HITACHI REVIEW

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Inspire the Next

Experience Design for Social Innovation

Experience Design for Social Innovation

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RECENTLY, the intensification of global competition has significantly accelerated the commoditization of products and services. "Experience"—the value provided by experiences—has received great attention as a new form of development strategy that is capable of overcoming this challenge. The experiences that attract users will lead to the repurchase of products and services. However, how to develop those fascinating experiences as services is the challenge.

To provide a high-quality experience, Hitachi believes that the starting point is to investigate the on-site conditions of the product and service in order to extract and analyze the potential and the actual demands. Then, the following essential steps must be conducted. The first is to create the solutions from the predicted future ideal image. Next is to validate the effects of the solutions with the users and the stakeholders. The last part is to repeat the brush-up process of the recognized ideas. This sequenced activity is called the "experience design." Through practicing this approach in designing products and services, the enhancement of users' experiences will be pursued. This issue of *Hitachi Review* describes the concept of this approach, the engagement of Hitachi, and the technologies for practical implementation.

The opening article presents our definition of "experience design" based on the perception of the logic that is cultivated from the marketing and design of experience. At the same time, the development of the approach and technology that can be applied practically is briefly introduced.

Multiple case studies from Hitachi are presented here. These articles introduce the details of the development process and the design of experiences in different fields, including railway interiors, vacuum cleaners, the operation of a large-scale plant construction, packaged software, an information system, and smart city business. Other articles explain the research status of "experience design" from the requirements development approach in ethnographic research and system development, and the methodologies for designing future experiences.

Through this issue of *Hitachi Review*, I hope that readers will understand Hitachi's engagement in "experience design." Also, I would be grateful if this design approach could provide value to everyone's business and social innovation.

One Person's View

Cultural Innovation and "Experience" Design

Professor Philip Kotler, a leading figure in the marketing field, recently co-authored a book titled *Marketing 3.0*. This book has aroused some controversy in terms of marketing concepts. In this book, Professor Kotler proposed a new marketing concept, in which, instead of "consumer-orientation," he emphasized "value-orientation." This means a transition from "consumer-oriented" marketing, which is based on "consumer needs," to "socially and culturally oriented" marketing, which is based on visions and values on how the world should be.

One might respond by pointing out that companies have always been fighting for the actualization of a desirable way of life by developing convenient and affordable products with excellent functionality. This brings to mind the old Japanese saying, "hana yori dango," which means people prefer eating sweet things to appreciating flower blossoms. This is a typical way of thinking of substantialism. But a problem lies in this view, Professor Kotler says. Other than substantial values like functionality and convenience, people share more important values, that are aesthetical and social values like appreciating flower blossoms.

Companies in the past several decades have been competing to produce tastier and more affordable "sweets" with the result that their products now all tend to be of a similar quality (commoditization), leaving them trapped in a mire of price-competition. No matter how affordable or tasty it is, a sweet is only a sweet. On the other hand, eating sweets under blossoming cherry trees is an emotional "experience" that will live on in memory.

What matters is a knowledge of "staging" experiences. The "experience" creates emotional outcome, that is likes and dislikes toward the world view, values, and aesthetics that the company or the brand possesses internally. Through these experiences, people feel favorably (or unfavorably) toward the company (or the brand).

However, knowledge and world views are not visible. It is the power of design that transforms them into something that can be felt. In the field of architecture, architect Kiyonori Kikutake expresses this power of design through the Japanese expressions, "ka," (values and aesthetics), "kata" (styles), and "katachi" (actual things we can see and touch). For example, a house is a visible form ("katachi"), but at the same time it also gives us an image of the lifestyle ("kata") of the people or family who live there. Underpinning that style, meanwhile, there exists a sense of the family's ideas, values, and aesthetics ("ka").

Similarly, companies' values, aesthetics, and shared approaches to value creation can be perceived in the form of "experiences" through their "katachi" at the various forms of "ba" (interfaces) or points of contact they have with consumers and other parts of society, and people can react positively or negatively to what they experience.

While in the past there has been a tendency to treat design only as a means of differentiation or as something to be managed (such as corporate logos), from the viewpoint of experience, "deities dwell in the details." That is, the essence of a brand lies in the details of the "ba" where that design is to be found, and it is here that its soul resides. It is design that can determine the details of such "ba." However, it is important to notice that the design being talked about here is not the same as in the past, and that it is the design of an "experience." Sharing such critical mind, the new design thought and method, which go beyond past design concepts, are becoming growing features in the fields of business and design.

Keiichi Okamoto

Professor, Tokyo Fuji University and Graduate School

Graduated from the School of Humanities and Social Sciences at Tokyo Metropolitan University (majoring in Social Anthropology) in 1972. After working at Dentsu Inc. and the Dentsu Institute for Human Studies, he took up his current position in April 2002.
His specializations are in marketing theory, branding, and advertising culture.
Director, The Japanese Association for Semiotic Studies, Permanent Director, Japan Academy of Advertising (Chairman of Research Projects Committee).
Professor Okamoto's main publications include co-authorship of "Designing," "For Students of Current Advertising," and "Case Studies in Knowledge Management," co-editor of "Current Marketing," and co-translator of "The Experience Economy."

Prototyping and Storyweaving

Kinya Tagawa   Co-founder and Design Engineer, takram design engineering
Kotaro Watanabe   Design Engineer, takram design engineering
Tsukasa Ariyoshi   General Manager, Design Division, Hitachi, Ltd.

Hitachi perceives social innovation as a pillar of business management. We place great emphasis on experience design aimed at enhancing customers' experiences. This design method is the key element for designing the process for creating customers' experiences. Among the extensive research development of experience design, a remarkable approach called "storyweaving" was developed by the design engineering firm, "takram design engineering." The ambition of this firm is to create a new approach to product creation by combining designing and engineering. Below is a discussion about the possibility of this new approach.

Amplifying between Paired Concepts

Ariyoshi: Recently, I feel that there is growing recognition of design research in many different fields of society. Also the concept of design thinking as an approach to innovation has become popular. My division is a design department of Hitachi, beginning with designing home appliances, where we have extended our capability to hardware, software, and designing services from products. Our involvement in projects that overlap the areas of design, art, science, and engineering has significantly increased. Under this kind of situation, let's discover the possibility of this new approach that is combining designing and engineering with takram design engineering (takram).

Tagawa: takram is a design engineering firm established by myself and another colleague in 2006. Design and engineering represent two major aspects of product creation. Rather than choosing to focus on one or the other, we wanted to take on the challenge of creating a new type of design work that integrated the required elements while straddling the two fields. In doing so, our aim was not to deny the existence of designers or engineers. Instead, we looked for what had been lost in the gaps between these two clearly demarcated disciplines. To put it another way, we felt there was a role to be had in filling these gaps.

Ariyoshi: I have seen your work. Your activities not only involve the design development of commercial goods such as user interfaces (UIs), but also deliver very artistic design solutions that cannot easily be considered as engineering.

Tagawa: There are two aspects to the job of design: that of creating solutions and that of creating visions. In our work for clients, which involves us in collaborating with manufacturers on the development of new products or services, what is needed is skill in the creation of solutions so that a set of constraints can be successfully transformed into product features. In contrast, it is the ability to express a vision that matters more for work that involves a high degree of presentation, such as exhibiting at a trade show. What you could call our culture comes about from how we equip ourselves with a clear recognition of the activities and concepts that form this pair—as well as of present and future, real and abstract—and that we move back and forth between them. I believe that this provides us with perspectives that would not be available to us were we to limit ourselves to one side or the other, and it prevents our creativity from stagnating.

Storyweaving

Ariyoshi: My team is a group of in-house designers in an organization. Due to this very reason, creating real-world design solutions is our value. However, as Hitachi is focusing on the Social Innovation Business, which involves the construction of more intelligent solutions for social infrastructure, it is becoming increasingly common for our product and service designs to require us to look 10 years into the future. Therefore, it is essential for us to possess an imagination that is capable of identifying social values 10 years ahead. Recently, we have focused on ethnographic research, a method for researching society and consumers using fieldwork from an anthropological perspective. We have been utilizing this research method to conduct actual research for railway maintenance and repair work on the
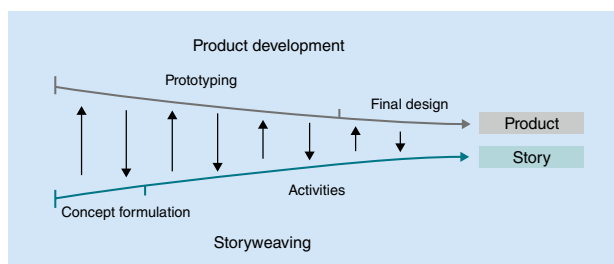
Interaction of Storyweaving and Product Development.

back of elevators. This is like pre-designing the blue sky 10 years in advance while conducting real on-site research. The demand for this sort of fairly complex design is actually growing. As you have noted, both solution making and vision making are becoming requirements for design. There is so much to learn from your activities. The prototyping and storyweaving workshop[1] is one example.

Watanabe: We have a design methodology at takram called "storyweaving" that has emerged from our past work on product development and other design engineering projects. We have been using it recently in activities such as workshopping or the training we perform for corporate clients, and it is based on a desire to help the people involved in product creation in a broader sense than just the design and other aspects of product development. Storyweaving is a way of taking the concept established at the start of a project and refining it into a story set in a richer context through an ongoing and flexible process of revision involving repeated prototyping. We use the terms "prototyping and storyweaving" to describe the overall process of the product development or design project based on this storyweaving. These two approaches allow us to represent both the real and the abstract sides of product creation, and we believe that it is important to proceed with both in parallel.

Ariyoshi: As for a conventional product development project,

the proceeding process is either to follow the pre-defined concept simply or to add the concept as the background explanation afterward for an existing product. Isn't this well-known?

Tagawa: While this may have been acceptable in the past, the current rapidly changing social environment means that any time lag between the storyweaving (concept formulation) and prototyping will result in the product not keeping up with the times. As factors such as the constraints or competition continue to evolve during development, rather than setting the concept in stone at the beginning, what I believe is required is a dynamic process that converges on a solution through repeated interplay with the actual prototyping work, and in which both sides are able to be freely modified.

Ariyoshi: If we explain "prototyping and storyweaving" statically as an approach to product development and its background description, the value will inevitably become much lower. If we determine the concept rigidly from the beginning, there will be a danger of inhibiting creative thinking. So, it is essential for us to be able to revise our own work constantly within any dynamic processes.

Tagawa: In the case of Internet services, for example, it has become normal practice to start by releasing a beta version and then to enhance it through interaction with the wider world. As people's idea of a product increasingly includes the services associated with it, the design can no longer be kept separate from the context in which the product will be used.

Tangent Sculpture

Ariyoshi: Our younger designers have attended your workshops. All of the activities from the workshops were very useful and helpful for our designing practically. The detailed content of your specialties are described in a published booklet called "Storyweaving."[2] So, I will not get

Kinya Tagawa

Co-founder and Design Engineer, takram design engineering

Graduated from the Faculty of Engineering at The University of Tokyo in 1999. Completed course at UK Royal College of Art in 2001. On returning to Japan, participated in Leading Edge Design. Established takram design engineering in 2006. He has been involved as a design engineer in product development in a wide range of fields extending from hardware to software.

Kotaro Watanabe

Design Engineer, takram design engineering

Graduated from the Faculty of Environment and Information Studies at Keio University. After receiving training in Europe through the Ministry of Economy, Trade and Industry and being involved in a venture business startup, he joined takram design engineering in 2007. His projects have ranged from user interface designs for the latest digital devices to the creation of art installations, and he has conducted workshops and other activities based on his own theory of "combining prototyping and storyweaving."

into it. However, I would like to hear more about one of your activities called "Tangent Sculpture," which has impressed me very much.

Watanabe: The tangent sculpture activity involves using a prose poem to express an idea such as rain without actually using the word "rain." By "telling without saying" the word in question, the aims of the exercise include redefining the true nature of the word or making explicit the implicit knowledge of the project members.

The risk with projects that involve working as a team or across a number of departments is that each person will proceed on the basis of their own ideas about what key words or concepts mean. Although the image that a word conjures up in each person may well be different, discussions proceed on the assumption that it means the same for everyone. These differences then do not become evident until the design finally starts to take shape. This is both inefficient and very risky. Instead, we believe that banning the use of particular words in project discussions can in fact bridge differences in understanding and bring out the maximum benefit from those words.

Ariyoshi: Currently, we are focusing on utilizing experience design for enhancing customers' values in product systems and services. This is not to determine customers' values without any logic, but actually it is to observe the facts using proven methodologies, then to predict the plausible future images that connect to technology. It is also possible that our predictions are different to the way it has been perceived. In fact, although we are exploiting experience design, an experience itself is not something that can be designed. While keeping this notion deeply in our hearts, we are aiming to inspire our customers by designing satisfactory customer experiences with great ideas. As for this designing process, your Tangent Sculpture approach has actually provided a unique role. Let me simply describe Tangent Sculpture.

Expressing experience design needs a vocabulary. But, one cannot input any vocabulary randomly. Instead, it involves tackling with numerous Tangents. By this process, the definitions of vocabulary will be revealed or embedded in the sentences. Then, at the end, the targeted value will appear as a Sculpture that stands very close to the essence. Is this correct?

Watanabe: That's right. It's about being able to share the contexts or stories that lie behind objects, both within the team and externally. Whether you can get a fulsome appreciation of them from the things you create. Tangent Sculpture can perhaps be thought of as a way of ensuring that this happens and getting at the true nature of something by densely layering the contextual Tangents.

Tagawa: While there are many design and other product creation techniques that people have devised in the past, we are putting the storyweaving method of product creation to the test in the hope that there will be ways of controlling reality more effectively. In an environment in which trends in product creation are undergoing major changes, technology is progressing at an accelerating pace, and products are taking on new forms, we will be glad if we can make practical product creation a highly imaginative and stimulating place by thinking about and trialing leading new methods. Surely it is in situations imbued with this sort of energy that innovation arises?

Ariyoshi: We also would like to pursue such a design workplace that can contribute to social innovation. Let's work together on initiating the new disciplines for design. Thank you very much for your time today.

*1 Corporate training workshops operated by Diamond, Inc.'s Diamond Design Management Network. Work from the first workshop held in FY2010 and mainly attended by in-house designers is presented in the booklet referenced below.
*2 By Kotaro Watanabe, Kinya Tagawa, and Motohide Hatanaka of takram design engineering. Published by Diamond, Inc. (Oct. 2011)

Tsukasa Ariyoshi

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Joined Hitachi, Ltd. in 1983, has worked at the Design Center (since renamed the Design Division) in a management role, and has been involved in the design of equipment and systems in various fields, including home appliances, video equipment, information products, manufacturing, public infrastructure, medical instruments, and rail systems. After working at Hitachi Design Centre Europe and the Rail Systems Division, he was appointed to his current position in April, 2011.

Experience Design: Theory and Practice

Kaori Kashimura

Kenta Kumagai

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NEW VALUES FOR SURVIVING COMMODITIZATION

JAPAN'S manufacturing industries have maintained an advantage in the global market by improving their ability to provide high-quality products based on advanced technology and maximized efficiency. However, the global market has been changing dramatically over the last 15 years. Therefore, companies throughout the world, not just those in Japan, need to drastically shift their strategies to keep up with these changes because intensified global competition has accelerated the commoditization[a] of products and services. A commoditized product is difficult to differentiate from others, and is subject to price competition. Even if the manufacturer adds many functions to the product and seeks to improve its performance, it is unlikely that the company will make a profit as other companies will soon catch up. This means that companies need to move away from the product-centered approaches of the past and instead learn how to add value in ways that go beyond the product itself[1], [2].

This has led to the concept of "experience" meaning subjective values that extend beyond functionality and convenience. This is seen as an approach that can overcome the challenges of price competition that comes from commoditization.

WHAT IS EXPERIENCE?

The concept of "experience," as used in this article, originates from two sources: marketing and user interface design.

Experience in Marketing

The concept of "experience" in marketing became widely known when *The Experience Economy*, written by B. Joseph Pine II and James H. Gilmore, was published in 1999[3]. During the process of economic development in the 20th century, major portions of the economy shifted away from agriculture, forestry, and fisheries (primary industries) toward product manufacturing (secondary industries) and then service industries (tertiary industries). Pine and Gilmore predicted that the next step in this process will be the emergence of the "experience economy." As the fourth in this sequence of economic values, experience values attract and engage customers by supplying products and services that deliver memorable events. This is the key to surviving commoditization[3]. According to Pine and Gilmore, a customer's state of mind and circumstances affect how he or she feels about an event they experience, therefore no two people can have the "same experience," even though they have experienced the same event. This means that the factors affecting how a customer reacts to a product or service include not only its characteristics and quality, but also the customer's own expectations, feelings, and other psychological states, and also the physical and social context in which they experience the product or service. In other words, experience is a subjective value, not an objective value. Around the same time, B.H. Schmitt and J.F. Sherry also pointed out the importance of experience in marketing[4], [5], [6].

Experience in User Interface Design

The concept of experience was introduced to user interface design by D.A. Norman, a "user experience architect" who left university and joined Apple Computer Inc. in the 1990s. He was also believed to be the first person to use the phrase "user experience" (UX) in the title of a publication. Thereafter, the concept was introduced to various fields, including user interface design, web design, and usability engineering. Nowadays, the term UX is widely known in the information technology (IT) field in particular.

Various scholars have proposed different definitions for UX. For example, E. Law, and his colleagues, surveyed at total of 110 researchers and practitioners

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(a) Commoditization

The process by which manufactured goods from competing suppliers cease to have any meaningful differences (in terms of factors such as their functions, quality, and brand). If products are commoditized, consumer purchasing decisions are made mainly on price. Commoditization tends to lower the price of products and puts pressure on corporate profits.

TABLE 1. Results of Survey on User Experience Definition.
When a total of 110 researchers and practitioners were surveyed using a questionnaire that offered five different definitions, the following two definitions gained strong support.

Definition most supported by researchers	Paul Hekkert (Professor of Industrial Design department at Delft University of Technology) User Experience is the entire set of effects that is elicited by the interaction between a user and a product, including the degree to which all our senses are gratified (aesthetic experience), the meanings we attach to the product (experience of meaning), and the feelings and emotions that are elicited (emotional experience).
Definition most supported by practitioners	Nielsen Norman Group (US usability consulting firm) User Experience encompasses all aspects of the end-user's interaction with the company, its services, and its products. The first requirement for an exemplary user experience is to meet the exact needs of the customer, without fuss or bother. Next comes simplicity and elegance that produce products that are a joy to own, a joy to use. True user experience goes far beyond giving customers what they say they want, or providing checklist features.

working in the field about which of the five major definitions of UX they felt was most appropriate. The results showed roughly equal support for four of the five definitions[7]. However, when the data was analyzed in terms of the attributes of the respondents, a clear division of opinions was found between those who worked in research, on one hand, and those who worked in a corporate environment and utilized UX in product development, on the other. Table 1 shows results of the survey[8][9].

E. Law and his colleagues held a subsequent workshop at the Dagstuhl Seminar in 2010, and went on to summarize the results in their *User Experience White Paper*[10]. The definition of UX was also included in the revised ISO standard for human-centered design (ISO 9241-210) in 2010. The shared features of these two documents are as follows:

(1) UX represents the values that users recognize in a product or service over time, before, during, and after their use (or purchase) of the product or service concerned.

(2) UX is affected by not only the characteristics of the product or service itself (appearance, functions, performance, and so on), but also the user's inner state (attitudes, skills, expectations, feelings, and so on) and the user's social and physical context.

Experience Design at Hitachi

Taking account of the reviews described above, Hitachi defines "experience" as follows based on the practical considerations of product and service design.

(1) Experiences (user or customer experiences) are the subjective values that the user perceives in a product or service, such as a product that conveys a sense of "extreme comfort," "never-before-seen surprise," "intellectual excitement," or "complete sense of security," which are all irreplaceable. These values are experienced over time in each stage of the product or service lifecycle: from the point of making the purchase decision through to using the product or service after purchase, maintaining the product or service, and purchasing a replacement.

(2) Experience should be considered in terms of the characteristics of users and products or services, as well as the situations in which they are used. Experiences are multi-dimensional and relative phenomena that cannot be evaluated by a single measurement scheme, such as "good or bad" or "55 out of 100 points."

(3) Delivering experiences requires an iterative process: (a) analyze the user's existing requirements and latent needs, (b) design solutions and draw a scenario of how solutions will work for users over time, (c) work with developers, engineers, and users to validate effectiveness, and (d) redesign the products or service if necessary.

EXPERIENCE DESIGN APPROACH

Hitachi believes that its extensive work on designing "experiences" from a user's perspective, primarily in home appliance design, will help to enhance the value of products and services in various industries, such as electric power systems, healthcare, transportation, and IT. Since the 1990s, Hitachi's Design Division has sought to expand its use of the "experience" approach. Furthermore, since 2002, the division has been striving to improve and develop the fundamental technology of experience design and establish a methodology by reviewing past activities[11]. Three elements are fundamental to experience design: a human-centered design process, workshops for developing and visualizing creative ideas, and creating scenarios of the future.

Human-centered Design Process

Human-centered design seeks to provide users with high-valued experience when they use the product or system[12].

One problem with using conventional processes to create high-experience products is the difficulty of obtaining an accurate understanding of how users feel about the products and how they see things. This is because engineers have too much technical knowledge about their products and services. Designers have become so proficient that they can no longer perceive or understand the areas that are apt to cause difficulties[13].

One approach to creating highly satisfying products is for the designers to listen to users' needs in the planning phase and design their products accordingly. That is, to identify problems by collecting user complaints and conducting interviews to determine the sources of user dissatisfaction. In most cases, however, a user's opinions are based on an unsatisfactory experience in a certain situation, and changing the product to satisfy their complaint may only create new problems that arise in different situations. Users are not necessarily able to express the entirety of what they really want.

Human-centered design is aimed at solving these problems by iterating the processes of "understanding and specifying the context of use," "specifying the user requirements," "producing design solutions to meet user requirements," and "evaluating the designs against requirements." Specifically, it involves first observing and interviewing typical users to understand each user's characteristics and the situations in which they use the product or service. Based on these findings, the next step is to define a "persona" (that represents a group of users) with a specific background, including a detailed description of their characteristics and circumstances. From this, a chronological story is developed to imagine what will constitute a satisfying experience for this persona when they are using the product or service for some purpose. The design specification capable of transforming this story into reality is determined. Finally, a prototype is built based on the specification for an iterated process of verification and improvement to make sure that the product or service really does deliver the intended experience to the user.

Experience design aims to provide high-quality experiences to users, but it cannot create the experiences itself. Therefore, it is imperative to iterate both the process of researching users and their circumstances, and the process of redesigning the product or service so that it can be tested to confirm whether it provides the experience intended.

Workshop for Developing and Visualizing Creative Ideas

What makes it possible to realize a design that can dramatically enhance the user experience? The key to this breakthrough is "communication." First, those existing or latent problems that most concern the user can be identified from the investigation of the user's characteristics and usage situations. A design can then be developed that overcomes these concerns and provides the user with a satisfying experience. In this phase, the developers hold workshops to review and share the issues of concern from their various different perspectives, which include themselves being users of the system being developed. The workshop includes the use of concept visualization methods that can be used as a basis for generating creative ideas.

Specifically, the "experience table" technique described later in this article is used to visualize the facts collected in the user research stage. This table presents the user's behaviors and experiences in chronological order. Another method is "stage prototyping," one example of which is the use of actual-scale mockups with dummy equipment and furniture to provide a realistic environment in which the people involved in the development can review the issues of concern and their objectives. Next, an ideal experience scenario ("To-Be" scenario) is created to represent the best-case experiences that that product or service should be providing to the user, along with ideas for how to bridge the gap between this ideal and the existing reality. Finally, the "business *origami*" technique, which is also described later in this article, is used to visualize and finalize the scenario.

The creative workshop focuses primarily on the perspectives of end-users, on flexible thinking, and on visualization. It places less emphasis on objectivity, completeness, and logic.

In recent years, conducting such workshops has become increasingly important in building a true consensus, especially in smart city and other areas of Hitachi's Social Innovation Business that involve multiple stakeholders.

Designing Scenarios of the Future

It is common for products and services created by Hitachi's Social Innovation Business to still be in use five or 10 years later. The study of experience needs

to identify both the current situation and what users will value in the future, so that these can be used to discuss how people's values will change, what sort of life will be regarded as prosperous by people in the future, and what they will be looking for in their products and services. This process can then be used to create scenarios of an ideal future.

Hitachi has made frequent use of movies and other techniques to design scenarios of future lifestyles, the effectiveness of which has been demonstrated in terms of new contracts won and trusting relationships established and deepened with customers. However, while the process of designing these future scenarios currently depends on the intuition and creativity of individual designers, the complex factors involved in designing scenarios of how society might look further into the future (such as in 10 or 20 years' time) means that systematic methodologies will be needed. Hitachi's response to this challenge is described in the article entitled "Methodology Research and Development for Designing Future Experience" in this edition of *Hitachi Review*.

TECHNOLOGIES AND TOOLS FOR USE IN EXPERIENCE DESIGN

Hitachi uses various techniques (methods, tools, and conceptual frameworks) for the three approaches to experience design discussed above. The following section describes some of these techniques.

Ethnographic Research

Ethnography is a social science methodology. Ethnographic research is conducted to observe how users behave with a particular product or service, and analyze collected data against factual data in order to generate an overview of the behaviors concerned. It can also reveal values that are presupposed by users and their latent needs. Frequently, what users say they are doing does not match what they are actually doing. Also, researchers who have investigated user complaints about particular systems have found that many users simply accept their dissatisfactions without speaking up about how they feel. Ethnography is an effective technique for revealing users' latent needs and clarifying the critical issues relating to their work and interaction with the system (see Fig. 1). The technique leads researchers to find solutions for the issues.

Experience Table

Hitachi's initial work in experience design involved developing narrative scenarios for how products and services can provide users with delightful experiences. It found that scenarios could be clarified by writing a story that described how the behaviors and feelings of a user with a specific profile changed over time, as they used the product or service. The problem with this approach, however, is that scenario writing is not a collaborative activity, making it unsuitable for group brainstorming. Instead, what was done in practice was to take a scenario written by one person and review it as a group. Also, the effectiveness with which such a scenario can illustrate its characters' emotions and impressions depends on the skill of the writer. This led Hitachi to develop and introduce a design tool called the "experience table" that allows project teams made up of planners, designers, and user researchers to participate simultaneously in scenario building.

Fig. 2 shows an experience table generated for a project that was developing a system for over-the-counter banking services. The horizontal axis represents time and the sequence of phases. The upper half of the table depicts the flow of bank staff experiences, and the lower half depicts the flow of customer experiences. In each phase, the customer wishes to accomplish a different task. Arriving at the bank, the customer may only want to obtain some information, but having expressed this request they may subsequently want to know more in order to resolve some uncertainty. Likewise, the value that the bank staff should provide to the customer varies from phase to phase. Welcoming a customer who visited the bank, the staff aims to relieve any

Fig. 1—Conducting Ethnographic Research.
The people on the right and left are researchers who are observing and recording the behavior of the worker in the center.

Experience Flow of Customer Satisfaction Improvement

| Before visiting | Over the Counter | Customer Identification | Listen to the customer requests | Transaction Account |

Bank Teller

Door-to-door sales staff visits customers

Want customers to feel an intimate connection

Share customer information with bank tellers

Registration of contact history

Customer Information DB

Get to know better

Trust Building

Understand who will come for what purpose before serving a customer

- Who is the customer?
- What's the purpose for today?
- What transaction history does the customer have?
- Who is responsible for the customer?

Customer Allocation & Handover

Gate to the hospitality

Well-prepared to serve the customer

Refer to the customer information before serving a customer

Home Screen

Transaction Screen | Customer Information

Requests

Low counter

High Counter

ATM

Pop-up

HP/Brochure
Transaction History

What are the customer's needs/wants?

What information needs to be referred?
HP? Brochure?
What was the homework assignment from the previous time?

Operation Support

The most efficient procedure
Coupling operations

Know-how

Determine the transaction steps

The operation flow is visually well-represented.

Show "your special" menu

Create a dedicated menu for the customer and show all the steps for the completion before transaction.

Need knowledge support

Hospitality to the Customer

Goal sharing/

Customer

Found the trustable bank

Tell my requests to the sales staff

Feel that the staff understands me well

Want to visit the bank for a personal consultation at ease

No hesitation to visit the bank

Feel much closer to the staff and service

Decide to start transaction, ensuing that requests are satisfied

They know about my name and situation. "Hello. Ms. □□."

I can tell any requests to this staff!

They understand my requests precisely

- Visit with concerns
- Not well-prepared

- How consultation should be provided and what should be decided depends on each customer

Choose by purpose | Choose by preference of staff | Choose the one with a short waiting time

Start with complete trust

I don't want to explain again.

Welcomed by a bank teller: "Ms. □□, you are here for ○○ today, am I correct?"

Want to feel secured

Tell what I need to bring beforehand

- deposit passbook
- Cash card
- Identify verification documents
- Personal seal
- Finger vein authentication

Know what to

Wondering why I do this for what?

The operation flow is visually well-represented.

"My special" menu

Transparent Schedule

Advance notice provided/ No double work required

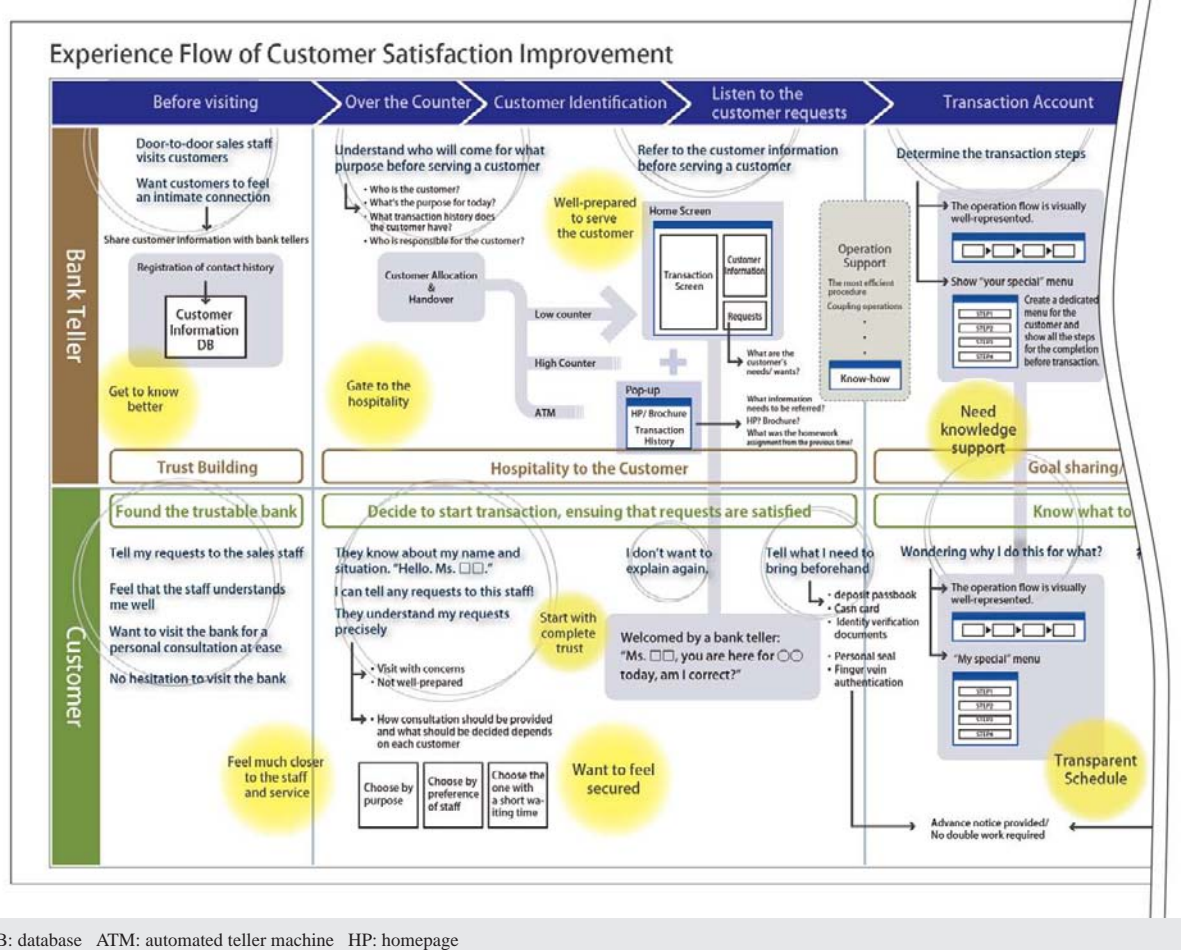DB: database   ATM: automated teller machine   HP: homepage

Fig. 2—Experience Table.
This experience table was created for the development of a next-generation system for over-the-counter banking services. With the aim of providing a high-quality experience for customers, it depicts the sequence of interactions between a bank teller and a customer who is seeking assistance and wants to consult the bank about finance or investment.

customer anxiety. When processing documents after the customer has specified the transaction they want performed, the aim is to impress the customer with the speed of service.

In this way, the experience table presents a clearly defined "To-Be scenario" for the system that reflects the perspectives, expectations, and feelings of the stakeholders. It allows project members to collaborate on scenario creation by providing a comprehensive and panoramic view of the series of interactions that make up an experience.

Another advantage of creating scenarios from a consensus of developers and users with different perspectives is that it is especially useful in large system projects where members are prone to lose sight of the initial requirements (the "To-Be scenario") as the project proceeds. This is because, while it is common for team members to focus excessively

on the detailed specifications, the experience table, having been created and shared by everyone involved, reminds them of the ultimate scenario that they are aiming for, regardless of where in the project they currently are. Recognizing the value of this, Hitachi uses the experience table as a crucial platform for presenting chronological representations of the concepts and visions that underlie a product or service.

Business *Origami*

After acquiring an understanding of current user experiences using research methods such as ethnography, researchers have to face the challenge of how to develop new services. An important aspect of this is to use a customer-oriented approach to the reconstruction of the existing value chain. It is always difficult for stakeholders to give up old value chains that prioritize their convenience in any system

development or service distribution. Accordingly, business *origami* was developed and introduced to support the customer-oriented construction of services[14].

Business *origami* is a design tool that gathers participants with different opinions around a table for a lively discussion of a new value chain, and involves placing *origami* models of people or buildings on the table to present an overview of stakeholders' interests and concerns. The method includes a facilitator whose role is to encourage participants to look at the situation from a service-oriented perspective and identify what features are missing. Participants are also encouraged to consider the overall picture and proactively contribute ideas to the discussion (see Fig. 3). In comparison to discussions around a whiteboard, which are apt to be dominated by the person writing on the board, business *origami* discussions around the table greatly enhance the involvement of all participants.

Hitachi Style

To provide an enriched experience through a product or service, it is necessary for designers to specify the objective they hope to achieve by offering a particular experience to users, as well as to create specific stories and scenes that show how this objective will be accomplished. In the case of an express train, for example, the customer experience will be different depending on whether they are traveling for pleasure with someone close or merely commuting to work. Possible emotions associated with the experience might include excitement, comfort, or the trip being a memorable event. Hitachi is involved in a wide range of businesses, with products and services that interact with users in a variety of settings, from the home to offices and public facilities. To respond to this diversity, Hitachi has created its own design philosophy called "Hitachi Style." This philosophy was developed firstly by analyzing users' expectations and what it would take to provide an ideal user experience. Next, Hitachi products and services are reclassified from a customer's perspective (which is different from Hitachi's business categories). Lastly, the design approaches suitable for these new classifications are identified and then grouped under the following categories:

(1) Hobby gear: an attractive design that provides pleasure in daily life with advanced technology
(2) Life component: a design that supports daily life through home appliances with utility and beauty
(3) Professional partner: a design that satisfies high-

Fig. 3—Using Business Origami.
Project members use origami models of people and buildings as props for holding active discussions with the aim of constructing a customer-centered value chain.

level professional requirements critical for daily work
(4) Natural support: a design that provides public utility through efficient infrastructure to make our daily life go smoothly
(5) Practical tool: a comprehensive design that achieves a specific goal
(6) Experience highlight: a design that provides great fulfillment in daily life by offering extraordinary experiences
(7) Symbolic infrastructure: a design that embodies the concept of the core technology that runs society

These categories provide directions on how to represent products and services, and on how to design user experiences (see Fig. 4).

ARTICLES IN THIS EDITION OF HITACHI REVIEW

The previous sections have discussed the definition of user experience and the different approaches and techniques used in experience design. This section provides an overview of the articles in this edition of *Hitachi Review*.

The article, "Interior Design for Gran Class of E5 Tohoku Shinkansen "Hayabusa": An Unprecedented Journey Experience," describes the design of a luxurious railway car intended to provide passengers with a special experience that they recognize as being worth a premium rate, and that they will want to repeat. The article reviews the design process, including its methodologies and how these are incorporated into the end product, and explains how the subjective values of passengers are identified and how the interior and services provided by the passenger car satisfy these values.
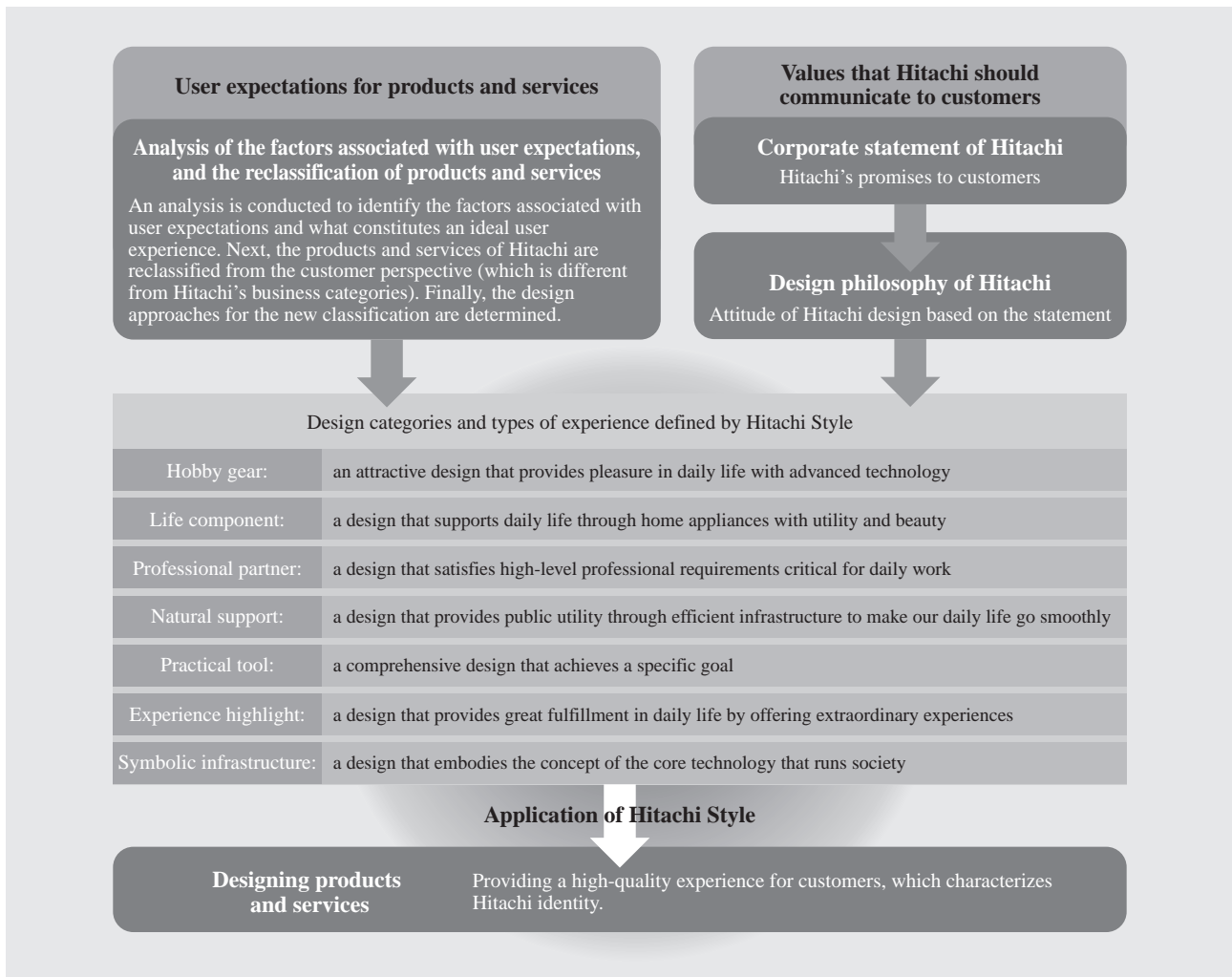
User expectations for products and services

Analysis of the factors associated with user expectations, and the reclassification of products and services

An analysis is conducted to identify the factors associated with user expectations and what constitutes an ideal user experience. Next, the products and services of Hitachi are reclassified from the customer perspective (which is different from Hitachi's business categories). Finally, the design approaches for the new classification are determined.

Values that Hitachi should communicate to customers

Corporate statement of Hitachi
Hitachi's promises to customers

Design philosophy of Hitachi
Attitude of Hitachi design based on the statement

Design categories and types of experience defined by Hitachi Style

Hobby gear:	an attractive design that provides pleasure in daily life with advanced technology
Life component:	a design that supports daily life through home appliances with utility and beauty
Professional partner:	a design that satisfies high-level professional requirements critical for daily work
Natural support:	a design that provides public utility through efficient infrastructure to make our daily life go smoothly
Practical tool:	a comprehensive design that achieves a specific goal
Experience highlight:	a design that provides great fulfillment in daily life by offering extraordinary experiences
Symbolic infrastructure:	a design that embodies the concept of the core technology that runs society

Application of Hitachi Style

Designing products and services
Providing a high-quality experience for customers, which characterizes Hitachi identity.

Fig. 4—Definition of Hitachi Style.
The Hitachi Style means delivering a "Hitachi experience" that satisfies customers by integrating users' expectations of products or services with the value that Hitachi seeks to offer.

The article, "Design of Hitachi's Carbon-fiber-reinforced Plastic Head and Pipe and Easy Grip: A Vacuum Cleaner with a Lightweight Feel," describes how Hitachi went about designing a vacuum cleaner with a physically and psychologically "light" maneuverability. The lightweight feel makes the experience of vacuum cleaning more pleasant for users. While home appliances are sometimes thought of as having exhausted the possibilities for design enhancement, this article explains how a traditional design approach could still create vacuum cleaners with a new sense of beauty and utility in our daily life.

The article, "Applications and Benefits of Ethnographic Research —Case Study of Management System Upgrade for Power Plant Construction Site—" describes the use of ethnographic research to identify the underlying problems associated with construction and management at a plant construction site. The

article explains how solution ideas were generated to improve the systems, and includes a detailed discussion of the effectiveness of ethnographic research.

Delivering an experience is not just about focusing on a user's direct interactions with the product or service concerned. The article, "Marketing Communication Support for Global Software Sales," describes a study that sought to identify what constitutes a high-quality user experience at the various points of contact with the customer. The study considered the sequence of steps performed by the customer, from collecting information from the Internet before purchasing through to downloading a trial version of the software, purchasing the software, and using and upgrading the software.

The article, "Development of Experience-oriented Approach to Information and Telecommunication Systems Business," introduces Hitachi's own

methodology for requirements development, which aims at providing a high-quality experience for system users during the upstream processes of system development. A characteristic of this methodology is that not only IT specialists, but also "designers" participate in the development process of system requirements, and use the different approaches and methods for experience design as described above. While a number of articles on features and benefits of this approach and methods were published before, the article, "Development of Experience-oriented Approach to Information and Telecommunication Systems Business" goes into greater detail about how they are applied in actual projects, and considers the most effective ways in which they can be used. It provides an example of how the scope of experience design extends to the planning phases of system development[15], [16], [17].

The smart city projects are integral parts of Hitachi's Social Innovation Business. The article, "Experience Design to Realize Value for Life in Smart Cities," illustrates how Hitachi is striving to create unique concepts for smart cities by studying their values from the perspective of experience design. It also presents specific measures for the design-oriented development of smart city solutions, along with prospects for the future.

The article, "Methodology Research and Development for Designing Future Experience," explores a methodology for plotting people's future experiences, which is an extremely challenging topic. Using smart city themes as an example, it explains a series of processes that are integrated into the methodology, starting with the collection of facts on social environment, followed by the analysis and interpretation of the structure of the value of experience pertaining to these themes, and concluding by depicting possible future social infrastructure and services.

DELIVERING BETTER QUALITY EXPERIENCES

Experience design begins with the discovery of happy moments that people experience in their everyday life. This edition has described examples of designs that deliver valuable experiences in various everyday situations, such as taking a special trip by train, taking a break from housework, or searching the Internet to purchase software for work.

To realize many more happy moments through social innovation, Hitachi intends to continue enhancing the study of experience design.

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Interior Design for Gran Class of E5 Tohoku Shinkansen "Hayabusa": An Unprecedented Journey Experience

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OVERVIEW: The Gran Class is the first new grade of passenger car to be introduced since the Shinkansen began operating. Its design needed to provide not only a luxurious interior, but also an extraordinary experience that would justify the additional cost of a premium seat. Hitachi had collaborated with the East Japan Railway Company to develop the design of the new Gran Class passenger car for the E5 "Hayabusa" used on the Tohoku Shinkansen. The aim was to provide an unprecedented travel experience. The initial design work involved visualizing how passengers would use the car. This was followed by the formulation of scenarios covering different travel experiences that were then used to determine passengers' latent requirements and subjective values. The final step was to develop the style of service and interior that would satisfy the requirements identified from the scenarios. In producing this design for an unprecedented premium passenger car, Hitachi found that it needed to trial a variety of different methodologies and to utilize manufacturing techniques with a high degree of craftsmanship.

INTRODUCTION

HITACHI and the East Japan Railway Company (JR East) have for some time been jointly engaged in the development and production of Shinkansen passenger cars for services to the new Shin-Aomori Station on the Tohoku Shinkansen.

The first of the new Gran Class Shinkansen passenger cars commenced operation as part of the E5 Shinkansen (production model) that entered service in March 2011 (see Fig. 1). Conceived as a premium passenger car that delivers an exclusive and spacious traveling service, the design of the Gran Class needed

Fig. 1—Gran Class Interior in East Japan Railway Company's E5 Shinkansen.
The E5 Shinkansen provides a new luxury-class passenger car of a type not seen on previous Shinkansen trains.

to embody an extraordinary experience unlike any provided by previous trains.

This article describes how Hitachi went about developing its ideas and then embodying these in the Gran Class in order to create an unprecedented travel experience for the Tohoku Shinkansen E5*.

ORIGINS OF NEW DESIGN

Normally, the requirements that form the basis of a design can be obtained by considering the relevant factors, such as who will use the service and in what way, in the light of past experience. In the case of the Gran Class project, in contrast, the initial requirements were not clearly laid out. Instead, the objective was to design an exclusive passenger car of a type that had never existed on the Shinkansen in the past, and that would provide an extraordinary experience.

In response, the Design Division of Hitachi looked at studies undertaken in Japan by JR East for use in developing the E5 Shinkansen, seeking to determine what dissatisfactions and expectations customers had regarding the current Shinkansen service. This analysis found that what customers were looking for in terms of facilities and services could be split into two levels. The first comprised basic requirements shared by everyone that will lead to dissatisfaction if not provided. Examples include wider seats or having two armrests. The second were higher level expectations that make the time passengers spend on the train more pleasant, such as having relaxing seats and providing proper cutlery with meals.

While eliminating the sort of universal dissatisfactions associated with the former category of requirements is a prerequisite for all classes, the exclusive Gran Class also needs to deliver an extraordinary experience that surpasses the expectations represented by the latter category. Hitachi concluded that these two levels of needs were the keys to creating a successful design for which customers would be willing to pay a premium.

DEFINING PERSONAS AND IDENTIFYING TARGET USERS

To add realism to the work on developing an extraordinary experience, Hitachi identified scenarios for the type of person who would likely use the Gran Class.

Different types of passengers will have different expectations for the services and interior provided by the new class. Accordingly, working on the assumption that Gran Class passengers will have a similar profile to passengers on existing Green Car services, Hitachi looked at the travel reasons and age distribution of Green Car passengers. This indicated that 70% of passengers on weekdays were traveling for business, whereas on weekends the proportions were reversed, with 70% traveling for pleasure. In terms of age, more than 60% of passengers were aged 50 or over (the "senior" category). As the Gran Class is positioned as a class above the Green Car, it was envisaged that the target passengers would be affluent people from among existing Green Car users, with the target age group being the same or slightly older. In other words, they would be discerning customers who were accustomed to high-quality environments and products, and would be a mix of people traveling for business and for pleasure.

Hitachi then went on to characterize archetypal Gran Class passengers as a way of explicitly representing the different passenger category scenarios that were to be used in the design process. The two passenger categories assumed for this purpose were: (1) executives traveling for business purposes, and (2) elderly couples traveling for pleasure.

To make the assessment of the Gran Class user experience more realistic, Hitachi defined "personas" for each of these passenger categories. For example, the business executive category was personified by a 57-year-old executive returning from a business trip in which he accompanied a customer on a visit to a production line in an Aomori factory. His job would have left him tired and looking forward to relaxing on the train, and he would be a frequent Gran Class passenger, traveling two or three times a month either in the morning or at night. In other words, the travel experience was studied with reference to these personas who were defined in terms of their age, occupation, reason for travel, how they wanted to spend their time on the train, and their travel schedule requirements.

TRIALS OF SCENARIO-BASED DESIGN

There are two reasons for creating a narrative describing how these constructed personas would go about catching the Shinkansen, spending their time on the train, and getting off at their destination. The first is to identify emotional expectations and latent requirements that are difficult to uncover from conventional surveys. The second is to use the story-telling process as a means for stimulating people's imaginations so as to expand their conception of the

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* The E5 Shinkansen has been adopted in other trains besides "Hayabusa," such as "Hayate," "Yamabiko," and "Nasuno."

interiors and required facilities that appear in the story. In both cases, these act as a framework for giving shape to abstract concepts during the process of deciding on actual train services, what facilities these services require, and what sort of lighting and other interior fittings are needed to realize the vision for the space.

The following is an extract from a travel scenario used in the detailed design that describes a trip taken by a business executive on the Gran Class.

The scenario imagines a business executive on his way home from Shin-Aomori Station in the evening. His work day went well, leaving him in a good mood as he took his place on one of two side-by-side seats, looking forward to relaxing in the Gran Class as it carried him back to Omiya Station.

(The first part of the story is omitted.)

"Having had a few beers, I decide I would like to drink a little more. Since there is still plenty of time before we reach Omiya Station, I press the call button to ask the service attendant for a glass of whisky on the rocks. This she promptly delivers, arriving with a tray containing a large glass and some nuts which she proceeds to place on my cocktail table, serving with a smile. I'm impressed that she even brings a chaser to go with the whisky. How thoughtful! Holding the crystal glass in one hand, I start checking my schedule. But today went so well, I decide instead to spend my return trip relaxing. As I enjoy the aroma and flavor of the single malt whisky, I use my finger to circle the big round ice cube.

"When I boarded the train at Aomori, I noticed a formally dressed woman in the adjacent seat and wondered whether she was on her way to a wedding. I am glad that the partitions between seats allow us to relax freely with no chance of meeting each other's eyes. The seat is spacious and large. The indirect lighting is slightly dim but comfortable, while a bright reading light is also provided specifically for my seat. The seat itself comes with special large armrests, and the exclusive personal space almost makes me forgot I am on a train. Everything I need is within reach. The passenger who is sitting next to me does not bother me at all. This luxury space is really specially made for me.

"After drinking the whisky, I decide to take a nap before arriving at Omiya station. I lower my seat into a comfortable reclining position that provides good support and a reassuring sense of encapsulation. I am more glad than ever that I decided to travel Gran

Class. The personal service provided by the attendant is delightful and thoughtful, and having this space to myself gives a sense of exclusivity. A pleasant break from my usual routine, it is almost like taking a room at a luxury hotel, giving me time to relax. I will definitely choose Gran Class again the next time I travel. While thinking this, I drift off to sleep."

The highlight experiences for the passenger in this high-end train scenario were the sorts of things that could not possibly be obtained from conventional surveys. Examples include the smiling and attentive attendant, the unexpected and thoughtful provision of a chaser, the exclusivity and spaciousness of the seating, and the satisfaction of being given adequate personal space without intruding on that of other people. These images also provided key pointers for designing the actual services and facilities.

Hitachi identified the experience provided by these "attitudes" (*furumai*) and "facilities" (*shitsurae*) with their attendant emotional values as being important elements in providing an extraordinary travel experience for targeted customers who would be prepared to pay for a premium seat. In producing a design capable of bringing these elements to life, Hitachi would be creating an unprecedented premium car.

Creating these detailed scenarios for different categories of target passenger served to clarify the various requirements that the Gran Class would need to meet. Based on these, Hitachi condensed the world view represented by the Gran Class experience into an overall design concept: "Exclusive dream: An unprecedented journey experience."

ACTUAL INTERIOR DESIGN

The next step was to use these scenarios as a basis for creating a specific visual design for each of the different situations. This process gave visual form to the space that would provide the business executive with this special experience, and the facilities needed to deliver the accompanying level of service (see Fig. 2).

To deepen the link between the visual images derived from the scenarios and the actual car interiors, Hitachi surveyed the interiors at five prestigious foreign-owned hotels in Tokyo to act as a benchmark for the level of luxury and hospitality needed to surpass everyday expectations. The reason for using these hotels as a reference was because they were seen as representing a commonly accepted standard for quality and service.

Fig. 2—Design Study of Space and Facility Requirements.
Travel scenarios for target users were represented as visual images and used to consider what spaces would provide this special experience, and what facilities would be needed to deliver the accompanying service.

Three elements were identified from this analysis. Firstly, the hotel rooms were furnished in a consistent simple and contemporary style. Secondly, a rich textured feel was achieved through the use of rustic wooden materials and glossy fabrics. The third element was that a high-end atmosphere was created through skillful color coordination in the arrangement of these high-quality materials. This approach of expressing a sense of quality through a simple basic design together with rich materials and finely balanced color combinations is called the "authentic modern" style, and it was designated as the benchmark for the interior design of the cars (see Fig. 3).

The hotel study also identified lighting design as another factor in creating a high-quality impression. The approach taken is to use multiple sources of indirect lighting that combine to provide a subdued atmosphere, with some areas left purposely dark while others are elegantly highlighted with spotlighting. This lighting method is called "task and ambient lighting." It creates a calm and relaxing mood in a room by using standing lamps to provide indirect lighting for overall illumination, with localized lighting provided where needed for specific tasks such as reading. This is a well-established approach to creating a sophisticated lighting environment in which the darkness emphasizes the brightness.

Hitachi saw the application of this design methodology for creating high-quality hotel rooms to the Gran Class as a means of creating an interior space that conveys an impression of quality the moment the passenger enters the car.

Specifically, to create a design in keeping with this "authentic modern" style of color and finish, a loop pile carpet in a Bordeaux wine color was combined with the matte white-beige finish of illuminated

Fig. 3—Selection of Materials for Achieving "Authentic Modern" Style.
The style is simple and contemporary. An atmosphere of luxury is created from a color-coordinated combination of high-quality materials, including rustic woods and glossy fabrics.

surfaces and seats of high-quality leather in a matching shade of beige, with the overall effect being accented by dark-brown wood with a clear grain pattern. The lighting also drew on techniques used in hotels, with a design that used multiple sources of indirect lighting to create elegant pools of light against a darker background, including cross-car-mounted ceiling lights, window frame lighting, and lights mounted under the overhead rack and in foot wells. This is called "multi-ambient lighting," and is intended to create a heightened sense of personal space and exclusive luxury though careful integration with the design of the area around the seat.

METICULOUS CAR DESIGN THAT DELIVERS "EXPERIENCE"

Incorporating a sophisticated design into the finished car has a vital role in achieving a richness of "experience". In designing the Gran Class, Hitachi faced a number of new challenges. In particular, if the intended effect was not achieved, the service would fail to inspire the discerning customers who were its target market. The way to leave passengers with a sense of having gained a special "experience value" was to build a level of facilities that could create an

environment where such an experience could be had. In this, the seat design and the multi-ambient lighting were recognized as being the key factors to consider. It was these factors that would determine how successfully the design achieved its aim of delivering "experiences" such as the sense of superiority that comes from being in an exclusive space with a level of luxury akin to that of a top hotel, or the satisfaction of occupying your own personal space.

Lighting

Light-emitting diode (LED) lighting was selected for use throughout the Gran Class cars, from the seating compartment to the private deck. This took advantage of the characteristics of LED lights, which provide an even distribution of light in a compact device, creating an innovative lighting method suitable for the limited spaces available, such as window frames, ceiling lighting, and lighting in the deck supporting rails. Close attention was paid to the lighting effects provided by the window frame lights. Specifically, the design was able to incorporate lighting into the limited space available in the window frames while keeping the light source itself invisible, something that was not possible using previous types of light fitting. Careful consideration was also given to the orientation and positions of LED lights to ensure a pleasant and even distribution of light across the side walls, which acted as a reflective surface for dispersing illumination. In selecting these side wall panels, the design team conducted a thorough investigation to identify ways of keeping joints and inspection covers hidden while also ensuring that they satisfied the requirements for cleaning and maintenance. Furthermore, the delicate nature of the indirect reflected light meant that any shadows or lack of uniformity in the illumination would be seen as a design flaw. To achieve an elegant gradation of light, the team made frequent visits to the factory for prototyping and testing, looking at factors such as the shape of reflective surfaces and the degree of sheen in surface coatings, until they were able to create a level of finish with which they could be satisfied (see Fig. 4).

For the private deck (entry lobby), it was recognized that this space needed to act as an entrance to an extraordinary experience that symbolically represented the beginning of the trip. Taking account of the path that passengers would follow, its design used indirect lights at the entrance door and supporting rail lighting to draw in the passenger in a way that expressed its role as a welcoming space. Spatial requirements meant

that the service attendant room was located between the seating area and bathroom. An exceptional design was used for the region in front of the service attendant room. This created a high-quality space that conveyed the impression of a lobby area leading into the seating compartment, with materials, colors, and furnishings that coordinated with the passenger area, and an indirect overhead lighting system that turned the entire ceiling into a source of illumination (see Fig. 5).

Seats

As the items of interior furniture with which passengers come into direct bodily contact, seats are the most important and effective factors in delivering the experience of exclusive space provided by the Gran Class. In putting together the seat design, Hitachi sought to have the seats convey both a sense of quality and a relaxing appearance, while also maintaining

Fig. 4—LED Window Frame Lighting.
Repeated prototyping and testing were conducted prior to achieving the finished product, looking at factors such as where to locate LED lights, which wall shapes were most effective, and the best choice of surface sheen.
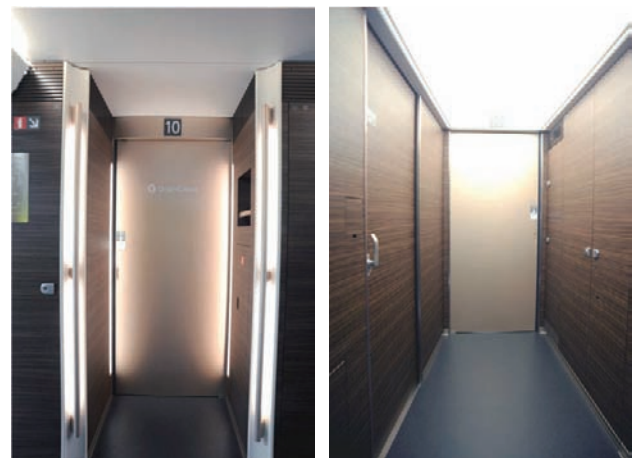

Fig. 5—Gran Class Private Deck.
The private deck (entrance lobby) on the Gran Class (left) uses lighting to draw passengers into the interior, and the passage to the bathroom (right) uses indirect ceiling lighting to create a high-quality space.

the optimum ergonomic form as recommended by the seat manufacturer. A further consideration was to design the seating in a way that integrated with the car interior. The seats are electrically operated with a single button for setting the most relaxing position, including the position of the foot-rest and leg-rest. A particular focus of the design was to give passengers the sense of a spacious personal area that provided enveloping support for their entire body. The seat pitch was increased to 1,300 mm and a design with a slim back shell was selected to maximize the space for each passenger while also satisfying the requirement, specific to trains, that the seats be able to rotate 180°. The design also ensured that the rear of the seats had an elegant flawless line, this being the part of the interior design that would spend the most time in the passenger's line of sight.

Other special features for enhancing seat comfort include partitions that separate people in adjacent seats from each other's view, flexible reading lights, movable headrests, folding tables, and magazine pockets (see Fig. 6).

Design for Sensory Stimulation

In addition to providing a quality visual experience, the design also sought to stimulate the other senses. Noise is one example, an issue that becomes more of a problem as trains get faster. The Gran Class, however, succeeded in significantly reducing noise levels compared to other classes through the use of thicker acoustic absorbents, wool carpet with a long loop size, and overhead storage compartments.

Use of carpet with a long loop size complements the properties of wool, being soft to the tread. Considerable testing was carried out to find the best combination of loop lengths and densities, with

numerous samples being tested before deciding on the final specifications. This included stepping on samples directly to assess the differences. A bright beige was chosen as the seat color to emphasize this high quality, the color being selected as one that would soon appear dirty unless frequently cleaned. The idea was to give passengers a sense of satisfaction that would come from being in a high-end car furnished using genuine materials that they could touch for themselves.

That is, as soon as the passenger entered the car, the furnishings presented their senses with an immediate impression of being in a special place. This was used as a way to give the passenger an experience of exclusivity, inducing a feeling of satisfaction that would make them glad they chose to take the train and want to do the same again in the future.

As the final stage of the development, a full-size interior mock-up was built to assess the actual experience created by the space, with its unprecedented interior layout and lighting effects. This was used to evaluate the interior design, verify that the intended lighting effects were in fact achieved, and confirm

Fig. 6—Gran Class Seats.
The seats provide an exclusive personal space designed for optimal seating comfort with enveloping support for the entire body.

Fig. 7—Full-size Interior Mock-up Used to Evaluate Design.
The mock-up was used to conduct an overall evaluation and verification of the interior design, lighting effects, compatibility between interior materials and the seating, and the sense of high quality conveyed by the space.

the compatibility between the interior materials and the seating. It was also used to assess and verify that these elements all worked together to convey the high quality of the space. The design team worked as a group to eliminate one by one any specific problems that were identified. The end result was a production model car that featured a level of exclusivity, quality, and finish that went beyond any existing train (see Fig. 7).

CONCLUSIONS

This article has described how Hitachi went about developing its ideas and then embodying these in the Gran Class in order to create an unprecedented travel experience for the Tohoku Shinkansen E5.

The E5 "Hayabusa" has already been in operation for several months, during which time it has received considerable positive feedback from passengers, with its exclusivity also featuring in a number of media reports.

While numerous ideas for the service were suggested in the early stages of the development, the need to consider operational implications made it difficult to make a detailed examination of their potential. Meanwhile, the key factors for further enhancing the passenger experience included not only special facilities or features that enhance passenger convenience, but also aspects of human behavior such as having service attendants who provide friendly and attentive service. Accordingly, the concept behind the Gran Class design included providing in-car facilities that would help service attendants provide better service. For example, providing adequate galley space to facilitate the preparation of meals and drinks will make the service attendants' job easier and less stressful, freeing them to concentrate more on providing a better service to their customers.

Drawing on ideas such as this, Hitachi intends to continue working on design proposals that deliver a richer and more sophisticated railway travel experience.

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Design of Hitachi's Carbon-fiber-reinforced Plastic Head and Pipe and Easy Grip: A Vacuum Cleaner with a Lightweight Feel

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OVERVIEW: When designing home appliances, Hitachi's Design Division aims to create devices that support people's everyday lives and are easy to use. Its traditional approach had been based on a process of observing actual appliance use to gain ideas, and then building and testing prototypes to create a potential product. This approach was also adopted for a project to design a new vacuum cleaner that began in the summer of 2010. The carbon-fiber-reinforced plastic head and pipe and easy grip vacuum cleaner, launched in July 2011, was designed and developed by using the experience design approach to home appliances, which involves the use of specific methods for discovering issues and solving problems.

INTRODUCTION

BECAUSE home appliances are widely used in everyday life, comfort and ease of use are key features. As vacuum cleaning is not a part of daily housework that people tend to enjoy, in developing this new vacuum cleaner, Hitachi sought to relieve some of the drudgery of the task by making it more relaxing and pleasant. To this end, various convenience features were developed for the new vacuum cleaner. These included a multi-angle head (vacuum mouthpiece) that can swivel 90° left and right to facilitate cleaning in narrow spaces and near walls. Another feature was a mechanism that allows the head and connecting pipe tube to lie flat on the floor, making it easier to clean under beds. The vacuum cleaner also has a one-touch zoom pipe for easy adjustment of the pipe length.

When developing the fiscal 2011 model, fiscal 2010 research by Hitachi found that "head operability" was ranked as one of the most important points when purchasing a vacuum cleaner. Therefore, when developing the new model, Hitachi focused on designing a head that would provide a better vacuuming experience for the user. This focus on operability was needed because, while the new vacuum cleaner would make the head, extension pipes, and grip functions more convenient, in doing so the structure of the vacuum cleaner would become more complicated, increasing both its weight and number of parts. The risk was that this would leave the vacuum cleaner feeling heavy and difficult to operate, leading to user dissatisfaction.

The objectives of the designers were to improve the vacuum cleaner's operability and reduce its weight without impairing its convenience. Therefore, the behavior of users was closely observed, and research was conducted to identify how to solve this problem. While seeking to make the vacuum cleaner physically lighter, they also focused on making it look and feel lighter in operation, even while the weight remained the same. The design of the carbon-fiber-reinforced plastic (CFRP) head and pipe and easy grip was developed by concentrating on these goals (see Fig. 1).

The design and development of the CFRP head and pipe and easy grip aimed for a feeling of lightweight operation. This article describes the methods used to discover issues and solve problems so that the user experience of the vacuum cleaner would be one of surprise at how light and easy to use it feels.

UNDERSTANDING BY OBSERVING ACTUAL USE

To develop the new vacuum cleaner, Hitachi conducted research and visited the homes of people using Hitachi vacuum cleaners (seven persons, aged 30 to 50) to understand and observe how their vacuum cleaners were actually used.

For the research, acceleration sensors and angular velocity sensors were attached to record information on movements of the head of the vacuum cleaner, and interviews with the users were videoed (see Fig. 2).

Study of the movement information recorded for the head showed a greater than anticipated frequency of up and down movements. In other words, lifting the head is a commonly performed action. An analysis of the reasons for this frequent up and down movement found that it was to perform the following actions.

CFRP head and pipe

CFRP is used in the head and extension pipe.

The revolving brush core (axis), the head upper case, and the inner and outer pipes are made from CFRP.

CFRP: carbon-fiber-reinforced plastic

Easy to push, easy to pull

Easy to lift

Easy grip

Fig. 1—CFRP Head and Pipe and Easy Grip (CV-SU7000).
Along with physically reducing the weight of the extension pipes and head, Hitachi sought to give the vacuum cleaner a lighter feel and appearance for the same weight. In addition, the CFRP head and pipe and easy grip design was adopted for the CV-SU7000, CV-SU5000, CV-SU3000, CV-SU20, CV-PU300, and CV-PU20 models.

(1) Lifting the head for floor coverings

To prevent mats and other floor coverings from getting snagged or entwined in the head and slipping during vacuuming, the user places a foot on the covering and lifts up the vacuum head. When putting the head on the covering, the user lifts the head to keep it from snagging.

(2) Lifting the head when moving or changing direction

When moving to a new location, the user lifts the head and changes position. (When the user lifts the head, turns, and changes direction after vacuuming the corner of a room, for example.)

(3) Crossing over cords and other obstacles on the floor

The user lifts the head to avoid the vacuum cleaner power cord and other obstacles on the floor.

(4) Crossing thresholds

When cleaning split-level rooms or crossing thresholds, the user repeatedly lifts the head off the floor during vacuuming.

(5) Lifting the head on the stairs

When vacuuming stairs, the user has to lift the head when moving up and down the stairs.

Table 1 shows the average number of times a user lifted the head during each of the five situations described above. When the number of times the head was lifted was calculated, a great variation was found between different users. Users who lifted the head infrequently did so about once every 25 s, whereas users who lifted it most frequently did so about once every 5 s.

These observations and analyses indicated that making the vacuum cleaner head lighter to lift would make it much easier to use.

Lifting the head over floor coverings (rugs, mats, carpets, etc.)

Moving to a new location

Fig. 2—Results of Research at Users' Homes.
Rather than trying to predict users' behavior without having any real appreciation of the task, the development team were able to understand and experience the actual situations involved in vacuuming by directly observing users' behavior.

TABLE 1. Number of Times User Lifted Vacuum Head during Vacuuming
The head was lifted more frequently than expected.

Situation	Average number of times head lifted
(1) Lifting the head for carpets, rugs, etc.	About 24 times
(2) Lifting the head when moving or changing direction	About 15 times
(3) Lifting the head over a cord or other obstacle on the floor	About 7 times
(4) Going to rooms on another level, crossing door thresholds*	About 15 times
(5) Lifting the head on stairs*	About 14 times

* Average number of times for houses or apartments where this situation applied

DESIGNING EXPERIENCE OF "LIGHTNESS"

One of the aims of the product development was to provide the user with an experience of "lightness." In other words, making a vacuum cleaner that would look and feel light to users and convey an immediate impression of being easy to use. This led the developers to set themselves three targets for the design: making the vacuum cleaner physically light, making it feel light, and making it appear light.

Making Vacuum Cleaner Physically Light

To make the vacuum cleaner physically light, a project team was created from various divisions, consisting mainly of staff from the Strategy Planning Division of Hitachi Appliances Inc., but also including people from other divisions, such as Product Planning, Production Technology, and Design. Staff from Hitachi's Design Division also joined the project team. The team held a number of discussions and made prototypes.

The main user actions when lifting the vacuum cleaner's head involve handling four parts: the head, the extension pipe, the grip, and the hose. Of these, the developers chose to focus their attention on the material used in the head and the extension pipe, the parts located in front of the user's hands, selecting a strong and lightweight carbon-fiber-reinforced plastic. The development work included an investigation of the material's strength and external appearance.

For strength, a conventional pipe die was used and several samples of different thicknesses were made. Endurance testing was used to determine the minimum thickness, resulting in a lightweight sample capable of maintaining its strength.

For the exterior, it was found that the method used to mix the CFRP resulted in uneven areas appearing on the fiber surface of parts after injection molding. In response, the project team studied the molding conditions (injection speed) and selected conditions that would smooth out the uneven carbon spots. A surface graining process was devised to make the uneven spots difficult to see (see Fig. 3).

CFRP was also used in the head. Specifically, it was used in the core (axis) of the revolving brush and the upper case. The aim was to make the structure of the head thinner and lighter while keeping its strength and making the internal motor smaller (see Fig. 4).

Through this process, Hitachi was able to reduce the total weight of the extension pipe and head in the development model from 940 g to 820 g (13% reduction).
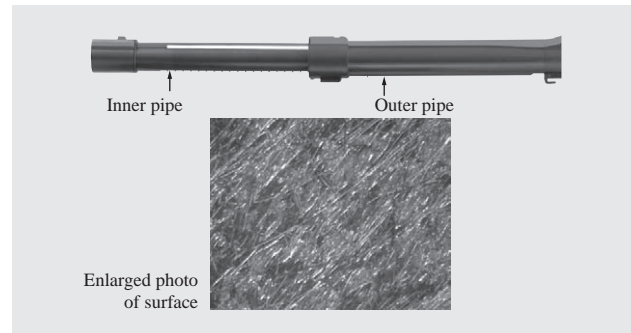
Fig. 3—Use of CFRP in Extension Pipes.
Adopting CFRP for the inner and outer pipes made the pipes thinner while maintaining strength, resulting in a reduction in weight.
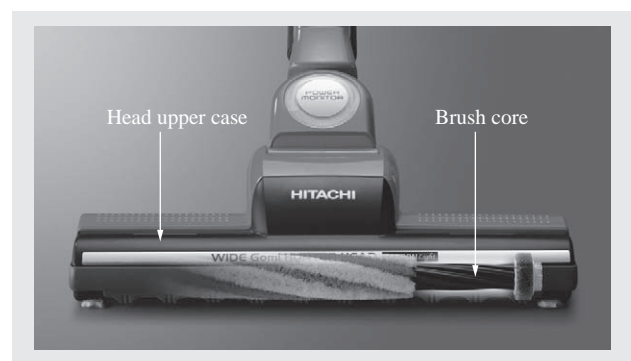
Fig. 4—Head Made from CFRP.
CFRP was used in the head upper case and in the revolving brush core (axis). The size and weight of the internal motor were reduced.

The developers then reviewed and optimized the length of the extension pipe and grip to reduce further the physical weight of the vacuum cleaner. The determining factor here is that the shorter the distance between the user's grip and the weight-bearing head, the lower the perceived force (moment) on the user's fingers and hand and the more easily the head can be lifted (see Fig. 5).

Statistical data on the height of Japanese people were used to characterize vacuum cleaner users. User height was assumed to be between 140.9 and 178.0 cm, which covers 98% of women aged between
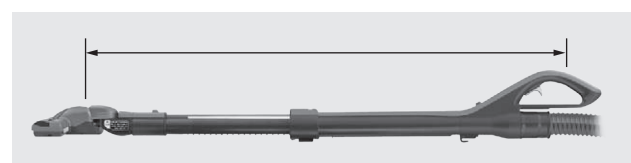
Fig. 5—Length from Head to Grip.
The length from the heavy head to the grip was optimized. The aim was to make the vacuum cleaner feel lighter by making greater use of the force exerted by the user's hand and fingers.

25 and 69, centered on the median height. In the case of men, it covers 85% of this age group although it is offset toward the shorter end of the height distribution.

A series of investigations was then performed to assess the optimum head-to-grip length that would allow persons in this height range to use the vacuum cleaner comfortably. This produced a head-to-grip length (for the case when the extension pipe is at its maximum length) that was 40 mm shorter than previous models. In other words, the vacuum cleaner was also made lighter in terms of the force a user would exert when using it.

Making Vacuum Cleaner Feel Light

Along with physically reducing the weight of the extension pipes and head, Hitachi also sought to give the vacuum cleaner a lighter feel for the same weight by changing the shape of the grip. To achieve this objective, a workshop was held by a project team consisting of staff from Hitachi's Design Division

Fig. 6—Workshop in Progress.
The workshop included a detailed discussion (above) that covered even minor points. A number of simple grip models were produced to evaluate their performance.

and from various divisions in Hitachi Appliances Inc., including the Design Division, Lifecycle Research Center, and the Strategy Planning Division.

The workshop participants started by trying out vacuum cleaners made by Hitachi and other companies. They then engaged in a detailed discussion of the elements that make a vacuum cleaner feel lighter, with a particular focus on the shape and cross-section of the grip.

Next, they built models to try out different grip angles and assess the optimal position for the grip. These included simple models with straight, convex, and concave profiles; models of varying grip thickness diameters; models that gradually narrowed or widened toward the grip end; and models in which the shape of the grip cross-section was a vertical or horizontal ellipse. The workshop participants subjectively evaluated these models (see Fig. 6).

As a result, they came up with the following hypotheses.

(1) A thicker grip feels lighter

A thicker grip is easier to hold, so the user grips it more lightly when moving the head over the floor. As a result, it feels easier to use.

(2) A thinner grip makes it easier to lift the head

When cleaning stairs or moving over a difference in floor level (such as a door threshold), the user lifts the head with one hand. In this case, a narrow grip makes gripping and applying force easier. It is also easier to lift, compared to a thick grip.

(3) A grip with a wider area for finger placement feels lighter

When the head is lifted with one hand, support comes from the index finger holding the grip from below. If the grip has a horizontal cross-section, this area is wider than it is if the grip has a vertical cross-section. This wider area makes it easier to transmit force and prevents discomfort when holding the grip [see Fig. 7(a)].

(4) A vertical elliptical grip fits easier into the hand

For a vacuum cleaner grip, a vertical elliptical cross-section fits the hand better than a horizontal elliptical cross-section. In addition, a vertical elliptical cross-section transmits force more easily and the grip can be more lightly twisted when held [see Fig. 7(b)].

(5) The head is easier to lift if the grip has a straight or concave profile

A grip with a straight or concave profile makes the head easier to lift with one hand because leverage can be applied at two points: with part of the hand and with the index finger. Conversely, with a convex
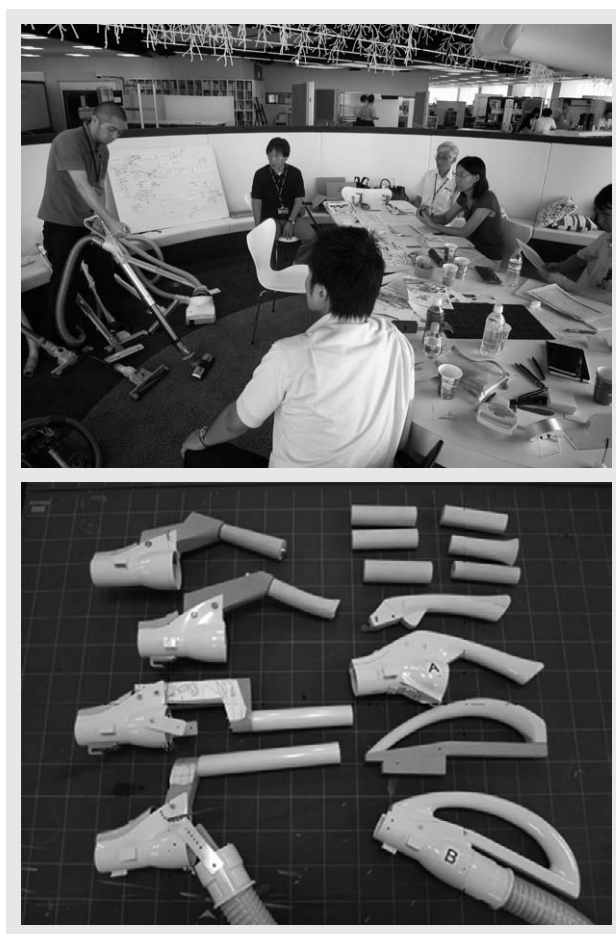
grip, it is difficult for leverage to be effective, and force applied by the user is more likely to result in slip [see Fig. 7(c)].

(6) A grip with changing thickness fits easier into the hand

Given the shape of the palm and the length of the fingers, a grip with changing thickness is a better fit with the hand. However, preferences differ as to the direction of tapering.

(7) The grip can be held more firmly when the grip end is thick

As with a baseball bat or golf club, the vacuum cleaner grip is tapered so as to be thicker at the end. Thinking of the vacuum cleaner as a tool used to move the extension pipe and grip forward and backward in front of the user, this thick-ended grip prevents the user's fingers from slipping and allows it to be held securely in the hand. Also, the vacuum cleaner's self-propelling head has an internal motor that drives a revolving brush, assisting forward movement and making head movements feel lighter. On the other hand, the user has to apply extra force when pulling the head back toward themselves, so a grip-end that prevents slipping is better [see Fig. 7(d)].

(8) The angle of the grip with respect to the extension pipe should be 20° to 25°.

When vacuuming stairs or moving between small differences in floor level, the best grip angle for normal vacuuming and the best angle for lifting the head are not the same. A grip angle in the 20° to 25° range was found to provide the best compromise between these competing requirements [see Fig. 7(e)].

The workshop participants used a number of simple models to assess the various elements that made a grip feel lighter. It was from these that the eight ergonomic hypotheses listed above were derived. These hypotheses were then used as the basis for designing the easy grip. The design process included changing the cross-section of the grip from a narrow, horizontal ellipse in the front to a thick vertical ellipse in the back, and straightening the upper surface of the grip to provide more effective leverage. Furthermore, a closed-end grip was adopted instead of a conventional open-end grip. This means that the grip will not slip from the user's fingers when pulling it toward them, and the user can carry it simply by using the grip as a handle (see Fig. 8).

Making Vacuum Cleaner Appear Lighter

Innovative ways were also devised to give the vacuum cleaner a new appearance, one that would give an immediate impression of being light and easy to use.
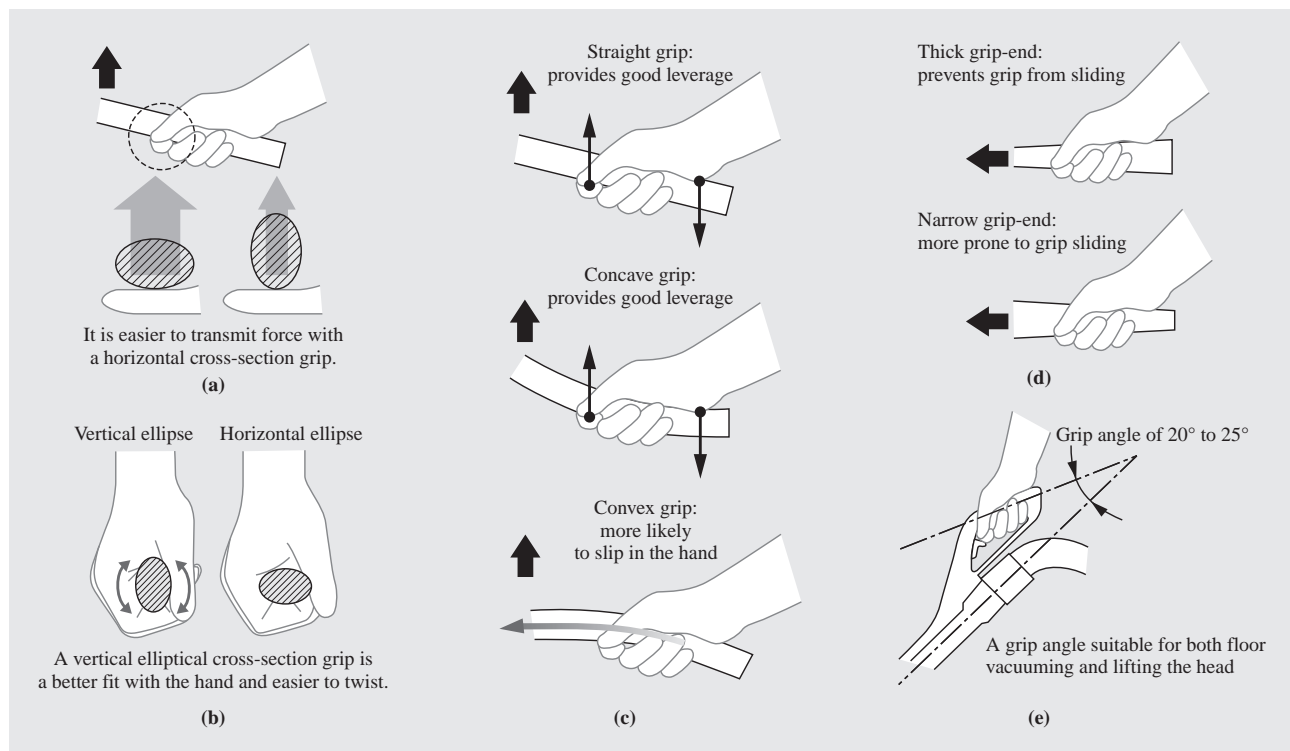
Fig. 7—Subjective Evaluation of Grip Shapes.
Simple grip models were created and subjectively evaluated. Hypotheses were established as to which elements made the grips feel light.
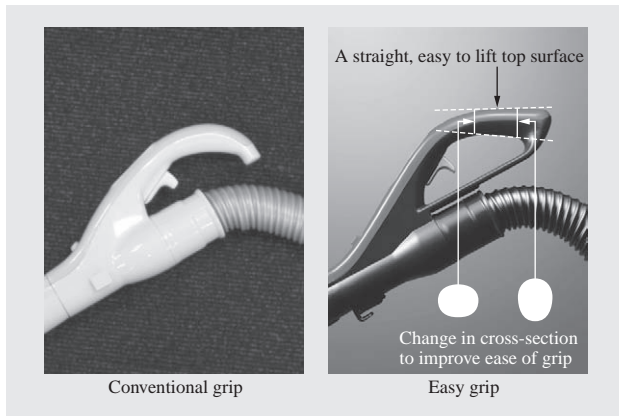
Fig. 8—Conventional Grips and Easy Grip.
The conventional grips are open-ended, with a curved convex shape at the back end of the grip. The easy grip, on the other hand, is closed at the back and straight along the top surface. Furthermore, its cross-section varies to improve ease of grip.

An attractive shape was achieved by giving the vacuum cleaner a sleek appearance while reducing concavity or convexity as much as possible.

The colors for the cover were chosen to reflect the black carbon of the head and extension pipe. The contrast between these colors and the strong-toned black makes the vacuum cleaner appear slim.

Metallic paint in colors that matched the vacuum cleaner body were also used for part of the cover. The metallic finish gave the vacuum cleaner a high-class modern appearance (see Fig. 9).

ATTEMPTS TO QUANTIFY EASE OF USE

While words and numbers can explain how the vacuum cleaner was made physically lighter and the ingenious methods devised to make it feel and appear light, phrases such as "feels light" and "easy to use" depend ultimately on subjective feelings, with meanings that vary from person to person.

For this reason, monitor tests were also conducted to make quantitative evaluations of the improvements in ease of use that resulted from the use of CFRP materials and the easy grip (which were developed to make the vacuum cleaner feel lighter during use).
(1) Actions evaluated
  (a) Forward and backward movement in a straight line: moving the head 60 cm back and forth over a carpet
  (b) Forward movement following a winding path: moving the head forward along an S-curve (like in a ski slalom) with a curve radius of 50 cm
  (c) Lifting the head over small obstacles: a number of 3-cm diameter pipes were placed across the path

of the vacuum cleaner and the user was required to move in a forward and then a backward direction, each time lifting the head over the pipes without touching them. This sequence of movements was repeated three times.
  (d) Lifting the head on to stairs: the user was required to lift the head onto each stair in turn, up to the third step, where each step was 20 cm in height.

To achieve a consistent speed, the movements in (a), (b), and (d) were done to the sound of a metronome.
(2) Evaluation of grip, head, and extension pipe combinations

To distinguish between the effects on lightness of the CFRP materials (in the head and extension pipes) and the easy grip respectively, tests were conducted to evaluate the following combinations:
  (a) Easy grip + CFRP head and pipe
  (b) Conventional grip + CFRP head and pipe
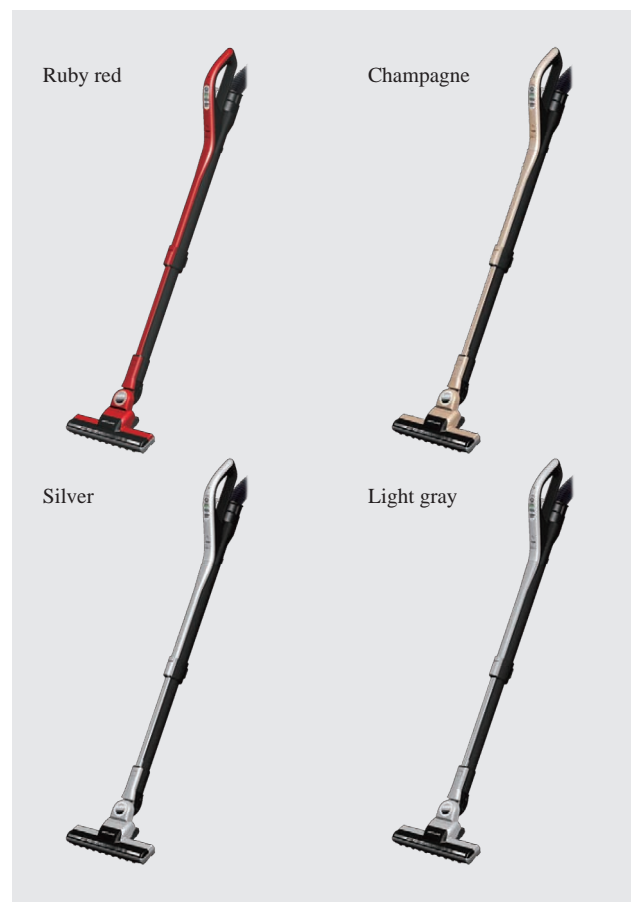
Fig. 9—CFRP Head and Pipe and Easy Grip Colors.
The ruby red and champagne colors are metallic paints. The silver color is a metallic plastic silver. The light gray color is a general-purpose plastic finish.

TABLE 2. Evaluation Results for Ease of Movement and Ease of Lifting
In conjunction with the CFRP material's effectiveness in reducing weight, the easy grip's ease of movement and ease of lifting were an improvement over conventional models.

		Movement			
		Straight	**Curved**	**Over obstacles**	**On stairs**
Easy grip	Developed CFRP head and pipe	71.0	77.3	59.2	59.3
Conventional grip	Developed CFRP head and pipe	69.7	70.9	52.5	59.2
	Conventional grip, conventional pipe	67.4	71.3	30.4	22.7

(c) Conventional grip + conventional head + conventional extension pipes

(3) Evaluation method

Performance measures such as "ease of movement" and "ease of lifting" (level of physical effort required) were evaluated using the visual analogue scale (VAS). The VAS method is based on users' self-assessment. A VAS is a 100-mm horizontal line on paper, with the left edge of the line representing the worst condition and the right end of the line representing the best condition. The subject of the experiment marks the point on the line that best represents their impression of the task. In other words, the user's evaluation of the experience is indicated by the position of the mark on the line.

(4) Evaluation participants ("monitors")

48 people: all were housewives unaffiliated with Hitachi, aged between 32 and 61 (average 48.9 years), and with heights between 146 and 165 cm (average 157.0 cm).

(5) Evaluation results

Table 2 shows the average scores for the 48 monitors. The closer the value in the table is to 100, the higher the evaluation.

The easy grip and CFRP head and pipe combination received the highest score in all four movement categories (straight line, curved, lifting over obstacles, and lifting onto stairs), with the score for curved movement being especially high. The scores also indicate that the lighter weight of the vacuum cleaner resulting from use of CFRP materials made lifting onto stairs easier. Furthermore, the easy grip received higher scores when used with the CFRP materials than did the conventional grip used with the same materials.

These quantitative evaluations showed that, in conjunction with the CFRP material's effectiveness in reducing the weight, the easy grip's ease of movement and ease of lifting were an improvement over conventional models.

CONCLUSIONS

The design and development of the CFRP head and pipe and easy grip aimed for a feeling of lightweight operation. This article has described the methods used to discover issues and solve problems so that the user experience of the vacuum cleaner would be one of surprise at how light and easy to use it feels.

Sales presentations were held with representatives of retailers, and briefing sessions were conducted with salespeople about the CFRP head and pipe and easy grip vacuum cleaner. These provided the participants with an opportunity to try the vacuum cleaner for themselves. As expected, there were a large number of reactions such as, "It certainly is light, isn't it?" In-store presentations using demo models were also prepared, and sales models were provided so that customers could experience the product's lightweight features first-hand. As users' favorable responses to the demo models show, fiscal 2011 sales also increased greatly over fiscal 2010 sales.

In the home appliance market, a balance is required between a product's functions and its performance. It is difficult for a company to differentiate its products from those of other companies. In this type of market, the affective aspects of a product, such as its "ease of use" and "familiarity," are thought to be important factors. A significant future issue will be to express these affective aspects of a product's quality coherently in its design and to evaluate them quantitatively.

Hitachi continues making efforts to create products that make the experience of daily housework easier and more comfortable for users, and hopes to increase the number of Hitachi fans.

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Applications and Benefits of Ethnographic Research
—Case Study of Management System Upgrade for Power Plant Construction Site—

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OVERVIEW: Hitachi has adopted RFID systems for improving reliability and work efficiency at power plant construction sites, and these have demonstrated various administrative advantages over paper-based work flows. On the other hand, sites that have adopted IT systems have also experienced problems, such as use of unexpected work practices and excessive workloads being placed on certain workers. This case study describes the application of ethnographic research to the development of next-generation construction management systems to identify the underlying problems and actual work practices.

INTRODUCTION

ENSURING that work is performed to an extremely high standard has top priority in power plant construction in order to guarantee work accuracy. Achieving this requires close management of whether worker competency and equipment satisfy the requirements specified in the work instructions. This in turn requires rigorous recording of data that includes the names of workers and the equipment they used. The construction of a power plant is a huge project that may last for five years or so and involve several thousand people. Projects of this scale face considerably greater project management challenges than those of normal construction projects.

With the aims of improving the reliability of production and quality of workmanship at power plant construction sites, and to enhance traceability and the efficiency of production and construction management, Hitachi-GE Nuclear Energy, Ltd. has been independently developing and implementing systems that use radio-frequency identification (RFID) tag technology since the 1990s. As a result, projects are now able to access and interpret information such as the latest design details or realtime updates on work progress at the construction site, facilitating fast and accurate decision-making.

When the RFID systems were introduced at actual sites, however, new problems arose. These included the systems being used in ways that differed from what was assumed in the design, and excessive workloads being placed on certain personnel, for example. In response, Hitachi adopted user experience design techniques in the development of its next generation of construction management systems in order to ensure that the systems

took adequate account of the viewpoints of site users. Specifically, the development included the following four processes: (1) use of ethnographic research and interviews based on on-site observations to determine how to take account of the actual work practices of site users and the underlying problems faced by the site, (2) identification of both explicit and latent user needs, (3) establishment of development policies and the development of ideas for next-generation systems, and (4) use of prototypes to undertake repeated cycles of user evaluation and feedback of results.

This article describes the methodologies and effectiveness of ethnographic research used to identify the underlying problems and latent needs at construction sites, and its role in enhancing the capabilities of power plant construction management systems.

ETHNOGRAPHIC RESEARCH

Ethnographic research is a social science methodology for explaining the culture and lifestyle of specific groups (such as a nation or society) in terms of anthropology and sociology. It involves observing and conducting interviews with people in the target group while living among them for an extended period of time.

In recent years, the introduction of various products and services (such as information systems) has changed the way people work and go about their lives. This has led to new problems associated with the relationships between information services and people or with the relationships between people that are mediated by these systems. When used in the development of products and services, ethnographic

research can create a picture of the structure and processes of various phenomena through detailed observation of people's real actions, and through analysis of the acquired data. Moreover, by identifying patterns that relate to frequently occurring problems and understanding these at a conceptual level, it is possible to shed light on the underlying issues involved in enhancing the user experience provided by products and services that are under development.

The problem with attempting to ascertain the content of work solely through interviews is that the results tend to be biased toward those aspects of the work of which the worker being interviewed is consciously aware (the explicit aspects, in other words). Ethnographic research, in contrast, uses researchers unfamiliar with the culture and rules of the work being studied to observe what the relevant people actually do. This means that the researchers can acquire information about implicitly presupposed sets of values and about behaviors that are performed unconsciously, and in doing so they can acquire a complete picture of the work being done by the organization, including its latent needs.

ETHNOGRAPHIC RESEARCH AT POWER PLANT CONSTRUCTION SITE

The following sections describe the ethnographic research procedures conducted at a power plant construction site.

Understanding the Outline of Work at Power Plant Construction Site

Before starting the research, the ethnographers attended four days of lectures where they learned the basic knowledge of work procedures and processes needed to observe the power plant construction work, details of administrative arrangements and other work practices, and details of the construction management systems at the site, including how they were intended to be used. As part of formulating their research plan, they also visited a power plant construction site to gain a first-hand appreciation of the project scale and on-site conditions.

Research Target

The construction of a power plant is a huge project, incorporating as much as 150 km of pipes, for example, and one that involves a wide variety of people. In the case of piping, for example, these include the groups responsible for pipe manufacturing, for the storage of pipes dispatched

from the manufacturer, for pipe assembly, and for piping quality control. As the plant designer, Hitachi-GE Nuclear Energy sits at the top of this hierarchy and is responsible for coordinating a large number of Hitachi and subcontracting companies whose roles are first-, second-, or third-tier. As attempting to conduct research throughout such a huge project would be impractical, the study is instead done in stages. Accordingly, the first work area selected for research was the groove fit-up* of assembled pipes, a process that is subject to the most stringent of quality control.

Field Observation Methods

Each round of research was conducted over two to three days and involved three sets of interviews and observations at different times of the day. As research progresses, if it is necessary, the scope of research should be expanded to other relevant work in order to obtain an overall picture of work practices. The research described in this case study ended up requiring three rounds.

During field observations, the ethnographers wore the same work clothes and used the same equipment as the on-site workers. This clearly differentiated them from visiting customers or administrators, and helped establish friendly relations with the workers (see Fig. 1).

Analysis Procedure

In addition to the problems and concerns expressed by the workers, the observations and interviews also collected information about informal practice being used to improve the efficiency and quality of work at the site. Rather than dealing with problems and concerns individually, the data analysis was able to uncover the underlying problems within the organization by taking a broad perspective that considered how these issues were interrelated.

RESULTS

The research identified various informal practices that contributed to quality increase. The research also discovered numerous opportunities for further improvements in quality and efficiency. The following sections describe two further improvement areas.

Site Worker Resistance to Use of IT Systems

The on-site workers understood the reasons for adopting IT systems, and used the systems provided.

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* Specified methods to align the joints between pipes, valves, pumps, and other components.

Fig. 1—Observation at Power Plant Manufacturing and Construction Sites.
Ethnographers conducting on-site observations wear the same work clothes and use the same equipment as workers, being distinguished only by different colored helmets.

However, the research also found that workers were not proactive in their approach to the system, and that, for example, they would use paper to record information in the field and then enter this data into the system after returning to the office. The major reason was that the systems were designed primarily to aid management, and provided less value to on-site workers. A second reason was that the working environment did not facilitate use of the systems. In the case of groove fit-up work, the available workspace is cramped and offers insufficient space for placing a notebook personal computer (PC).

The site workers see their mission as being to complete the groove fit-up work correctly and on time, and they dedicate all of their efforts to achieving these goals. However, for the reasons described above, they have a negative attitude to the use of IT systems.

Inconsistency between Actual and Intended Work Flow

This section describes a problem that arose between the groove fit-up department responsible for assembling the pipes and the stores department responsible for their storage and delivery.

The first step in groove fit-up is pipe preparation, and before this can start a request must be sent to the store to deliver the required pipes. However, because the store covers an area equal to two or three 400-m athletic tracks, responding to such an unexpected request takes several hours (see Fig. 2). To avoid

Fig. 2—Construction Site Store.
This store is used for storage of items sent to the construction site for use in plant construction, including materials like pipes, valves, nuts, and bolts.

this problem, a rule at the site being studied was that delivery requests must be sent to the store three days in advance. In other words, the store expects to be able to get requests three days in advance in order to carry out delivery work on schedule.

Unfortunately, work does not always go according to plan for reasons such as weather-related delays or other unexpected circumstances, such as scaffolding shared with another section being suddenly removed for some unknown reason. At such times, the department responsible for the groove fit-up instructs its staff to do some other work that is ready to proceed. This helps avoid work delays in the overall project. In other words, the change to the groove fit-up work is the way to respond flexibly to such a contingency.

A sudden change of plan noted above causes the person in charge of the groove fit-up work to send a request for pipes that are needed to start work later that same day. The store staff need to put in a lot of effort to respond. This kind of urgent request will absorb the store staff's time. They are not able to meet the three days notice for regular delivery. A further result of this would cause a negative spiral in which the delay in delivery triggers another change of plan in the groove fit-up work. This conflict between, on one hand, the store working practices that assume a particular schedule and, on the other, the operational need to avoid delays to the overall project by keeping work moving forward, regardless of whether it is performed in the planned sequence or not, creates confusion and triggers a negative spiral at the work site (see Fig. 3).

The ethnographic research also identified many other problems in addition to those described above. Rather than dealing with these individually,
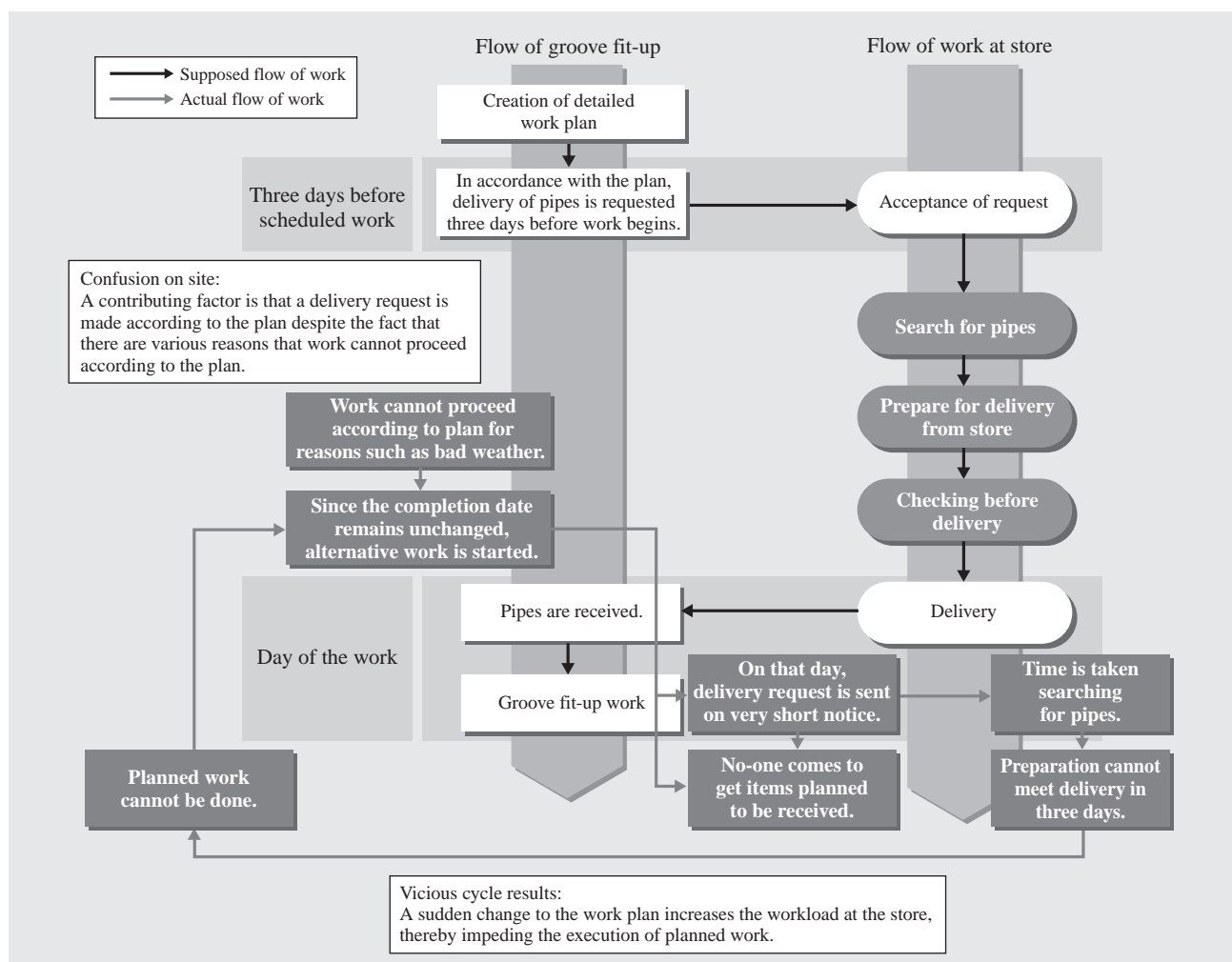
Fig. 3—Problems at Store and Groove Fit-up Workplace.
Confusion at the work site and vicious circles result when the store assumes that work will proceed in accordance with a particular schedule, whereas working practices are based on the operational need to avoid delays to the overall project, which means keeping work moving forward regardless of whether it is performed in the planned sequence.

if improvements are to be made, it is essential that a broad-based analysis be undertaken of how these various issues interrelate, and that changes be made that get to the core of the problems. In this case, an overall picture linking together problems from across the entire plant was illustrated based on Fig. 3. In this way, the interrelation of issues was clearly represented in a way it is easier to share with stakeholders.

IMPROVEMENTS TO POWER PLANT CONSTRUCTION MANAGEMENT SYSTEM

Drawing on the results of the ethnographic research, the scope of the improvement is now being broadened to include the operation of the power plant construction management system rather than just the user interface of the system.

For the groove fit-up work, an idealized operation such as how the site workers would like to undertake

the tasks was drawn as Fig. 4, considering the issues described in the previous section. This chart expresses, what are the site workers' primary concerns and how those concerns would change through the different phases of their work. This includes, for example, that workers want to put maximum resources into performing their work precisely without delay, and to get work preparation done efficiently because these tasks are important but simple.

This chart allowed us to share the demands of the groove fit-up workers with stakeholders, and to extract valuable solutions for improvement from the perspective of the on-site workers.

FEATURES AND BENEFITS OF ETHNOGRAPHIC RESEARCH

As this power plant case study demonstrated, ethnographic research provides a means to identify

FU: fit-up   CAD: computer-aided design
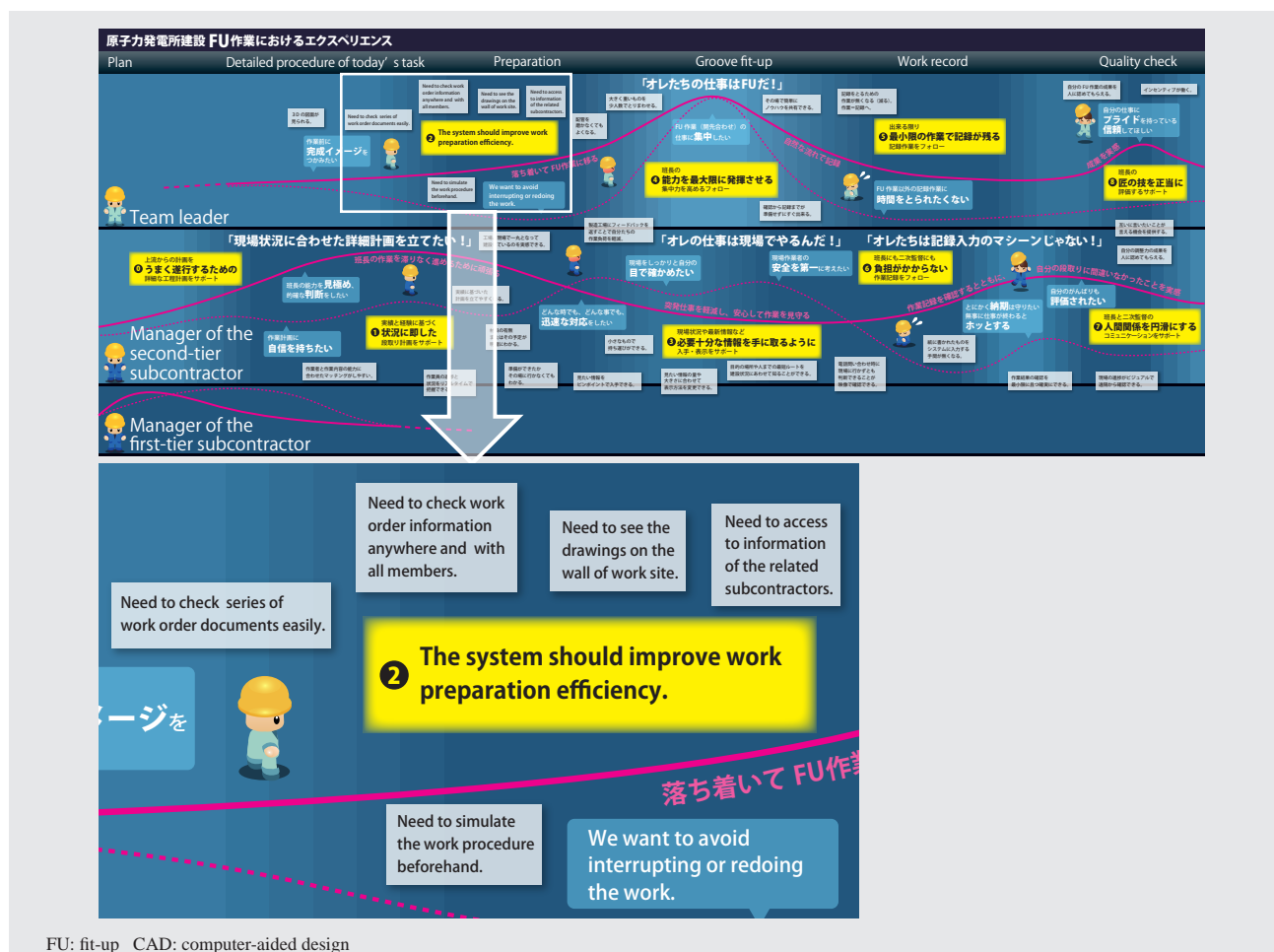
Fig. 4—Work Practices as Seen from Viewpoint of Site Workers ("Experience Table").
The horizontal axis shows work processes involved in groove fit-up, and the vertical axis shows the workers involved in those processes. The figure indicates the importance workers place on each process. The groove fit-up workers see their mission as being to perform the fit-up work accurately, in accordance with the instructions, and on time. They want to complete preliminary preparations as quickly as possible, and without complications, so that they can focus their time on the actual fit-up work.

the underlying problems at a work site. The following sections describe the features and benefits of ethnographic research.

Fact-based Analysis

Ethnographic research gathers information mainly by on-site observations.

On-site observations involve going to a site and observing what is really going on. In contrast, the interview-based investigations often used in business are typically conducted in a meeting room and have the interviewee answer questions from memory. Comparing these two approaches reveals that the information acquired in each case is very different. Interview research is effective in extracting explicit needs that subjects are not aware of. However, it is difficult to uncover the latent issues that they have taken for granted. In the case of on-site observation, in contrast, observing the subject performing particular actions, even actions of which they themselves are not consciously aware, can provide opportunities to ask them about background details. On-site observation can obtain reliable facts about what takes place in the workplace, regardless of whether or not the subject is aware of the matter.

Interview is useful in acquiring detailed background information regarding the findings from on-site observation. That is to obtain an in-depth understanding of the reasons for the action.

Ethnographic research allows us to understand "what they are doing" and "why they are doing in this way."

The following sections describe three different examples that demonstrate the features and effectiveness of analysis results obtained by ethnographic research (see Fig. 5).

Feature 1 of Analysis Results: Overall Understanding of What People are Doing

An overview of a particular work process can be obtained by identifying the tasks associated with the products or services being studied, and then also determining how that work is done, including, for example, the relationships with other departments that come about through the work and

Information collected by ethnographic research

Observing the work site as is

Understanding not only what on-site users are thought to be doing but also understanding what they are really doing

Interviews with people to understand the context of their acts

Understanding the reasons behind various acts, namely, why a person thinks he or she should do something in a certain way (such as a way of thinking or the circumstances at an organization)

Analysis based on fact

Situations that become apparent through ethnographic research

Complete picture of what people are doing

• Whole picture (including not only systems but also work processes) concerning problems and their associations
• Context information about why a person is doing a certain act

Implicit value judgments

• Approach and motivation concerning efforts made at work
• Things that are taken for granted by a person doing a certain kind of work, and things during work that are given great care and attention

Latent needs

• Things to which people have become resigned
• Actual practices on site

Advantages of using ethnographic research in system development

Establishing solutions adapted to customers' environments

Reducing the risk when introducing solutions

Fig. 5—Features of Ethnographic Research.
Ethnographic research can identify a kind of information, such as worker's implicit needs and values, that cannot easily be extracted by other research methods.

the conversations between people brought together by these relationships. This approach can identify not only simple system improvements but also the need for improvements to the entire work process.

Feature 2 of Analysis Results: Understanding of Implicit Values

On-site observations can collect information on numerous practices being undertaken by individuals in areas they consider important, including the use of workarounds that they have adopted at their own initiative. Delving into the details behind these practices can then uncover the values held by the workers with regard to their work, including what approach they take to the job and what matters most to them in going about their work.

Feature 3 of Analysis Results: Understanding of Latent Needs

Numerous actions at a workplace can appear unnecessary at first glance, such as sticking notes on displays and materials, or printing out and checking data before sending it electronically. Nevertheless, site workers have their reasons for these practices, such as avoiding problems or ensuring that downstream processes proceed efficiently. By identifying these problems, ethnographic research can clarify the latent needs of workers.

Effectiveness of Ethnographic Research

As described above, ethnographic research is an effective way to acquire information that is difficult to acquire by other research methods. It is a suitable method for uncovering latent needs and underlying problems in situations where the exact source of the problem is unknown but something still needs to be done about it, or when a new system has been installed but is not being used effectively.

Furthermore, a key feature of ethnographic research is that it not only helps to improve systems but also identifies potential improvements across the overall work process.

CONCLUSIONS

This article has described the methodologies and effectiveness of ethnographic research used to identify the underlying problems and latent needs at construction sites, and its role in enhancing the capabilities of power plant construction management systems.

Ethnographic research provides a means of identifying underlying problems at a site that are difficult to uncover using conventional interview-based research and questionnaires. Although ethnographic research has often been used for consumer products or enterprise systems, its use has also expanded in recent years to cover the development of systems used by specialists, such as medical information systems and semiconductor inspection equipment.

Hitachi is planning to expand its utilization of ethnographic research in its Social Innovation Business, and to use it as a means of identifying the underlying problems at a workplace.

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Marketing Communication Support for Global Software Sales

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OVERVIEW: The Hitachi IT Operations series is an operations management software package for small and medium-sized businesses. Hitachi information technology sales company in the USA has been selling this software package worldwide through a network of partners. Global marketing of the software is mainly carried out through a website. To provide a superior user experience, it is important to design a product on the basis of not only when it will be used but also in terms of how it connects with overall purchasing behavior. This was done by visualizing the user's total experience (the series of events from the user's initial purchase through to the use and subsequent upgrading of the software) on a chart. This chart was then used to analyze the user's experience in detail and to determine the points needing improvement. This resulted in the identification of three key touchpoints: a promotional product movie, the product website, and sales promotion media that convey a consistent image.

INTRODUCTION

THE Hitachi IT Operations series is an operations management software package for small and medium-sized businesses. The Hitachi information technology sales company in the USA markets this software package globally through reseller partners.

The graphical user interface (GUI) for this product was developed based on human-centered design processes[1], producing a rich, web-based user interface with excellent operability. The design of this GUI has been highly acclaimed, including winning a Good Design Award 2010 from the Japan Institute of Design Promotion, a public interest incorporated foundation. In addition, Hitachi IT Operations Analyzer won a silver medal at the Interactive Product Experiences category of the 2010 International Design Excellence Awards (IDEA). These awards are sponsored by the Industrial Designers Society of America (IDSA) in the USA. The quality of this product in use has been highly rated worldwide (see Fig. 1).

To provide a high-quality experience to the user, it is important not only that touchpoints be designed for the times a customer uses the product but that they be designed so that they work together smoothly, from when the user becomes aware of the product until the user begins using it.

The marketing communication support team has focused on providing users with experiences of consistently high quality, from sales promotion to finished product delivery. While getting an overview of user touchpoints, especially on the website, the team analyzed website interactions and identified points for improvement. This article describes this work together with examples of its application in specific design projects, including a proposal for unifying the product image, improvements in the design of a website offering product information and trial downloads, and the creation of a promotional movie for the product.
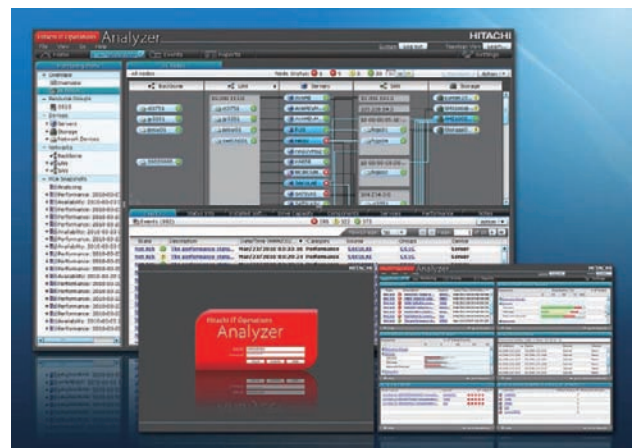
Fig. 1—GUI Screen from Hitachi IT Operations Analyzer.
The GUI for this software received the Good Design Award 2010 sponsored by the Japan Institute of Design Promotion, a public interest incorporated foundation. It also won a Silver 2010 International Design Excellence Awards (IDEA) in the Interactive Product Experiences category. The IDEA awards are sponsored by the Industrial Designers Society of America (IDSA). Users worldwide have not only praised the software's GUI design but have also rated its quality in use highly.

VISUALIZATION OF USER'S TOTAL EXPERIENCE

First, to share and understand current touchpoints, the user's total experience was visualized by relevant staff in Japan and the USA working in a workshop format. The result was used to identify points for improvement in the sequence of steps leading up to product purchase.

At the workshop, the characteristics of the US market as seen from the marketing division in Japan, which is close to product development, were compared with the characteristics as seen from the marketing division in the USA, which is close to the actual market. The starting point was the clarification of differences in awareness between the two viewpoints.

This visualization was done using a chart in which the vertical axis represented the various stakeholders and the horizontal axis represented time. The chart presented each stakeholder's "behavior," "the user's feeling at that time," and the "issues at that point" in a format that could be viewed at a glance. The time axis was based on the attention, interest, desire, memory, action (AIDMA) model, which is a consumer psychological process model that covers the processes from a consumer becoming aware of a product through to its purchase. For this product, additional "trial" and "operation" phases were also added. The result was an overview of the user's experience that was easy to understand (see Fig. 2).

Developing an overview of the series of experiences of each stakeholder in this way made it easy to understand the actual relationships and the cause and effect relationships for each issue. It thereby became possible to clarify issues from an overall, optimized standpoint.

These efforts clarified two main points for improving the user's experience: "strong brand appeal to potential customers" and "strong inducement to trial the product." Both the Japanese and US workshop participants brought up these points. These two points were developed into the measures described below for unifying the product image and strengthening cross-media sales promotion.

PROPOSAL FOR UNIFYING PRODUCT IMAGE

A user's image of a product is created not only from words but also from visual elements. Unification of these visual elements creates a consistent image of the various aspects of the product or service and establishes its brand identity, which can create feelings of security and trust.

SNS: social networking service   IT: information technology   CTO: chief technology officer
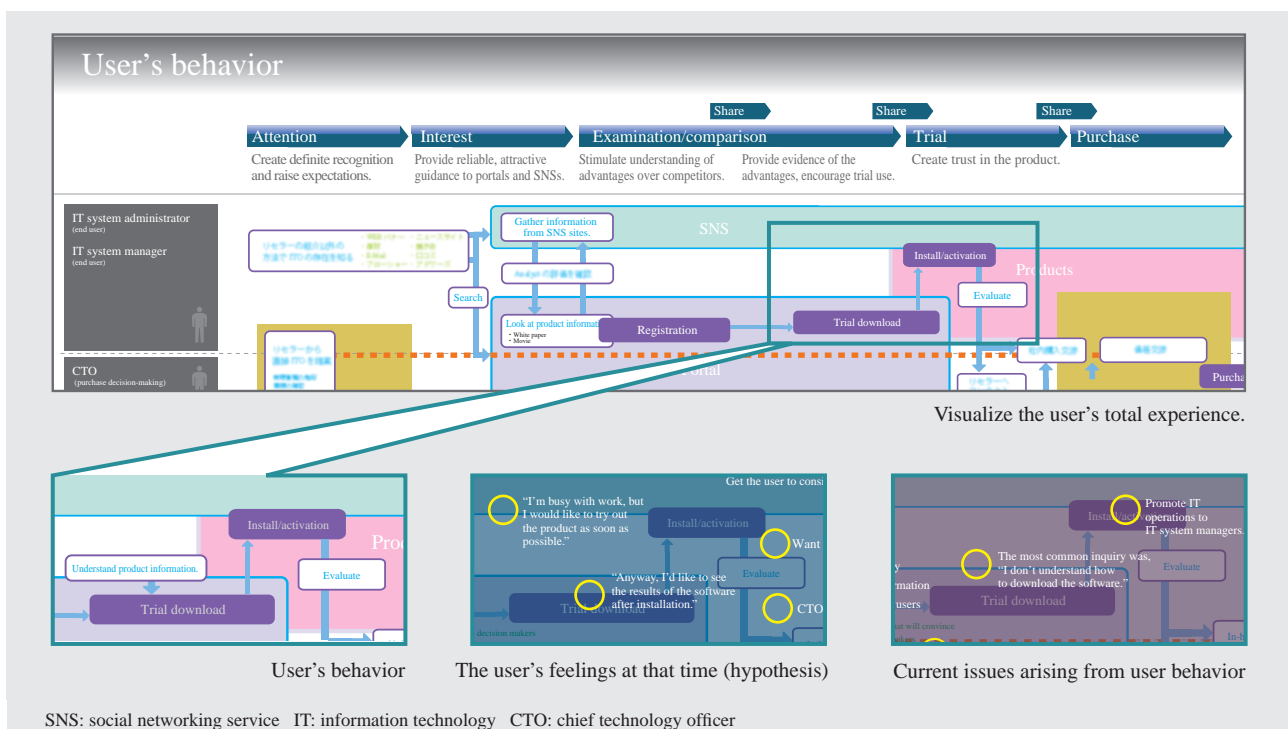
Fig. 2—Visualization of User's Total Experience (Excerpts).
The vertical axis represents stakeholders (mainly users) and the horizontal axis represents the sequence of user experiences. This visualization has been highly effective in clarifying relationships among various factors and identifying points for improvement.

Fig. 3—Prototypes of Advanced Visual Designs for Unifying Product Image.
A unified product image helps create a common awareness among stakeholders.

CD-ROM: compact disk read-only memory

Fig. 4—Development from Prototype of Various Packages to Convey Unified Image in Japan.
The product materials include software packaging, CD-ROMs, CD-ROM cases, and L-size folders.

With this approach in mind, the media to be used in sales promotion (catalog covers, magazine advertisements, posters, and product packaging) were selected, and prototypes of visual designs were created (see Fig. 3). For each type of media, red was used as the key color for all products, and a design was created using this color to give the impression of a suite of products. Key visuals from the product were used as accents, making it possible to appeal to end users in terms of both color and form.

With this idea as a starting point, the direction of visual design was shared among the staff in Japan and the USA, and various media designs were made in Japan on the basis of the prototypes (see Fig. 4).

CROSS-MEDIA PROMOTION

Efforts were also made to strengthen cross-media sales promotion.

Website

Since the user can download a trial version of the product from the website, a key feature of the product presentation is that the flow (sequence of steps) from recognizing and obtaining product information to its actual use is uninterrupted. The two issues here are how to get a user who has shown an interest in the product to download a trial version and how to get the user to recognize the quality of the product at an early stage. We accordingly set two objectives: to provide strong inducements to download the trial version, and to present the feelings and images associated with the product.

The experience of using the trial version was designed to provide the same quality as the actual product. Several use cases were described in the process as they were during product development, and the website architecture and page information structure were developed on the basis of these use cases.

In constructing the website architecture, we emphasized our visualization of the end-users' feelings. That is, "If they like it, they'll want to download it right away." Therefore, we set up links to the trial download page on every page of the website. We made sure that the trial download page could be reached from any page, thereby reducing barriers to the trial download. We also set up a page that explained the process from download to installation in easy-to-understand terms.

We also paid attention during the design stage to making the software user-friendly and making the website appealing by enabling users to directly access the pages of most interest.

We also focused on using product branding that was consistent with our other sales material in terms of the images presented, and on ensuring that we communicated the feelings and images associated with IT Operations Suite[2] to users (see Fig. 5).

The US marketing staff reported that the improved website design had increased both the number of trial download registrations and the actual number of trial version downloads. This approach was also put to good use in the design of the website for the Japanese version of this product[3].

In realizing and describing experiences in the global market, it is not easy to understand what people in each country and region see as valuable and what captures their interest. It is also not easy to identify
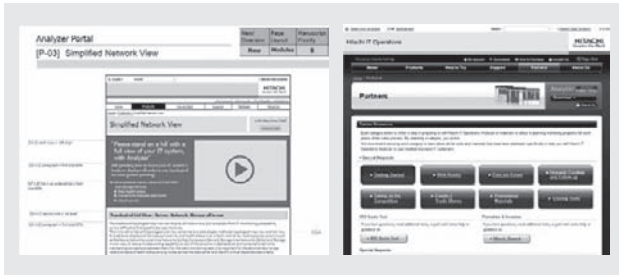
Fig. 5—*Examples Used in Study of Website Screen Operability and Visual Expression.*
In constructing the website, drawings were used to investigate the information needed for the screens and their configurations, and to present the sequence of operation. Also, visual elements that were as close as possible to the final form were repeatedly reviewed with US staff.

Fig. 6—*Promotional Product Movie on Website.*
A storyboard (left) and a scene from the movie (right) are shown. The visual imagery in the movie was designed to look as if it had originated in the USA.

the points that should be optimized. Therefore, a new approach was adopted for this project whereby the designers from Japan spent two months working with the marketing division in the USA, including building prototypes, conducting reviews, and making improvements. This approach was an effective way for Japanese designers to share values and viewpoints with staff in the region, who have a more thorough knowledge of its market. It also helped develop in a short time a common awareness transcending language and cultural barriers, enabling the designer's visualization skills to be displayed at their best and the designer to propose ideas on the spot.

Promotional Movie

The product is targeted at people who are highly literate in the use of information technology (IT) products. These people have demanding expectations for collecting information from the Internet using a variety of methods, covering both static and dynamic formats.

The availability of services such as YouTube* means that the USA has a well-developed infrastructure for video distribution, with few barriers to viewing video on the web. Therefore, we focused on creating a movie that would create a strong, lasting impression of the product, while also making the gathering of information an enjoyable and absorbing experience. In the scenario for the Japanese version of the movie, there were many lines such as, "problem points are clarified, and this product solves them." The resulting movie had a positive scenario in which the user (an IT manager) effectively handles problems that arise

* YouTube is a trademark of Google Inc.

and becomes a hero. This scenario came about from a comment by an end-user during the experience visualization who wanted to be able to use state-of-the-art tools for dealing with IT operations problems in ways that suited him.

The movie needs to hold the interest of the viewer until the end in order to communicate the message effectively. To achieve this goal, the producers focused on language and scenes that could be understood immediately. They also incorporated devices to hold the interest of the viewer, such as the depiction of sharp facial features like those in American comics, the use of the dynamic scene changes that are possible with animation, and strong changes of expression.

Also sound effects such as a door closing would clearly differ between Japanese and European or US viewers. Therefore, the background music and narration were prepared in collaboration with a US production company (see Fig. 6).

The completed movie was shown on the web and at exhibitions. The content itself was expanded to other touchpoints, and progress was achieved in providing users with a consistent understanding of the product, both in the real world and the online world.

CONCLUSIONS

In order to provide users with an experience of consistently high quality from sales promotion to product purchase, the marketing communication support team strived to acquire an overview of user touchpoints, especially on the website. They also analyzed interactions on the website and identified points for improvement. This article has described this work together with examples of its application in specific design projects, including a proposal for unifying the product image, improvements in the design of a website offering product information and trial downloads, and the creation of a promotional movie for the product.

To offer a high-quality experience to the user, the various situations in which a user would come into contact with the product were imagined. Important points were to make sure to always consider the feelings of the user at these times and to convey a consistent message and image in user contacts with the product.

Hitachi plans to carry out similar activities in global markets other than the USA, and to contribute to realizing the concept of user experience to get much closer to users' true feelings.

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Development of Experience-oriented Approach to Information and Telecommunication Systems Business

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OVERVIEW: The importance of experience to the creation of new corporate value is coming to be widely recognized, a trend that is exemplified by Apple Inc., an iconic company that has delivered many innovative products. In 2009, Hitachi systematized the experience-oriented approach of the super-upper process methodology for aiming at creating new values in system development. The enhancement and accumulation of the know-how of this approach have been achieved through application and deployment to business process re-engineering in particular for our financial, manufacturing, and retailing customers.

INTRODUCTION

AS corporate activities are becoming more global, the responsibility of information systems is increasing respectfully. In recent years, awareness of the use of the super-upper process such as in business analysis and stakeholder management has increased substantially. In July 2009, Hitachi announced its original experience-oriented approach as a requirement development technique that can enhance the experience of system users and assist with building a consensus among the stakeholders in the super-upper process of system development. This experience-oriented approach has been implemented primarily in the finance industry, and also in the manufacturing and power sectors. Our recent effort has been to expand the application of the approach widely, such as collaborating with application lifecycle management or constructing urban planning for Hitachi's smart city business.

This article describes the specific techniques used by the experience-oriented approach, how solutions are implemented in practice, and how the approach is applied to new solution services through integration with system operation.

USE OF EXPERIENCE-ORIENTED APPROACH IN SUPER-UPPER PROCESS

Our original experience-oriented approach is a framework for building consensus over the requirements that consider customer experience extensively with a common understanding of the fundamental subjects among all stakeholders in the super-upper process of any system development[1]. The super-upper process includes conceptualizing the basic system structure, formulating the system plan, and processing requirements definitions. Our approach consists of three steps: "the excitement of the comprehension," "the excitement of the expectation," and "the excitement of the acceptance." The purpose of these steps is to achieve consensus through various visualizations and interactive communication among the stakeholders (see Fig. 1). In addition to involving
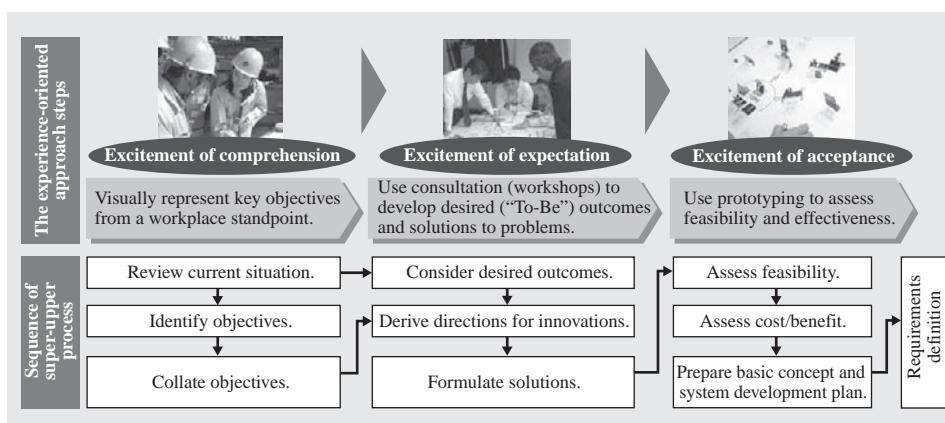
Fig. 1—Features of the Experience-oriented Approach. The experience-oriented approach utilizes experience design techniques to identify objectives and provide a visual overview of the system during the super-upper processes of system development.

the system engineers and business consultants, having Hitachi designers participate in the super-upper process is a special feature of our original experience-oriented approach. By utilizing the experience design techniques established by Hitachi through its own design development of its own products, and by visualizing the key objectives, the unexpressed demands, and the new system images, the development of the system requirement specifications that are with the higher experience values become possible.

Excitement of Comprehension: Visualization of Fundamental Objectives from On-site Operations

In this step, to share and to understand the objectives among all the stakeholders from the management, marketing, and system departments, is undertaken based on focusing on the on-site operations where the system has actually been used. The first stage is to collect the operational manual, the structure of the system, and a list of the existing operational issues that were investigated by the customers. Based on this information, an experience table[2] is applied to structure an overview chart of the current operational flow. While plotting the existing operational issues, re-investigations are conducted for specific targeted issues and overlooked areas. The techniques applied for these re-investigations here consist of a combination of several data analyses such

as the system log, with an ethnographic research focus. The researchers conduct observations and interviews at the on-site operations to capture the reality. The workshops are then held to share the investigation results with the stakeholders, for structuring an objectives map that shows the relationships, and to prioritize the objectives (see Fig. 2).

Excitement of Expectation: Development of Future Operational Image ("To-Be") and Solutions

This step utilizes the shared and understood objectives in the "excitement of comprehension" step in order to develop a "To-Be" operation image that can enhance the experiences of the customers and all stakeholders who are involved in the system. The development is conducted by visualizing "where" and "how" to optimize "the overall structure of operation and service" for improving the experience value. The followings are the two perspectives for conducting this development.
(1) The "stories" of all the stakeholders in the operations
(2) The "structures" that produce the deliverables

The example of developing the objectives by stories is shown in Fig. 3. Regarding purchasing of the products in the shop, the on-site voice of "too many products to understand" and the "hospitability" for "wanting to fulfill the expectations" are illustrated as stories.
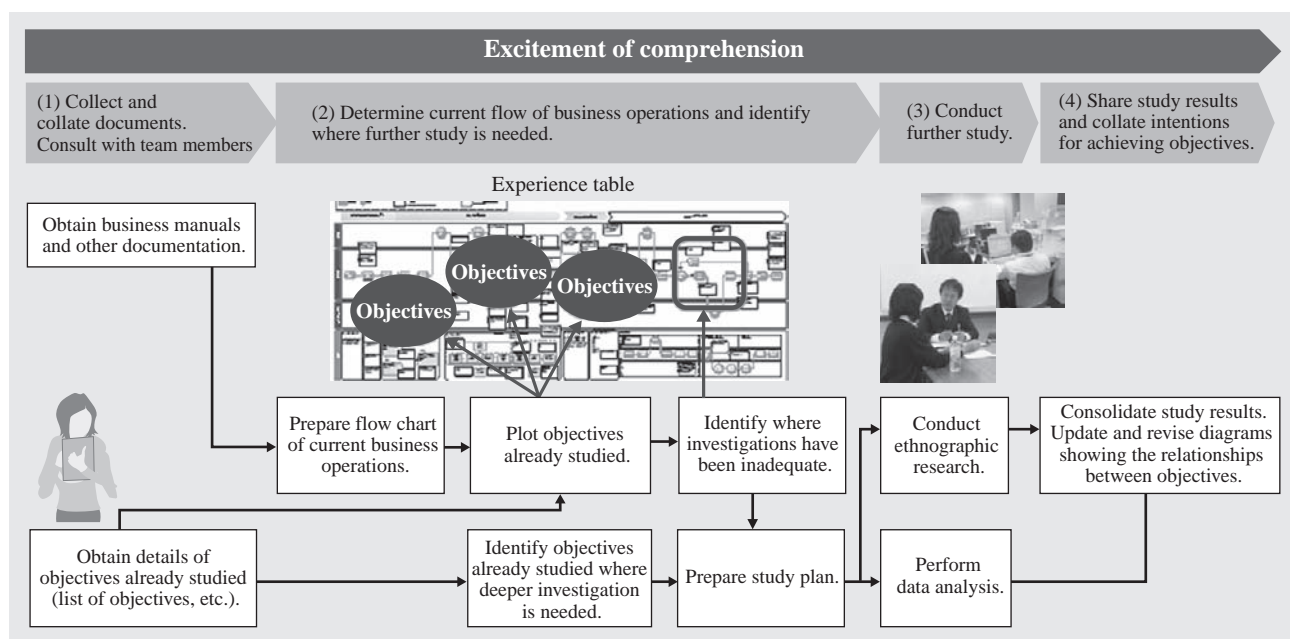
Fig. 2—Processes and Tasks for Achieving "Excitement of Comprehension."
This step uses experience tables and ethnographic research to produce a visualization of the current situation in the workplace, including its genuine objectives and needs, from the perspective of the overall business.
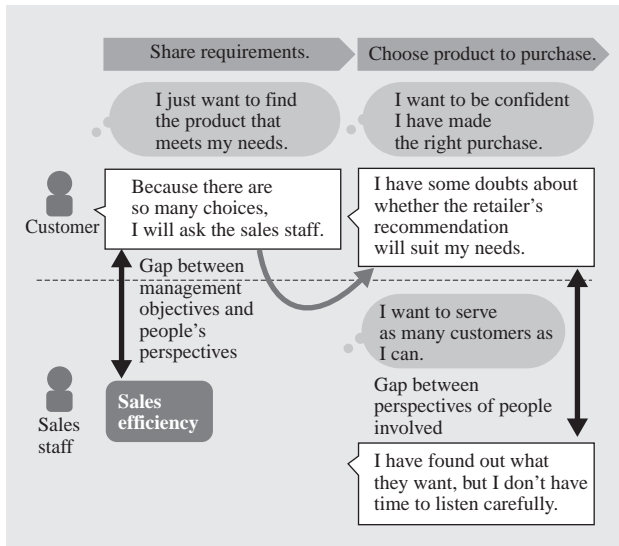
Fig. 3—Use of Stories to Identify Objectives.
The gaps between management objectives and people's
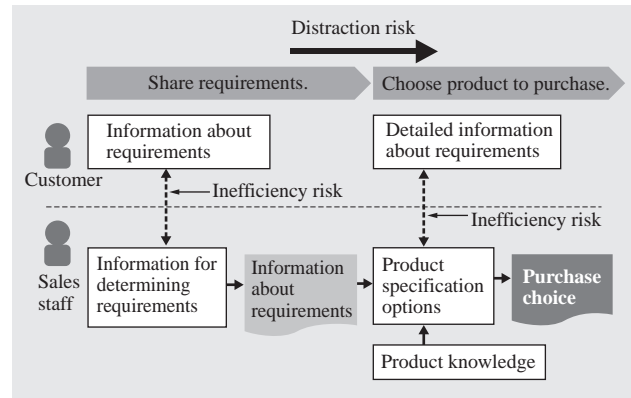perspectives are used to identify objectives.

Fig. 4—Identifying Objectives from Structural Perspective.
Objectives are identified from considerations such as the
reasons for performing processes or inefficiencies resulting from
too much or not enough information.

The bottlenecks can be identified as the following gaps.

(1) Gap between the "management objectives" and the "voices": the objective is to achieve "sales efficiency," but the customers "seek assistance from the shop staff."

(2) Gap of perspectives among stakeholders: the shop staff have "certain responsibilities to fulfill," but "the customer" is coming with "uncertain and anxious feelings."

On the other hand, the example of developing the objectives from the structures that produce the "deliverables" is shown in Fig. 4 with the same format. The product relation-based process (PReP) model is utilized here to visualize the relationships of information. The PReP model is a descriptive model that describes the actual activities in terms of the deliverables.

From this, the inappropriate factors appear from the following perspectives.

(1) Rationality for the processes of achieving the final deliverables

(2) Risks and inefficiency from excessive or lack of information

The next step is to determine "how to change," which means to establish the relationships for the information and the optimized processes with a perspective of structure. One example might be that "the overall efficiency could be improved if the customers could specify the potential purchasing of products by themselves in the shop."

As per the perspective of story, the new story is designed to satisfy both the expectations of stakeholders and the management objectives, as shown in Fig. 5. For example, "the overall performance would be enhanced if customers were given the tools to choose products for themselves in the shop."

An optimization from overviewing the whole operation and service is achieved by repeated interactive communications and transparent information sharing among the stakeholders in the project. To achieve this, the experience-oriented approach utilized both an original tool called an experience table for co-creating the stories and a PReP model for describing the structures. The stories are mainly used in interactive communications with management and business departments, whereas the structures are used for the communicating information technology system departments of the clients interactively.
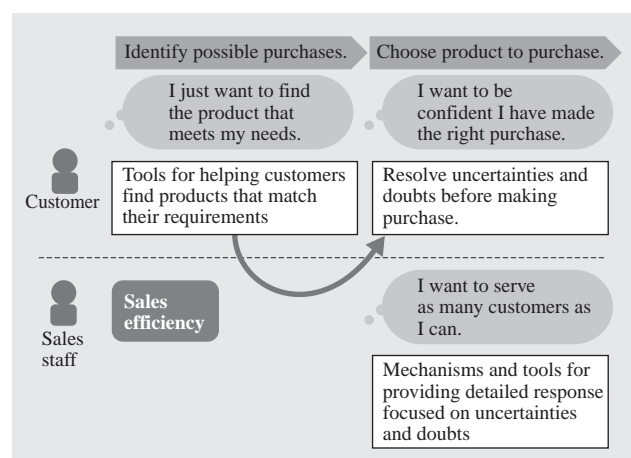

Fig. 5—Use of Stories to Derive Possible Solutions.
A new story is created from the ways and means of satisfying
both stakeholders' expectations and management objectives.

Through the repeated visualization and interactive communication, creative solutions are developed by triggering the conversion of implicit and explicit knowledge of projects.

Excitement of Acceptance: Verification of Effectiveness and Feasibility of Solutions

In this step, the solutions reviewed in the step of the excitement of expectation are verified from the perspective of finding the possibilities of its feasibility and examining its effectiveness. The purpose of this process is to develop a project plan that is agreed and accepted by all stakeholders in the project. The experience-oriented approach is capable of investigating the return on investment and the feasibility of each solution to focus on the predictable

significant changes in the operations by re-evaluating the operation process and introducing the new IT tool. The actual procedural steps are listed below (see Fig. 6).

(1) Selection of operations for validating feasibility and effectiveness

The particular operations that are important for conducting the dramatic changes and actualizing experience value are selected. The future operation (To-Be) that is generated and shared by the experience table and the PReP model in the step of excitement of expectation are compared with the current structure (As-Is) that is built in the step of excitement of comprehension.

(2) Refinement of the operation and confirmation of acceptivity by action model
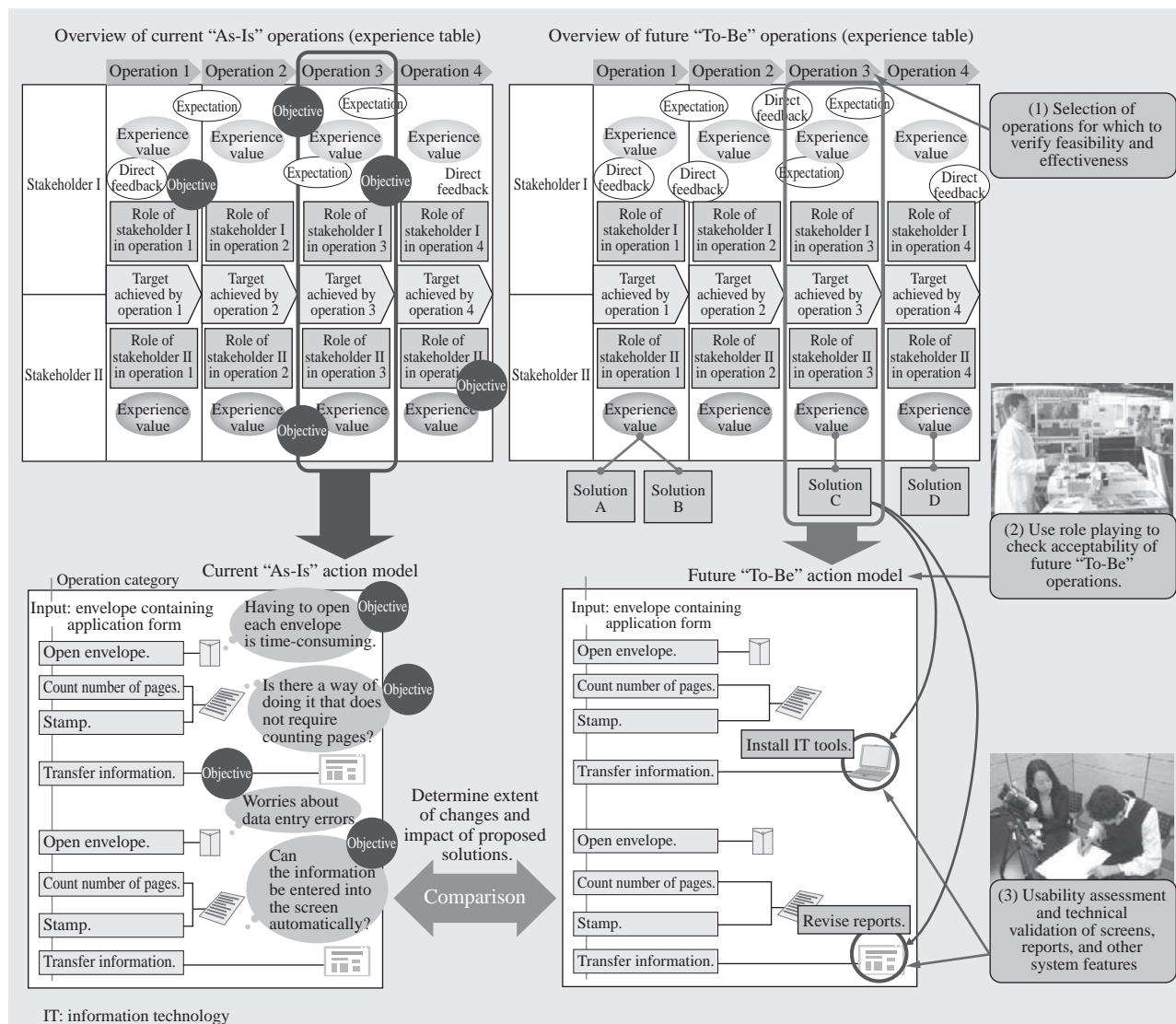
Fig. 6—Role of Prototyping Methods in "Excitement of Acceptance" Step.
Various prototyping methods are used to compare the current "As-Is" and future "To-Be" operations at the level of specific action models and assess what impacts and benefits the proposed solutions will have on operations.

Regarding the selected future operation, the action model is applied to define the details of the operation (To-Be) manual. Also, role playing activities for the future (To-Be) operation take place in the workshop for all stakeholders in the operation. The purpose of this process is to confirm the feasibility and the effectiveness of the future operation from the perspectives of the on-site operation including the gaps with the current (As-Is) operation, the advantage, and the disadvantages.

(3) Usability evaluation and technology validation of application displays and documents

Usability evaluation is carried out using simple prototyping methods so that the acceptivity of on-site operation and the more realistic effectiveness of return of investment can be verified and captured. This process is conducted to implement the new information technology, develop the application, and review the documentation procedure for actualizing the future operation (To-Be) as the solution.

APPLICATION PATTERN OF EXPERIENCE-ORIENTED APPROACH BY INDUSTRY

The experience-oriented approach was implemented in more than 30 projects between 2009 and 2010, primarily in the finance industry, and also in the sectors of manufacturing, logistics, and power. Currently, there are four application patterns depending on the industry.

(1) Super-upper process of system development that supports the sales process

In a sales process, the purchasing process of the consumer (end-user) is re-captured as the "experience of purchasing." The ideal purchasing process is redefined as the targeting sale process. This is important for examining the effectiveness from the customer's perspective. Recently, transformation of the sales process by utilizing tablets and smartphones has been popular. However, for this type of new technology implementation, consideration of acceptance and proficiency of the tool in the on-site sales process is essential. Applying the prototyping method in the excitement of acceptance step of the experience-oriented approach is effective for validating the technology implementation.

(2) Super-upper process of system development for the operation of customer channels

An overall optimized development procedure that overcomes the organizational barrier is crucial for achieving the enhancement of customer satisfaction by operating multiple customer channels thoroughly, including the call center, the website, and the store.

There are two types of development that are effective. One is the visualization of operations fully from the end-user's perspective by utilizing the experience table. Another is to research the solution and to share the objectives by conducting workshops that involve all the related departments.

(3) Super-upper process of system development that supports the on-site operation

Today, even with widely spread IT systems, on-site operation based on know-how and implicit knowledge that are accumulated from long-term operational experience, such as in equipment maintenance, can be found commonly. Along with a decrease in the number of experienced talent, the difficulty of maintaining operation quality and efficiency is increasing. The ethnographic research that is focused in "the excitement of comprehensive" of the experience-oriented approach is capable of converting the implicit knowledge of an organization to explicit knowledge by visualizing "unconscious know-how" that was cultivated in the on-site operations. This has become not only the essential requirement for improving the system, but also an element to be applied increasingly in human resources development.

(4) Application to enhance BA process

Business analysis (BA) is a series of activities that are carried out for bringing values to organizations and solutions to business issues. The BA process at a corporation must sufficiently reflect the corporate culture, which includes the decision-making process. The elements here can also be referred as the elements that are "not suitable for formal and uniform standardization." The experience-oriented approach is not only capable of systematizing a specific approach based on promoting the consensus development and creativity advancement, but also of allowing a flexible combination to be utilized for different corporate cultures and each individual project. For this reason, we did not develop any new standard or process for improving the BA process. We believe that an approach of "continuous improvement" is effective. The Business Analysis Body of Knowledge (BABOK)[*] and the experience-oriented approach use a phased implementation within a necessary range for responding to different corporate cultures based on the existing standards and processes. Currently, this is being evaluated with customers.

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[*] BABOK and Business Analysis Body of Knowledge are registered trademarks owned by International Institute of Business Analysis, an international non-profit organization headquartered in Canada. It provides systems for dealing with the knowledge required in BA processes.
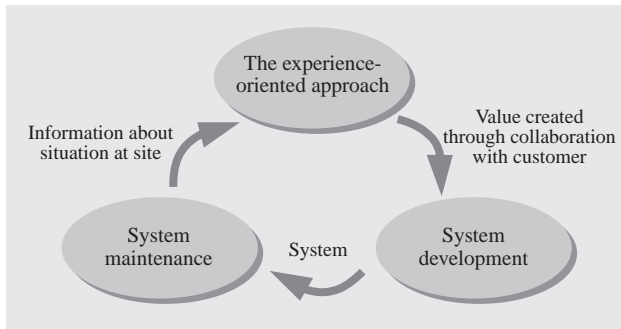
Fig. 7—Using the Experience-oriented Approach with Services.
Value created through collaboration with customers is achieved
by working through the experience-oriented approach, system
development, and system maintenance lifecycle.

COLLABORATION WITH SERVICE BUSINESS

Although the experience-oriented approach is for the super-upper process of system development, we are conducting research that collaborates with system maintenance and services in the phase of development and implementation for delivering a systemization that will support the collaboration with the customers and not spoil the collaboration results (see Fig. 7).

There are two key issues that need to be considered when collaborating with the service business and the experience-oriented approach (see Fig. 8).

The first issue is that we need to build two processes for completing the system life cycle. One is for extracting the objectives of the current operation (As-Is) from the collected maintenance data. Another is for defining the specifications from the ideal future operation (To-Be) for the system development. However, constructing To-Be from As-Is can be achieved by co-creating with clients through the experience-oriented approach.

The second issue concerns whether the information is abstract or concrete. The information involved in the operation of maintenance or system development is specific and inclusive due to its direct connection to the system. However, in the experience-oriented approach, the development process is carried out with customers in a way that allows an easy intuitive understanding rather than an inclusive comprehension. This includes ignoring issues that are not important for creating value. Overcoming this gap is a key issue for this collaboration.

Taking account of these issues, Hitachi is working on utilizing the experience-oriented approach in the service of system maintenance and development.

Collaborating with System Maintenance

Hitachi offers an application lifecycle management (ALCM) service that provides total maintenance for
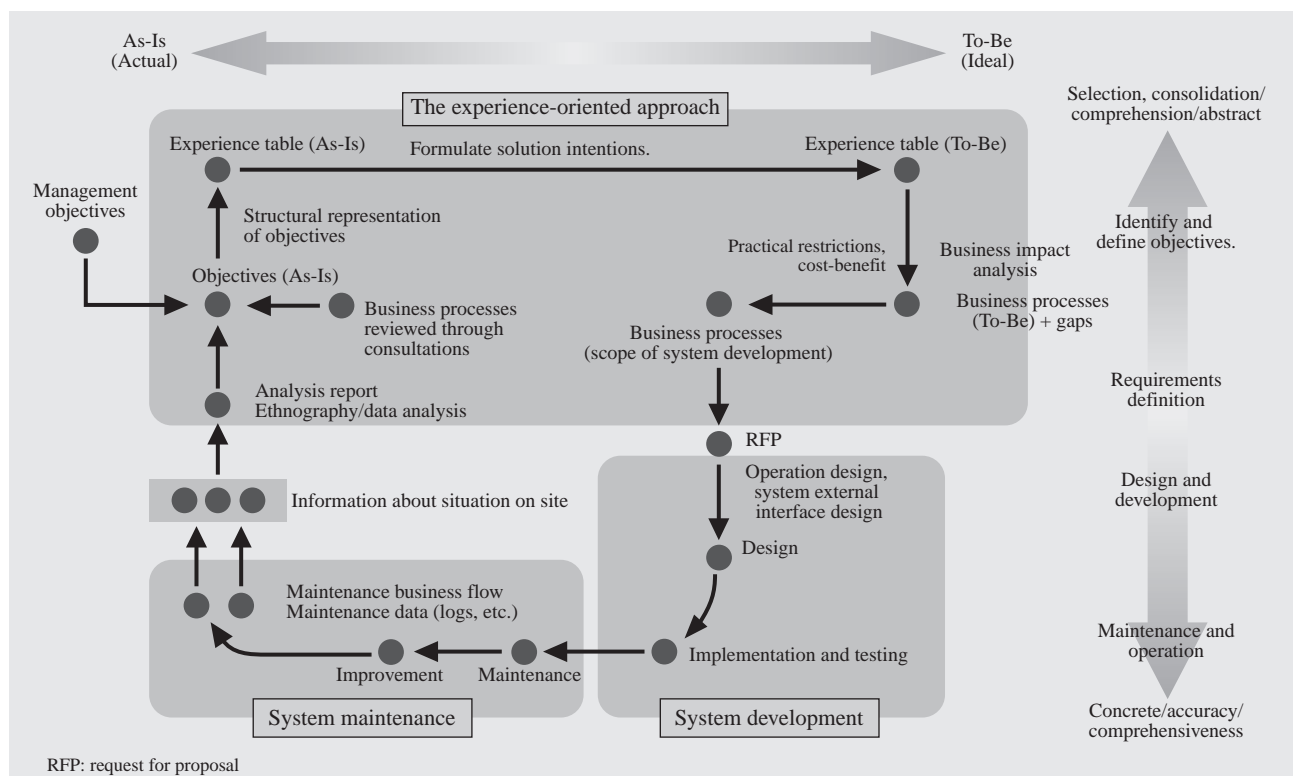

Fig. 8—The Experience-oriented Approach and System Lifecycle.
The lifecycle is linked together by filling in the gaps in the actual/ideal and concrete/abstract axes.

all system applications. Improved efficiency and quality are achieved by a one-stop maintenance service that was originally conducted by multiple vendors.

ALCM consists of the following three phases.

(1) Assessment phase

This phase involves taking an inventory of existing system resources (including programs, data, and documents), and clarifying the resources required for the maintenance work associated with modifying or expanding these system resources, and also the procedures and deliverables for using these resources for maintenance work.

(2) Transformation phase

Based on the result of the assessment phase, resources that are lacking and manual worksheets are established to ensure that maintenance can be performed in accordance with these.

(3) Execution phase

System operation and maintenance are conducted under the environment established in the transformation phase. The user's requirements are prioritized and the modifications based on the impact analysis are specified for carrying out modification and testing. While conducting maintenance, improvements are also made to the manuals for higher efficiency and for the supporting tools.

Along with operating these services, information useful for capturing the current business operation, such as the flows of customer operations, the operational and error logs, and the complaints of users, are generated. Utilizing this information in the excitement of comprehension step of the experience-oriented approach allows analysis to be conducted efficiently and accurately. In response to the abstract/concrete gap between maintenance and the experience-oriented approach as previously described, the following are the two perspectives for connecting the information from the ALCM service to the experience-oriented approach.

(1) Macro-analysis

For analyzing the issues that occurred in the current operation, the information from ALCM (the operation conditions and the error situation for a certain traffic volume and time frame) is collected for use in developing a supportive environment that provides the effective standpoints for clarifying the objectives. The gap that is identified by the on-site SEs and the staff in the To-Be operation can be perceived as "different sentiments" by viewing the collected information from the perspective of the entire operation.

(2) Micro-analysis

Here, the information for determining whether to improve the "different sentiments" extracted from macro analysis is provided by analyzing detailed situations, such as the operation steps for each operator and in each case.

Utilizing the analyzed results in the "excitement of comprehensive" step of the experience-oriented approach allows an understanding of current operation. As well as making analysis more efficient, improvements and the completion of ethnographic investigations from capturing the objectives over the long term can also be expected.

Collaborating with System Development

On the other hand, achieving consensus with customers on the business's required specifications requires connecting the contents accurately to system development. Hitachi has a standard development process called Hitachi Phased Approach for High Productive Computer System's Engineering (HIPACE) that provides a development methodology for determining the specific processes of the required operation for system development and the deliverables for inputs and outputs. The experience-oriented approach responds to each process in HIPACE, such as the specifications definition, the systematization planning formulation, the basic system structure establishment. In two of these processes, which are the establishment of basic system structure and the planning of systematization, the main task of the experience-oriented approach is to be capable of responding to the process of analyzing and developing the customer operation. The customer operation includes understanding, analyzing, and developing the operation. However, regarding the formulation of an operation model in the process of specification definition, there are incompatibilities in the aspects of abstract/concrete between the deliverables of the experience-oriented approach/experience table and the deliverables of HIPACE. The deliverables of the experience-oriented approach/experience table are for describing future images (To-Be) to be shared with customers. The deliverables of HIPACE, in contrast, are the operation flows for defining the system specifications. Therefore, a process for overcoming these incompatibilities is required when the development of the operation model is taking in the deliverables of the experience-oriented approach/experience table as the deliverables of HIPACE. The following three processes are added.

(1) In the experience-oriented approach, the experience table and the PReP models are developed based on the main operations, not all the operations. As for developing the system applications, the other operations that are not described above are also reported on for constructing the operation model.

(2) By making a mock-up of the interface screen, which is based on the operation model and the focused partial operation, the operation flow and the input/output information in each operation are defined.

(3) Based on processes 1 and 2, the required property and the structure of the data of the system are defined.

By executing the experience value described in the experience table from processes (1) to (3), it is possible to offer a system development with experience value to system users.

These three processes can provide the inputs for the Hitachi modeling framework (HMF), a model-based development environment, in future process planning. In HMF, the function of generating the programs from this model is already activated. It also brings efficiency to system development and implementation.

CONCLUSIONS

This article has described the specific applications of the experience-oriented approach, its solution patterns in actual implementations, and its development of new solutions in service businesses from collaboration with system management.

The experience-oriented approach has been adopted primarily for operation system development in the finance, manufacturing, and logistics industries. In the future, its application will be expanded to industries on which Hitachi focuses, such as collaboration with the service business and smart cities, which are expected to be markets for the information and telecommunication system. Furthermore, Hitachi would like to contribute to social innovation through "co-creation" with enterprise customers.

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Experience Design to Realize Value for Life in Smart Cities

Kaoru Watanabe
Hiroki Kitagawa
Yoshitaka Shibata

OVERVIEW: Hundreds of smart city projects are currently underway around the world. However, many of these projects are still in the conceptual or planning stage. The term "smart city" is generally interpreted as meaning "a next-generation city that is conscious of the environment and makes efficient use of energy and other resources by drawing on the power of IT." In the conceptual and planning stages, discussions are focused on how to deploy IT and urban infrastructure technologies. In addition to these considerations, Hitachi is conducting advanced research that exploits experience design to bring forth value in smart cities, and has established a valuable framework and approach for planning and study.

INTRODUCTION

NEEDLESS to say, the ultimate value that smart cities should seek is the same goal shared by humankind: sustainable development. The form of a city for realizing this value is the smart city, "a next-generation city that is conscious of the environment and makes efficient use of energy and other resources by drawing on the power of information technology (IT)."

Figs. 1 and 2 show the relationships between stakeholders in a smart city from the standpoint of experience design. These figures summarize the results of a variety of studies and analyses conducted by Hitachi on the basis of the most basic concept in experience design: "Showing experience value from stakeholders' point of view on a time axis."

This article describes Hitachi's efforts to realize value for life in smart cities through experience design.

Fig. 1—Smart City Stakeholders.
To create experience value, it is critical to undertake a broad study of the benefits, costs, and risks to stakeholders.

SUSTAINABLE DEVELOPMENT

By analyzing and organizing the concepts of smart cities on the basis of experience design, Hitachi has established the following planning and study framework/approach for realizing a sustainable society.

(1) Stakeholders

The primary stakeholders in a city are its consumers, companies, and government. These stakeholders also relate to the city from a variety of perspectives. All of these stakeholders work together toward the shared goal of sustainable development in accordance with their own roles, and they seek to enjoy its benefits. The public infrastructure of smart cities supports the establishment, maintenance, and development of dynamic relationships and coexistence among these stakeholders.

Fundamentally, the target of experience design is "the experiences of natural persons." However, when dealing with something as complex as a city, we can make an exception and apply the ideas of experience design to smart cities. Companies and the government are treated as stakeholders.

(2) Experience value (by stakeholder)

(a) Consumers: optimal balance of "eco" and experience

The public infrastructure of smart cities, with an optimal balance of environmental ("eco") values and experiences, provides the following two types of support for consumers. Firstly, it confers the beneficial experience value of a secure, convenient, and prosperous urban lifestyle, a form of value that makes consumers want to continue living in the city. It also enables the urban lifestyle to be compatible with environmental protection. Secondly, the public infrastructure of smart
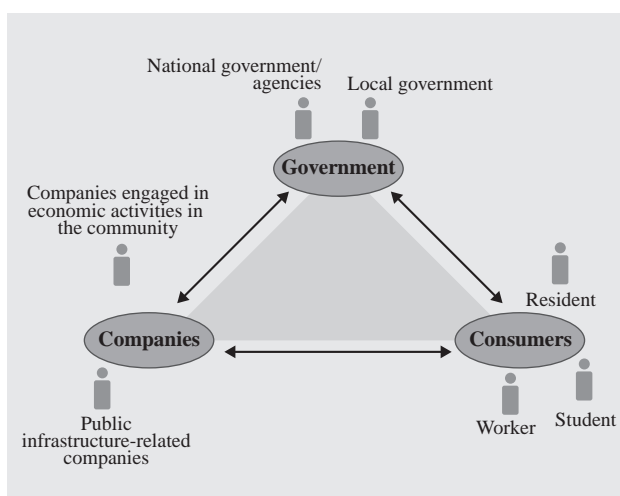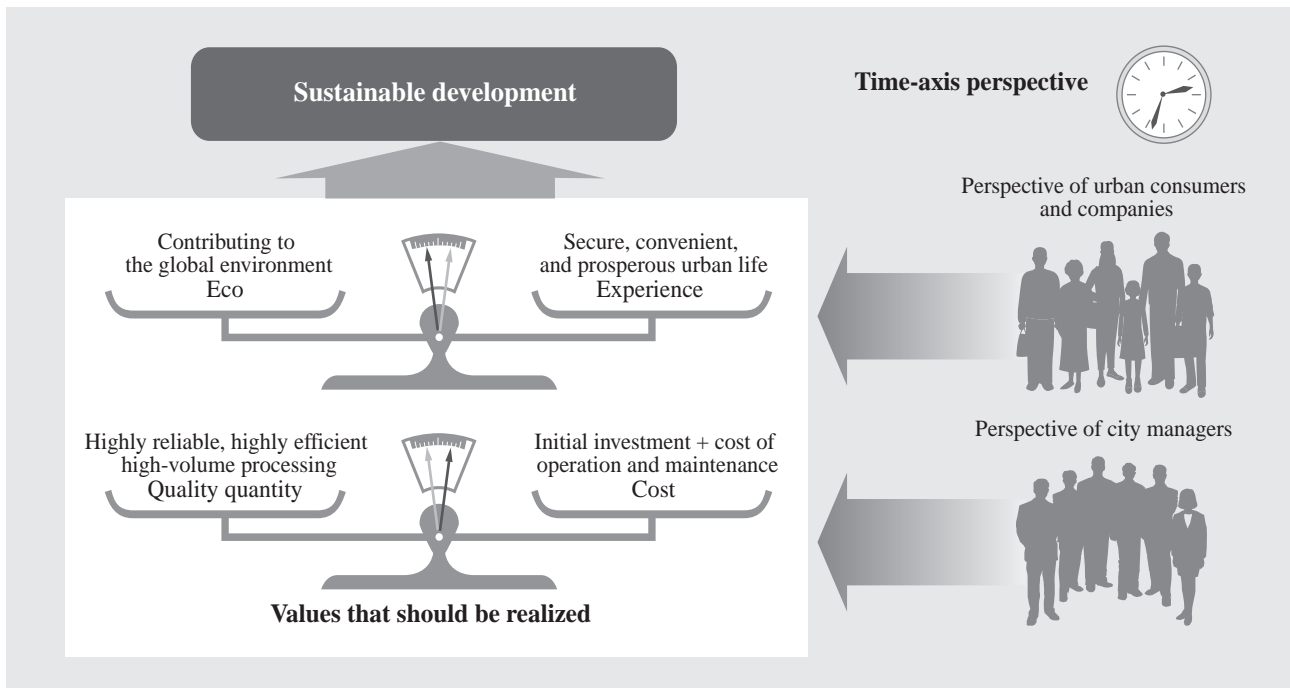
Fig. 2—Sustainable Development in Smart Cities.
Sustainable development in smart cities requires a time-axis perspective. This requires building a public infrastructure that can sustain the "optimal balance of eco and experience" that meets conditions such as changing population, economics, social environment, and geographic restrictions, and realizes sustainable development.

cities provides plenty of opportunities and options to consumers who wish to contribute more actively to protecting the global environment.

(b) Companies: optimal balance of "eco" and business operations

The public infrastructure of smart cities provides the following two types of support for companies. Firstly, it enables business operations with a high level of economic rationality, which increases the desire to invest in the community. It also enables the continuity and development of these companies to be compatible with environmental protection. Secondly, this public infrastructure provides plenty of opportunities and options to companies that wish to contribute more actively to global environmental protection.

(c) Government: optimal balance of just-enough public infrastructure and cost

Besides supporting (a) and (b) above, the public infrastructure of smart cities is implemented at a cost that is optimally compatible with both the central government's environmental policies and the local government's finances.

(3) Time axis

A city's population, economic trends, and social demands, and its consumers' lifestyles and needs, change greatly over time. Also, external factors and restrictive conditions (such as available resources)

may vary greatly depending on the city. The public infrastructure of smart cities makes possible the continuation and sophistication of the balance described in sections (1) and (2) above by taking into consideration these factors and variations.

The framework and approach established here have become the basis of the vision and concept of smart cities presented by Hitachi on its website and at exhibitions. They are also used as the framework when supporting Hitachi's upstream design of smart cities (meaning the conceptual and planning stage).

"ECO" LIFESTYLE

Seeking to realize a sustainable society, Hitachi has set out its priorities for global environmental protection in its Environmental Vision (see Fig. 3). The vision's three basic components are "Prevention of Global Warming," "Conservation of Resources," and "Preservation of Ecosystems."

From the standpoint of experience design, the technologies and solutions for achieving this environmental vision can be divided into those that directly contribute to accomplishing the vision's goals, and those that support behavioral patterns and lifestyles that contribute to accomplishing the vision's goals. This classification and representative examples are shown in Fig. 4.
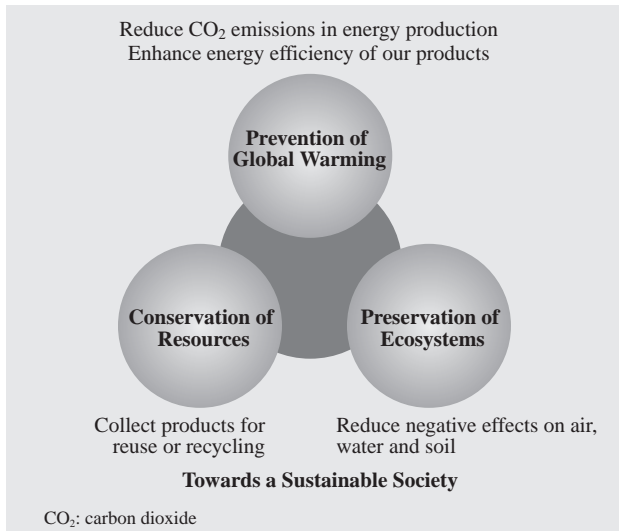
Fig. 3—Hitachi Environmental Vision.
Based on its environmental vision, Hitachi is working to realize
a sustainable society by promoting global production that
reduces the environmental burden of products throughout their
life cycle.

Hitachi has been undertaking the comprehensive and systematic development of technologies and solutions that directly contribute to realizing its environmental vision, such as renewable energy and sewage treatment. It is also studying the deployment of these technologies and solutions in ways that help achieve an overall optimal balance. Meanwhile, separate technologies and solutions, such as car sharing and home energy management systems (HEMSs), which support behavioral patterns and lifestyles that contribute to realizing the Hitachi Environmental Vision, are in the early stages of development and testing. Hitachi has commenced research into "eco" lifestyles that utilize experience design so that it can investigate and develop technologies and solutions that support behavioral patterns and lifestyles that fulfill a comprehensive and systematic vision of the environment.

The first effort of this research drive is the development of "I Am Being Ecological." This is a collection of findings developed by Hitachi, Ltd.'s Design Division that explore users' fundamental values in order to clarify the meaning of the experience values to be provided. Similar to "24 Chapters of Happiness" (a booklet summarizing 24 elements that make up experience value, with examples provided), which is being used in solution development, "I Am Being Ecological" summarizes keywords and suggestions to keep in mind when conceiving "eco" experiences and the solutions that realize them. Like "24 Chapters of Happiness," this project uses the
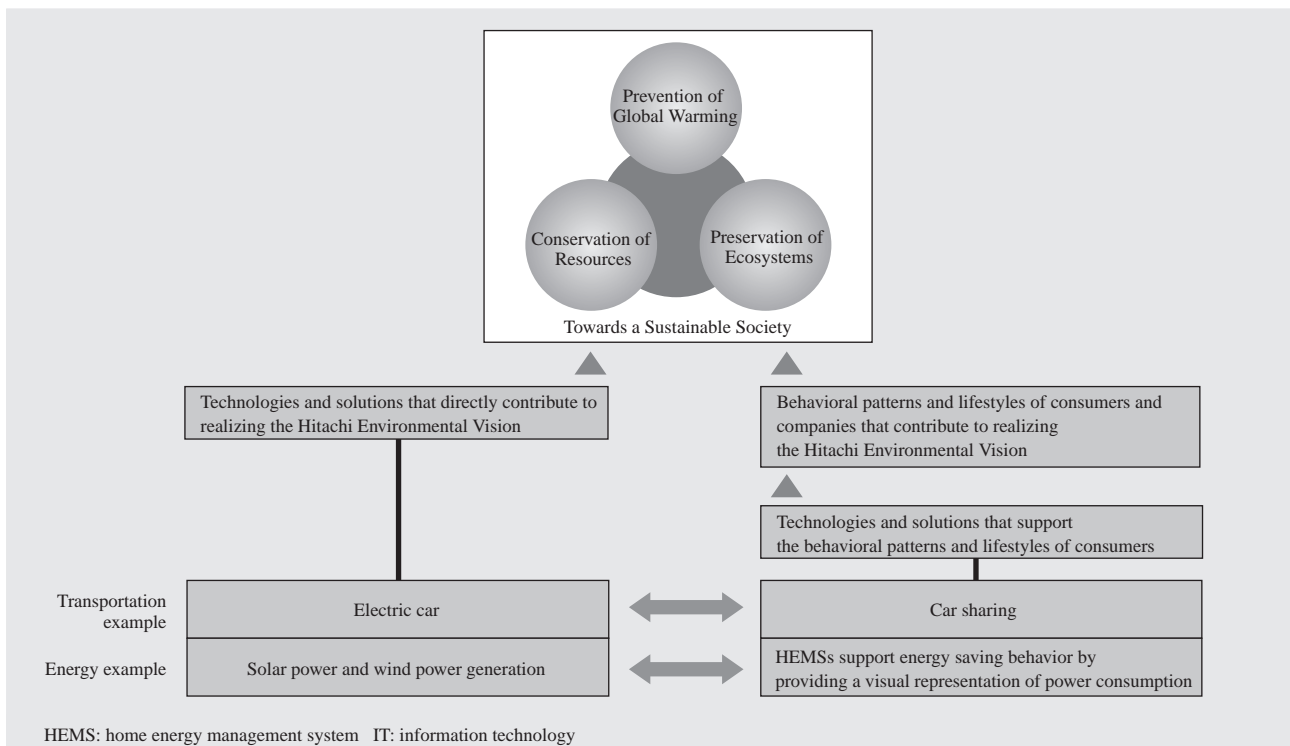

Fig. 4—Solutions for Protecting Global Environment (Experience Design Standpoint).
Supporting the lifestyles of consumers and businesses in ways that help protect the global environment is also a critical goal for utilizing IT in smart cities.

methods of experience design to study what kinds of experiences (that is, what did we do?, what kinds of feelings did it invoke?, and what was the experience?) make us feel that we have contributed to protecting the environment (being "eco"). A current, tentative version is shown in Fig. 5. "I Am Being Ecological" is being developed as a conceptualization tool, just like "24 Chapters of Happiness." It is not intended to be comprehensive or logically complete.

The six keywords in "I Am Being Ecological (tentative version)" are listed below. These can be thought of as representative "eco" experiences from a consumer's point of view. From the standpoint of experience design, the public infrastructure of smart cities should seek to utilize IT and a variety of solutions so that when consumers act to gain "eco" experiences, they are supported by "being able to take actions comfortably," "being able to take actions without stress," "having actions occur automatically," and "having sufficient opportunities and choices."

(1) Well-balanced, in moderation

This keyword means that the quantity, quality, and timing of items and services are well-balanced and in moderation for their needs.

(a) Well-balanced air-conditioning (quantity): Over-cooling is avoided when using the cooler and over-warming is avoided when using the heater. Also, to avoid waste, the air-conditioning system can turn itself off in areas where no one is present.

(b) Well-balanced use of water (quality): Reclaimed water and rainwater can be used for water sprinkling and vegetation irrigation.

(c) Well-balanced transportation (timing): Because consumers can use a public transportation system with right timing, gasoline expenses that are incurred from the use of family cars can be kept down.

(2) "What a waste!"

This keyword means taking care so that life can be lived with minimal resources. The feeling of "What a waste!" is prevented.

(a) Don't throw it away: Consumers can easily understand how something can be recycled. When an item is no longer needed, it can be recycled anytime.

(b) Don't own it: Because cars can be shared and a variety of items can be conveniently rented, consumers can make do without owning items that they rarely use.

(c) Use it up: Formulating a plan of purchasing, storage and consumption of food becomes easier, which means food can be used without waste.

(3) Don't pollute

(a) Air: Modes of transportation and types of energy that minimize air pollution can be used.
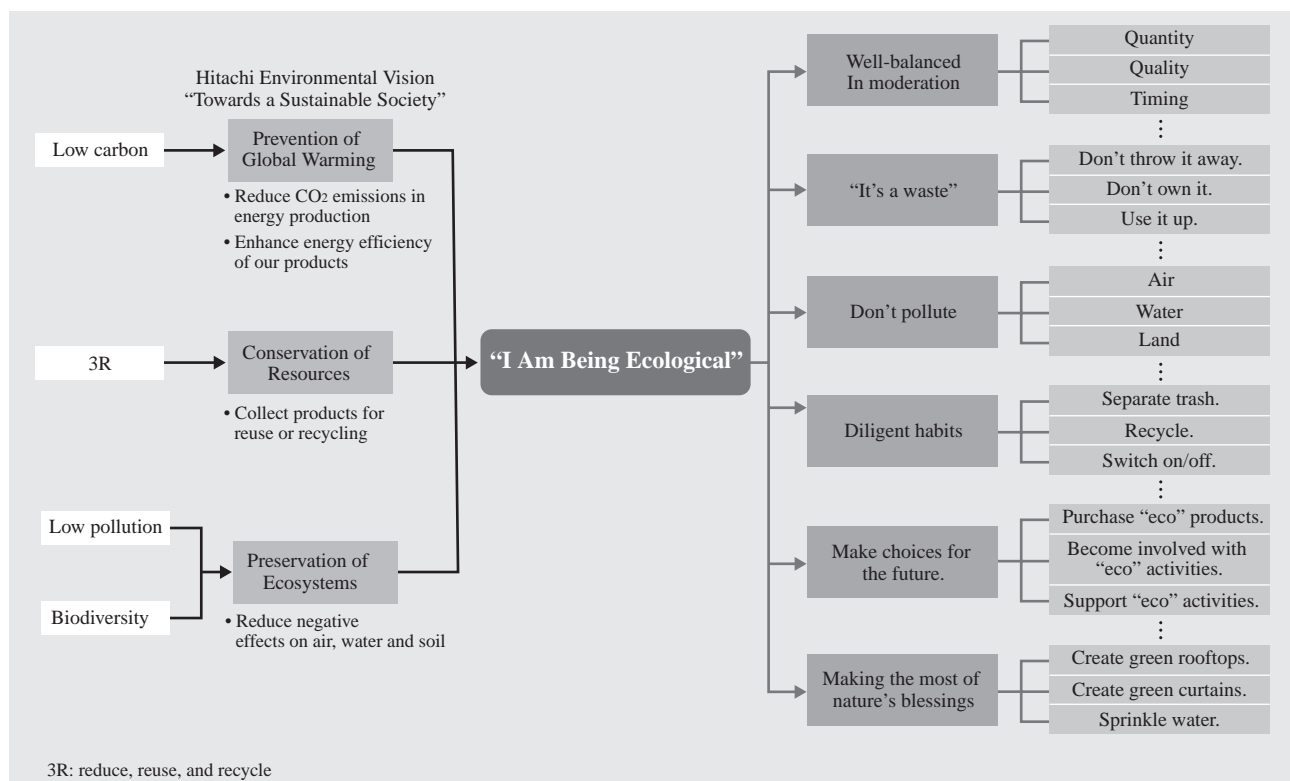

Fig. 5—"I Am Being Ecological" (Tentative Version).
This reference guide shows lifestyles that contribute to environmental protection from a consumer's point of view.

(b) Water: Because an environment is established where used water can be processed and reused, consumers can use water without worries. Laundry and dishes can be washed with minimum water pollution.

(c) Land: Consumers can choose products that are produced with minimum pollution of the land.

(4) Diligent habits

(a) Separate trash: Consumers can easily understand how a variety of waste items should be separated. They can separate them often without mistake or delay.

(b) Recycle: It is easy to understand what can be recycled and how. When an item is no longer needed, it can be recycled anytime.

(c) Switch on/off: Systems such as air conditioning and lighting are automated or can be controlled externally so that they can be switched off with certainty when not needed.

(5) Choose for the future

Consumers use more environmentally conscious products and services because of the priority they place on the future (their children's future), even if at present they sacrifice convenience and face somewhat higher costs.

(a) Information: Because sufficient information about more environmentally conscious lifestyles, products, and services can be easily obtained, consumers can think about what choices to make for the future, and can continue doing so until they are completely satisfied.

(b) Opportunities: Sufficient options are provided and made easily available when consumers think about choosing more environmentally conscious products and services (such as car sharing or renewable energy)

(c) Involvement: There are sufficient information and opportunities to take part in activities to protect the global environment (such as planting trees or recycling) so that consumers can become proactively involved.

(6) Making the most of nature's blessings

By making the most of nature's blessings, such as creating green roofs, making green curtains, and sprinkling the ground with water, consumers can live comfortably while significantly curbing their consumption of energy.

LIFESTYLE REFERENCE GUIDE

Hitachi is working on the creation of a smart city lifestyle reference guide in order to provide suggestions relating to the development and commercialization of technologies and solutions for realizing and supporting experience and "eco" lifestyles in smart cities. This reference guide maps the experiences (including "eco" experiences) that diverse consumers living in smart cities in the future can obtain onto a variety of life scenes. At present, the Design Division has nearly completed this task of organizing these experiences into several hundred life scenes.

Fig. 6 shows a map of experiences in the typical life scenes of "working," "living," "mobility (traveling)," and "studying and playing."

This lifestyle reference guide is also being utilized in the creation of materials (websites, exhibits, and presentations) for explaining Hitachi's vision for the smart city and its technologies and solutions in an easy-to-understand manner.

SMART CITY PROJECTS IN EMERGING ECONOMIES

While smart city activity is taking place around the world, numerous large-scale projects in emerging economies such as China and India are of particular note. Smart city projects in which Hitachi is participating include the Tianjin Eco City and Guangzhou Knowledge City projects in China, and the Delhi-Mumbai Industrial Corridor Project in India.

Implementing experience design in emerging economies requires the resolution of the following dilemma.

(1) Because the experiences that people seek vary depending on their characteristics, including their culture and their economic and social conditions, experience design requires a deep understanding of the local environment and it is desirable for projects to be carried out by local people who empathize with the experiences being sought.

(2) However, newly emerging economies lack people with knowledge of and practical experience in experience design.

Hitachi, Ltd.'s Design Division implemented a trial project with the goal of developing practical techniques to overcome this dilemma and to carry out experience design in emerging economies. It also sought to provide useful knowledge for existing smart city projects in which Hitachi is involved.

The Design Division selected the Smart City Solutions for Guangzhou Knowledge City project for the trial. Of all the smart city projects and related solutions being undertaken in China, this project has the strongest affinity with experience design. The Design Division chose safe and secure living in Guangzhou Knowledge City as the theme of its experience design.
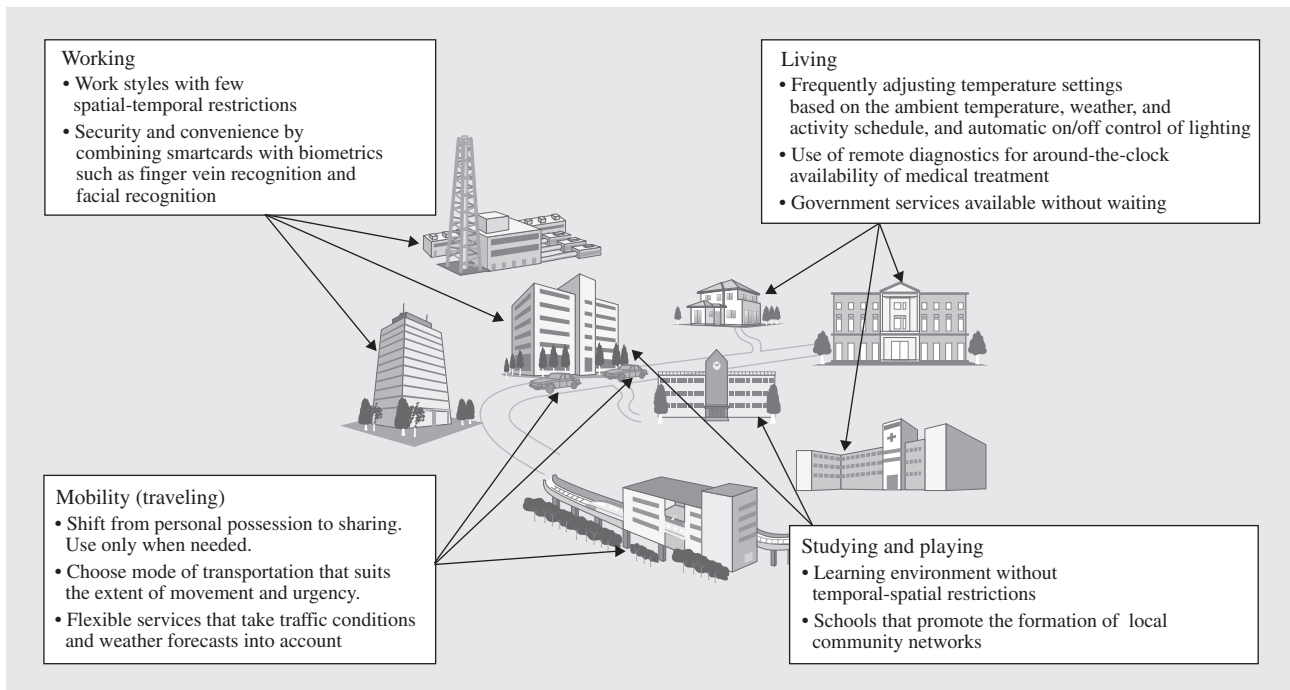
Fig. 6—Example Lifestyle Reference Guide for Smart Cities.
The lifestyle reference guide is used to communicate the smart city vision and to identify specific solution needs.

This trial project was carried out principally by experience design specialists from the Design Division. The Design Division also received support from graduate students working under Professor Makoto Watanabe at the Chiba University Graduate School of Engineering (five Japanese students and five exchange students from China). The students were studying experience design and belonged to Professor Watanabe's lab. The project also set guidelines for the effective use of specialist Chinese companies for specific aspects of experience design, such as interviews with stakeholders. Fig. 7 shows an overview of the structure and processes of the trial project.

In order to carry out the study effectively, the following two methods were used to integrate knowledge of experience experts and knowledge from Chinese exchange students who understand their people's characteristics, culture, and economic and social conditions from a design standpoint:
(1) To provide sufficient preparation, a hypothetical study was carried out in a workshop in Japan. This workshop was grounded on research results obtained by a local research firm in Guangzhou City.
(2) Field work was conducted locally, and the information on actual conditions shared among the participants. Afterwards, an experience table was finalized at another workshop, and improvements were made to the solution ideas.

Fig. 8 shows a scene from the local workshop.

The results of the trial project showed that the composition of personnel (skill mix) and basic methods of advancing the project were sufficiently effective and practical. Meanwhile, numerous issues concerning individual techniques were discovered. The plan going forward is to keep conducting trial projects in stages in order to apply the knowledge gained to actual experience design projects in emerging economies.

As a result of the trial project, the Design Division also obtained a considerable amount of useful knowledge on the development of smart home solutions. As initially expected (as hypothesized at the initial workshop), there were no major differences in the major components of experience expected by the residents of Guangzhou City compared with Japanese residents in terms of safety and security. However, new knowledge was gained concerning the thoughts and expectations of communities, and relationships of trust between people. The knowledge obtained from this trial project is expected to be utilized in the development of smart home solutions by Hitachi's Information & Telecommunication Systems Company.

CONCLUSIONS

This article has described Hitachi's efforts to realize value for life in smart cities through experience design. The smart city itself is a new global effort,
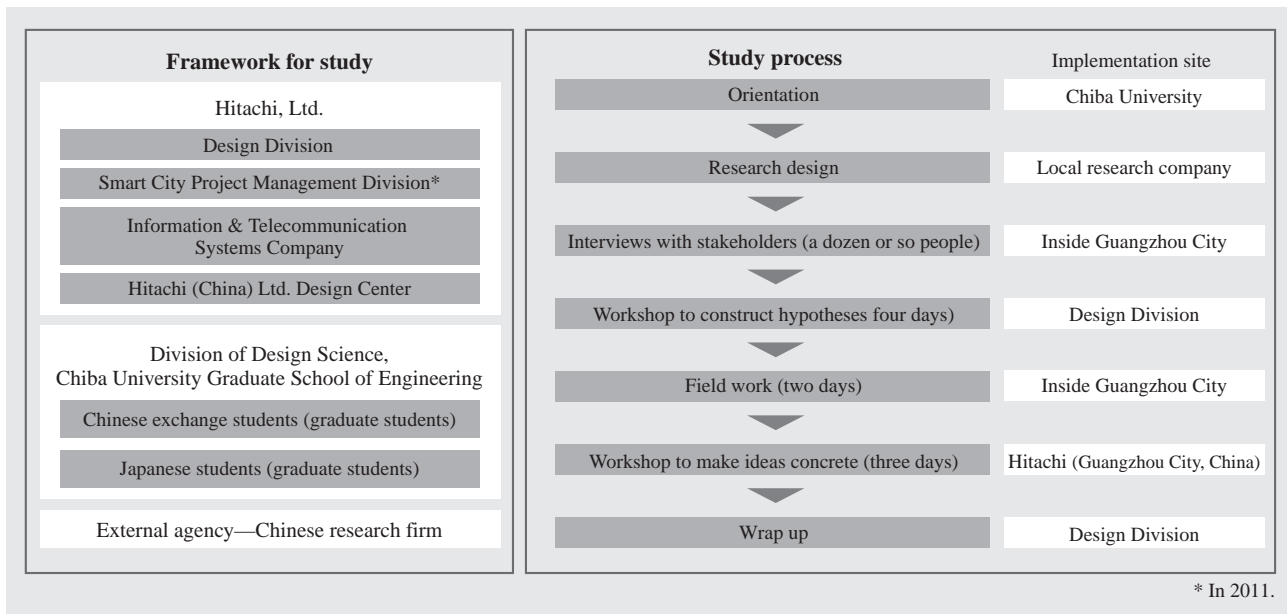
Framework for study	Study process	Implementation site
Hitachi, Ltd.	Orientation	Chiba University
Design Division	Research design	Local research company
Smart City Project Management Division*	Interviews with stakeholders (a dozen or so people)	Inside Guangzhou City
Information & Telecommunication Systems Company	Workshop to construct hypotheses four days)	Design Division
Hitachi (China) Ltd. Design Center	Field work (two days)	Inside Guangzhou City
Division of Design Science, Chiba University Graduate School of Engineering	Workshop to make ideas concrete (three days)	Hitachi (Guangzhou City, China)
Chinese exchange students (graduate students)	Wrap up	Design Division
Japanese students (graduate students)		
External agency—Chinese research firm		

* In 2011.

Fig. 7—"Safe and Secure City Experience in Guangzhou City" Study Project.
This study was carried out principally by Hitachi, Ltd.'s Design Division with support from the Chiba University Graduate School of Engineering and the then Hitachi Smart City Project Management Division.

Fig. 8—Scene from Workshop.
Workshops were held in Guangzhou City immediately after the two days of field work (on-site research).

and the application of experience design to smart cities has just begun. As a result of previous efforts, Hitachi is currently at the stage of establishing a useful framework and approach for the conception and planning of smart cities. The Design Division is creating keywords and references to inspire the conceptualization of the development of smart city solutions, and is carrying out trial projects. The knowledge gained from these trial projects will be applied to actual projects in emerging economies.

Going forward, Hitachi intends to utilize experience design to build smart cities that realize a high level of experience values by involving itself and utilizing its know-how in real-world projects.

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Methodology Research and Development for Designing Future Experience

Yukinobu Maruyama
Takeshi Hoshino
Tadaaki Ishikawa
Takuya Akashi

OVERVIEW: To pursue smart city and other Social Innovation Business projects with the understanding and support of stakeholders, it is important to create an image of the ideal society of the future, not only by making predictions about the near future but also by looking ahead 10 or 20 years. As experience design techniques able to assess changes both in the social environment and in people's values will be essential for constructing this image of how society will cope with important lifestyle issues in the future, such as the super-aging and urbanization of the population, Hitachi has applied the concept of experience design, and is using it to capture transitions in the social environment and people's values. Hitachi intends to continue contributing to society by conducting research into the construction of the ideal-lifestyle-image in the future.

INTRODUCTION

IN terms of the social issues facing Japan, background factors include growing demand both for the reconstruction and updating of domestic social systems, and for collaboration with developing and developed economies. These social issues include the environment, the declining birthrate and aging population, and the recovery from the 2011 Great East Japan Earthquake. Given the growing concern about the safety and reliability of infrastructure, there is a need to determine what form future environmentally sustainable urban planning should take.

This image of future urban development includes factors such as energy conservation and traffic management. An important part of this future will be the adoption of measures in which the small contributions made by individuals come to be recognized not as a burden but as both a source of satisfaction and a motivator (see Fig. 1). This requires an approach to design based on "value reinforcement," whereby residents have a positive attitude toward the available services and rules and therefore act on their own initiative to help create the sort of society in which they want to live. Hitachi has been undertaking research into methodologies that incorporate these experience values into the design of ideal future cities.

Fig. 2 shows how the overall framework for this research is split into three major parts. The first part is called the "*kizashi* method" and studies signs (*kizashi*) of changes in people's values by forecasting changes in external factors. The second is the "constructive

approach to experience values," whereby specific cases are analyzed to establish archetypes of experience values. The third is the process whereby field research in the area being considered is used as a basis for constructing an image of future lifestyles that draws on the "*kizashi*" and "experience value archetypes." Finally, the image of the future is developed in the designers' imaginations by taking an understanding of reality as it currently exists as a starting point and then applying prediction and intuition.

This article describes how this research constructs an image of ideal future lifestyles by extracting insights from social and technological trends, understanding how these will lead to changes in
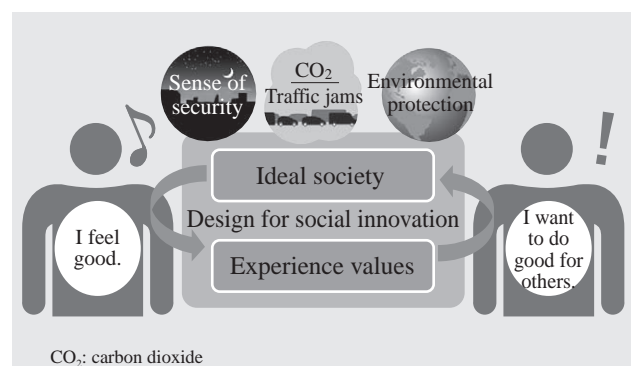

Fig. 1—Social Innovation and Experience Value.
By encouraging people to feel good about what they receive from society and what they can do in return, experience values facilitate the creation of a better society through value reinforcement.
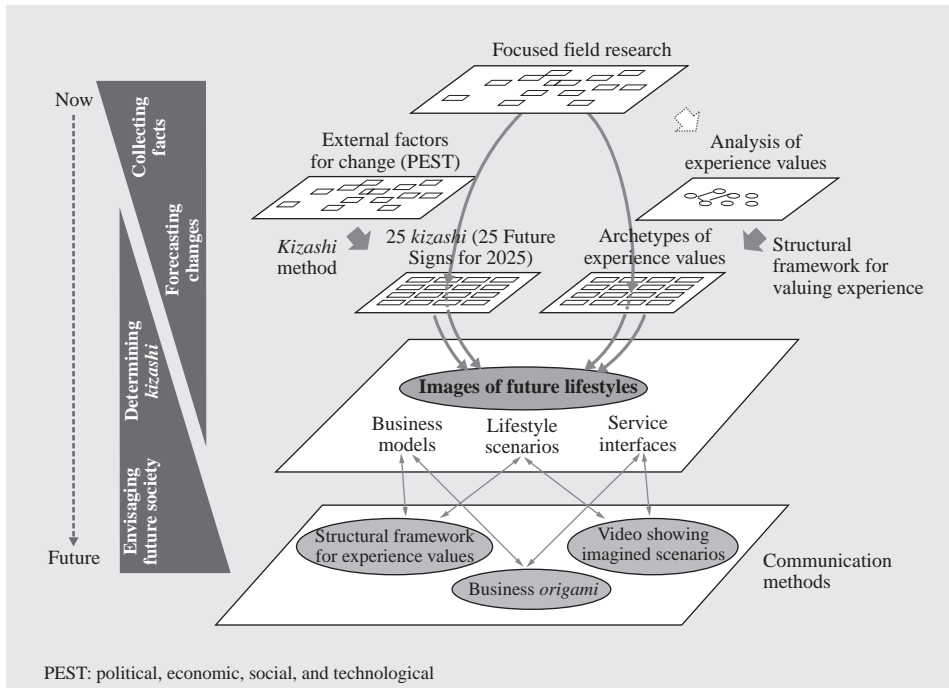
Fig. 2—Overall Framework of Study.
The ideal forms that society could take in the future are envisaged through techniques for considering future social change and techniques for analyzing the value people place on experience.

people's values, and then generating ideas about how to enrich people's way of life.

PREDICTING FUTURE SOCIAL CHANGE

To determine how consumer values will change in the future and consider what attractive experiences will suit this future world, the approach taken by this research was to analyze the social changes that have a significant influence on people's values, and then to utilize techniques from cognitive engineering and social science to assess and categorize these in order to design, from a consumer's perspective, what form should be taken by social systems and services.

Development of Kizashi Method to Identifying Changes in People's Values

Desktop research drawing on published studies and web-based sources and using political, economic, social, and technological (PEST) analysis was undertaken to produce a chart representing the relevant factors and there interrelationships from 2005 to 2030 (see Fig. 3). The vertical axis represents the PEST categorization and the horizontal represents time.

The detailed procedure is explained in Fig. 4. After the factors were classified, the next step was to generate hypothesized scenarios by forcibly generating ideas from combinations of topics. The kizashi signs that provide valuable insights into the future were then identified from the results of these scenarios.

The hypothesized scenarios were also examined with the help of the gerontologists to determine the factors, such as aging and generational changes, that influence people's values. This identified 25 kizashi (25 Future Signs for 2025) that are likely to have an influence on society over the next 15 years.

25 Kizashi (25 Future Signs for 2025)

The most crucial factors for a sustainable and sound society are people's safety and security, social participation, and self-reliance. The following section describes those kizashi that relate to these factors.
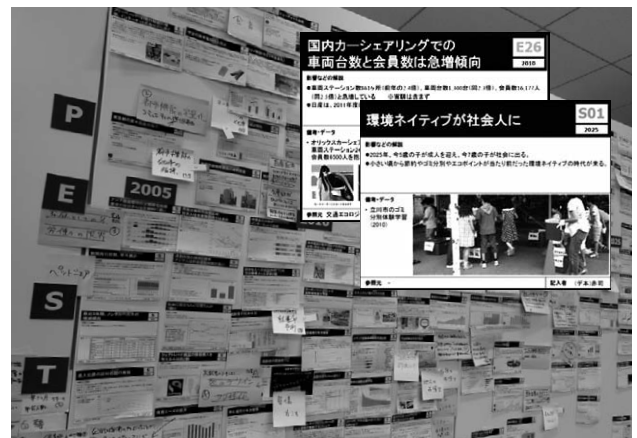

Fig. 3—PEST-based Approach to Forecasting Future Trends.
This process is accomplished by classifying and combining collected information on a matrix. The vertical axis represents the PEST classification and the horizontal axis represents time.
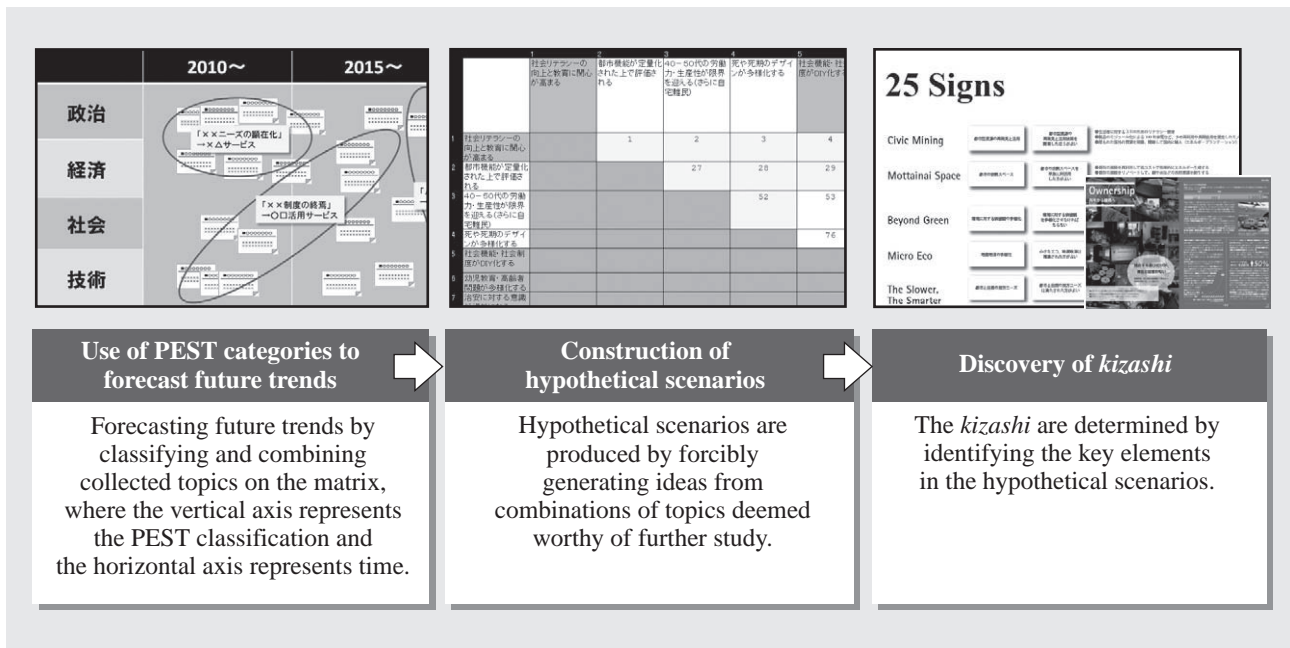
Fig. 4—Procedure for Kizashi Method.
Predictions of the future are created through the forcible generation of ideas based on consideration of social trends by arranging the PEST analysis against the time axis.

Ensuring safety and security for people living alone – singleship

In addition to those people who live alone as a result of separation from their partners, there are also an increasing number of people who choose this lifestyle for their own reasons, including the elderly who choose not to live with their adult children. Because such households are at greater risk of crime, they will rely on social systems to protect them from this and other social risks, and will create a growing demand for training in social literacy to achieve a balance between freedom and security.

Encouraging social participation—from ownership to usage

As our consumer society becomes more mature, people are less concerned with personal ownership of goods. Instead, they start attaching greater importance to the experiences these goods and services deliver, the formation of human relationships, their personal beliefs, and their role in society. This new awareness encourages a sense of shared responsibility for public services that will help make these services more sustainable.

Supporting independent living—the right to mobility (demand for new forms of mobility that provide freedom of movement)

The right to mobility should be guaranteed for the elderly and the disabled, and society should not leave them disadvantaged in this respect. This view has come to prominence recently in relation to issues such as people giving up their driver's license and in debate about public transportation policy. In the future, it is anticipated that this line of thinking will lead to the view that public transportation should respond to people's personal circumstances and objectives while also meeting society's circumstances and objectives. It will also mean that the existing transportation infrastructure will need to be upgraded so that mobility can be provided even during emergencies such as pandemics or natural disasters.

DEVELOPMENT OF METHODS FOR ANALYSIS OF FUTURE EXPERIENCE VALUES

When considering the experiences of future users, it is reasonable to assume that changes in the external factors described above will influence the cause and effect relationships between those things that determine the value people place on experiences. The following section explains how to categorize and visualize the cause and effect relationships through which goods and services influence the value of experience.

Fig. 5 shows a structural framework for valuing experience. The underlying idea is that the way people value experiences is not based on the goods or services themselves but on the feelings of pleasure or other favorable outcomes that result from the activities or opportunities that the goods or services make possible.

Based on this approach, the framework consists of three layers: the goods or services, the activities or opportunities, and the experience value.

Structural Framework for Valuing Experience

Fig. 6 shows the procedure for putting the value of experience into a structural framework. The first step is to analyze the cause and effect relationships between the elements that determine the value of the experience. This is done by conducting interviews and making field observations of the activity being studied. The second step is to generate a pair comparison matrix that is used to identify whether cause and effect relationships exist and to assess their strength. Records of this work are kept so as to be available for later review. The third step uses an algorithm developed specifically for the purpose (based on graph theory) to provide a visual representation of the degree of importance of each element and the sequence of the cause and effect relationships. The resulting graph indicates which points to focus on and evaluate. A software program was written to perform this step automatically.

The validity of this method was verified by using it to produce a structural framework of the experience values for a widely used railway smart card (see Fig. 5). The ability of the system to calculate fares automatically at the ticket gate has delivered improvements in three aspects of user behavior: (1) it has eliminated the time and effort associated with buying tickets, (2) cash handling is no longer required, and (3) it is not necessary to decide on where to get off the train before purchasing a ticket. In other words, the experience value delivered by the system is that it reduces the stress of train travel. In Fig. 5, the circle sizes symbolize the degree of importance of each element, while the vertical axis and the thickness of lines together indicate the sequence of the cause and effect relationships.

Application of Structural Framework for Valuing Experience

In analyzing the causal relations between the elements that determine how experiences are valued, this method can also be used to identify the causes of unfavorable user experiences. This has included its use to determine what obstacles exist to mobility by the elderly and to study how best to make improvements.
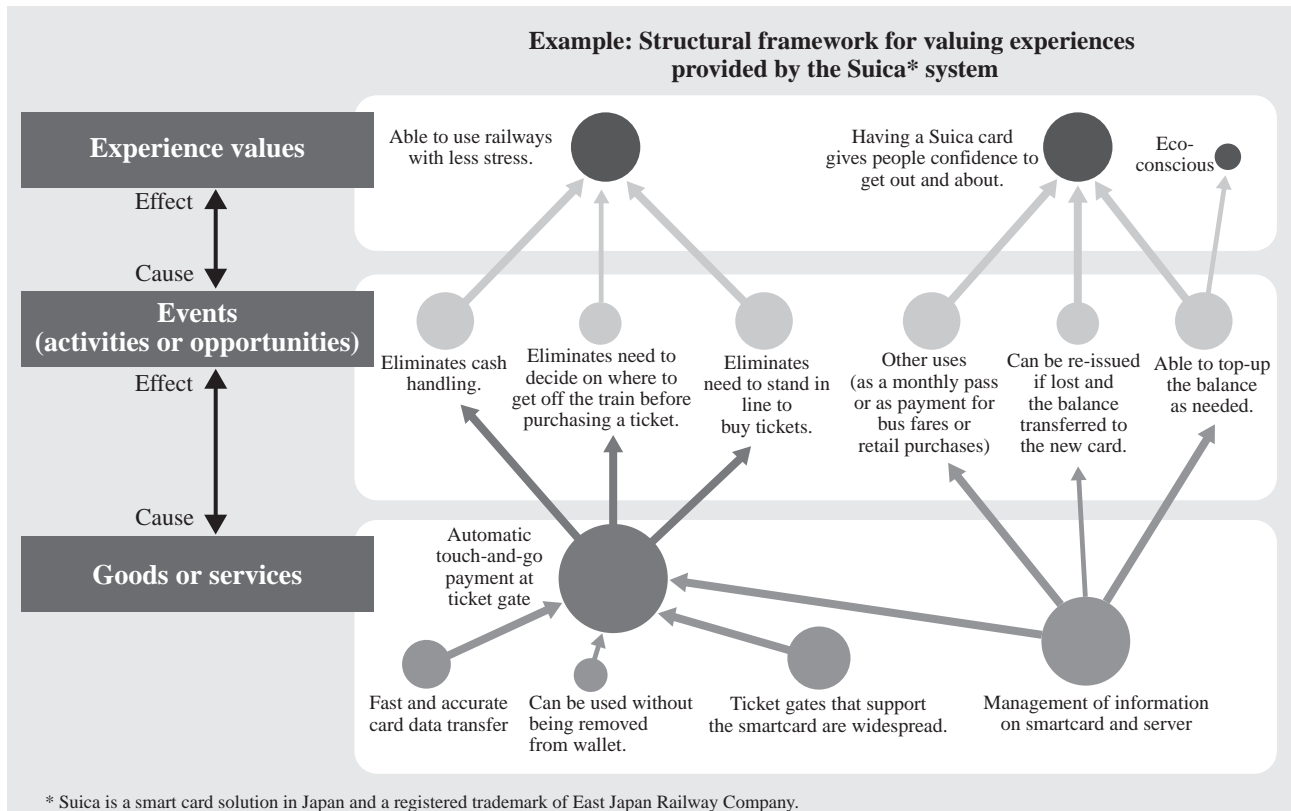

Fig. 5—Structural Framework for Valuing Experience.
The framework provides a visual representation of the values placed on experience by analyzing the causal factors and arranging them into three layers, namely goods or services, activities or opportunities, and experience values.
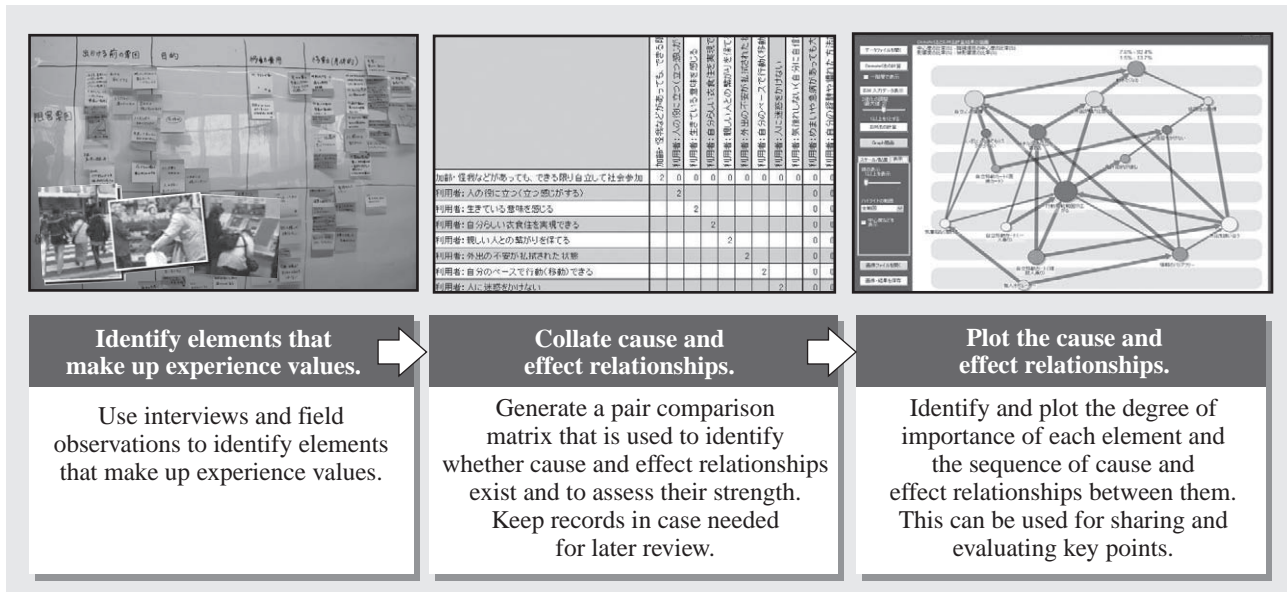
Fig. 6—Procedure for Putting Experience Values into Structural Framework.
First the elements that make up experience values are identified, and then pair comparisons are performed to create a visual representation of the overall structure of cause and effect relationships and the importance of individual elements.

The method also has the potential for use in the visualization of future experiences and their values. There are three factors that can influence value: (1) the effects of aging on the individual, (2) progressive changes over time, and (3) generational change. Hitachi has already collected knowledge about these factors, some of which is currently used in the study of mobility, and intends to continue this work to build up knowledge about the various elements and their expected impacts.

The overall framework for this study shown in Fig. 2 includes the identification of archetypes for experience values that can be used in formulating a vision of the future. Unfortunately, the current extent of collected knowledge remains insufficient to provide what could be described as archetypes. Instead, the elements that have been identified to date are used independently within the scope of their respective studies. Therefore, the objectives for the future will be to accumulate more knowledge and expand its scope of application.

EXAMPLE VISUALIZATION OF FUTURE LIFESTYLE

This section describes an example of service design from a consumer perspective for a social system that combines people, society, and technology.

This example envisions the "society in the year of 2025" where people of all ages can live a healthy and active life with a shared sense of security, including how to reduce the load on the environment, the declining birthrate and aging population, and the growth of the urban population.

Society in which Everyone Can Live Healthy and Comfortable Lives

A primary concern of society in the future will be to provide mobility and a quality healthcare system for all members, with both hard and soft infrastructure providing the crucial technological base. The following section uses the example of mobility to describe the process of developing a vision for a future lifestyle.

The subject selected for this case study was the redevelopment of an area around a station. In order to enable stakeholders to vividly imagine the future and to enliven their discussions, a video was produced that presented the proposed redevelopment and its business model. The following sections describe four concepts associated with providing solutions that enhance people's mobility (see Fig. 7).

Concept 1: Pedestrian-friendly urban environment

The pedestrians of the future are likely to include people with different levels of knowledge and physical capabilities, including the elderly and people from other countries. The numbers of senior carts and shared bicycles are also predicted to increase. Given such requirements, the current situation in which streets are split between car and pedestrian traffic will no longer be suitable.

Fig. 7—Mobility Concept Example.
Four concepts were identified as relevant to this example of a society in which everyone can live a healthy and active life.

The main focus for this example was on how to create a vibrant urban space in the neighborhood around a railway station by turning the area within a 250-m radius into a pedestrian mall (based on the assumption that 500 m is the limit to how far the elderly can walk). The idea was that the mall would be able to accommodate both pedestrians and small vehicles fitted with safety features, thereby creating a retail precinct in which people can move at their own pace and maintain a comfortable distance from each other.

The services proposed for this project included mobility scooters, a dynamic pricing system for railway fares, and digital signage units.

Concept 2: Active communities

Providing an environment that facilitates mobility and gives people the freedom to move about at their own discretion encourages the elderly and others to participate in social activities and gives them an incentive to get out and about. This includes consideration for those without driving licenses or the elderly who may be concerned about their ability to find their way back home after visiting an unfamiliar location. One of the proposals in this example is to provide auto-driving vehicles that are shared by the community. The aim is to provide the elderly with an alternative means of transportation that offers a similar level of convenience to owning their own car.

The main service proposed here is an on-demand car sharing service that uses self-driving vehicles and is accessed from mobile devices.

Concept 3: Communities that make sense

As is the case with environmental problems, it is anticipated that urban life will face an increasing number of complex interrelated social issues. Whereas in the past matters proceeded in accordance with rules set by local government without requiring the active involvement of the general public, in the future individuals will need to make their own decisions, and to acquire the knowledge they needed to do so under their own initiative. In this context, the visualization of social systems will enable people to clearly see how their actions and behaviors influence society, and this will enhance their problem-solving abilities. The proposal in this example is to provide systems that allow individuals to contribute through their decisions and actions to achieving the best outcomes in fields such as recycling or emergency services.

The main services proposed here are an ambulance system that takes patients straight to the appropriate hospital based on their symptoms and a trash-collection vehicle system in which the vehicles are designed to facilitate resource recycling, the idea behind the latter is to shift from an emphasis on disposal to emphasis on recycling.

Concept 4: Supportive communities

As the population continues to age, civic participation will play a vital role in maintaining social security systems. The proposal in this case is to provide systems in which the benefits of voluntary work or financial contributions by individuals are immediately visible, thereby motivating people to do

more for their community. Systems such as these can also provide the more accommodating management basis for the cross-community support during large-scale disasters.

The main proposal here is a community bus service financed from public funds and individual contributions that will contribute to make the challenging business sustainable.

Structural Framework for Experience Value of Mobility for Elderly

This section describes how the structural framework for valuing experience was utilized in developing the concepts described above.

First, the interviews were conducted with 12 elderly people to identify obstacles to their mobility. Some were able to walk on their own, whereas others used a wheelchair or needed assistance. These obstacles and their interrelationships were then examined in light of the aging, changes over time, and generational changes expected over the next 15 years. A graphical representation of these obstacle relationships forecast for 15 years into the future was created from a pair-comparison matrix and compared with a similar graphic representing the current obstacle relationships. The results of this work found

that, while improvements would be made in terms of providing attractive places to visit and the removal of mobility constraints, psychological barriers would remain, including anxiety about unexpected events and a desire not to trouble other people. In other words, obstacles to encouraging the elderly to get out into the community would still be present.

This finding was utilized in the study of the "active communities" concept described above to design services that could eliminate these psychological barriers. Examples included mobility scooters able to carry more than one person or designed specifically for hospital use. Fig. 8 shows the structural framework for experience values that was utilized in the proposals associated with this concept. It demonstrates the effectiveness of taking account of future experience in service designs and comparing the benefits under different scenarios.

CONCLUSIONS

This article has described how this research constructs an image of ideal future lifestyles by extracting insights from social and technological trends, understanding how these will lead to changes in people's values, and then generating ideas about how to enrich people's way of life.
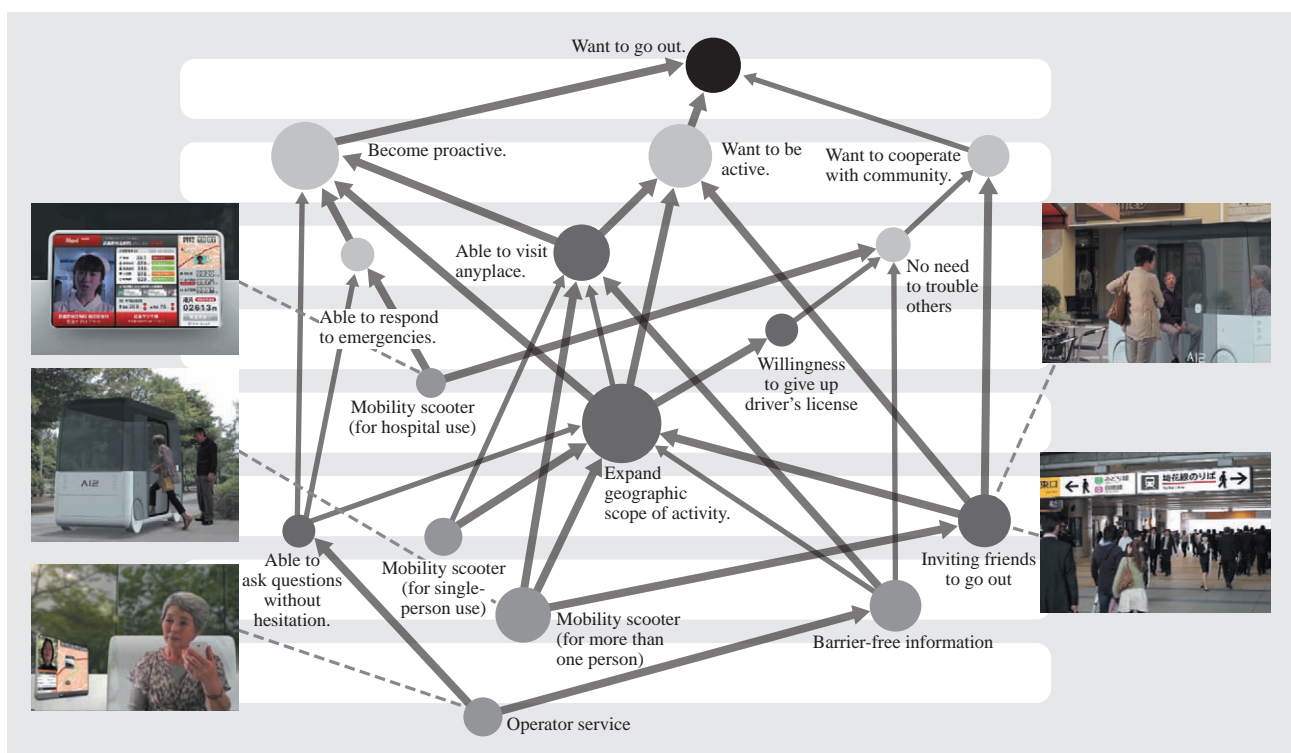

Fig. 8—Example Use of Experience Values in Design.
The design classifies the factors involved in proposals for creating an environment that encourages the elderly to be active in the community.

Further research aimed at predicting future experiences will need to accumulate more knowledge through actual business projects in order to refine the methodology. It will also be ideal for the research to be extended beyond studies of the elderly in developed nations to include the collection of knowledge on the best lifestyle options for people in newly industrialized and emerging nations. To this end, Hitachi intends to continue pursuing this social science based approach to accumulating knowledge and to researching the make-up of values held by people in different countries.

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