Featured Articles

Spatial Data Management for More Advanced Facility Management

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OVERVIEW: While urban, venue, and retail spaces are becoming increasingly sophisticated and complex, this progress is taking place without an understanding of what is actually happening on the ground, and therefore improving the sophistication of the IT and other social infrastructure that provides ongoing support for this activity poses a challenge. Hitachi is working to build a society that combines economics with safety and security by accelerating innovation in IT and other social infrastructure using spatial data management platforms that collate and manage a variety of information on the makeup of public spaces to determine what is happening in these spaces, now and in the immediate future, and providing this information as feedback to the infrastructure.

INTRODUCTION

THE urban, venue, and retail spaces in which people go about their activities are becoming increasingly sophisticated and complex. The behaviors of the people who use these spaces are continually changing. For example, it is a regular occurrence for small changes, such as a specific advertisement or an accident in some distant location, to have a major effect on the movement of people.

However, the information technology (IT) and other social infrastructure that provides ongoing support for these spaces operate in accordance with predicted or planned numbers, and improving their sophistication to the extent that control can be performed based on the actual situation on the ground poses a challenge.

Crowding in railway stations is a familiar example. This crowding can arise for a variety of reasons, such as an accident on another line or at some other distant location, and frequently results in a buildup of people on platforms at other stations. If it were possible to identify indications in the movement of people before this unfolding situation occurs, and to predict what will happen next so that appropriate measures such as limiting entry to the station can be implemented before the situation worsens, it should be possible to improve safety and security.

This has created a need for the establishment of new methods for dealing with spaces, people, and social infrastructure that combine economics with safety and security by making quantitative assessments of ever-changing public spaces and the behavior of the people who use them, and providing this as feedback to IT and other social infrastructure.

WAYS OF DEALING WITH SPACES AND PEOPLE

This section uses commercial facilities such as shopping centers or large exhibition venues as examples to describe methods for dealing with spaces and people.

When dealing with spaces and people at commercial facilities, the influence those spaces have on people can be broken down into the following three processes (see Fig. 1).
(1) Attracting people to the space (pulling power)
(2) Getting people to stay and look around (holding power)
(3) Encouraging people to make purchases (sale-closing power)

By breaking down the influences that spaces have on people in these terms, and by identifying what is currently happening in each process, it becomes possible to take appropriate steps to achieve the desired outcomes.

ACTIVITIES BY HITACHI AND POSSIBILITIES IDENTIFIED

To provide examples of pulling power, holding power, and sale-closing power when considering these as methods for dealing with spaces and people, the
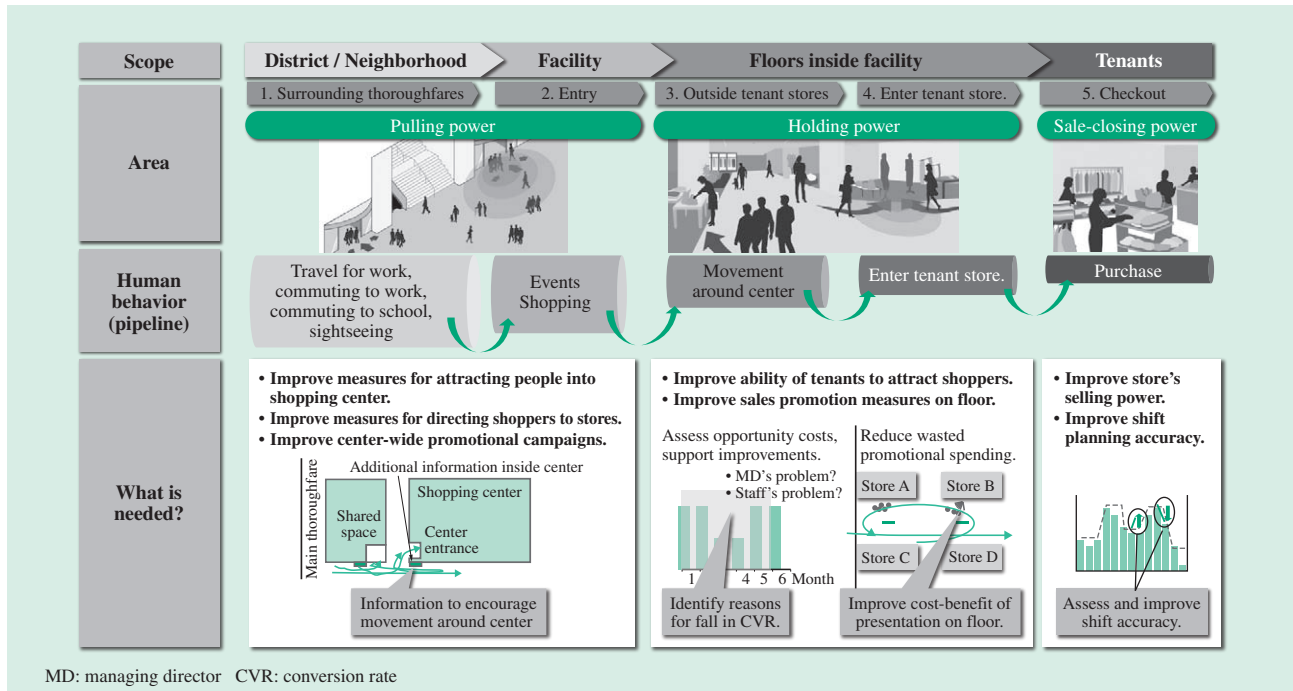
Fig. 1—Behavior Model for Inside a Shopping Center.
By using quantitative assessment to identify behavioral tendencies in the different processes that lead up to a purchase at a shopping center, appropriate measures can be taken to deal with each process.

following section describes the measures taken at Hitachi Innovation Forum 2013, a large trade show.

Activities by Hitachi

Hitachi Innovation Forum 2013 was a Hitachi Group trade show staged over three days at a 5,000-m^2 venue, attracting more than 40,000 visitors.

Sensors were installed at 13 locations inside the venue to measure the behavior of people in realtime and provide "visibility" as to what was happening there. Effectiveness measurements were made of the venue's pulling power, holding power, and sale-closing power, and this "visibility" was utilized to work through the plan, do, check, and act (PDCA) improvement cycle.

Pulling Power: Ability of Event Staging to Attract Visitors

Since the Forum is intended for promotion, its ability to inform people about Hitachi's products is an important management indicator. Accordingly, how effective events (measures taken to attract visitors to each of the spaces at the Forum) were at attracting visitors was assessed by defining key performance indicators (KPIs) for pulling power, namely the number of visitors and whether they stayed for long (ability to attract visitors = total time spent by visitors at the event) (see Fig. 2).

The analysis of the ability of each event to attract visitors found that their effectiveness varied widely depending on their location within the venue. In particular, while venue-wide events naturally have the greatest ability to attract visitors, being large and located close to the entrance, events 1 to 3 were all located along the same main thoroughfare and the analysis found that their ability to attract visitors diminished the farther into the venue they were located. This demonstrates that, for the same outlay, the cost-benefit varies widely depending on location at the venue.

Next, an analysis of the behavior of visitors to the venue-wide events with the greatest ability to attract visitors indicated that people moved in ways that were not originally envisaged. The venue is designed such that visitors who pass through the entrance will follow a one-way route that first takes them past the venue-wide events and then into the venue interior. However, an analysis of changes in people entering and exiting (moving in the opposite direction) at the start of an event found that, contrary to expectations, within three minutes of it starting, people were moving back through the venue in the opposite direction and gathering in groups from a radius of about 20 m around the event. It was calculated that 66% of all visitors turned around to go back to the venue-wide event.
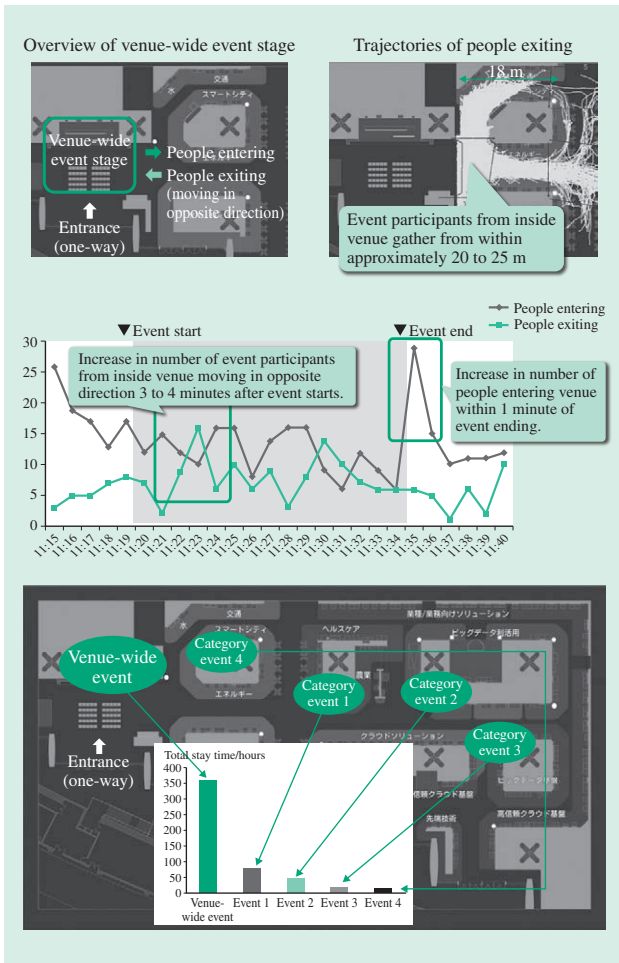
Fig. 2—Pulling Power (Assessment of Ability of Venue-wide Events to Attract Visitors).
It is possible to undertake a quantitative assessment of factors such as the ability of venue-wide events to attract visitors, the time taken for the attracted visitors to gather, and the extent to which they gather.

Holding Power: Looking around and being Guided through Venue

Similar to tenants at a shopping center, the Forum was organized by exhibitors paying the venue for the right to exhibit. Accordingly, in addition to the ability to attract visitors to the venue, the extent to which visitors were directed to each exhibit (tenant) (ability to bring visitors to an exhibit = proportionate increase in number of visitors passing exhibit) was defined as one KPI for holding power and used to assess the effectiveness of promotional activities at bringing visitors to exhibits (see Fig. 3).

Specifically, to measure how effective measures were at bringing visitors to exhibits, an experiment was conducted to assess the level of benefit achieved by a simple advertisement promoting a specific exhibit. The movement of people through the venue
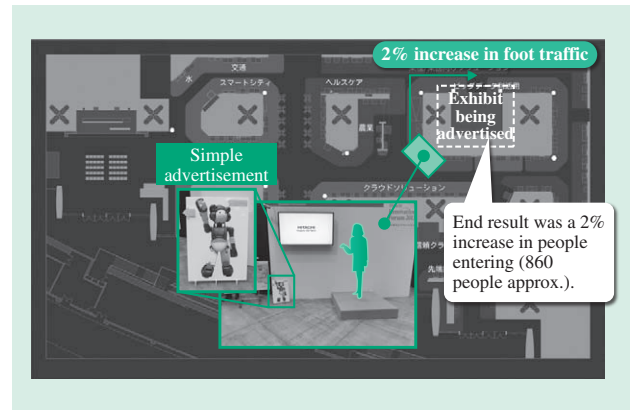

Fig. 3—Holding Power (Ability of In-venue Advertising to Bring Visitors to Exhibits).
The best places to locate advertisements encouraging people to visit a particular exhibit can be determined by analyzing the movement of people through the venue.

was analyzed to identify the main thoroughfares and an intersection was chosen as the best place for an advertisement. As a result of this choice, it was found that the intersection (shown as the colored box in the figure), which was some distance from the exhibit being advertised, acted as a branch point in people's movements. Although proceeding in the upward direction from the intersection (in terms of the map in Fig. 3) would quickly bring a visitor to the exhibit, only a very small 18% of visitors turned in the way intended.

When a simple advertisement was placed at the intersection to counter this, the number of people turning increased by 6% (to 24%), resulting in a 2% increase in the ability to bring visitors to the exhibit (2% increase in foot traffic past the booth). This demonstrates that advertising at facilities such as shopping centers can achieve a high cost-benefit ratio if an appropriate location is chosen.

In another approach to holding power, meanwhile, an assessment of which factor had a large impact on the ability of exhibits to attract visitors found that it was the layout of the venue (see Fig. 4).

The analysis found that exhibits located opposite places where the layout protruded into a thoroughfare were seven to 20 times better at attracting visitors than other exhibits, and that the number of visitors diminished the farther away an exhibit was from the protrusion. This demonstrated that layout is a major factor influencing the ability of exhibits at a venue to attract visitors. Although this is something that has been known empirically, the quantitative analysis and assessment have reinforced this conclusion.
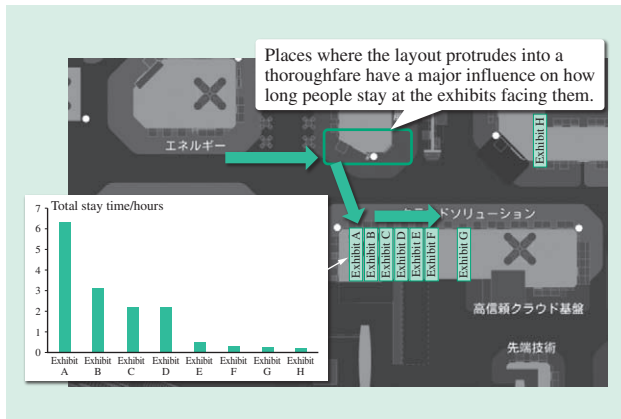
Fig. 4—Holding Power (Effect of Layout on Ability to Attract Visitors).
An analysis of how people move and gather at a venue found that places where the layout protrudes into a main thoroughfare have a significant influence on the ability of the exhibits facing them to attract visitors.

Sale-closing Power: Encouraging Visitors to Enter Exhibit

At a shopping center, sale-closing power means the ability to get a shopper to enter a store and make a purchase. Accordingly, for this example, the KPI for sale-closing power was defined as whether potential visitors passing an exhibit are persuaded to enter (number of visitors entering exhibit as a proportion of passing foot traffic), and the PDCA cycle was worked through to make improvements to a display at the entrance to the exhibit, while monitoring in realtime the proportion of passers-by who entered. What was found was that the simple measure of placing a desk with pamphlets in front of the exhibit increased this proportion by about 4%, and that this was sustained over two days (see Fig. 5).

PDCA and Feedback for Venues

These experiments assessed the effects that venues have on people by breaking them down into the pulling power, holding power, and sale-closing power processes, and demonstrated that even small improvements can deliver benefits by working through the PDCA cycle in an appropriate manner.

Hitachi utilized the knowledge obtained from these experiments at Hitachi Innovation Forum 2014, which involved implementing the PDCA cycle for the venue (see Fig. 6). While a variety of measures had been adopted based on the knowledge gained in 2013, in addition to working through the PDCA cycle for a physical space, Hitachi also intended to have visitors try out how this could be done in tandem with social
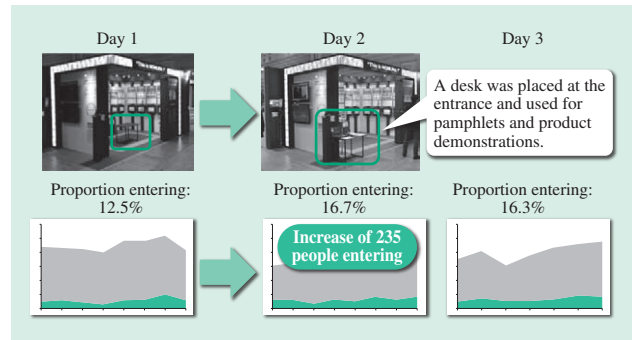

Fig. 5—Sale-closing Power (Increase in Proportion of Visitors Entering Exhibit due to Promotion of Exhibit).
Small changes in an exhibit's display can produce a sustained increase in the proportion of passers-by who enter the exhibit.
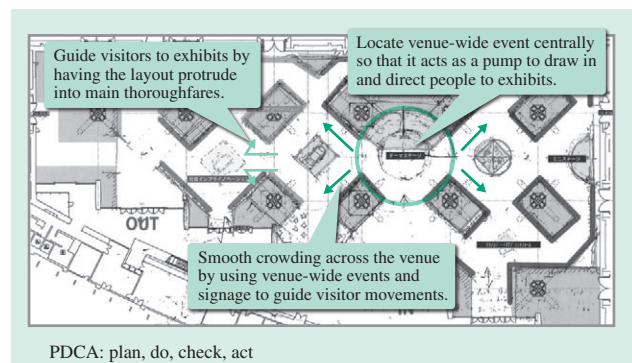

PDCA: plan, do, check, act

Fig. 6—Working through PDCA Cycle for Venue.
The analysis of human behavior at a venue can be used as a basis for working through the PDCA cycle to identify the most effective factors and decide what to do next.

infrastructure in the form of Hitachi's Intelligent Operations, which will be used to create future public spaces.

CONCLUSIONS

This article has described methods for making improvements at venues by using a variety of techniques to determine what is currently happening on the ground, something that could not previously be measured.

Hitachi plans to launch a spatial data management service in FY2015 that will collate this analytical know-how and present the results of analyzing such things as promotion effectiveness and the state of health of tenants to customers in the fields of retail center development, tenant management, and the management of joint sales promotions.

Hitachi also plans to create smart public spaces by integrating with new services that deliver higher levels of safety and security. This includes contributing
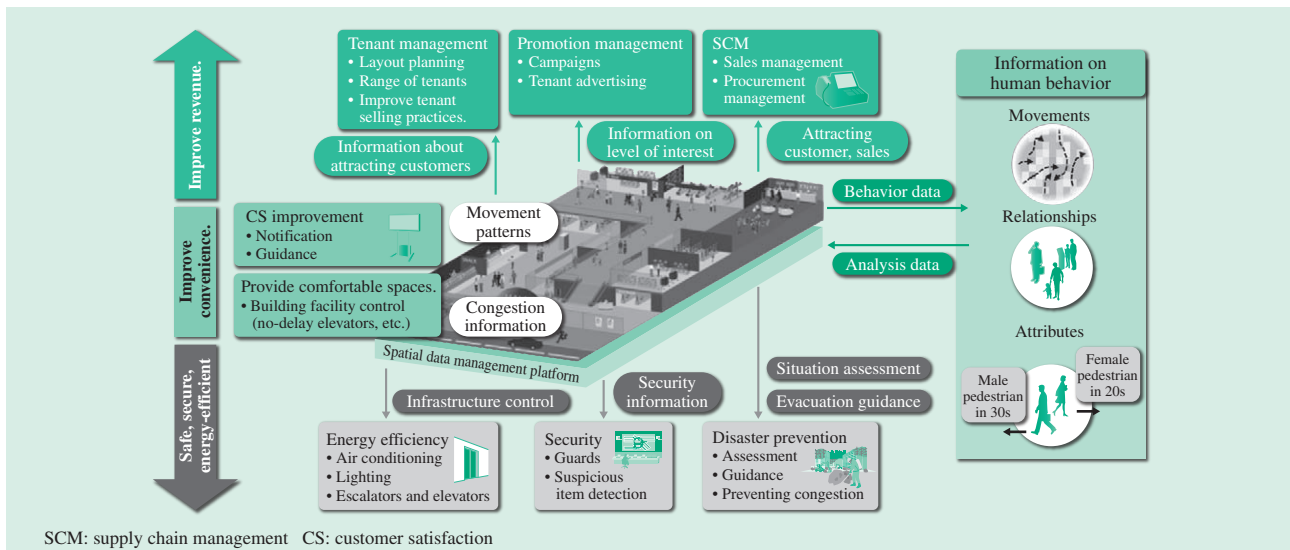
Fig. 7—Smart Venues.
Facility management and venues can be made smarter (such as becoming more energy-efficient) by linking human behavior at a venue to various different business systems and other social infrastructure.

to reducing center-wide energy costs and improving customer satisfaction (CS) by utilizing information obtained from the analysis of human behavior at retail centers in tandem with social infrastructure such as air conditioning, elevators, and escalators, and taking pre-emptive measures to prevent congestion at venues by determining the current situation, predicting how it will develop, and using this information together with signage or other means of directing the movement of people (see Fig. 7).

Meanwhile, as these practices become practical, it also raises the importance of privacy measures. Hitachi is strengthening measures for privacy protection in public spaces and incorporating these into services and solutions so that customers and partner companies can feel more confident about utilizing data without concern for privacy breaches.

In the future, Hitachi intends to work in cooperation with partner companies to help create a better society, not only through analysis but also by including improvements to physical spaces in what it offers to users.

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