitably to fit user needs. It is also expected that a significant amount of modification may thus be eliminated at the development stage.

When developing the flight information system (FIS) at Haneda International Airport, various design plans were discussed before materializing our design concept. Prototypes of the FIS were manufactured and were evaluated many times (**Photo 3**). The evaluation processes were undertaken not only with prototypes but also using printed documents and sometimes with the data displayed on the actual monitor screen.

Photo 3 Example of design evaluation using a display layout prototype.

2.4 Evaluate the Designs against Requirements

At this stage, an evaluation will be carried out to check if display designs examined at the design stage are capable of being easily understood by users, or if the requirements of the display designs are adequately understood. The results of this evaluation will be fed back to the development staff. If possible, we will arrange for the potential users to use the prototype FIS, however, if such an arrangement is not possible, we will check the display layouts by ourselves using a check list that has been prepared beforehand. Alternatively, we will operate them by ourselves from the perspective of potential users by conducting a walk-through evaluation. This is conducted by viewing the prototype and evaluating the display design with our own eyes. We will also conduct a heuristic evaluation with the help of specialists. These evaluations will all be conducted during the development stage.

In order to acquire unbiased evaluation results, we usually conduct these evaluations together with third parties. However, our designers and engineers are also directly involved in the evaluations so that more detailed ideas can be acquired to enable the sorting out of issues more quickly.

When evaluating the FIS at Haneda International Airport, the evaluations were conducted repeatedly to check visibility by targeting elderly people and also to check that designs achieve satisfactory Universal Design by targeting people who were color blind (**Photo 4**).

Photo 4 Example of visibility evaluation of an elderly person.

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3. Activities Undertaken by Designers to Achieve Satisfactory UCD

As described above, the role of design in the UCD process is broad. When we look at the activities that designers pursue in the successful application of UCD principles in their design work, those activities can be divided into three types: imagination, visualization and materialization.

Capability of imagination: Generating new ideas is one of the designer's fundamental aptitudes. However, when designing a product in order to make it attractive, designers are expected to generate innovative ideas that are free from stereotypes. They are also expected to generate ideas from the perspective of the user, which is even more important, and is the quality that characterizes the concept of UCD. In order to generate satisfactory ideas from the perspective of the user it is difficult for the designers themselves to acquire such ideas. In such case, it is effective to hold brain storming meetings that are attended by staff from the various relevant departments.

Capability of visualization: Designers are expected to express various subjects via images or in three dimensions. Not just for the project employing the UCD concept, the large number of staff are continuously involved in the development process for other projects. This means that sharing concepts and necessary information among all of the related staff is important. To help this process along, visualization is an efficient way to share concepts and information among the relevant staff. Once the concepts or information are visualized, more detailed images of products and services can be communicated to other staff. Moreover, when a concept is too vague to convey to other people as information, illustrating it will help other staff to understand it deeply and will result in the extraction of more underlying issues that hide within a project.

Capability of materialization: Designers are expected to materialize their ideas into diagrams, directive documents or specification sheets, which are all essential for effectively carrying out a project. However, in the UCD work process, manufacturing prototypes is essential. Preparing prototypes at various stages in a timely manner is especially important. If a prototype is prepared at the stage in which the other requirements to be examined are not yet ready it is expected that the prototype will function as a catalyst among staff to trigger identification of hidden issues.

The practice of the UCD concepts requires three elements: process, method and teamwork. Designers play an important role in the application of diverse methods and putting UCD concepts into practice as members of a team involved in the entire process. The above three capabilities are fundamental to the fulfillment of this role.

4. Approach of NEC Design & Promotion

In addition to proven expertise in the above mentioned areas, the Design Department of NEC Design & Promotion also has accumulated extensive know-how and experience in projects employing the concepts of UCD (user-centered design) and UD (universal design).

In some cases, evaluation is conducted during the UCD user evaluation process (**Photo 5**). NEC Design & Promotion has been conducting usability evaluations for many years. This approach has been adopted because we are sure that total usability evaluation including planning, execution and analysis are enabling our design department to discuss precise and effective solutions in a speedy manner. Usability evaluation is becoming more and more important in the UCD process.

We also support Universal Design activities from education and training activities to product development support and systems guideline productions. As one of our unique activities, we organize people who need the benefit of Universal Design such as disabled and elderly people, etc. as participants in our evaluation tests, so that appropriate evaluation tests may thereby be conducted at any time.

Introduction of the UCD concept will provide maximum advantages to users. If designers participate in UCD activities

Photo 5 Example of usability evaluation test.

and contribute the three above mentioned aptitudes, the strategy is expected to shorten the time required for prototype development and to reduce the modification workload in the later process schedule.

5. Conclusion

As a member of the NEC Group, NEC Design & Promotion performs activities that are intended to achieve the NEC Group's vision of the "Information society, friendly to humans and the earth." We intend to achieve our Group's vision by carrying out our functions as described in the above flexibly and by applying the expertise accumulated via our long experience. To achieve this, we need designers' capabilities but we also need cooperation from the staff of the planning, development and other related departments as well as of the research laboratories. We will thereby be able to provide optimum designer capabilities in the design process of UCD activities. We will also do our best to promote UCD activities so that the products of the NEC Group will be employed not only by users in the traditionally favored markets but also by people in a much wider range of the emerging markets.

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