New Approach to Product Development Based on Service Design Process: Next-Generation Event Management Solution "EXBOARD"

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Competition in the market for IoT has been growing fierce in recent years. In this climate, it is important to differentiate the products/services we offer from those of our rivals, and this requires prompt realization, and repeated evaluation and validation, of ideas and hypotheses to perfection. This will ensure that these products/services deliver value to customers. Fujitsu Advanced Engineering Ltd. has developed an event management solution, EXBOARD, leveraging its sensor technology. In an event venue, EXBOARD gathers data from the sensor beacons embedded in visitors' devices, and stores the data on a cloud system. These data are used to visualize information in real time, such as numbers and locations of people staying in each zone, people's interest levels in certain exhibitions, visitor flow, and so on. The collected data are also used to help to develop further innovations through analyses. In the development of EXBOARD, we employed the service design process. Working with designers from Fujitsu Design Ltd., we evaluated the concepts and hypotheses at an exhibition venue, to verify its potential and practicality. This paper describes the development of EXBOARD. It outlines how we evaluated the system at the exhibition venue, and presents some examples of application.

1. Introduction

We are entering the era of IoT where a diverse range of devices are connected to the Internet, and the approach to manufacturing is undergoing a significant change. In the IoT market, companies from across the world, small and large alike, are keen to pursue R&D in order to increase their market share. Given this as a background, it is crucial for companies not only to efficiently develop and implement a system to obtain various pieces of data from the real world, but also to deploy it and create new value for customers, if they want to differentiate their products and services.

We have conducted many field studies on the subject of new value creation and provision. From these studies, we learned that there were many issues found in events such as exhibitions that were organized in many places and on many occasions. In an event, there are organizers, participants, and visitors, who represent unique user groups, and there are issues particular to each of these groups. The idea was that these issues might be solved by introducing new services leveraging IoT.

Fujitsu is proactive in a so-called service design process, which starts with various ideas based on customer/field feedback, followed by evaluations and verifications repeated promptly, to develop new services and products. Fujitsu Advanced Engineering Ltd. (FAE) employed this process in creating new services based on IoT as described above. The development and design divisions jointly worked on the ideas from feedback, and refined them through repeated verifications to finalize the value to be offered. As a result, we produced EXBOARD in February 2016, as an event management solution that visualizes and analyzes visitors' movements and interests.

This paper explains the development of EXBOARD based on this new service design process, from its planning and verification to product launch. It also describes cases in which the service is applied.

2. Service design process

Design thinking is increasingly known in the business world today. Design here is not understood by a narrow definition of the word, like colors and shapes of

objects, but it refers to a wider perspective that revolves around human perception. It is rather the fundamental definition of "design" as a comprehensive concept that includes planning and designing to achieve a satisfactory user experience (UX).

The service design process is based on the design thinking model[1)] proposed by the d.school at Stanford University in the USA, to which elements from the lean startup method[2)] are added to assist in the speedy launch of new services/products. While designing an overall scheme and interfaces in user experience, the process clarifies user requirements, which tend to be vague, by assessing the prototype-based ideas and feeding the results back into the scheme.

The service design process applied in the development of EXBOARD has two unique aspects. First, it is comprised of three stages: observation (for ideas and interviews), integration (development of prototype / minimum viable product [MVP]), and evaluation (interviews and measurement). The process aids in refining the ideas and developing satisfactory services/products by repeating these stages rapidly (**Figure 1**).

Second, the process engages designers and engineers in collaboration to pursue a project. Designers can contribute to the project with their abilities to create ideas based on observations and interpretations, to visualize information, and to integrate the ideas under various restrictions.

The service design process with these characteristics makes UX-based ideas develop quickly and be refined through verifications, while projects evolve smoothly.

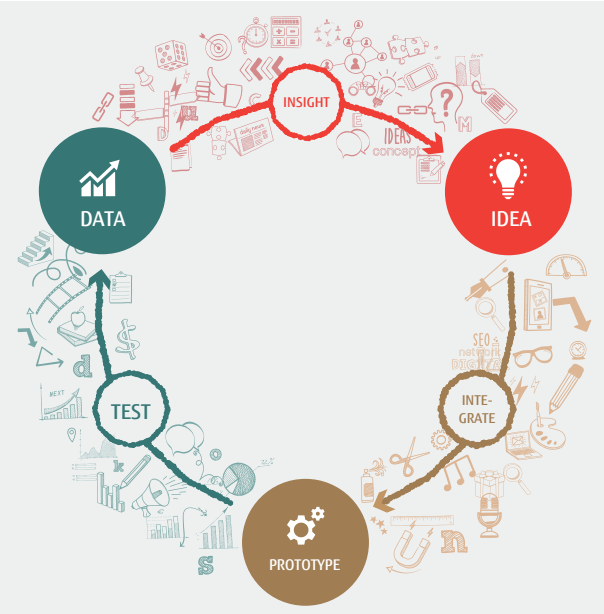

Figure 1
Service design process.

3. Efforts toward product launch

In view of the IoT-enabled society, FAE explored the need for sensing devices that can be flexibly installed and easily connected. Then, working with another Fujitsu Group company, FDK Corp., we embarked upon the development of an ultra-thin sensor beacon and sensor logger in 2014 (**Figure 2**).

The hardware was thus developed using FDK's technology for high-frequency circuits and high-density packaging, with the company's proprietary thin and long-running battery to support power sources for important purposes. For the software development, FAE leveraged its authentic firmware-software development technology for realizing firmware that efficiently employed and operated sensing devices. In this way, we pursued the development of a new solution, including the applications for smartphones and gateways as well as a cloud system, to utilize the data received from those devices.

The companies thus jointly developed the ultra-thin sensor beacon and sensor logger, with the following unique features:

- The world's thinnest sensor device
- Equipped with multiple sensors, including an accelerometer

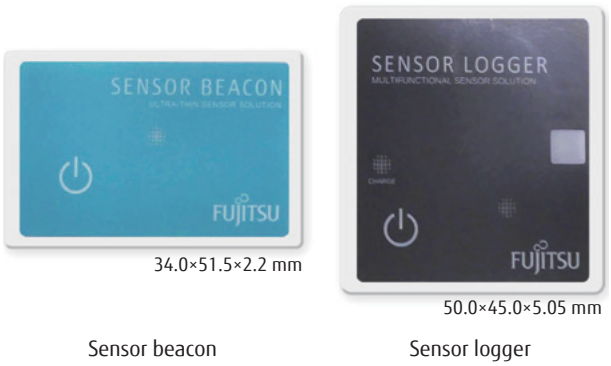

Figure 2
Ultra-thin sensor beacon and sensor logger.

- Capability to transmit sensor data to universal devices, such as smartphones, using Bluetooth Low Energy (BLE) technology

Note in particular that the third point above successfully addressed the challenge of the compromised data transfer in an area that has multiple data-accessing devices, by employing a unique method to establish a many-to-many connection and connectionless communications.

Before embarking on the development of a solution to leverage the ultra-thin sensor beacon/logger, we developed a concept "to visualize unseen issues." More specifically, we developed a tentative idea for the solution based on the visualization of people and objects in terms of their positions and statuses, designed for production sites in the manufacturing, logistics, and public services industries.

We then developed dashboards, for managing the safety of on-site workers (**Figure 3**) and for quality control in logistics, as an MVP for the integration of the concept and solution. We also created some promotional items in order to present these features in an easy-to-understand fashion. The product was entered in Embedded Technology 2014, where visitors to the exhibition were asked to give their opinions on the idea underlying the solution.

On this occasion, it was only the ultra-thin sensor beacon that was exhibited alongside the two solution models. Previously, the model used the thin sensor logger with a high-capacity secondary battery. At this exhibition, however, we adopted the ultra-thin sensor beacon with FDK's thin lithium battery as the primary battery. This enabled the device to be thinner and smaller, enhancing the portability. From the interview conducted at the exhibition, positive opinions were obtained about employing the device at various events. Also, we identified a potential need at events because, so far, it has only been possible to measure the effectiveness of an exhibition by means of exchanged business cards and questionnaire surveys. These findings from the exhibition provided some useful insights that led to the development of EXBOARD.

Furthermore, we conducted a demonstration during Fujitsu Forum 2015 held in Tokyo, to test the ultra-thin sensor solution specializing in exhibitions and similar events. In preparation for the demonstration, we asked the event operators for their opinions about problems that were expected during the event. Some responses related to their expectations for enhanced efficiency in managing events, such as for an ICT-enabled system that allowed sales personnel to attend to visitors, who numbered more than 800, without

Figure 3
Demo screen displaying workers' accident detection.

having to wait for them at the entrance all the time. From the opinions obtained in the interview, we determined the concept for EXBOARD solution to be realizing a smart exhibition for everyone, including not only the event organizers, but also the visitors and participants.

Based on this concept, we defined the MVP features to discern the number of people staying in certain areas and measure their locations, to notify sales personnel of customer arrivals, and to visualize customer interests and engagement levels. We further created a dashboard adapted to a large screen, and a web application for sales agents' smartphones.

At Fujitsu Forum 2015, FDK and Fujitsu Design as co-sponsors provided name-plates for 800 visitors, each embedded with the ultra-thin sensor beacon, and conducted a demonstrative experiment. In this experiment, technological aspects proved successful, but the system development tasks, complex installation, and high maintenance cost turned out to be the weaknesses. In order to remain competitive in the market, we aimed to reduce the time and cost of production, and thus, focused on simplifying the structure and assembly.

1) Simpler structure

We reorganized the EXBOARD application features, while maintaining the system scalability, as follows:

- Gathering: features to gather sensor data
- Analysis: features to analyze sensor locations and area engagement
- Display: features to visualize the real-time analytical results

Through these measures, we succeeded in simplifying the system structure and reducing the time required for system assemblage down to 1/5 of the time spent at the demonstrative experiment (as short as half a day).

2) Simpler assemblage

Sometimes, event layouts may be delayed until the last minute. This situation would cause a problem by delaying the installation of maps to be displayed during the event and gateways. Therefore, we created a GUI tool, which made it possible to determine the venue layout online. With this tool, the site layout could be adjusted without having to shut down the system even during the event.

4. Resulting EXBOARD and its characteristics

EXBOARD is a solution to be employed at events, to visualize the event operation based on positional and other data gathered using sensor beacons carried by event visitors. The system offers value based on the following three user perspectives:

1) Operator's perspective

Popular areas within the event venue and flow congestions can be captured in real time, enabling event operators to smoothly guide people, and adjust room temperature, etc. The gained data serve as quantitative marketing information, for post-event analyses of visitors' flows and their interest tendencies, helping to make future improvements in venue arrangements and so on.

2) Exhibitors' perspective

Specific clients and customers such as VIPs may be tracked, to enable exhibitors to make use of valuable opportunities for negotiation. By sending an e-mail position alert to sales personnel when a specific customer passes through certain areas at the event, they can be better prepared to give the customer more personalized attendance.

3) Visitors' perspective

Visitors are provided with a sensor beacon, together with an entry ticket at the entrance. With this beacon, the visitors can experience IoT-integrated services as they operate the beacon to indicate their responses to the exhibits. Coupling the beacon with the entry ticket means the visitors do not need to download and install a dedicated application on their portable devices.

With EXBOARD, sensor beacons are carried by visitors, and the gateways installed in the venue gather positional information, which is then stored on the cloud (**Figure 4**). The data thus gathered and stored are integrated and analyzed using an application, and visualized in real time to indicate congested areas. The service offered is a comprehensive package to include all arrangements necessary for organizing an event, including the sensor beacon kitting, gateway layout, development of cloud service, and reception operation.

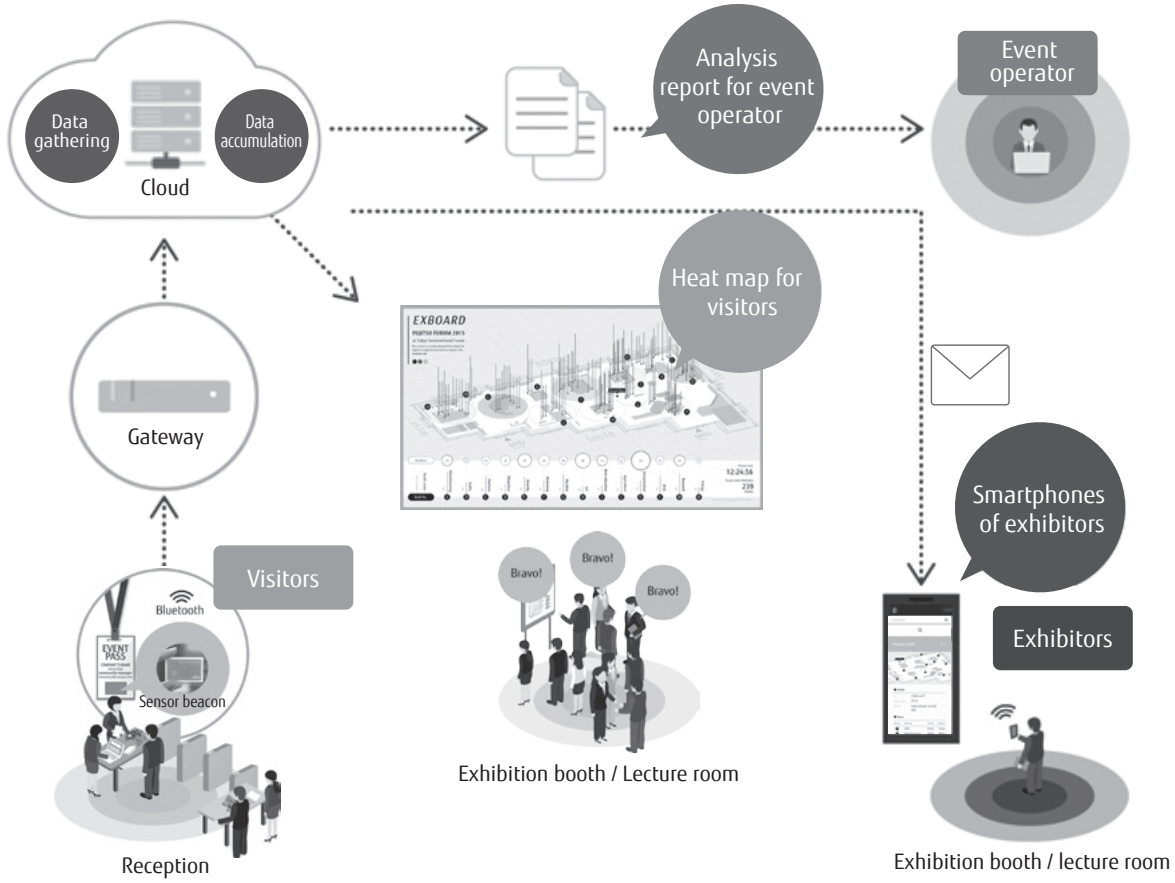

Figure 4
Outline of EXBOARD system structure.

5. Application examples

EXBOARD is designed to cater to various business contexts apart from exhibition/event management. We are thus developing approaches to different industries. Two examples of this initiative are described below:

1) Application to the manufacturing industry

Shimane Fujitsu Ltd. is a manufacturing base of laptop PCs and tablets. Here, noncompliant products detected in the in-line performance test are sent to the repair process. While measures such as these help to implement rigorous diagnosis, analysis, and repair of defects, on occasion, the initially detected faults cannot be reproduced in the repair process. In such a situation, it is necessary to run a comprehensive analysis on the work executed during the performance test, the tools used, and the conditions faced by the identified machine at the time of the test, to clarify the cause. Previously, however, the level of visualization of the work during a performance test was not sufficient to clarify the status of the performance test processes, so that cause identification and prevention were not possible. This situation resulted in products being assigned to unnecessary repair work.

To counter this situation, Shimane Fujitsu introduced EXBOARD. They attached sensor beacons to repair-assigned products, and tracked them in an attempt to solve the problem. After a 6-month trial, they conducted an interview with the site workers. As a result, they verified that the work became more efficient than it was before the introduction of the solution. Based on this result, they continued improving their system, and made it possible for all workers to understand the states of the entire process, prioritize the work on the products nearing shipping deadlines, and reinforce the line staffing where work is congested. These changes resulted in enhancing the work efficiency and increasing the self-efficiency. This work efficiency enhancement helped to reduce the number

of transfer trucks that needed to be additionally ordered when there was a shipment delay, bringing the transport cost down by 30%.

2) Application to the retailing industry

In urban areas, many restaurants run their businesses on several floors in a building in densely built areas. Client A is a company operating a fast-food business, and it had some multiple-floored restaurants. The problem Client A had was that staff working in these multi-floor restaurants had a greater workload than those in single-floor establishments, as it took longer to deliver orders to the tables on different floors.

To address this issue, the client introduced EXBOARD. The sensor beacon attached to the number tags, which were previously used as visual tags to identify customers, made it possible to find the customer promptly.

This has enabled faster serving, and enhanced the customer satisfaction as well as task efficiency.

6. Conclusion

This paper presented an example of a service design process leveraged in creating services with high value for customers, in the form of an event management solution, EXBOARD. It also explained the development process and the effectiveness of the product.

The market for IoT-related services and products is expected to expand and grow more competitive. In this climate, it is a viable strategy to work closely with designers in the development process, turning ideas into products quickly, enabling repeated testing and verifications involving users or the market.

We will continue our further investigation and interviews, and refine the solution to expand the scope of application to other industries and to overseas.

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