

Railway Systems

Green Energy & Mobility

#Carbon Neutral #Co-creation and Open Innovation #Sustainability #Generative AI #IoT/Data Utilization #Railway Systems

1. Limited Express Train Spacia X for Tobu Railway

Hitachi has supplied its new Limited Express Train Spacia X to Tobu Railway Co., Ltd., with the first services commencing in July 2023. As a suitable successor to the 100 Series Spacia, the new rolling stock is intended to deliver new benefits to the railway by improving tourism demand and other value along the lines on which it operates.

As the market for limited express trains in Japan is characterized by high design standards and the short-run production of multiple models, Hitachi pursues a platform approach to enable efficient production of rolling stock with demanding requirements. This includes the use of three-dimensional (3D) design to shorten design lead times for the many different models.

In the production of rolling stock, Hitachi adopted a concept of updated and connected trains derived from services and designs inspired by changing perceptions of value (including concern for the environment and growing diversity in what people want from travel), using the latest technologies for 3D design and digital transformation (DX) to turn the concept design into reality and achieve a high-quality finish. Hitachi has also put in place rolling stock manufacturing practices that help to reduce the load on the environment. These include adopting energy-efficient traction systems and other technologies that lessen the total impact on the environment across the entire life cycle of rolling stock, from production and operation through to disposal. The Limited Express Train Spacia X was the winner of an FY2023 Good Design Award and the production of a further two trainsets is scheduled.

[01] Exterior design of new Limited Express Train Spacia X



2. 400 Series Rolling Stock and Electrical Components for Osaka Metro Co., Ltd.

Osaka Metro 400 Series rolling stock was developed to meet the requirements of providing access to Expo 2025 Osaka, Kansai, Japan and is currently being brought into service as an upgrade to the 20 Series trains operating on the Osaka Metro Chuo Line.

The rolling stock was designed using 3D computer-aided design (3D CAD). To ensure that the cab controls would be easy to use, the CAD data was also used to create a virtual reality (VR) replica of the train cab that the train crew were able to try out prior to production. The traction system uses hybrid silicon carbide (SiC) devices to improve energy efficiency. Similarly, the static inverter (SIV) was designed to cope with pantograph bounce by enabling it to synchronize its operation with the train's auxiliary power supply. The use of SiC devices throughout also improves cooling performance and allows for smaller size and high-speed switching. A Synaptra train control and management system is used for onboard communications, providing a high-speed 100-Mbps Ethernet link between units.

400 Series is also equipped with systems for the wireless transmission of onboard data to ground stations and Hitachi is investigating the use of this rolling stock data for maintenance. Other new initiatives include the ability to view surveillance camera video in real time on the Synaptra crew display units.

[02] Osaka Metro 400 Series rolling stock



3. 737 Series AC Commuter Trains for Hokkaido Railway Company

The 737 Series alternating current (AC) commuter trains were developed to serve as replacements, including for the aging Kiha 143 Series diesel trains of Hokkaido Railway Company. The 737 Series was the first commuter train to support single-driver operation. Hitachi's involvement in the project included winning orders for key rolling stock components, including the carbodies, bogies, main converters, and traction motors. The exterior design utilizes a pale pink color scheme that conveys a youthful and welcoming impression, instilling good will in people taking local transportation to and from school or work. Similarly, the interior design has seats covered in a dotted pattern evocative of the colorful flowers of Hokkaido. Light-emitting diode (LED) lighting is used both internally and for the headlights to save on electricity use.

[03] 737 Series AC commuter train



The main converters utilize Hitachi's platform for AC rolling stock that features hybrid SiC modules for smaller size and lighter weight. Power consumption has also been reduced compared to previous rolling stock by the adoption of a regenerative braking control system and other energy efficiency measures, with performance settings being optimized to suit the passenger numbers and operating conditions identified by route surveys. Hitachi intends to use this main converter platform in other new rolling stock.

A total of 13 trains were delivered between December 2022 and May 2023, with commercial operation commencing on the Muroran Line between Tomakomai and Muroran in May 2023.

4. Adoption of Three-car Trains on Okinawa Urban Monorail (Yui Rail)

The Okinawa Urban Monorail is the only railway service in the prefecture. It commenced operation in August 2003, running for approximately 13 km between Naha Airport and Shuri stations. The line was extended to 17 km in October 2019 with the addition of a further 4 km of track from Shuri to Tedako-Uranishi station. Hitachi, Ltd. has contributed to monorail operations by supplying key equipment, including the rolling stock and traffic management. Since it started operation, the Okinawa Urban Monorail has earned a strong reputation among locals and tourists for punctuality and safety. It has also made a major contribution to reducing traffic congestion, to promoting tourism and industry, and to the vitality of the community.

To further improve convenience, a decision was made to add four three-car trains to the existing fleet of two-car trains as part of a plan to boost transportation capacity. Hitachi, Ltd. was commissioned to manufacture all four trains, with the first two entering service in August 2023 on the 20th anniversary of the line opening. The new three-car trains are based on the two-car rolling stock for ease of maintenance and feature service and safety enhancements that include multi-lingual internal signage, large luggage space, security cameras, and evacuation chutes. The remaining two trains are scheduled to be delivered by the end of 2023.

[04] Exterior and interior of Okinawa Urban Monorail (Yui Rail) three-car train



5. Skyline - USA's First Fully Autonomous Urban Railway Transit System

Hitachi Rail delivered the first autonomous mass transit system to the USA. Honolulu passenger service on Skyline began June 30, 2023. Hitachi Rail Honolulu JV handled the system implementation, maintenance, and delivery of rolling stock as part of their contract with the Honolulu Authority for Rapid Transportation.

The state-of-the-art Hitachi technology of Skyline embraces automatic train operations that are safer, more efficient alternatives to manually driven railroads. The deployment of driverless technology means cleaner rail transportation with improved punctuality, reduced energy consumption, and enhanced safety for passengers.

Honolulu faces the worst traffic congestion among medium-sized US cities. The new Skyline system functions as an elevated guideway, providing commuters with a reliable mode of transportation reducing their commute time. Cutting traffic congestion and eliminating thousands of daily car trips also means less air pollution and CO₂ emissions, which is better for the island's delicate environment. Skyline of Honolulu is revolutionizing transportation on Oahu, providing a long-lasting and eco-friendly infrastructure that will shape the community's future mobility and quality of life.

(Hitachi Rail Honolulu JV)

[05] Skyline - East Kapolei Station and Train Ariel

View



6. Demonstration Project for AI-based Automation of Traffic Rescheduling at Kyushu Railway Company

The rescheduling of railway traffic to recover from timetable disruptions has become more complex in recent years due to factors that include greater variability in scheduling to improve convenience and measures for coping with adverse weather.

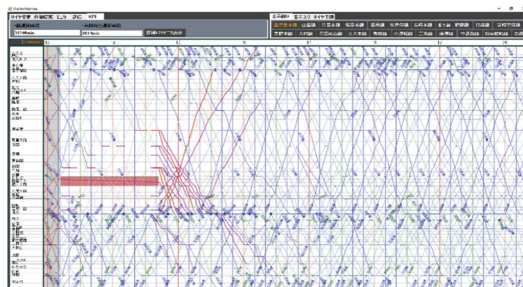
To support this rescheduling work and facilitate its automation, Hitachi has developed a hybrid traffic management artificial intelligence (AI) that incorporates a new form of machine learning into the existing AI that it has developed for this application over many years.

This hybrid traffic management AI is currently being used in a joint project between Kyushu Railway Company (JR Kyushu) and Hitachi to demonstrate the viability of using AI to automate train rescheduling. This has involved incorporating knowledge, expertise, and other train rescheduling resources from JR Kyushu into the hybrid AI.

The joint project has demonstrated the AI's ability to learn the practices that traffic control staff use for rescheduling and to generate rescheduling plans. Ongoing work will include determining whether the AI can formulate and synthesize plans when similar events occur, such as coordinating with rolling stock scheduling or the rescheduling of trains that run over different sections of track or during events such as heavy rain that cause problems over wide areas.

Furthermore, rather than one-way interaction whereby the AI is limited to proposing rescheduling plans to the traffic control staff, the goal is to have people and AI working more closely together by incorporating the ability to query the AI.

[06] Rescheduling plan by AI trained on practices of traffic control staff (for Kagoshima Main Line)



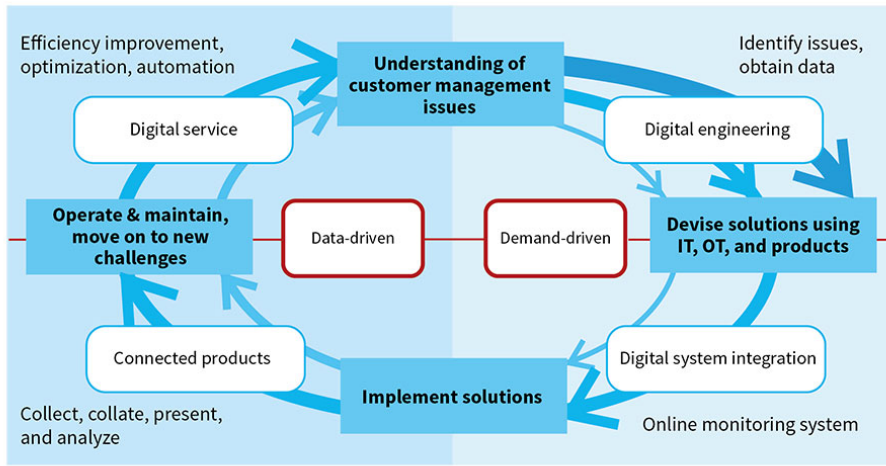
7. Online Monitoring System

Online monitoring systems (OLMs) can deliver new value to railway operators and vendors by collecting, collating, analyzing, and presenting data from rolling stock and trackside infrastructure. Unfortunately, it is difficult to deliver value to customers through data-driven practices that involve analyzing the available data, and many such collaborative creation efforts with customers go no further than the proof of concept (PoC) stage. By working through a growth cycle that is both demand-driven and data-driven, however, Hitachi is able to deliver ongoing step-by-step improvements in the efficiency of railway operations and maintenance.

Improving operational efficiency involves understanding business processes, identifying opportunities for improvement, and obtaining the data needed for improvement. When configuring an OLM, Hitachi first consults with railway operators to identify priority issues and then has its in-house designers obtain the data. The data collected by the OLM is analyzed and verified by data scientists familiar with the railway industry to transform it into valuable information. It can be used to calculate performance indicators, for example. These could include indicators that assess the recovery from faults based on rolling stock location and condition; maintenance based on operational information and data from compressors and air conditioning systems; energy savings based on operational information, run curves, and power consumption data; and timetables or the number of cars to run in each train based on operational information and passenger numbers. Incorporating these conversions into the OLM can improve operational efficiency, while interoperability with other systems can likewise facilitate optimization or automation.

To contribute to improving the operational efficiency of railway operators, Hitachi intends to make OLMs available as a service from 2024.

[07] Growth cycle using online monitoring system



OT: operational technology

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