Taiwan High Speed Rail

Keeping passenger safety at the forefront

Overview

The Need
Taiwan High Speed Rail Corporation (THSRC) needed a highly reliable, cost-effective and proactive means of addressing the demanding maintenance requirements of high-speed rail transport.

The Solution
THSRC employed IBM Maximo® to build an advanced maintenance management solution that employs advanced sensing and condition-based monitoring.

What Makes it Smarter
Automated, rules-based workflow management ensures that maintenance issues are addressed before they can become passenger safety issues.

The Result
"With IBM's Maximo, we've succeeded in building an intelligent transportation system designed to meet the growing demand for safe, high-speed travel in Taiwan."

— Ming-Der Lee, manager of Maintenance Management Information Systems, Taiwan High Speed Rail Corporation

Like a few countries, life on the island nation of Taiwan is shaped by the quirks of its geography. With the eastern two-thirds of the country covered by rugged, mountainous terrain, the vast majority of Taiwan's 23 million citizens—along with much of its economic activity—are clustered along the gently rolling plains of the country's western coast. While Taiwan as a whole is ranked 15th in population density, its bustling western economic corridor would rank roughly sixth if measured on its own.

Such concentration puts a lot of strain on the public infrastructure, especially in the area of transportation. Indeed, within Taiwan's western corridor, the road and rail network that connects Taiwan's major cities (including Taipei, the nation's capital) had become increasingly congested, while the physical infrastructure itself was showing the signs of intensive utilization.

Aware of the growing inadequacy of its existing transportation network, Taiwan's government saw high-speed rail links between its major cities as a way of reducing congestion and—by extending the reach of economic activity—laying the foundation for the country's long-term prosperity. Thus was born the Taiwan High Speed Rail (THSR) system, a fully electrified railway that enables passengers to make the 214-mile run from Taipei in the north to Kaohsiung in the south in just 90 minutes, a stretch requiring 4.5 hours by traditional modes of transport. A five-year, $15 billion effort, the construction of the THSR network faced major engineering challenges, such as the fact that nearly 90 percent of the route traverses either tunnels or raised viaducts due to steep gradients in the terrain. Compounding the challenge was the need to design these structures to withstand the seismic activity that characterizes much of the THSR route.

High-speed challenges

However significant these build-out challenges were, THSRC realized that keeping its trains safe, reliable and on time would pose a new—and in some ways, larger—set of challenges. With maximum train speeds approaching 190 miles per hour, high-speed rail raises maintenance requirements to a new level due to the extraordinary stresses on tracks, brakes and wheels, to name a few. To meet these requirements,

Business Benefits

- Increased safety and reliability of the Taiwan High Speed Rail network through condition-based maintenance capabilities
- Extended life of fixed-asset investments
- Improved process efficiency by virtue of asset management and ERP process integration
- Improved asset efficiency through higher network uptime
- Optimization of human resource planning, parts inventory management and purchasing practices through a more holistic and proactive approach to maintenance

THSRC used IBM Maximo to build an advanced equipment maintenance system capable of automatically triggering maintenance activities by detecting potential problems in the network and—through automated alarms—addressing the problem before it becomes a risk to passenger safety.

THSRC designed the solution, known as the Maintenance Management Information System (MMIS), to gather data from existing monitoring and telemetry systems (such as SCADA, Signaling Systems and rolling stock sensors) and integrate it into a simplified planning and maintenance workflow. The system currently gathers over 320,000 data elements, from the rotation and temperature of wheels to the thickness of the overhead wire from which the train draws its power. In the case of the train wheel, for example, condition-based data is sent wirelessly, in real time to a central repository, for comparison to normal specifications. Specific attributes of IBM Maximo ensure the accuracy and integrity of information within the system.

In the event of a deviation on a particular parameter, such as excessive brake wear, an onboard monitoring system automatically sends an alarm to the MMIS system, which automatically generates the appropriate work order request (designated as preventive maintenance, corrective maintenance or emergent repair). To prioritize the request and determine the best way to fulfill it, the system needs to take into account the specific maintenance parameters of the asset in question (i.e., is the deviation within a tolerable range) as well as the availability of parts inventories, maintenance personnel and existing work requests. After processing these factors, the MMIS system issues a work order to THSRC's ERP system, which is integrated with the MMIS system through IBM Maximo Enterprise Adapter.

Upon completion of the job, the MMIS system closes the work order and updates the maintenance record accordingly. Within the MMIS, IBM Maximo provides the core functionality for asset management,

Smarter Rail: Proactive maintenance through intelligent asset management

Instrumented

THSRC's monitoring and telemetry systems track and report the condition of over 320,000 asset elements (e.g., tracks, tunnels).

Interconnected

In the case of a maintenance problem, warnings are sent in real time to THSRC's maintenance management solution, based on IBM Maximo.

Intelligent

Based on stored maintenance rules and the status of service resources, the system automatically creates, prioritizes and schedules work orders.

Solution Components

Software

- IBM Maximo® Asset Management
- IBM Maximo Enterprise Adapter

Services

- IBM Software Group
- IBM Global Rail Innovation Center

work order scheduling, project management, inventory management, resources management, purchase management and application interface. In the course of implementation, THSRC turned to IBM Software Group for advice on optimizing Maximo performance, and has since consulted with subject matter experts from the IBM Global Rail Innovation Center in Beijing on advanced new approaches.

Staying on time, maximizing uptime

In the two years since THSRC commenced service, adoption has been strong, with average daily volume of more than 90,000 passenger trips (and projected to reach 145,000 trips by 2033). While this represents a validation of the need for faster north-south transport, it also reflects the outstanding record of punctuality—99.15 percent of train arrivals and departures to within six seconds of the schedule time—that THSRC has achieved from the start. Ming-Der Lee, manager of Maintenance Management Information Systems at THSRC, sees the company's new solution as a key underpinning of THSRC's solid, on-time record. "IBM's software has helped us gain greater insight into the condition of our assets, develop more efficient work processes and to stay one step ahead of maintenance issues," explains Lee. More than 95 percent of THSRC's maintenance work orders have been generated and managed through the MMIS system.

Perhaps the best way to measure the safety impact of the new solution thus far is to look at the operational risks that THSRC faces every day—risks that it has effectively managed through the real-time monitoring of its assets. One dimension is the rail and switching infrastructure, including the 50 tunnels and long stretches of raised viaducts distributed over 214 miles of track, some of it passing through earthquake-prone areas. Then there are the trains themselves, 30 12-car "train sets" moving over the tracks at speeds of up to 186 mph. Given the intense physical stresses, and the complex array of variables that need to be monitored at every moment, automated, condition-based monitoring is a must to ensure passenger safety. The deadly 1998 crash of a high-speed train in Germany—caused by a single fatigue crack in one wheel that went undetected—illustrates the importance of pervasive asset monitoring in maintaining passenger safety.

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— Ming-Der Lee

While the importance of safety is paramount, THSRC also sees the MMIS as an important tool to lengthen the life span of its assets and thereby minimize spending on unscheduled maintenance. The company sees a significant part of its savings resulting from more efficiency in every part of its asset management process. Higher uptime for THSRC means more asset efficiency. A more holistic and proactive approach to maintenance enables it to optimize its human resource planning, parts inventory management and purchasing practices.

Improving mobility, spreading prosperity

With its condition-based maintenance solution in place, Ming-Der Lee sees THSRC as well-positioned to fulfill its role within Taiwan's strategy for reducing congestion, improving intercity mobility and—in the process—spreading the country's prosperity. "Passenger safety is our top priority," says Lee. "With IBM's Maximo, we've succeeded in building an intelligent transportation system designed to meet the growing demand for safe, high-speed travel in Taiwan."

For more information

To learn more about how IBM can help you transform your business, please contact your IBM sales representative or IBM Business Partner.

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