The JR East Japan Design Manual was created in 1990. From this design manual, the guide signs section was spun off into an independent manual in 2001, and minor changes were made. Now guide signs are under gradual improvement. While stations are improved and layouts of in-station spaces are changed, introduction of variable information, or information that changes in a timely manner using IT, is expected as a method of information delivery. As dramatic changes will be made to hub stations such as Tokyo and Shinjuku stations in the near future, we conducted a study from an objective perspective on a paradigm for a next-generation sign and information delivery system so as to introduce such a system to these hub stations.

Keyword: IT, cognitive psychology, visual psychology, environmental psychology, informatics

1 Introduction

The objective of this study is to suggest a new framework for the creation of a next-generation sign and information delivery system, and clearly specify its future paradigm as well as detailed plans for realizing such a system, while focusing on "scenarios in which customers use stations." When examining the plans, from various types of fast-evolving IT, we chose a technology that we assumed can be introduced in the near future, created a road map, and then suggested solution images. At the same time, based on surveys and research conducted so far, we paid close attention to two factors that will shape the next-generation sign and information delivery system: the relationship among information content, means of expression, and location of information; and also the principles behind the means of information expression. Consequently, we examined in-station guidance measures based on a fusion between design and IT.

2.1 Perspectives used in examinations of the next-generation sign and information delivery system

When creating the concept of the next-generation sign and information delivery system, we looked at this issue from the perspectives of the main users, or customers, and examined the system based on the concept of universal design covering various scenarios of system use.

2.1.2 Problems related to the current guide sign and information delivery system

As a result of past studies, subject stations were found to have the following four common problems:

1. It is difficult to understand signs since a large number of signs and advertisements are indiscriminately displayed on station premises or on platforms.
2. Facility or information contents are provided with the same importance, meaning that none of them have clear priority.
3. Rules of signs or guidance systems are not shared with customers. For example, some of the rules such as where information is displayed, which place names are displayed as destinations, and how pictograms are displayed are not shared with customers.
4. Information centers or station crew must respond to customers individually since information displayed in the sign and guidance system is not properly conveyed to the customers. In some cases, only person-to-person guidance is available for customers who need detailed information.

2 Future trends of new applicable technologies

Next, for creating the concept of the next-generation sign and
guidance system, we studied trends of IT that can be used as future guide signs.

2.2.1 Mobile terminal technology

Wireless LAN, Bluetooth, and RF-ID are now available for local communications, and the environment for "push-style" provision of necessary information, or information distribution for passive recipients, has been improving. Also, release of mobile terminals with FeliCa and Suica functions is scheduled in 2006; therefore, we believe that in the future there will be more types of fusion between mobile terminals and other functions, such as GPS or authentication functions.

2.2.2 Display technology

In the near future, cathode-ray tube (CRT) displays will decline in popularity and be replaced with flat panel displays (FPDs). Among FPDs, liquid crystal displays (LCDs) are in the lead while competition in development of plasma display panels (PDPs), organic light emitting (organic EL) displays, and field emission display (FED) panels have been intensifying. Currently, cost and creation of large size models have been problems to be solved for LCDs and PDPs, while product life has been an issue for organic EL displays.

As for organic EL displays, however, although life and screen size have been problems, a large part of these problems are expected to be solved by 2010 and therefore its future is promising. As for LED with the backlight technology, its luminous efficiency is rapidly improving, and its improvement is expected to continue at a steady pace. By 2010, it is estimated that its luminous efficiency will reach 120 lm/W. Also, electronic paper can be named as an example of other note-worthy technologies.

2.3 Adaptation to the next-generation sign and information delivery system

Based on the envisioned system use by customers, we suggested how IT applicable to the next-generation system could be adapted to each of six guidance categories (Figure 1).

Table 1: Flat panel display technology road map

<table>
<thead>
<tr>
<th></th>
<th>2001</th>
<th>2005</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic EL</td>
<td>2001</td>
<td>2005</td>
<td>2010</td>
</tr>
<tr>
<td>Screen size</td>
<td>13 inches</td>
<td>15 inches</td>
<td>20 to 30 inches</td>
</tr>
<tr>
<td></td>
<td>480,000 pixels</td>
<td>1,2 million pixels</td>
<td>2 million pixels</td>
</tr>
<tr>
<td></td>
<td>1,000 to 2,000 hours</td>
<td>5,000 to 10,000 hours</td>
<td>30,000 to 50,000 hours</td>
</tr>
<tr>
<td>Screen size</td>
<td>28 inches</td>
<td>30 to 40 inches</td>
<td>20 to 30 inches</td>
</tr>
<tr>
<td></td>
<td>2 million pixels</td>
<td>4 million pixels</td>
<td>4 million pixels</td>
</tr>
<tr>
<td></td>
<td>30,000 to 50,000 hours</td>
<td>30,000 to 50,000 hours</td>
<td>30,000 to 50,000 hours</td>
</tr>
<tr>
<td>Screen size</td>
<td>60 inches</td>
<td>60 inches</td>
<td>80 inches more</td>
</tr>
<tr>
<td></td>
<td>1 million pixels</td>
<td>2 million pixels</td>
<td>4 million pixels</td>
</tr>
<tr>
<td></td>
<td>300kHz</td>
<td>150kHz</td>
<td>100kHz</td>
</tr>
<tr>
<td>Luminous</td>
<td>250lm/W</td>
<td>60 to 90lm/W</td>
<td>85lm/W</td>
</tr>
<tr>
<td>efficiency</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.3.1 Platform and train time guide

Full-color LEDs installed at the South Exit of Shinjuku Station have been received well by customers, and there is a demand for further expansion of this application. In order to improve service quality, it will be important to examine the possibility of adopting organic ELs due to the high image quality and...
response speed, as well as preferred thickness and weight. At the same time, as a means for checking necessary information, installation of floor-type navigation terminals or “pull-style” information distribution, in which recipients actively request and retrieve information via mobile terminals will be a possibility. For the latter, use of mobile phones may be the best option since they can realize a seamless functional link with devices using radio in the vicinity such as wireless LAN, Bluetooth, and IrDA that are already widespread.

2.3.2 In-station guidance
It is necessary to minimize installation of visual information such as guide signs and advertisements for simpler and better visibility. For a hub station with a complicated multi-level structure, an autostereoscopic display can be used as an in-station map.

2.3.3 Area guidance
In order to create an easy-to-understand area guide, it is necessary to install a screen that shows different guidance information on a timely basis or to provide customers with a means for checking necessary information by themselves.

2.3.4 Train operation information in case of abnormality
In case of an emergency such as a train accident, station crew are likely to receive an extremely large number of inquiries. At the same time, however, station crew do not have sufficient information regarding the accident or alternative routes and therefore cannot provide timely information. In an emergency situation, not only prompt provision of information regarding the accident or alternative routes, but also provision of constantly changing information such as train operation information and use of variable display screens that can show accident information on a route map are important so that both customers and station crew can check necessary information.

2.3.5 Guidance for International People
It is necessary to install floor-type information / navigation terminals or to permit the use of dedicated mobile terminals in order to allow them to check necessary information. Also, it is necessary to make plans for supporting them with information on how to use these devices, including the use of ticket vending machines, through multi-language guidance.

2.3.6 Guidance for middle-aged and elderly people
Some middle-aged and elderly customers seem to not notice guide maps and signs even though they are right in front of them. Or, some seem to not know how to read signs or understand directions on maps. As a result, there are many cases in which customers, mostly female, directly ask questions to station crew. Also, even though they ask questions, they will get lost on the way if the destination is far and therefore cannot get to the destination. For customers like these, a navigation service to the destination must be provided individually.

3 Paradigm for Information Delivery at Each Station
We established a hypothetical theory about the next-generation sign and information delivery system. Since this theory is a generalized theory, it will need to be adjusted to the status of each station when being examined. On this occasion, among information centers located at 11 stations within the JR East Japan management area, we analyzed customers’ inquiries received at eight information centers at five major terminal stations. Then we compared the results among six information centers at three stations in order to understand the status differences among stations.

3.1 Use of information at an information center
Among 14 information centers we installed at 11 stations, we chose six information centers at three stations, Station A, Station B, and Station C. Then we used business logs kept at these information centers to determine the trends of information delivery at each station.

3.1.1 Station A (Counter ①, Counter ②, and Counter ③)
Questions asked at this station were mainly regarding how to get to a certain destination, about in-station facilities or shops, and about train ticket usage. At Counter ② information regarding specific facilities around the station was requested more often than at other counters, and at the other 2 counters, general area guidance was given often more than at Counter ②.

(N = 366,000 cases at three information counters)
3.1.2 Station B (Center \(q\) and Center \(w\))
Center \(q\) is located inside the South entrance/exit ticket gates, and Center \(w\) is located inside the East entrance/exit ticket gates, and there is a large difference in the amount of guidance given between these centers. As for guidance for specific facilities around the stations, information regarding commercial facilities such as department stores or hotels, and also regarding office buildings was most frequently requested. There are also many questions regarding facilities far away from the station or facilities in different areas.

3.1.3 Station C
In-station guidance, area guidance around the station, and train transfer information were frequently requested and the number of questions for each was about the same. Although Station C has limited shared tracks and a relatively simple station structure, it is noteworthy that needs for information regarding train transfer and in-station guidance are large.

3.1.4 Problems and concept requirements
Information collected at information centers is personal and the latest information that customers have requested, and it may include not only facts about individual guidance but also tips for service improvements. Information kept in the form of business logs at each information center and station concierge desk is used for improvement of service efficiency and quality. Information accumulated at an information center is shared only among center crew, and there is no mechanism for systematically sharing the information. Therefore, information accumulated at Station A will not be used at information centers of other stations. Also, since center crew are usually temporary staff from our subsidiaries, personal know-how cannot be accumulated. In the case of station concierge desks, know-how is accumulated at the subsidiaries, but installation of such desks in stations is limited. Furthermore, there is no system to gather collected information and therefore the situation now does not allow the information to be effectively used for service improvement. From now on, it is necessary to aggregate information from each station and use it effectively in the development of the next-generation sign and information delivery system.

### 4 Proposal for the Next-Generation Sign and Information Delivery System

4.1 Proposal for the basic concept
The next-generation sign and information delivery system simultaneously aims for sophistication of information delivery methods and information contents. The approach to achieve such a system is based on the following basic concepts.

1. **Position space within a station as a base of information delivery and exchange for customers in that area as well as for visitors.**
2. **Optimize the information delivery system by showing the basic patterns of station and railway use and by sharing views toward station and railway use with the customers in order to actively support their self-reliant travel.**
3. **In order to meet customer needs which will differ according**
to each customer's familiarity in using railways or stations, or with each individual purpose of using railways or stations, improve the information delivery system by using IT-based navigation and also realize a sophisticated concierge-style interpersonal information delivery.

4.2 Proposal of individual elements for materialization of the basic concepts

4.2.1 Philosophy of universal design
Information must be provided not only for users of particular attribute segments such as elderly users or physically challenged users, but also all users regardless of situations in order for them to travel smoothly.

4.2.2 Pursuit of simplicity
In order to allow users to be self-reliant as they find their way through stations, it is necessary to show and share basic travel patterns in that space so that, through the sign and guidance system, it is possible to accurately provide prioritized "key" information (platform number display).

4.2.3 Support for individual users
While promoting self-reliant travel of users, information must be provided to individual users who need more detailed and specific information. Also, in accordance with user needs, efforts must be made to realize sophistication of information contents not only in terms of railway information or in-station guidance, but also in terms of a concierge-style information service in which information regarding facilities around the station, various events held in the area, and various recommendations is offered.

4.2.4 Active use of IT
Information associated with the basic patterns for promoting users' self-reliant travel will be provided through display technologies. Also, in accordance with each basic pattern, a guidance system based on a navigation infrastructure and terminal will be introduced. Since the "pull-style" information provision is required in the navigation infrastructure, new IT such as RFID will be used to create high quality user interfaces.

4.2.5 Active use of knowledge
Inquiries received at information centers have not thus far been used outside of the place of origin. It is necessary to systematically take up such information and use it as important tips for diversification and sophistication of services.

4.3 Basic patterns of station use
In order to allow station users to fully understand information and be self-reliant as they move about inside station premises regardless of situations, users and railway operators must share the understanding of the basic pattern of station use. Here, assuming that a user, after arriving at the station, moves about inside the station premises and catches the correct train to his / her destination, we define information to be understood by the user along the route and provide such information through guide signs.

4.4 Concept of the basic patterns
Figure 6 shows the concept of the basic patterns.

1. In a basic pattern, with the platform number as the key information, a user will reach the stairs to the platform from which a train for the desired destination departs, and then reach the platform.
2. By using the basic pattern, a user can move about self-reliantly by using a minimum of information provided by guide signs.
3. For those who have difficulties finding their way only by using guide signs, or for those who are not comfortable finding their way with only the minimum amount of information, information will be provided to each of them...
through a navigation terminal. Considering the current status, the appropriate approach will be to replace guide signs provided at various places inside the station concourse with information delivery systems for providing navigation.

5 Proposal for the Next-Generation Sign and Guide System

5.1 Proposal for user interfaces

5.1.1 Notice-board type sign and guidance system

For notice-board type signs, the following policies must be established in accordance with the basic pattern of station use in order to reliably guide users to the correct platform rather than to provide all train-related information.

1. When moving from the outside to the inside of the ticket gate, users must be able to check the notice board, understand which train to catch, and acknowledge “Platform (number)” information as the key information.

2. Information that must be provided to users when they decide which train to catch should be limited to “Line district and train type (direction),” “Departure time,” and “Destination.”

3. The “Number of cars” information currently provided makes the whole train information appear more complicated and the key information, or platform numbers, attract less attention as both are expressed in numbers. Therefore, the “Number of cars” information should be displayed only in special cases or it should be displayed in a smaller font size than that of the key information.

4. It is desirable that information such as size of cars or location of Green Cars on a platform be provided to individual users in a station concourse, at stairs, or on a platform through a navigation-type information delivery system.

By preparing the notice-board type sign system in accordance with the above mentioned policies, users can find the correct train to catch based on a minimum of information, and after going through the ticket gate, all they have to do is to go to the correct platform by relying only on the key information, or a platform number.
Information for individual users displayed on users' mobile terminals or dedicated terminals installed in a concourse through a navigation infrastructure in order to supplement the basic pattern must be able to provide not only information for supplementing the notice-board type guide system but also more detailed information in accordance to users needs or user specific information.

It is necessary to create a system that allows users to choose necessary information such as the key information through the use of the terminal instead of flooding them with information.

5.2 Proposal for user service

5.2.1 Concierge-type interpersonal guidance

Among guide interfaces for users, an interpersonal information service is the most basic and provides more of a human-like touch.

Since thorough and time-consuming responses to individual customer needs, including not only railway or in-station information but also information on shops around the station, are required in this type of information service, it is necessary to review and examine whether such an information service must be included as one of the railroad operators’ services.

5.2.2 Aggregation and effective use of front-desk information

1. Effective use of front-desk information

Currently, understanding of front-desk information collected at various stations in order to use it for service improvement and systematic ways to use such information are required. One of the possible systematic methods is to establish an organization to collect and analyze front-desk information from various stations, classify collected information into knowledge common to all stations, information regarding typical and prioritized needs, and information regarding unique and atypical needs, and then to provide feedback to operation sites by the methods appropriate for each information class.

After information is collected and analyzed, a knowledge management database system (KMDB) needs to be established. Atypical information can also be used as basic data for service improvement or know-how of interpersonal information services by an affiliated company that dispatches information center crews.

2. Improvement of an information structure that supports knowledge management

As a mechanism to systematically aggregate and analyze front-desk information, and then to provide the feedback to stations, a knowledge infrastructure system needs to be created.

3. Effective knowledge management and its future

By aggregating information from each station, it will be possible to systematically review the information service.

- It will be possible to aggregate information with high priority at each station.
- The collected information can be displayed on IT-based devices.
- It will be possible for stations without information centers to obtain information from hub stations and that information can be delivered to customers who request it.

![Fig.9: Image of Systematic Use of Front-Desk Information at a Station](image)

(Note) KMDB: knowledge management database (system)

5.3 Designing of in-station space

The following five items must be examined as elements of in-station space creation.

1. Ensuring of visibility
2. Space for information delivery and exchange
3. Safety in traveling
4. Ensuring of security
5. Creation of space that allows users to feel like they are in a private space

6. Image of the Next-Generation Sign and Information Delivery System

6.1 Image of a ticket gate (Figure 10)

1. Information to be displayed here is limited to information that helps checking of train destination, train time, and platform number. Information must be displayed in a big font and must be differentiated by train-line specific colors.
2. An information center that can be used outside the ticket gate...
gate. Users can either use a terminal or talk directly to station personnel to check which train to catch or to obtain information on various facilities around the station.

6.2 Image of an information center (Figure 11)

①: Train operation information in emergency situations is displayed in real time.
②: Train to catch can be checked by destination search and the result can be printed out.
③: 3D display functions are used in this station map. Through the use of the touch panel, information on a target facility can be displayed.

6.3 Image of a concourse and area around the stairs, inside the ticket gate (Figure 12)

①: This railroad diagram also works as a destination search and input terminal.
②: This is an image of an easy-to-see-and-understand guide sign. If detailed information is required, then users can obtain it from the terminal installed below.

Fig.10: Image of a Ticket Gate

Fig.11: Image of an Information Center

①: Information such as train destination, train time, and door locations is displayed in a uniform way (installed mainly on Shinkansen and rapid train platforms).
②: This railroad diagram also works as a destination search and input terminal.

Conclusion

Different station types require different types of next-generation sign and information delivery system; therefore, creation of systems in accordance with station type must be considered. Also, by creating an information delivery database for each station, future system proposals can include methods for providing information to customers, and this will lead to realization of real-time customer service.

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