Proposal for Service-Oriented Design Processes

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Product design is typically based on market research to clarify the features and benefits desired by consumers. However, the trend among customers has recently shifted from only purchasing products to experiencing services. This makes it more difficult for manufacturers to create products to attract customers. Manufacturers should focus on offering customers good experiences through their products and services. In this situation, designers should envision future lifestyles by observing customer behavior. They need to contribute to product development by imagining our future lives, creating scenarios of services desired by customers, and designing products on the basis of this approach. In this way, product design will promote "service-oriented design". This is important because service-oriented design will be mandatory in the ubiquitous era. In this paper, we introduce service-oriented design processes with specific design examples.

1. Introduction

Twenty years have passed since the concept of ubiquitous computing was first put forward by Mark Weiser in 1988. During this period, telecommunication technologies have evolved at a rapid pace, and computing environments in which the functions of computer networks and sensors interact organically are gradually becoming a reality. The ubiquitous era is truly about to begin. However, it is not necessarily clear how lifestyles and work styles will become richer and more comfortable in this ubiquitous society and what types of benefits that we as consumers will come to enjoy. At the same time, users' consumption awareness is shifting away from tangible products; users are seeking value in new experiences, and it is becoming increasingly difficult to develop products that capture the hearts of customers using traditional approaches to design and production. What we need to do right now, when developing information technology (IT) systems and products, is to imagine the lifestyles and work styles of the near future, and achieve "human-centered" development that will allow consumers to feel the benefits of the ubiquitous society.

In this paper, we propose "service-oriented design processes" to support human-centered development and look at examples of development that incorporates these design processes.

2. Vision proposal approach and its significance

There are two main approaches to developing IT systems and products from the perspective of human-centered design (HCD). The first is the problem solving approach, which involves evaluating current IT systems and products from an HCD perspective and then improving upon the problem areas discovered through those evaluations. The second is the vision proposal approach, which involves imagining new possibilities for satisfying the fundamental needs of consumers

Table 1
Two HCD approaches.

Problem solving approach	• This design approach aims to resolve current problems and issues. • Surveys are conducted to analyze and inventory the issues, ideas are developed on the basis of the results, and these are then carried over to the development of new designs.
Vision proposal approach	• A vision of future society and human lifestyles is created and designs are developed to bring about new forms of services and products. • Insight into near-future society, lifestyles, and human characteristics is used to think of new services; then, the interactions required to provide these services are imagined, and designs based on these concepts are developed.

and then studying and developing IT systems and products that will make those possibilities a reality. When deciding which of these two HCD approaches to use, it is important to take into consideration the goals and objectives of the development (**Table 1**).

In the coming ubiquitous society, it will be important to provide new value and experiences in lifestyles and work styles. This means proposing new services and products that have never been seen before. As technological development continues to accelerate, and as complex mechanisms and black box technologies come to be used, we cannot deny the possibility that we may see the birth of new systems and products that cannot be understood on the basis of the concepts that consumers have learned up to now. There is a growing risk that from the consumers' perspective, new proposals will come in the form of systems and products that are more intrusive than they are welcome. At the same time, however, consumers have strong demands and very high standards with regard to the use of IT, so to ensure that new proposals for the ubiquitous era are not intrusive, it will be important to develop IT systems and products that can be used intuitively, on the basis of a vision proposal approach. Developing IT systems and products using this vision proposal approach will offer the following benefits for companies as well, so it is expected to contribute to corporate management.

1) The "customer value" at the starting point of development can be clearly identified.
2) This approach enables the development of IT systems and products that are easy to use and easy to understand.
3) It enables the development of popular products and IT systems that make customers happy.
4) Developers can share a clear understanding of the "business vectors" toward the next generation.
5) Developers can reach consensus smoothly, which facilitates faster development and cost reductions.

3. Service-oriented design process

In conventional design processes, it was most common to design products starting from marketing data or hardware specifications, then develop the interactions required to operate that product, and finally devise services using that product. These conventional processes are no longer sufficient, however, for creating "usable IT systems and products" that meet users' essential needs and allow them to feel the benefits first-hand. We have therefore endeavored to build and propose a service-oriented design process for creating new, human-centered IT systems and products.

3.1 Construction of service-oriented design process

We believe that in order to develop designs based on the vision proposal approach, it is necessary to delve more deeply into the HCD concept in the following manner:

1) Create an image of a near-future society and lifestyles from the consumer's perspective.
2) Think about what service the customers will need in this near-future society.
3) Define the customers who will use the service.

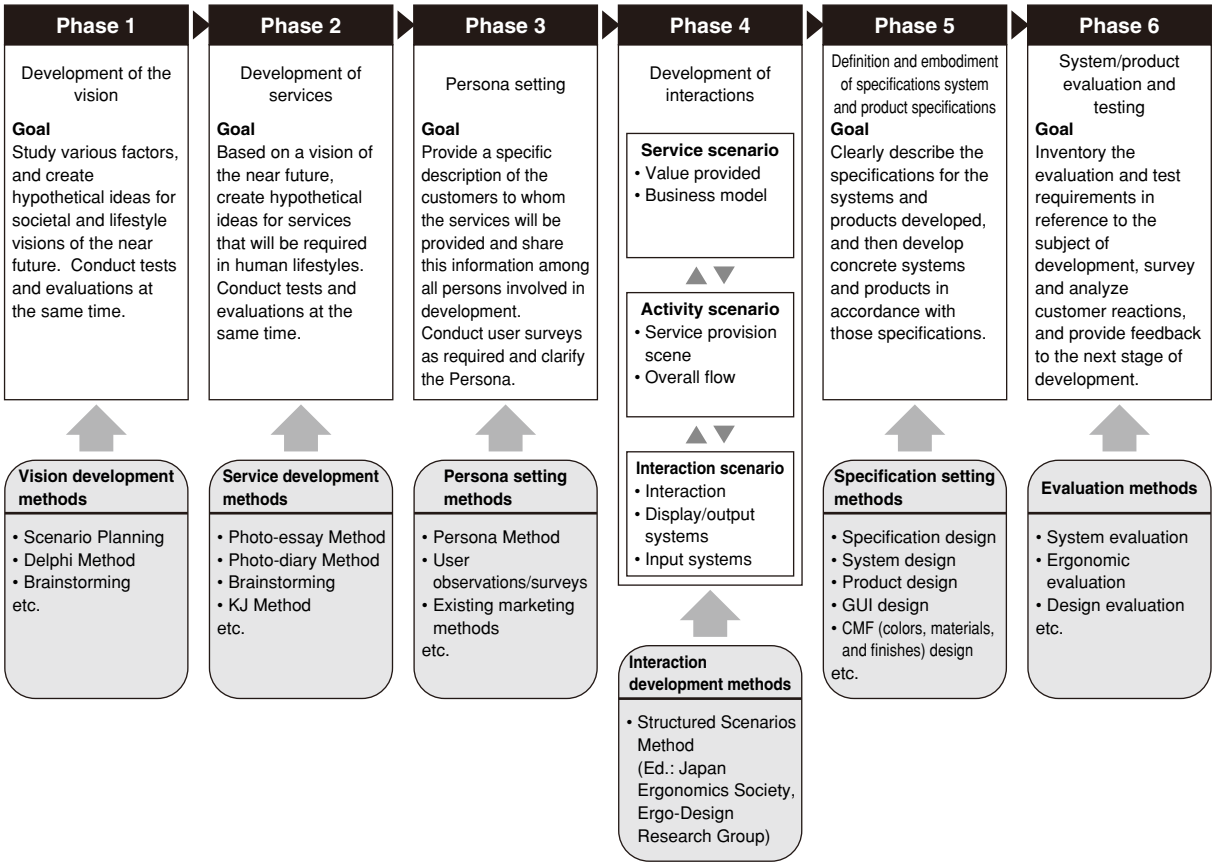

Figure 1
Service-oriented design processes.

4) Imagine the interactions that are most appropriate to the service and the customers.
5) Study the IT system and product specifications that will make those interactions possible and give them concrete form.

We feel that this service-oriented design process—starting from studies of services, then imagining interactions, and finally creating the system or product—will be very effective in the future. The unique characteristic of this process is that it is like a mirror image of traditional development approaches; the development of IT systems and products begins from a macro perspective or a future vision.

3.2 Task phases and methods in proposal process

Developing service-oriented designs requires six task phases that reflect the concepts described in the previous section (**Figure 1**). Here, we describe the goals of each phase, as well as the specific methods used to perform the tasks.

1) Phase 1: Development of the vision (create an image of near-future society and lifestyles)

The goal of this phase is to create an image of the near-future society; for example, in terms of future lifestyles and work styles. In order to create these images systematically, tasks are performed using existing methods that have been used in the past, such as the scenario planning method and the Delphi Method.

2) Development of services (study the services

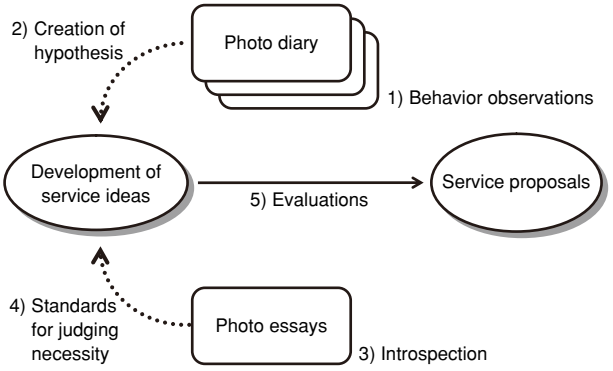

Figure 2
Service development methods.

that customers require)

The goal of this phase is to develop services that customers require in the envisioned near-future society. In order to systematically develop services that allow consumers to feel the benefits, one performs tasks using methods such as user observation, photo diaries, or photo essays (**Figure 2**).

3) Phase 3: Persona setting (define the customers who will use the service)

The goal of this phase is to describe, in detail, the image of the users; for example, their characteristics and unique attributes. The Persona method is one way of describing the user image. This method has been used in a wide range of applications, including software development and new product development.

4) Phase 4: Development of interactions (imagine the interactions that are most appropriate to the service and customers)

The goal of this phase is to imagine interactions using the service as a starting point. To accomplish this, it is necessary to describe, in detail, the situations in which the service is provided, or the interactions required to use the service.

The scenario method is one method used to achieve this goal. Scenarios enable concrete descriptions of the situations in which the product or service will be used. The process involves creating a story to describe what types of users use what types of behaviors in which environments. Based on this scenario, the developers can discover problems and issues in design and identify clues for resolving them. The key here is to establish specific scenarios in which the new service is used and to create a clear overview of the interactions involved. One example of a commonly used scenario method is the structured scenarios method,[1)-3)] which was developed and popularized by the Japan Ergonomics Society, Ergo-Design Research Group.[4)]

5) Phase 5: Definition and embodiment of specifications (establish and embody specifications for IT systems and products)

The goal of this phase is to describe the IT system and the product specifications required to achieve the interactions outlined in the previous phase. In order to create specifications quickly and systematically, it is deemed efficient to use the methods and tools chosen in the past, such as paper prototyping and graphical user interface (GUI) simulators.

The next goal of this phase is to design specific IT systems and products based on these specifications. To enable designs to be developed quickly and systematically, the methods used in the past, such as GUI design simulators, 3D modeling, or mockups, are reused.

6) Phase 6: Evaluation and testing (evaluate and test the developed IT systems and products)

The goal of this final phase is to evaluate and test the IT systems and products designed from a variety of perspectives, for example to determine whether they are actually effective, can be used efficiently, or are capable of satisfying the customers. The evaluation and testing requirements are inventoried, and evaluation and testing is done using methods such as ergonomic methodologies and impact evaluation methods, including surveys and analyses of actual customer locations where the systems and products have been implemented. Then, the results of those tests and evaluations are used to make improvements to

the product or service, or, in some cases, to provide feedback to the next stage of development.

3.3 Significance of proposal process from HCD perspective

ISO9241-11[5] defines "usability" as the degree of effectiveness, efficiency, and user satisfaction achieved when a product is used by a specified user in specified circumstances to achieve a specified goal. In other words, the pursuit of usability means increasing the effectiveness, efficiency, and satisfaction of a system product in a certain usage situation. In this proposal process, we set the user information clearly and in detail in the form of Persona expressions. When developing services, we conduct studies aimed at increasing the level of user satisfaction by studying and clarifying the value provided for the user. When visualizing interactions, we imagine the overall flow of activities in relation to the use of the IT system or product and draw a detailed and layered scenario of the user's goal and the process that the user goes through to reach that goal by using the product in question. At this stage, we must therefore pursue effectiveness and efficiency.

Performing the tasks in each phase of the proposal process is equivalent to performing activities involving the study and pursuit of evaluation items outlined in the ISO definition of usability. Design based on the service-oriented design process is consistent with this definition, so this process may be considered extremely significant from an HCD perspective as well.

4. Examples of design

Here, we look at the design of mobile phones as one example of design using the service-oriented design process.

4.1 Background to mobile phone service development

Mobile phone services began in 1987, and the "mova", a pocket-sized mobile phone, was released in 1991. Since then, mobile phones have developed at an astounding pace. The "digital mova", released in 1996, measured only 100 cm^3 and weighed less than 100 g. Once i-mode services began, enabling Internet connections, the flow of technological innovations accelerated even more, to the extent that mobile phones have now become the IT terminal most familiar to Japanese consumers.[6]

When mobile phones were first released, they were capable of offering only voice service, but during 21 years of technological innovations, new services were rolled out one after another. If we look at the background to this development on a timeline, we see that pocket-sized terminals offered voice services in 1991, and that i-mode services began in 1999; at the same time, in addition to voice services, it became possible to use text media and to gain Internet access, so subscribers could use E-mail and view Websites. In 2000, some manufacturers began to install cameras in mobile phones, so users could take still photographs. In 2001, 3G (third generation) mobile phones arrived on the scene, and the speed of communications increased dramatically. As a result, users could send and receive not only still photographs but also videos and could even enjoy visual communications by videophone. As mobile phones continued to gain popularity, new personal terminals began to appear with a wide range of features including music playback and health management functions. The services offered via mobile phones continue to expand even today; for example, we can use our phones to purchase products and make ticket reservations, and we can even use electronic money services as an alternative to credit cards or cash.

4.2 Service-oriented design for mobile phones

In addition to the expanding services described above, the design of mobile phones has been changing almost daily. In the mobile phone market, the designs most suited to the key ser-

Figure 3
Advanced design proposals.

vices at any given time become the de facto standard, taking the market by storm.

Specifically, in the era when mobile phones offered only voice services, the mainstream design was a simple cylindrical form that could be removed from a pocket and used immediately. When i-mode services began, however, and new applications such as mobile phone E-mail and i-mode sites came on the scene, the market was overwhelmed by phones with a folding design that offered keys that were easier to operate and screens that were larger and easier to view. Mobile phones also began to feature built-in cameras, along with access to TV broadcasts and full-spec Internet services, which brought about a dramatic change in the basic style of mobile phones.

Fujitsu anticipated these service transformations and undertook advanced design to seek out the most suitable designs for these services. Ahead of product development, we developed a wide range of design proposals, like those in the photographs shown in **Figure 3**, ranging from media viewing to i-mode applications and voice communications, all aiming for maximum ease of use. We evaluated these advanced designs and decided on the "swing style" as the new basic style for mobile phones. As a result, we were able to substantially expand Fujitsu's market share. If we take into consideration the future expansion of ubiquitous computing, we can expect that "push" style services will become even more prevalent than they are now. When that era arrives, yet another new basic style will be needed. At the same time, with regard to user interfaces, we believe that interactions ideally suited to new services will also be required (**Figure 4**).

The most significant key to the success of IT systems and products will thus be designing fundamental ease of use suited to new services. IT environments are evolving every day, and the services provided are becoming more diverse. In other words, given that we are developing designs

Figure 4
Transformations in mobile phone design resulting from expansion of services provided.

that take advantage of the strengths of Fujitsu—a solutions company—our success will depend on whether we can stay one step ahead of the competition, with designs that are ideally matched to diversifying services.

5. Conclusion

In future design activities, rather than thinking of IT systems and products using ubiquitous technologies as the starting point, it will be important to think about human-centered IT systems and products based on studies of the services that will be needed in human lifestyles of the future. Development using the service-oriented design process will be an essential part of achieving this goal, as will a reversal of the paradigm for design processes used in the past. Having understood the effectiveness of the scenario method as a central method in the service-oriented design process, we asked academic societies to assist with the proliferation and refinement of this method. The Ergo-Design Research Group of the Japan Ergonomics Society has formed a Working Group and is currently conducting research and development aimed at establishing the scenario method as a methodology that can be used by many people involved in the development of designs. We believe that this will be an effective methodology for the ubiquitous era.

What we had been thinking about only indistinctly up to now has finally come together clearly as a single desire with regard to standards for design. The noted German architect Ludwig Mies van der Rohe once used the phrase “Form follows function.” to express the standard for design. Today’s designs are often developed based on marketing and user surveys. This could be considered a design standard of “Form follows marketing”. In this paper, we have advocated service-oriented design as being effective in the ubiquitous era when information technologies become even more advanced and complex. In the ubiquitous society of the 21st century, we can add a new design standard; namely, “Form follows service”.

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