

Series: Digital Services Powered by Connected Products (1)

Turning Elevators and Escalators into Connected Products to Deliver Value to Customers

#Disaster Prevention and Resilience #IoT/Data Utilization #Building Systems

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Highlight

As the spread of the IoT brings digital connectivity to a diverse range of products, the data collected from these products is being leveraged to offer more sophisticated service-based business models that deliver new value.

With a focus on digital services powered by connected products, this series of articles describes new initiatives and future directions for Hitachi's extensive portfolio of technologies, products, and solutions.

Once little more than a means of transportation, elevators and escalators have in recent years evolved into connected products that utilize IoT technologies to offer advanced services.

Hitachi uses its HERIOS remote and intelligent diagnostic system to provide customers with safety and security by the early detection of faults through real-time monitoring of elevator and escalator operation.

The latest models also offer innovative solutions inspired by customer needs, incorporating features for enhanced customer convenience that utilize the BUILLINK support tool for building owners and managers.

This, the first article in the series, describes how HERIOS serves as a platform linking Hitachi with its customers and the services this has made possible.

1. Introduction

Elevators, escalators, and other critical infrastructure for safe vertical transportation inside buildings have come to represent an essential service for the users of these facilities. As such, there is a need for appropriate maintenance to manage and maintain their functionality combined with elevator inspections and measures for minimizing downtime due to faults and other issues.

Recognizing this need, Hitachi developed the Hitachi elevator remote and intelligent observation system (HERIOS) in 1994, incorporating it into its maintenance practices and using it to identify electrical or mechanical changes in elevator equipment and perform predictive maintenance¹⁾. Through ongoing functional enhancements, it has also sought to make the transition of maintenance from a series of discrete points (periodic inspection performed by field engineers with the support of the system) to a continuous line (24-hour/365-day maintenance performed by the remote intelligent diagnostic system in place of humans)²⁾.

This use of HERIOS for maintenance work was largely prompted by the goal of improving maintenance quality. Meanwhile, Hitachi also recognized that the data collected by HERIOS could be utilized to support the work of building managers. This led to the launch in 2019 of the BULLINK solution for using this data³). This provision of a wide range of services based on data collected via the Internet of Things (IoT) has seen elevators and escalators evolve into “connected products.”

This article presents elevators as connected products, describing how HERIOS serves as a platform linking Hitachi with its customers and the services this has made possible.

2. Hitachi’s Remote and Intelligent Observation System for Elevators and Escalators

2.1 Development of Remote and Intelligent Observation System for Elevators and Escalators

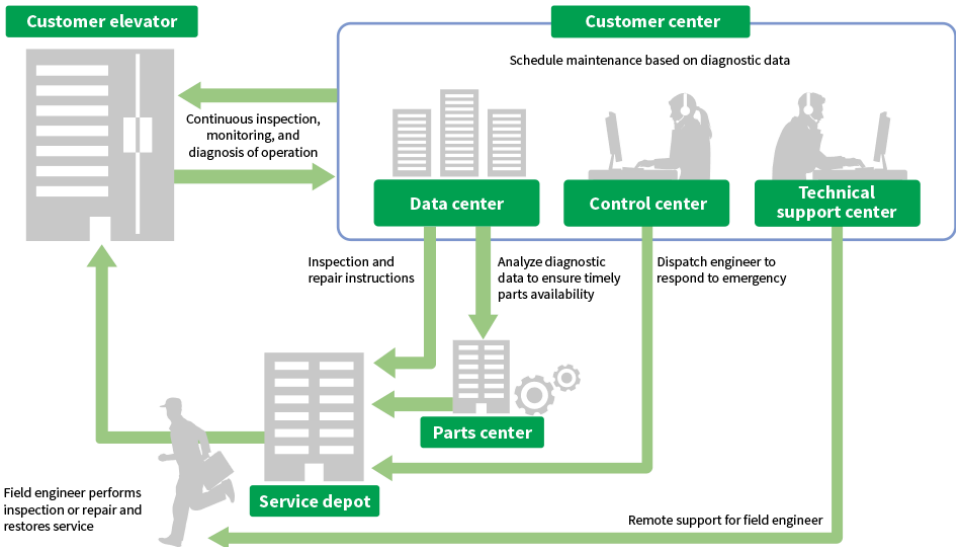
Developed as a remote and intelligent observation system for elevators and escalators to ensure their safety and comfort, Hitachi’s HERIOS has evolved alongside advances in the IoT.

Hitachi launched HERIOS in 1994 as a system for the remote monitoring and diagnosis of elevator operation. While the initial objective was to improve the quality and efficiency of maintenance work, the focus has gradually shifted toward the improvement of safety and service quality.

2.2 Remote Maintenance Using HERIOS

Figure 1 shows a block diagram of a remote maintenance system that utilizes HERIOS. The system collects operational data from customer elevators at regular intervals and uses online communications to forward it to the customer center. This data is analyzed at the customer center to detect signs of potential equipment failure or degradation and the data is used as the basis for automatically generating an optimal maintenance schedule. If a fault does occur, a rapid response is made possible by sending notification to the customer center in real time and instructing the service depot to take action. In this way, the technology enables a speedy response to emergencies such as incidents of passengers being stuck in an elevator.

Figure 1—Block Diagram of Remote Maintenance Services Utilizing HERIOS



Optimal maintenance scheduling is made possible by the remote inspection, monitoring, and diagnosis of customer elevators and the collection and analysis of operational data. The Super HERIOS remote and intelligent observation system can also be used to further improve quality and minimize downtime.

2.3 Evolution of HERIOS

HERIOS has been progressively upgraded with new features such as the HERIOS remote rescue system, which significantly improves the response to incidents where passengers are stuck in an elevator by providing access to video from inside the elevator car during a rescue; the HERIOS watcher feature for passenger safety, which automatically detects abnormal operation or holdups; and the HERIOS Drive system, which automatically diagnoses and provisionally restores service after an earthquake. These features go beyond simple maintenance, providing all building users with safe and comfortable services⁴).

Underpinned by these functions, innovation is a stand-out product feature of the advanced Super HERIOS remote and intelligent observation system. Super HERIOS uses the IoT for 24-hour/365-day real-time monitoring of elevators and can detect even minor anomalies. One example is how it can prevent faults by identifying anomalies in the opening or closing of an elevator door with a measurement resolution of 0.1 mm. The retry function for opening and closing doors has also been enhanced to prevent elevators from being held up by incidents such as people or items getting stuck in the door. By identifying potential problems at an

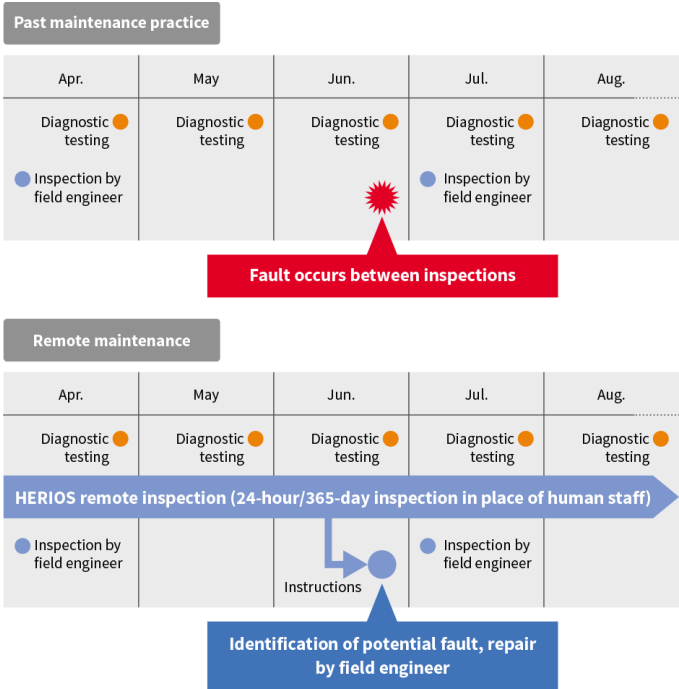
early stage, the system reduces the incidence of sudden unexpected faults and thereby further improves maintenance quality and minimizes downtime due to inspections or faults.

Super HERIOS can also use big data analytics to optimize maintenance work. The extent of parts degradation can be predicted by applying big data analytics to the operational data from elevators that is collected at the customer center. Maintenance work and parts replacement can be optimized, for example, by making an accurate count of how many times flexing occurs in the main rope and setting the optimal rope replacement or inspection intervals accordingly.

2.4 Super HERIOS Value Proposition

The most valuable benefit offered by Super HERIOS is its ability to combine safety with efficiency. Past maintenance practices have involved a field engineer performing periodic on-site inspections while HERIOS supported this inspection work by providing ongoing remote monitoring and measurement and performing diagnostic testing at regular intervals. The problem with this was that faults could still occur between inspections, sometimes resulting in extended downtime. To minimize this risk, Super HERIOS can use continuous remote monitoring for some of these inspections (see Figure 2). This improves convenience for users by significantly reducing downtime due to inspections or faults. Super HERIOS also enhances the quality of maintenance work by providing field engineers performing on-site maintenance with the data they need to be precise in their work.

Figure 2—Comparison of Past Practice with Remote Maintenance



While past practice primarily relied on on-site inspection by field engineers, with HERIOS being used to support this work, there were still instances of faults occurring between inspections. In contrast, Super HERIOS can identify potential faults, reduce the incidence of sudden unexpected faults, and minimize downtime through the use of continuous remote monitoring for some of these inspections.

3. Data-driven Solutions

The above sections have focused on how HERIOS links customer elevators to Hitachi for data acquisition with the goal of improving the quality and efficiency of maintenance work. This section, in turn, looks at how the BUILLINK solution uses data to deliver new value to customers.

BUILLINK is a support tool that uses the data acquired by HERIOS to provide building owners and managers with information on a personal computer or smartphone, including data on elevator operation and maintenance (see Figure 3). The solution provides a variety of functions for remote administration, including monitoring the operation of building systems (elevators), showing the progress of service restoration after a disaster or fault, and operational control. By doing so, it improves customer productivity and convenience, especially for customers who manage more than one facility. The following are three such functions that help to reduce the amount of building management work and make it more efficient.

- (1) Operation monitoring and progress tracking of on-site service restoration
This function allows managers to keep track of elevator operation and inspection work, the progress of service restoration after a shutdown due to an earthquake, and the work of an engineer dispatched to deal with a fault or other problem, and to do so from a remote location in close to real time. This frees the manager from things like having to visit or telephone the site.
- (2) Elevator control settings and user notification
This function protects elevators against flooding damage. It acts to prevent water inundation during natural disasters such as typhoons or rainstorms by relocating the elevators to the top floor or temporarily suspending operation when weather information indicates that this is necessary. It also provides a selection of up to eight predefined notices that can be remotely displayed to passengers on the elevator’s indicator panel, thereby eliminating the need to post this information in the building by hand.
- (3) Viewing and centralized management of work reports
This function provides building managers with centralized management of work reports, enabling the viewing and digital archiving of routine inspection reports or reports on monitoring and diagnostics performed by HERIOS.
In addition to these primary functions, BUILLINK has also been equipped with features for elevator car air cleanliness and for the prevention of close contact. The elevator car air cleanliness function works by automatically opening the elevator door and running the ventilation fan to refresh the air inside the car after each use. Similarly, close contact is prevented by playing an announcement reminding people of social distancing when the car weight indicates that this is necessary. These features were added to ensure that BUILLINK will serve as a highly valuable tool for building owners and managers.

4. Conclusions

This article has presented elevators as connected products, describing how HERIOS serves as a platform linking Hitachi with its customers and the role of BUILLINK as a data-driven solution. With advances in IoT technology connecting more and more products to the Internet, there is scope for new solutions such as preemptive fault detection and efficient maintenance scheduling that leverage the collected data and artificial intelligence (AI). How best to make use of data will be an important factor in the creation of such solutions, including progress toward digital transformation (DX) and the digitalization of business processes on the basis of knowledge acquired through the analysis of data.

Figure 3—BUILLINK Home Screen



The screen shows an example smartphone display. BUILLINK can be used on a smartphone to display the operation of building systems and to check on the progress of fault responses, inspections, or other work.

Hitachi intends to continue utilizing the IoT to supply products and solutions that deliver value to customers, and in doing so, to keep in close touch with market needs.

REFERENCES
1) M. Nakamura et al., “Remote Monitoring System for Elevators and Escalators Providing Safety and Security,” Hitachi Hyoron, 90, 9pp. 742-745 (Sep. 2008) in Japanese(PDF Format, 210.7 KB) 2) K. Yamashita et al., “Remote Maintenance System and New Maintenance Service for Elevators Enabled by New IoT Service Platform,” Hitachi Review, 66, 2, (Feb. 2017). 3) Hitachi News Release, “Hitachi Launches Dashboard for Building Owners and Managers to Check the Operation and Maintenance Status of Building Facilities, Including Elevators,” (Oct. 2019). 4) Hitachi News Release, “Launch of Building Care Pack with Flexible Choice of Maintenance Services for Elevators and Escalators,” (Aug. 2017) in Japanese. 5) Hitachi Building Systems Co., Ltd., “Hitachi Super HERIOS for remote maintenance” in Japanese. 6) Hitachi Building Systems Co., Ltd., “BUILLINK Support Tool for Building Owners and Managers” in Japanese.

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