Railway Systems

1 East Japan Railway Company Hydrogen-hybrid Train (FV-E991 Series)

Decarbonization efforts are accelerating worldwide to achieve a sustainable society.

As part of these efforts, East Japan Railway Company developed the FV-E991 series (HYBARI: hydrogen-hybrid advanced rail vehicle for innovation), a hydrogen-hybrid train that uses fuel cells, with the goal of diversifying energy sources.

Hitachi greatly contributed to the project. It was contracted to develop the main circuit[*1] system of the FV-E991 series; produced the power conversion equipment[*2], main circuit battery, and traction motor; and managed the hybrid system including the fuel cell system. The main circuit system of the FV-E991 series covers various functions such as vehicle driving control, charge and discharge control of the main circuit battery, and output control of the fuel cell system. Hitachi collaborated with East Japan Railway Company, who manages the entire project, and Toyota Motor Corporation, the fuel cell manufacturer, to implement and operate the vehicles on the main line.

Since March 2022, it has been conducting verification tests (e.g., vehicle performance evaluations) on the Nambu Line (between Kawasaki and Noborito), the Tsurumi Line, and the Nambu Line Shitte Branch Line, and continues to work with East Japan Railway Company to promote the practical use of hydrogen-hybrid trains.

*1 Circuit involved in driving the vehicle
*2 Equipment including inverters, auxiliary power supply, and control devices for driving

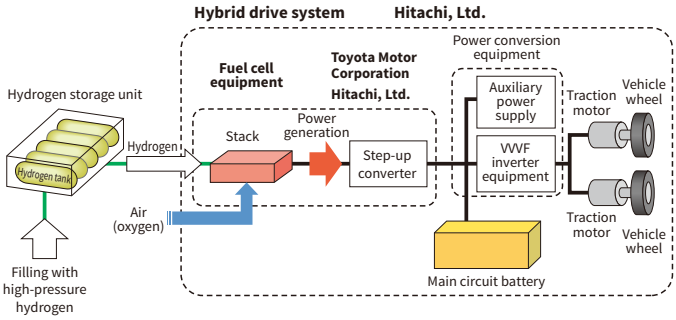
2 Order for EMU3000, a New Intercity Express Train, from Taiwan Railways Administration

The Taiwan Railways Administration, Ministry of Transport and Communications (TRA) established the "TRA Train Purchasing and Renewal Plan (2015–2024)" to increase its railway transport capacity and renew the aging fleet. To this end, it is promoting the large-scale procurement and expansion of new vehicles.

This is the largest procurement project in the history of TRA, involving the bulk purchase of 600 intercity express train cars (50 trainsets with 12 cars each). Hitachi implemented full three-dimensional (3D) design using digital technology to seamlessly link the design and manufacturing processes, and in design and development, it utilized 3D models and virtual reality (VR) to facilitate consensus-building with customers. Compared to the traditional 8-car intercity express trains, this train features a 12-car configuration that enhances its transport capacity, and introduces new concepts such as TRA's first-ever business class car, which comprises one of the 12 cars.

The first trainset delivered to Taiwan in July 2021, underwent a trial run period, and began commercial

Photo courtesy of East Japan Railway Company



VVVF: variable voltage variable frequency

1 Hydrogen-hybrid train (FV-E991 series) and mechanism of fuel cell hybrid drive system

2 New intercity express train, EMU3000

operation on December 29, 2021. Since then, it has been in daily operation as an intercity express train running throughout Taiwan.

3 Masaccio Multimode Train

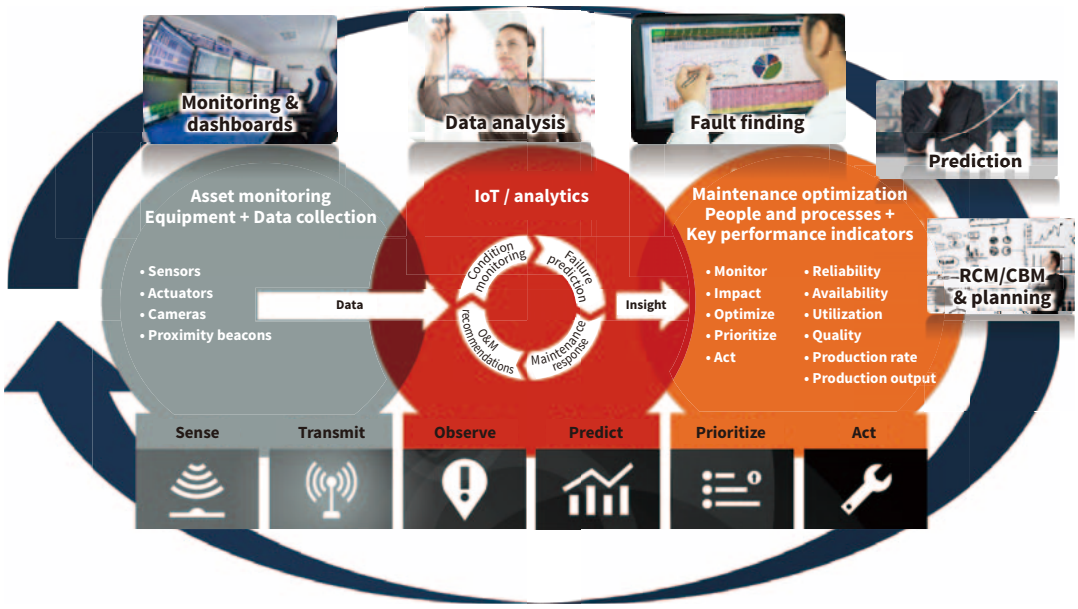
Masaccio is the new multimode single deck train for the regional transportation. A framework contract with Trenitalia S.p.A, Italian railway company, foresees up to 135 trainsets, two configurations: 3 cars able to carry 220 seated passengers and 4 cars up to 300 seated passengers.

The sustainability is one of the key goals of the Masaccio development, not only through the use of highly recyclable materials in the cars, but also through a four mode operation to optimize energy consumption as well as to reduce noise and pollution in urban areas without electrified lines. Masaccio can run as an electric train in the sections with overhead wire, also as a diesel train, a hybrid train to reduce the fuel consumption and operate in battery only mode when entering in town with start and stop function of the diesel engine. The energy management technology has been developed by a joint engineering team of Hitachi Rail Ltd., based both in Japan and Italy.

4 HFMT Lumada + IoTrain

Hitachi Fleet Management Tool (HFMT), one of the Lumada digital platform, is one of world first integrated solution developed in collaboration between partners in UK, Japan, and Italy and Hitachi Vantara LLC. HFMT is Hitachi Rail's strategic digital asset monitoring

3 Masaccio single deck



O&M: operation and maintenance RCM: reliability-centered maintenance CBM: condition-based maintenance

4 Advanced IoT and big data technologies come together to efficiently maintain assets

platform, powered by Internet of Things (IoT), condition based maintenance methods that delivers advanced wayside remote capabilities to customers to assist passenger service trains in service and enable effective and efficient methods for fleet maintenance and asset reliability. HFMT has been in operation in the UK since 2019.

Key innovative solutions include:

(1) Train operation and control functions

Headline and map view of all units, energy monitoring and usage, passenger counting, remote commands, seat reservation and timetable data feeds, and driver advisory

(2) Train maintenance functions

Events triggered based on asset condition, fault finding, advanced signal viewer, maps, system of concern, overhauls driven by asset condition and usage, reliability reports, and predictive maintenance

(3) Assets management functions

Infrastructure track monitoring, closed-circuit television (CCTV), infrastructure alerts, pantograph and overhead lines, and asset reliability reports

Integration of all these capabilities enables Hitachi Rail to deliver trains with high performance reliability, availability, safety at the same optimizing on maintenance.

Capitalizing on HFMT, battery as a service (BaaS), and maintenance as a service (MaaS) business models supported with unified platform generate significant business opportunities in the market. Software as a service (SaaS) business has been implemented via Perpetuum Ltd.'s platform.

257 trainsets in the UK are currently connected and are benefiting from HFMT digital capabilities, more than 100 trainsets are being planned as the company deliver more trains to its customers.

5 360Pass with Lumada Intelligent Mobility Management

In July 2022, Hitachi Rail released a new service called 360Pass, which uses Lumada Intelligent Mobility Management. 360Pass is currently offered under the local brand name GoGoGe in Genoa, Italy.

Through a mobile app that utilizes Bluetooth* sensors, the service enables hands-free use of all public transportation within a city while automatically charging the cheapest possible fare. Users can also hire electric vehicles, pay parking lot fees and find an e-moped through the app. Moreover, it can provide passengers with information related to travel conditions, such as the level of congestion on the route, and provide transportation operators with detailed data related to passenger movement.

In addition to 360Pass, Lumada Intelligent Mobility Management includes control of passenger and vehicle flows along with e-mobility solutions, accelerating the transition to sustainable transportation.

*See the list of "Trademarks."

5 360Pass with Lumada Intelligent Mobility Management

6 ETCS Onboard Equipment as a Global Product

In the early 2000s, Hitachi entered the European Train Control System (ETCS) market, a standardized railroad signaling system in Europe. In 2013, the company obtained certification for ETCS onboard equipment in the UK and began manufacturing products for the UK intercity express railway, for which it had received an order the previous year.

Hitachi then expanded its business beyond the UK and developed ETCS onboard equipment for existing Waratah trains and new Sydney Growth Trains in Australia from 2018 to 2020, successfully delivering 119 trains. Since then, the company has been expanding its share in the market for ETCS onboard equipment, which has become a global product.

Queensland Rail in Australia is improving transport capacity by constructing new railway lines and introducing ETCS Level 2 to alleviate congestion in the central area of Brisbane. Hitachi is participating in this project in collaboration with Hitachi Rail STS S.p.A. (HRSTS), which became a member of the Hitachi Group in 2019. Hitachi is responsible for the ETCS onboard equipment and part of the operation management system, and HRSTS for the scope including the ETCS ground-based equipment. They successfully integrated the entire signaling system and are conducting running tests in preparation for the start of commercial operation.

The company plans to implement automatic train operation (ATO) over ETCS, which will operate in coordination with ETCS, and continue to contribute to the construction and development of railway infrastructure.

6 ETCS onboard equipment