

## Overview

# Railway Systems Supporting the Next Generation of Transportation

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## WHAT HITACHI IS DOING ABOUT GLOBAL TRENDS IN RESPONSE TO NEEDS OF RAILWAY FIELD

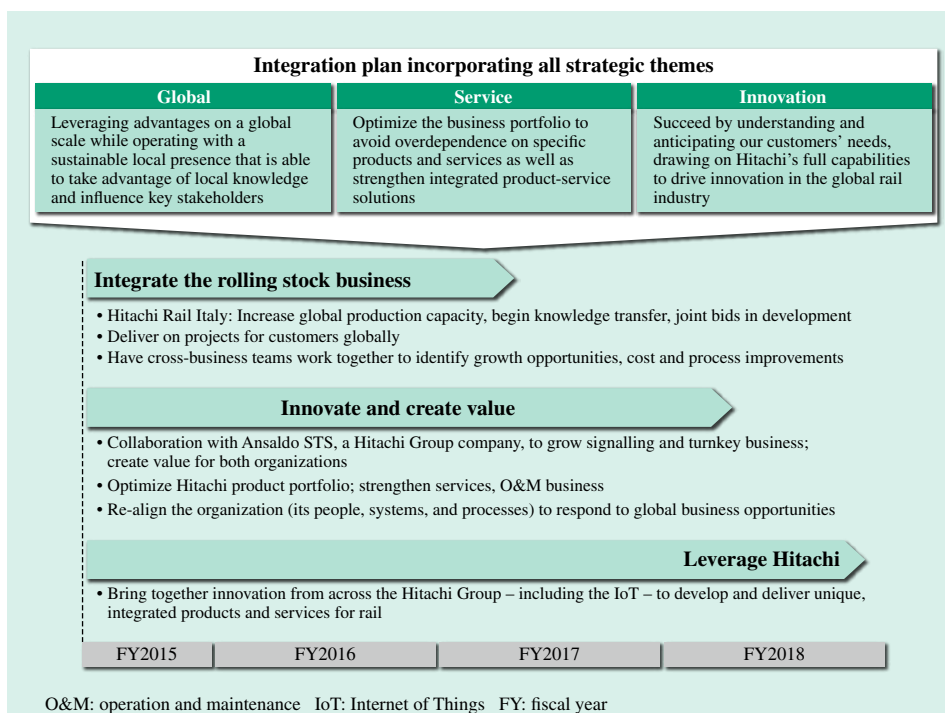
THERE is growing interest in the role of railways, with transportation being called on to confront environmental problems by reducing carbon dioxide (CO<sub>2</sub>) emissions and preventing pollution of the atmosphere, to deal with the congestion that arises from the urbanization of populations, and to reduce the amount of energy consumed for transportation in order to respond to the global challenges that currently face the world.

Meanwhile, advances in electronic and communication technologies are being accompanied by the use of information to reform operations and the rapid development of new businesses. The railway sector is also deploying new technologies in applications such as safety, operations, services, and

sales, with integration between systems extending beyond this sector.

Given this background, the railway market appears ready to grow internationally, with numerous projects planned for providing infrastructure, particularly for intercity high-speed rail services that link major cities and urban transportation services in large urban areas.

In its Mid-term Management Plan, Hitachi states its objectives of becoming an “innovation partner for the Internet of Things (IoT) era,” accelerating collaborative creation with customers through its Social Innovation Business, which has been developed utilizing digital technology, and also further developing the technologies it has built up over many years. Hitachi has identified “global,” “service,” and “innovation” as the three themes in the business strategy of its Railway Systems Business Unit, and is engaged in activities aimed at integrating the rolling stock business, technical innovation, and value creation, and is working at the group level to



*Fig. 1—Business Strategy of the Railway Systems Business Unit. The three themes identified in the business strategy of Hitachi's Railway Systems Business Unit are “global,” “service,” and “innovation.”*

develop and deliver solutions that combine products and services through the consolidation of innovative technologies (see Fig. 1)<sup>(1)</sup>.

The Railway Systems Business Unit's efforts with regard to these three themes are described below (see Fig. 2).

## GLOBAL EXPANSION

Outside Japan, Hitachi is seeking to improve the project execution capabilities of its overseas locations and to transform its business portfolio by taking advantage of economies of scale to develop key components and undertake turnkey projects.

### Standard Commuter Rolling Stock

The standard AT-200 commuter rolling stock was designed to share components and reduce the component count by adopting the mother design of the AT-300 intercity trains. This makes it possible to achieve competitive lead times and to take advantage of economies of scale in global markets. Hitachi is also establishing a globally balanced portfolio of projects

by improving its ability to influence stakeholders and collect information in ways that are tied to local regions. Seeking to expand its global market share, Hitachi is also optimizing production and supply chains throughout the world to strengthen its production capacity and project execution capabilities.

### European Train Control System

With plans in place for it to be adopted in various parts of the world, ETCS<sup>(a)</sup> is a key component and the acquisition of this technology is essential to participation in the international signalling business. Supplying products and bringing them into operation involves not only system development, but also a series of steps that encompass becoming qualified to bid on projects by obtaining standards conformity certification from a certifying agency, obtaining equipment conformity certification, rolling stock certification through on-vehicle testing, and

#### (a) ETCS

The abbreviation for European Train Control System. ETCS is the standard signalling system in Europe. It was implemented to allow for mutual through services that cross country borders (with track-sharing by different operators).

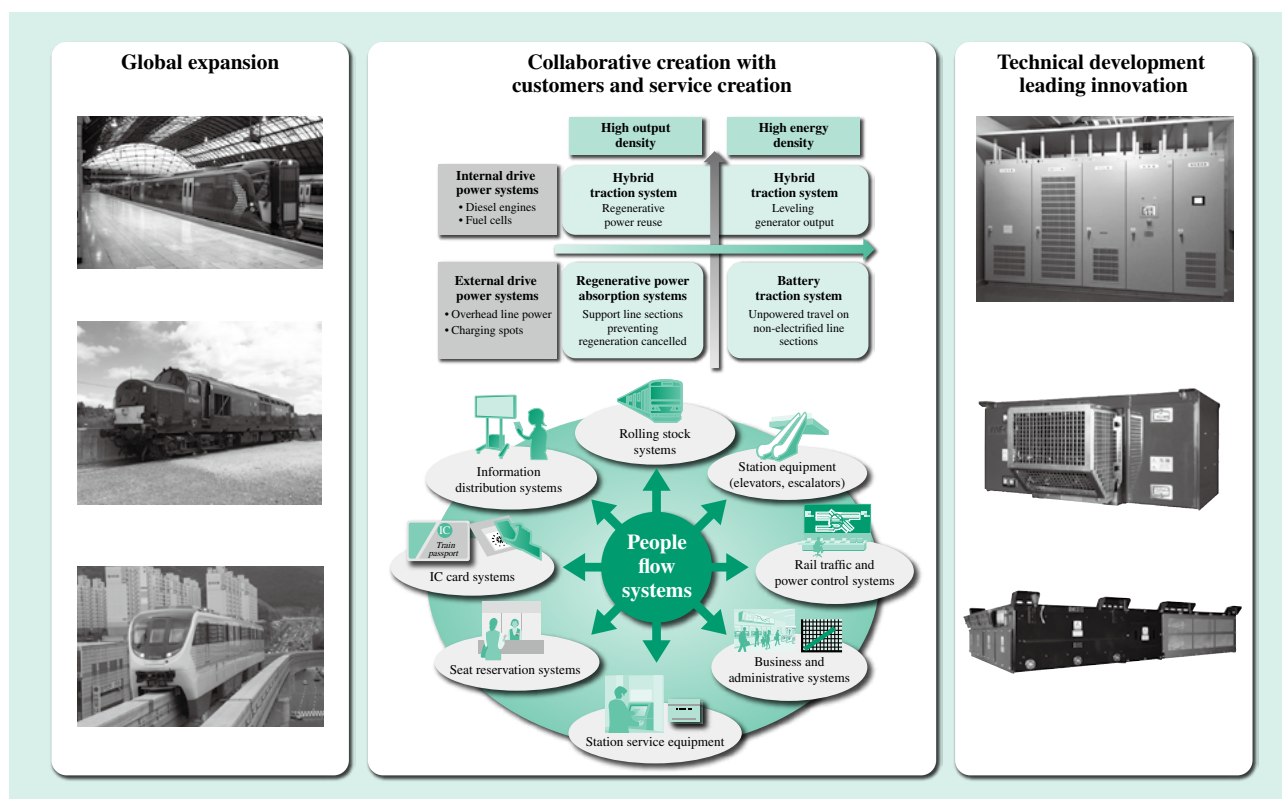


Fig. 2—Products and Solutions Covered in this Issue of Hitachi Review.

Articles in this issue of Hitachi Review are split into three categories based on the themes in the business strategy of the Railway Systems Business Unit: “collaborative creation with customers and service creation,” “technical development leading innovation,” and “global expansion.” The figure shows some diagrams and photographs that are indicative of some of the article themes.

operational authorization. Hitachi has become the first non-European company to accomplish this (ETCS Project for Class 37 Locomotives).

Orders for signalling and operational systems obtained during FY2015 include a signalling system for a dedicated freight line in India and a transportation management system for Thameslink. In the future, Hitachi plans to further develop its signalling systems business with Ansaldo STS S.p.A, which has become part of Hitachi.

### **Autonomous Driving Systems**

Hitachi Rail Italy S.p.A. and Ansaldo STS S.p.A. are strong in turnkey projects, especially metro systems, and organizationally are sufficiently competitive to win major orders in global markets.

### **Monorail Systems**

Hitachi has experience with turnkey projects for the rolling stock, track switches, and signalling systems that are core products for monorails, a recent example being the supply of Daegu Urban Railway Line 3 in South Korea that opened in April 2015. For overseas projects, Hitachi organizes and runs the project structure because these projects require working with local vendors, complying with regulations and standards, and so on.

## **COLLABORATIVE CREATION WITH CUSTOMERS AND SERVICE CREATION**

In the Social Innovation Business Hitachi has promoted, it aims to accelerate collaborative creation with customers, and is working to create new businesses and technology and service innovations that meet the needs of society and customers through collaborative creation.

### **Real-time, Multi-route First-arriving Train Information System**

Increasing railway transportation capacity and convenience, particularly in the case of mutual through services in urban areas, with track-sharing by different operators, has created complicated routes, modes of service, and types of rolling stock. This in turn requires that transportation systems include not only operation management functions that ensure safe and reliable transportation, but also accurate information services for passengers. The East Japan Railway Company and Hitachi have drawn on their many years of experience with passenger information

systems to develop a real-time, multi-route first-arriving train information system for travel between Omiya and Yokohama, with two routes available that do not require changing trains, using the Ueno-Tokyo Line and Shonan-Shinjuku Line. The system obtains timetable and train location information in real time from the Autonomous Decentralized Transport Operation Control System (ATOS), the transportation management system for the Tokyo region, and uses it to guide passengers to their destination in a way that takes account of timetable changes or train delays, even when a timetable disruption occurs.

### **Battery-powered Traction System**

Progress is being made on the practical application of technologies for installing high-capacity lithium-ion batteries in rolling stock and using them for traction power. In particular, installing batteries in rolling stock that runs on non-electrified sections of track can save energy, minimize noise, and reduce maintenance requirements compared with conventional diesel railcars.

Hitachi has commercialized a battery-powered train that can run on non-electrified sections of track by using energy stored in batteries that are charged from the alternating current (AC) overhead lines. For hybrid rolling stock, Hitachi has also developed a function that enables them to operate as electric railcars by fitting them with small-capacity emergency storage batteries that can be used when the main batteries are unavailable.

In the future, Hitachi plans to provide support for configurations that combine a wide variety of power sources and charging systems depending on the type of track or intended use. It is anticipated that the length of track available for using this technology will expand as the distance traveled by battery increases.

### **People Flow Technology**

Hitachi's people flow technology is an operational technology (OT) that applies analysis, forecasting, and simulation techniques to train management system information, automatic ticket gate information, surveillance camera images, and other big data from existing railway infrastructure, utilizing information technology (IT) such as Lumada<sup>(b)</sup>, which is supplied

(b) Lumada

An IoT platform developed by Hitachi. Lumada is an open platform with a broad range of applications, it includes software technology for acquiring knowledge by integrating data together with analysis and simulation. Using Lumada makes it possible to develop IoT solutions quickly.

by Hitachi. These technologies can analyze data from a variety of perspectives and visually represent states ranging from congestion levels in trains to flows of people walking in the station facilities. Based on this combination of OT and IT, people flow technologies can be thought of as social innovations that deliver new value, with the aim being to assist railway operators, urban development, and so on.

These technologies play a role in social innovation, delivering new value in ways that have not previously existed, through the synergies generated by combining them with existing systems, such as using them to maintain safety inside railway station facilities by helping guide passengers, or connecting to them to create train timetables to alleviate crowding.

## TECHNICAL DEVELOPMENT LEADING INNOVATION

Hitachi is investigating and implementing technologies that utilize the IoT for monitoring the operation of onboard equipment and systems by using ATI<sup>(c)</sup> systems for recordkeeping and the transmission of data to wayside systems, using this as feedback to perform maintenance management or to improve control techniques, and for cause identification when a problem occurs.

The following sections describe specific examples of innovations based on a more in-depth understanding and anticipation of customer needs, and utilizing technologies (applications of IoT) and resources from throughout Hitachi.

### Stationary Energy Storage System with Emergency Train Travel Function

Along with the growing interest in energy efficiency and renewable energy since the Great East Japan Earthquake, the issue has also arisen of how to provide safety guidance to passengers when the electric power supply from the electric power company fails. To overcome this, Hitachi has developed a stationary energy storage system with an emergency train travel function that enables trains (with passengers still on board) to travel to the nearest railway station under their own power using energy stored in lithium-ion batteries.

(c) ATI

The abbreviation for autonomous train integration. Rolling stock information and control equipment with functions that include monitoring equipment and systems, providing information to crew, performing control, and using the recorded information for inspections and maintenance.

### SiC Inverters

Energy-saving technologies are among the most in-demand technologies for traction control systems, and it is no exaggeration to say that they are the top priority for customers when purchasing. These technologies contribute not only to improving customers' businesses, but also to improving the reputations of operators, who face strong societal expectations to show that they are making an effort to improve energy efficiency. Rolling stock traction systems have been made more efficient, smaller, and lighter, with higher performance and reliability, thanks to advances in power devices, a core technology for power electronics, and to improvements in the efficiency of induction motors. Ways of achieving miniaturization have included using low-loss power devices made from silicon carbide (SiC), a new semiconductor, the adoption of highly efficient induction motors, and improvements to their control technology.

A newly developed SiC inverter from Hitachi features a 40% reduction in weight and a 40% reduction in volume.

### Liquid Cooling System with Integrated Traction Converters and Auxiliary Power Supplies

To deal with the limited availability of underfloor space on rolling stock, Hitachi has succeeded in reducing the size of its traction converters and auxiliary power supplies by developing an integrated liquid cooling system, a configuration that is commonly used in Europe.

### Functional Enhancements to Onboard DS-ATC Equipment

Two new functions have been developed for onboard DS-ATC<sup>(d)</sup> equipment to enable mutual through services between multiple Shinkansen train companies to operate on the same track. One function divides the onboard database (containing speed check patterns) into separate databases managed independently by each train company, and the other function handles

(d) DS-ATC

The abbreviation for Digital communication & control for Shinkansen – Automatic Train Control. A digital ATC system implemented in the Shinkansen trains of the East Japan Railway Company. The system was developed by extending the digital ATC used on conventional lines for use with the Shinkansen. The digital ATC sends a digital signal from the ground equipment to the train containing information about the distance to the stopping point. The onboard equipment that receives the signal then calculates the optimum speed pattern and operates the brake for smooth deceleration. Compared with the analog ATC used in the past, the digital ATC provides better ride comfort and faster arrival times.

switching from one onboard database to another while crossing company boundaries.

Since the onboard databases are an important safety element, development started with creating an organizational structure for building them, and the development work was approached in a coordinated manner while listening to the opinions and requests of the client companies. The development also kept modifications to the existing DS-ATC system to a minimum, and incorporated the new functions into the system without interrupting commercial operation. Currently, the new system is running smoothly in the mutual through services between the Hokuriku Shinkansen and Hokkaido Shinkansen companies.

Along with inter-company issues, future requirements for systems based on onboard databases will include dealing with the increasing amount of data when services are extended or faster speeds are adopted, and handling special sections of track such as the Seikan Tunnel. Maintaining ongoing management systems and know-how is essential for improving coordination with customers with regard to creating, updating, and handling databases.

## RESPONSE TO CHANGE

As indicated by its business strategies of “global,” “service,” and “innovation,” while still keeping rolling stock and systems at the core of its railway business as in the past, Hitachi also plans to expand the business to include the service sectors that arise from these and solutions based on the utilization of information. Moreover, along with establishing a technical platform with Japan playing a central role in development and strategy, activities that involve working with international partners and other stakeholders will be important to the globalization of the organization.

## REFERENCE

- (1) Railway Systems Business Unit Business Strategy, Hitachi IR Day 2016 (Jun. 2016), [http://www.hitachi.com/New/cnews/month/2016/06/160601/20160601\\_05e\\_rs\\_presentation.pdf](http://www.hitachi.com/New/cnews/month/2016/06/160601/20160601_05e_rs_presentation.pdf)

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