
“ecute Shinagawa” Retail Outlet at JR Shinagawa Station

Special Report

# Railway Systems for Smart City Development

## Cities around the world are upgrading their railway services.

**Railway systems that offer excellent economics, environmental performance, and punctuality are recognized as a core element of urban development. They play an increasingly important role in alleviating problems such as road congestion and air pollution and new plans for high-speed intercity railway links are being initiated around the world. Progress is also being made on incorporating advanced information systems into stations and other parts of the railway network as a core aspect of the creation of “smart cities” that take advantage of IT. Hitachi has been producing products such as rolling stock, electric power systems, train operation management systems, and passenger reservation systems since the 1920s. In addition to contributing to fields such as urban transportation and high-speed railways in its role as a total railway system integrator, Hitachi is also working actively to improve railway services based on this technology.**

### Bustling Station Malls

The recent transformation in Japanese railway stations has been astonishing. Inside, restaurants, book stores, convenience stores, fashion boutiques, and other retailers vie for attention while station neighborhoods are well provided with hotels, shopping, and similar facilities.

“Rail is a service industry. The breakup and privatization of Japanese National Railways in 1987 provided the impetus to reinforce awareness among all staff from top management to the front line that we are a company that provides services to customers and we have introduced numerous innovations based on convenience for our customers,” explains Yoshio Ishida, Vice Chairman of the East Japan Railway Company (JR East).

In the post-war era, Japanese National Railways focused on strengthening its freight capabilities in its role as a main artery in Japan’s economic reconstruction to help establish the platform for rapid economic growth. Financially, however, it produced a long series of losses starting from FY 1964, the year it introduced the Tokaido Shinkansen service. Although it maintained a nationwide network in its role as a public transport agency, changes in Japan’s industrial structure were driving progressive depopulation of rural areas and this combined with greater use of motor vehicles resulted in a rapid increase in the number of unprofitable lines and progressively larger losses each year.

Eventually, the company was split up and privatized for renovation in 1987 to create six passenger companies and one freight company. Initiatives taken by the new companies included more convenient timetables, the upgrading of old rolling stock, and innovations such as ticket gate automation. JR East designated service as its number one business priority and the way it kicked this off by cleaning up station toilets has become a matter of legend.

This pursuit of customer satisfaction has led to other changes including greater use of track sharing between public and private railways to allow passengers to travel to their destination without needing to change trains, the provision of more retail areas in stations, and making access to station buildings barrier-free. A particular milestone was the introduction by JR East of the Suica smart card ticketing system in November 2001 for the Tokyo region.

"At the time we thought we would not need to issue more than 5 million cards at most. In fact, by making the system available for use as electronic money in high street stores as well as vending machines and other retail outlets inside stations, the total number of cards issued has now exceeded 30 million," says Vice Chairman Ishida.

This service improvement has seen sales by JR East's non-transport businesses reach approximately 30% of total sales, putting them on a par with income from the Shinkansen.

## Development of World-leading Information Systems

Information and communication systems have played a very large role in service improvements and other advances in railway systems.

In the field of information systems, MARS (multi-access reservation system), Japan's first online system, was completed in 1960 back in the Japanese National Railways era. This system automated a process that previously involved customers calling by telephone and having their reservation manually entered into a ledger. "JR Ticket Offices (Midori-no-madoguchi)" were subsequently added at major stations when the Tokaido Shinkansen entered service in 1964. This business is developed and operated by Railway Information Systems Co., Ltd. and now provides services such as airline and accommodation reservations in addition to train tickets and passes.

In the field of control systems, COMTRAC (computer-aided traffic control system), the world's first computer-based train operation management system, was completed in 1971 to support safe and punctual operation of the Shinkansen whose services continued to grow in frequency.

After privatization, JR East embarked on the development of ATOS (Autonomous Decentralized Transportation Operation Management System), a transport management system for the Tokyo region which was used for conventional railway lines around the metropolitan area. Because the railways in and around Tokyo run to a very tightly packed timetable involving trains of many different types traveling to many different destinations with a complex system of signals and points, computerization of operation management was thought to be impossible. However, these obstacles were overcome and ATOS was first introduced on the Chuo Line in 1996 and is now used on 19 lines in the Tokyo region. ATOS not only allows for quick recovery when trains get behind schedule, it also keeps passengers informed of the current situation by providing information in stations and trains.


A range of new services are emerging that take advantage of IT (information technology), including smart card ticketing, electronic money, and digital posters.

Images courtesy of East Japan Railway Company

## Hitachi Railways Systems Spanning 90 Years

Hitachi has been contributing to advances in railway systems for 90 years.

In the 1920s, it produced the class 8620 steam locomotive at its Kasado Works. In 1924, in response to the plan to electrify the Tokaido Line, Kasado Works and Hitachi Works worked together to develop and supply the class ED15, Japan's first large electric locomotive. In 1936 it supplied a set of power generation equipment to the Ministry of Railways' Shinanogawa Senju Power Plant.

After the Second World War, Kasado Works was the first of its war-damaged plants to resume production of rolling stock. The class C62 steam locomotive produced in 1948 was the Japanese National Railways' largest locomotive and was used to pull the Tsubame express trains. Meanwhile, the passenger cars fitted with coolers for the Asakaze sleeper express completed in 1958 were a forerunner for the production of further luxury rolling stock. Hitachi also participated in the development of the Tokaido Shinkansen from the earliest stages including the production of rolling stock, key control equipment, and automatic train control systems.

In the field of information systems, Hitachi's involvement with passenger reservation systems started with its participation in the joint development of MARS-1 and spanned MARS-101 (1964), MARS-105 (1972), and MARS-501 (in operation since 2004). Hitachi also has extensive experience in center systems for managing smart cards including smart card ticketing systems like Suica. Omika Works was the principal site of development for COMTRAC and Software Works and Kanagawa Works also participated. The system was delivered to the Shinkansen General Command Center at Tokyo in December 1971.

Hitachi also developed train operation systems for various JR companies as well as other public and private railways including joint development of ATOS and the COSMOS (computerized safety, maintenance and operation systems of Shinkansen) Shinkansen coordination system of JR East.

In rolling stock, Hitachi developed the A-train which uses aluminum components designed for easy recycling and a low impact on the environment. Numerous Shinkansen, express, commuter, subway, and other rolling stock have been delivered and the A-train was also selected for a high-speed railway service in the UK that commenced operation in 2009.

## Working toward a Low-carbon Society

Japanese railway systems are now taking on the world.

Internationally, many cities suffer from chronic traffic congestion and air pollution. Together with the rapid rise in oil prices, this is increasing the perceived value of railway systems because of their energy efficiency and lower impact on the environment. Various countries are working on plans for high-speed inter-city railway links. Even the USA, home of the automobile, has included railway systems in its Green New Deal policy. In Japan, the Tohoku Shinkansen was extended to Shin-Aomori in December 2010, and the Kyushu Shinkansen will enter full service in the spring of 2011.


COMTRAC train operation management system (left) and ATOS, Autonomous Decentralized Transportation Operation Management System for Tokyo Region (right).

Japan's rapid, reliable, safe, comfortable, and convenient railway systems are among the most advanced in the world and, as one of the companies behind these systems, the time has come for Hitachi to contribute globally.

Hitachi has exported electric engines and other monorail systems for urban transport to Chongqing in China as well as to Singapore and Dubai.

In 2005, Hitachi won an order from the British railways authority for 174 high-speed railcars for the Channel Tunnel Rail Link (High Speed 1) which commenced commercial operation in December 2009. The contract included maintenance services. Whereas maintenance is normally handled by the railway company in Japan, provision of maintenance services by the supplier was one of the terms of the UK project. Accordingly, Hitachi entered into a consulting contract with JR East and East Japan Transport Technology Co., Ltd. and established a dedicated train maintenance center at Ashford International railway station.

The bidding for the UK project was in competition with international train suppliers from Germany, France, and Canada. To compete in this global market for railway systems development, Hitachi needs to take a comprehensive approach involving both collaboration with other Japanese companies in the railways, trading, and other sectors and also support for things like railway policies and financing. The collaboration with JR East in the UK represents a significant first step along this path. Based on this experience, Hitachi is now working on a project to replace the UK's entire fleet of high-speed trunk line trains through a joint venture investment company in partnership with British businesses.

## Making Railway Systems a Core Part of Urban Development

Together with the pursuit of efficiency, safety, reliability, and energy savings, the concepts likely to prove key to the future of railways systems include making railways into a more attractive service business. The adoption of advanced information systems in stations, trains, and other railway industry applications is also likely to play a key role in new urban developments based on the use of IT (information technology).

For example, in addition to digital train radio systems that provide passengers with Internet access, Hitachi is also working to achieve more sophisticated train operation management. For railway stations, Hitachi is putting particular effort into the development of digital signage to display service status, news, and guides to the station and surrounding areas.

Integration of smart card ticketing systems between different railway companies already allows cards to be used interchangeably over a wide area of the country and further work will extend use of the smart cards as electronic money and allow integration with credit cards, debit cards, and other payment services. To this end, Hitachi is working on further initiatives including enhancing security and improving the speed of the center systems that lie at the core of these services.

Through these initiatives, Hitachi is contributing to the progress of railway systems around the world by helping make railway systems more advanced and improving the services they provide.


Hitachi's Ashford
Train Maintenance Centre in UK

Interview

# Sharing a Grand Design for Further Development of Railway Systems

**Yoshio Ishida** | **Vice Chairman, East Japan Railway Company**

I became involved in COMTRAC soon after joining the company. That was the first time I had come into contact with Hitachi. Despite inadequate technical and human resources, we shared a vision for creating a world-leading system and were able to pool our knowledge in a way that transcended the boundaries between customer and supplier and led us to achieve our goal.

Similarly, despite the deeply embedded idea in those days of command and control as something done by people provided specialists could be trained for the role, I decided during ATOS development at JR East that computer control was essential. This was because we operated the highest density of urban railway services anywhere in the world. To integrate signaling, automatic train control systems, energy control, and other distributed systems and optimize their overall operation, we assembled a team of specialists from a wide range of fields including Hitachi staff. Although the setbacks we experienced were not inconsiderable, we were able to overcome these thanks to the team sharing a grand design. This was particularly helpful for spreading the benefits of integration across the organization.

With railway systems currently a topic of global interest, it is essential that we have a grand design for railway systems that encompasses the future. Although Japan has led the world with advanced systems such as the Shinkansen, I feel that we have been slower to publicize these successes and offer them as a template for the rest of the world.

Railways require systems with excellent energy efficiency and the ability to make good use of alternative energy. The individual technical capabilities and track records of Japan's railway companies and suppliers compare well with the big three international manufacturers and what is needed is an all-Japan grouping that can compete across the board including in operations and maintenance management. In emerging economies, the need is not only for railway infrastructure proposals that encompass logistics and urban planning but also for ways of helping foster personnel with policy-making ability. Countries with advanced railway networks such as in Europe and America, meanwhile, require solutions that take account of their individual railway industry practices.

With its experience in track sharing between Shinkansen and conventional railway services, JR East is able to offer effective solutions that provide seamless integration of high-speed and commuter services. We need to be considering how we can build on our experience with Suica smart cards in fields such as lifestyle services based on IT. I also believe we need to extend the role that railway stations play in urban development.

One very interesting example of the potential for railway stations comes from the Liège-Guillemins station in the Kingdom of Belgium which opened in late 2009. Because of its location within two hours' high-speed train ride of many of the major cities of Europe, Belgium is seen as a potential hub within the EU (European Union) and the redevelopment around the Liège-Guillemins station is attracting attention as a new landmark in this process.

I have high hopes for the diverse activities, solutions, and proposals that Hitachi can offer in initiatives like these. It may be a sign of the times, but it feels to me that greater organizational barriers have grown up within Hitachi compared to the days when systems like MARS and COMTRAC were being developed and awareness of the overall picture has also become diluted within JR East. In order to promote Japanese railway systems amid strong international competition, I believe it is important that we work together based on shared ideals just like we did in the pioneering days of information technology.

Liège-Guillemins Station in Kingdom of Belgium