Railway Business Strategy and R&D in Europe

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OVERVIEW: Hitachi's European railway business has achieved considerable success with its Class 395 high-speed trains in the UK, the birthplace of the railway. Hitachi has contracted to supply rolling stock and maintenance services for the Intercity Express Programme in the UK, including extensive work as the total systems integrator including electrical traction equipment, signaling etc. Aiming at further expansion of the railway business, Hitachi Europe Ltd. European R&D Centre is strengthening the railway research activity to resolve issues specific to European requirements in fields such as rolling stock, maintenance, signaling, and traffic management.

INTRODUCTION

THE Class 395, the first high-speed train supplied by a Japanese manufacturer to Europe, is built by Hitachi and running on the High Speed 1 line (a dedicated line for high-speed trains) that links London to the Channel Tunnel (see Fig. 1). Since the formal commencement of commercial operation in December 2009, the Class 395 has contributed to the highly reliable passenger service on the line. Representing the first step of Hitachi's European railway business plans, the record of success of the Class 395 is set to boost further business expansion, promoting the strong technical capabilities of Hitachi in the field of railway systems.

This article features how Hitachi is moving on from the Class 395 to further success in European railway business, and how the Hitachi Europe Ltd. European R&D Centre is tackling it.

Fig. 1—Class 395 High-speed Train in UK.
A Class 395 high-speed train is shown at St Pancras International Station in London.

RAILWAY BUSINESS ACTIVITIES IN EUROPE

Having built up a solid base for its railway business in Japan, Hitachi is stepping up its moves into overseas markets as a way of further expanding its business. A key facet of this strategy involves its UK subsidiary, Hitachi Rail Europe Ltd., taking a leadership role in promoting an expansion of sales in Europe.

Europe has well-developed railway networks built using railway transportation systems supplied by European manufacturers. The following sections describe what Hitachi has achieved to date in this mature market by utilizing the technical strengths built up in Japan, and also the prospects for the future.

Past Strategy and Business Success

Hitachi's strategy for entering the European railway market was the verification train (V-Train) project in the UK (see Table 1). This initiative successfully demonstrated the viability of Hitachi's railway technology in the European environment and led to orders in the UK.

TABLE 1. V-Train Project
Hitachi's involvement in a series of rolling stock verification trials in the UK contributed to its winning of orders such as for the Class 395.

Project	Schedule	Description
V-Train 1	2002 to 2005	Performance verification of electrical traction equipment Helped win Class 395 order.
V-Train 2	2007 to 2008	Verification of technical capabilities through use of a hybrid traction system in a high-speed train
V-Train 3	2008–	ETCS system development and performance verification

V-Train: verification train ETCS: European Train Control System

The Class 395 has made a remarkable contribution to the business success. The project was in the form of a package deal, including maintenance services as well as the supply of 29 trains with a total of 174 cars[1]. Maintained at Hitachi's Ashford Depot, which is located at a junction between the High Speed 1 line and other existing lines, the Class 395 is delivering highly reliable transportation every day. In addition to the Class 395 high-speed trains, Hitachi also has a successful track record on other work, such as the replacement of electrical systems on the Class 465 commuter trains, steadily promoting its presence in the European market.

Future Business Prospects

The largest project is the Intercity Express Programme (IEP) in the UK. Following the contractual close in July 2012 which Hitachi, Ltd. announced, Hitachi will provide service and maintain a total of 596 rail carriages to run on the UK East Coast Main Line and the Great Western Main Line to replace the aging fleet of Intercity (HST) trains (see Fig. 2). This contract announcement paves the way for the investment by Hitachi to build a rolling stock manufacturing and assembly plant in the UK[2].

Fig. 2—Image of New Rolling Stock for IEP and Planned Routes.
The Intercity Express Programme (IEP) project will replace aging high speed trains (HSTs) on the Great Western Main Line from London to the west, and the East Coast Main Line to the north.

In addition to the rolling stock and maintenance services, Hitachi is also seeking to draw on its strengths as a total systems integrator to expand its operations into a wider range of railway business, including electrical traction systems and signaling. Hitachi, including Hitachi Rail Europe Ltd., is now working hard to build comprehensive capabilities in these areas especially focusing on the IEP project.

RESEARCH AND DEVELOPMENT SUPPORT FOR EUROPEAN RAILWAY BUSINESS

In expectation of further expansion in its European railway business, Hitachi set up a railway research team at the Transportation, Energy and Environment Research Laboratory (TEEL), which was established in April 2011 at the European R&D Centre. The aim is to support this expansion and strengthen Hitachi's research capabilities in a range of fields such as rolling stock, maintenance, signaling, and traffic management. Based in the London office of Hitachi Rail Europe Ltd., the railway research team works closely with the on-site operations department, customers, and also in collaboration with local universities so as to identify and resolve issues specific to European circumstances. This section describes the research on rolling stock, maintenance, and signaling.

Rolling Stock

An important consideration for rolling stock is compliance with the specific requirements imposed by the technical standards and other infrastructural circumstances that apply in Europe. For example, trains must provide good ride comfort when running on the track used in Europe. Other examples include the need to satisfy standards for crashworthiness requirement (to ensure safety in the event of a crash) and aerodynamic characteristics (to improve passenger comfort and reduce noise in tunnels).

To work on these problems, the European R&D Centre utilizes analysis leads design in cooperation with the research and development department in Japan. This design method uses computer simulations based on advanced analysis techniques to perform tasks, such as optimizing designs or verifying compliance to obtain standards certification, more quickly and at lower cost than using prototype testing.

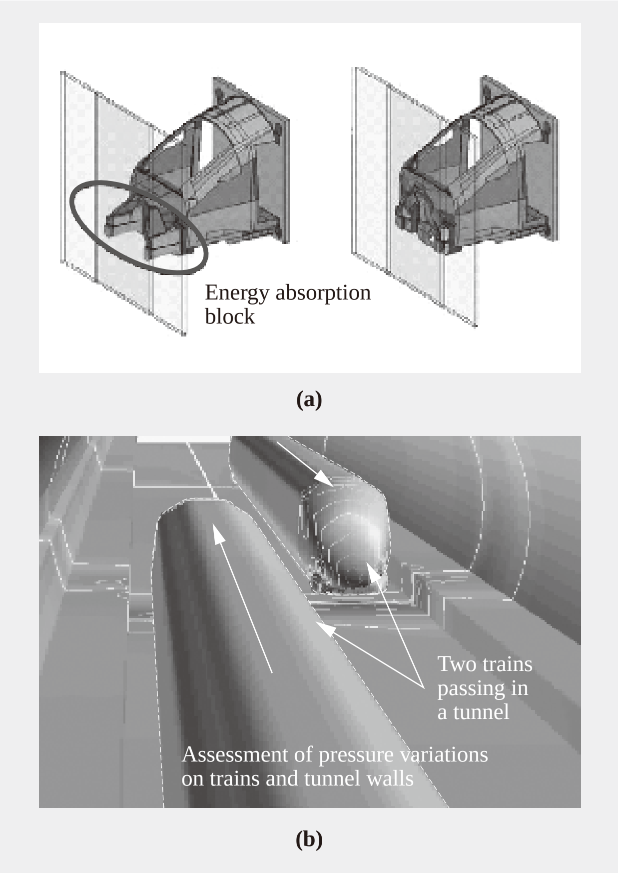

Fig. 3—Example Applications of Analysis Leads Design.
Crash analysis for leading car fitted with an aluminum energy absorption block (a), and analysis of surface pressure variations on two trains passing in a tunnel (b) are shown.

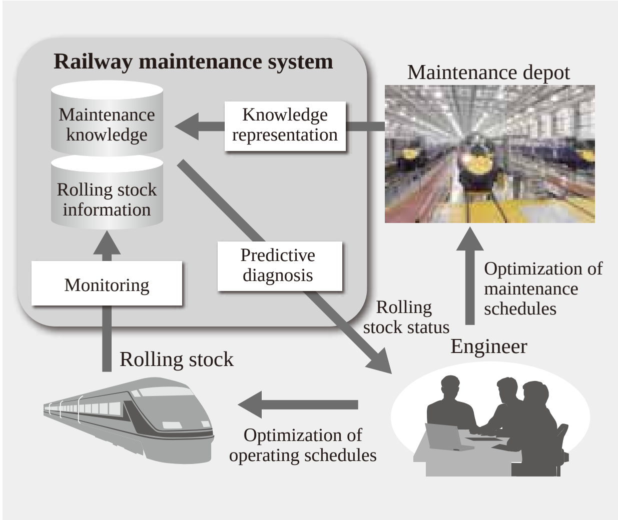

Fig. 4—Overview of Railway Maintenance System.
Practices include status monitoring and maintenance that combines technologies for monitoring and predictive diagnosis, and techniques for representing knowledge about fault detection and analysis at the maintenance depot.

This method proved its ability to shorten lead times and reduce costs when it was used in the design and development of the Class 395 to identify and verify designs that would satisfy requirements such as for the maximum body acceleration during a crash, or the variations in the internal and external pressure when a train passes through a tunnel[(3)] (see Fig. 3).

For the future, European R&D Centre intends to press forward with the use of analysis leads design on the UK IEP and other projects by taking the needs identified by working closely with local players, environmental circumstances, and knowledge gained through discussion with local experts, and feeding this information back into the analysis techniques.

Maintenance

In addition to being the first example of a Japanese manufacturer delivering high-speed trains to Europe, the Class 395 project is also the first case where Hitachi has taken on a long-term maintenance contract for rolling stock.

Rolling stock maintenance is essential to safe and reliable operation. As rolling stock maintenance is always handled by the railway operator in Japan, this constituted a new challenge for Hitachi, but the business was able to be put on the right track thanks to cooperation from local staff and consultants as well as knowledge acquired from railway operators in Japan. For the future, the challenge is to establish maintenance schemes that suit the European market, and also, to maintain and improve reliability of railway service.

For this challenge, Hitachi is developing condition based maintenance technology, based on wireless remote monitoring and predictive diagnosis of faults based on sensor data. Also under development is technology for the structuring of knowledge acquired through the systematic collection of information on fault analysis and countermeasures so that measures can be put in place quickly and appropriately when a problem does occur. Through these technologies, Hitachi is seeking to achieve even higher levels of reliability and safety by allowing maintenance to be undertaken based on the actual condition of the rolling stock[(4)] (see Fig. 4).

The European R&D Centre is working in conjunction with the maintenance team in the UK on research and development aimed at implementing these technologies in the field. The technologies are also intended to contribute to the IEP, which, like the Class 395 project, is a package deal that includes both rolling stock and maintenance services.

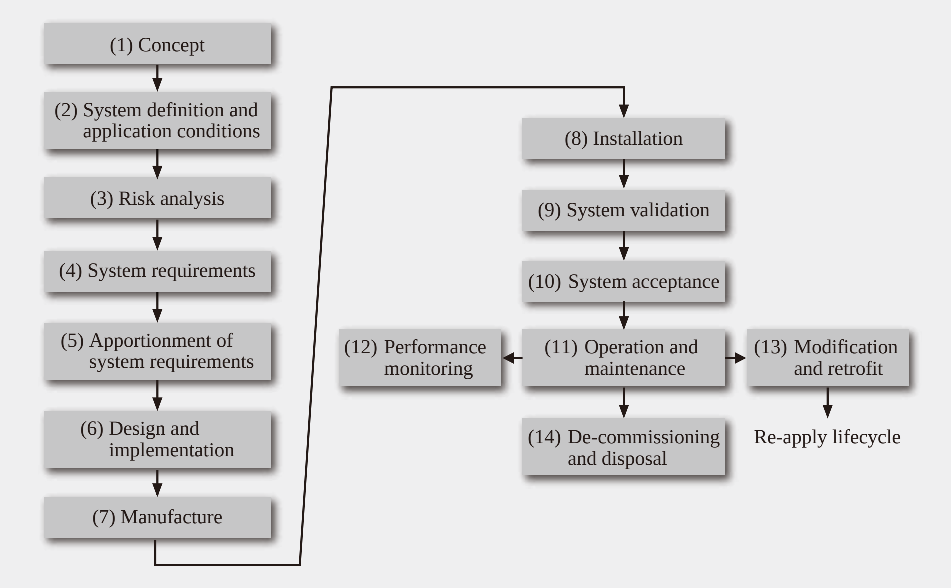

Fig. 5—System Lifecycle for Railway Applications.
The EN 50126 shows the tasks to be performed at each phase of the system lifecycle.

Signaling

The signaling system is responsible for train detection and control to prevent crash, hence requires the highest level of safety design in a railway system. The challenge in this field is to demonstrate the required safety in line with the European safety standards.

Having built up a track record in the signaling products utilizing digital or wireless communications technology, Hitachi is now developing new product compliant with the European Train Control System (ETCS) standards.

In this development it is required to satisfy and demonstrate the safety levels stipulated in the ETCS standards. For example there are some European standards to stipulate the development process for preventing an erroneous output causing a hazardous event[(5)] (see Fig. 5). While based on Hitachi's proven safety design, it is also necessary to satisfy these standards.

For this challenge, the European R&D Centre is contributing to more efficiency in development with analysis and systematization of the differences between European approach to safety design and the Hitachi proven one through consultation with local experts.

CONCLUSIONS

This article has described Hitachi's railway business strategy for Europe and some of the works being carried out by the European R&D Centre to support this, focusing on the fields of rolling stock, maintenance, and signaling in particular.

Hitachi has broken into the European market through its success with the Class 395 in the UK, and is seeking to expand its business further by strengthening its European railway business capabilities based around the IEP. The European R&D Centre is going to commit further to enhancing and developing railway activity to support the business.

REFERENCES

(1) T. Mochida et al., "Development and Maintenance of Class 395 High-speed Train for UK High Speed 1," Hitachi Review **59**, pp. 39–46 (Apr. 2010).

(2) Hitachi News Release, "INTERCITY EXPRESS PROGRAMME FINANCIAL CLOSE PAVES WAY FOR HITACHI INVESTMENT IN RAIL MANUFACTURING AND ASSEMBLY PLANT," (Jul. 2012), http://www.hitachi.com/New/cnews/120725a.html

(3) Hitachi Mechanical Engineering Research Laboratory, Environmental Research Topic 4, "Development of Rolling Stock System that Satisfies European Regulations," 2010 Environmental Report, Research & Development Group, Hitachi, Ltd. (2010) in Japanese.

(4) Research and Development, Railway Maintenance Systems, http://www.hitachi.co.jp/rd/research/hrl/rail_control_03.html in Japanese.

(5) EN 50126: 1999 Railway applications—The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS).

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