Nick Kingsley
Managing Editor

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The digital future: helping rail fulfill its potential

Hitachi Energy

The European Commission has designated 2021 as European Year of Rail

with the goal of highlighting rail as a sustainable, smart and safe mode of transport.

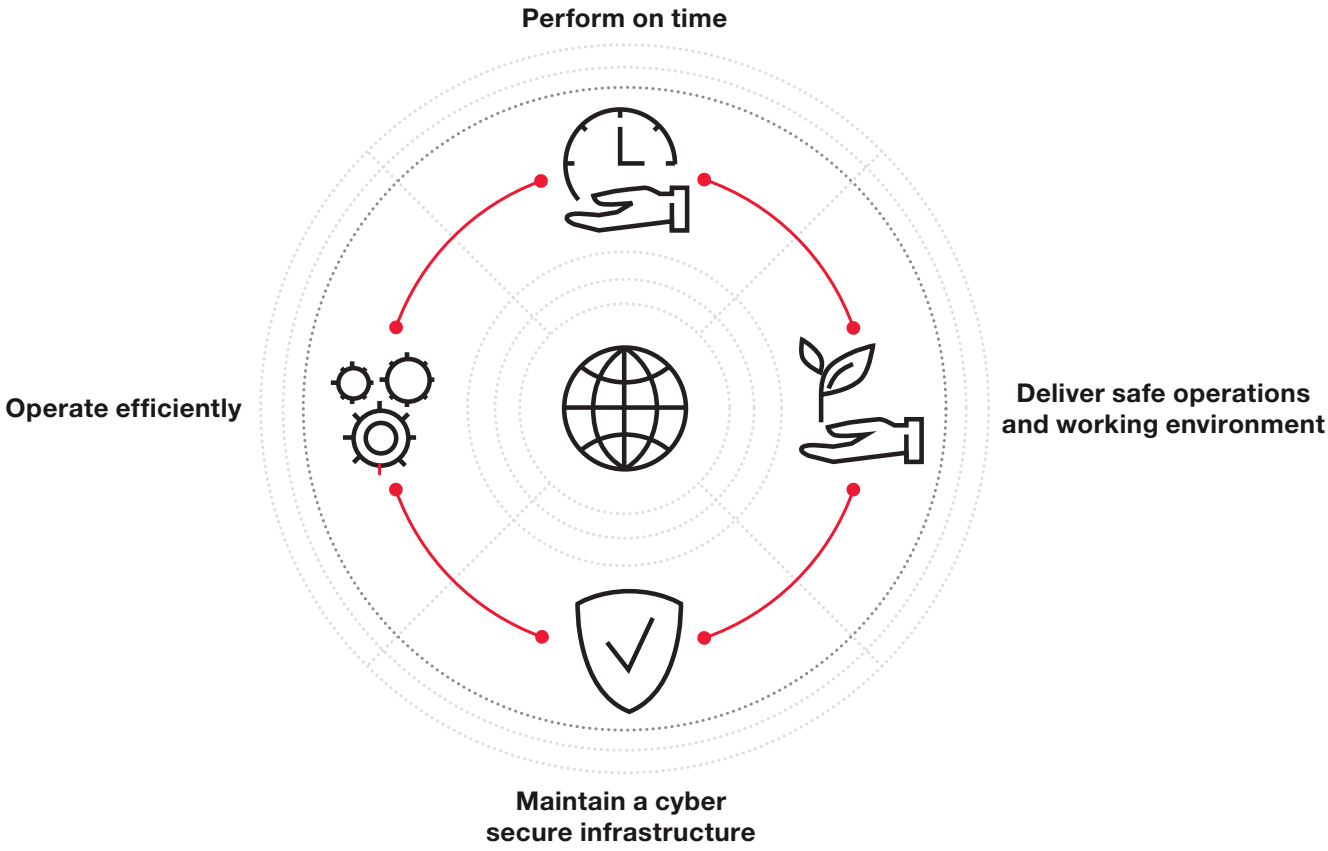
This is just one example of how stakeholders across the globe are acknowledging that railways can play a critical part in mitigating the effects of climate change, but as the world grapples with fallout from the COVID-19 pandemic, any investments in rail will be subject to increased scrutiny in terms of return on investment.

The history of railways is arguably a history of reinvention. Amid societal and macroeconomic change, the rail sector has repeatedly adapted its role and developed technology to support its evolving context.

Today, railways are grappling with the stark contrast between the lifespan of its physical assets (40+ years in some cases) and supporting software technologies that are constantly in flux. This tension is driving the next era of reinvention and is where digitalization of the industry comes in.

Hitachi Energy provides a broad portfolio encompassing a deep understanding of rail applications plus a strong focus on next generation digital solutions. This breadth of expertise will play a key role in ensuring the rail mode can fulfill its potential as a backbone of sustainable transport in the coming decades.

Digitalization plays a key role in helping rail operators continue to fulfill the pillars of their most basic mission:



To do this, rail operators need to engage with experienced application experts to combine the reality of a data-driven future with the intricacies of the rail network and its critical support infrastructure, such as electrification supplies or telecommunications. Hitachi Energy is a proven partner to rail operators around the world and works closely with them to co-create innovative solutions that accelerate their shift to digitalized operations.

1. Performing on time: the most basic customer expectation

Reliable assets are fundamental to ensuring that railways can meet their most basic aim, delivering a punctual and reliable service for their customers. Fortunately, the digital era means asset-intensive organizations like railways can monitor their assets like never before. Digitalization enables railways to rapidly move from the legacy methods of reactive and periodic intervention into a smarter future of predictive, condition-based maintenance. By anticipating failures before they occur, digital solutions help keep trains moving and meeting the most basic service expectation.

With more data and leading-edge technology available, rail system operators now have the ability to proactively improve performance and their customers' experience through digital transformation. However, most digitalization projects are retrofits and require a clear strategy based on technology and industry expertise. A trusted partner can help manage the complexity that many railway operators encounter and focus on achievable outcomes as a starting point that maps out a clear pathway to success.

Within the rail industry, digital technology is widely understood to hold the key to unlocking new levels of efficiency and safety from rail networks across the globe. This makes sense — after all, railways have decades of experience already in deploying digital control systems and in realizing the potential of automated train operation, particularly in the metro sector. For new rail projects, it is natural that cutting-edge digital asset monitoring and train control systems can be installed from the outset, but much investment covers the modernization, retro-fitting and optimization of complex and often, decades-old infrastructure.

In Europe meanwhile, Hitachi Energy is is a leader in keeping even modern rail infrastructure at the forefront of best practices in asset management. This is typified by its collaboration with UK Power Networks Services and HS1 Ltd on the 109 km high speed link between London and the Channel Tunnel. Key elements of this solution include both Hitachi Energy Lumada APM (Asset Performance Management) which connects the operational technology to the informational technology to provide advanced intelligence to optimize future performance and ensure safety as well as the deployment of MicroSCADA X, the latest power automation solution from Hitachi Energy.

2. Delivering safe operations and working environment: keeping boots off the ballast

While rail is widely accepted as the safest surface transport mode, safety must remain the bedrock of every operator, contractor and infrastructure authority. A key trend in further enhancing railway safety is the use of digital tools to minimize the need to deploy staff on the trackside itself, thereby eliminating a potential source of risk.

Hitachi Energy has worked with Australian Rail Track Corporation (ARTC) in Australia to deploy digitalized remote monitoring strategies that enhance employee and contractor workflows to deliver efficiencies in maintaining the vast and remote inter- state network. ARTC have proactively improved their compliance metrics and their productivity by moving from pen and clipboard to digital forms used for field data capture.

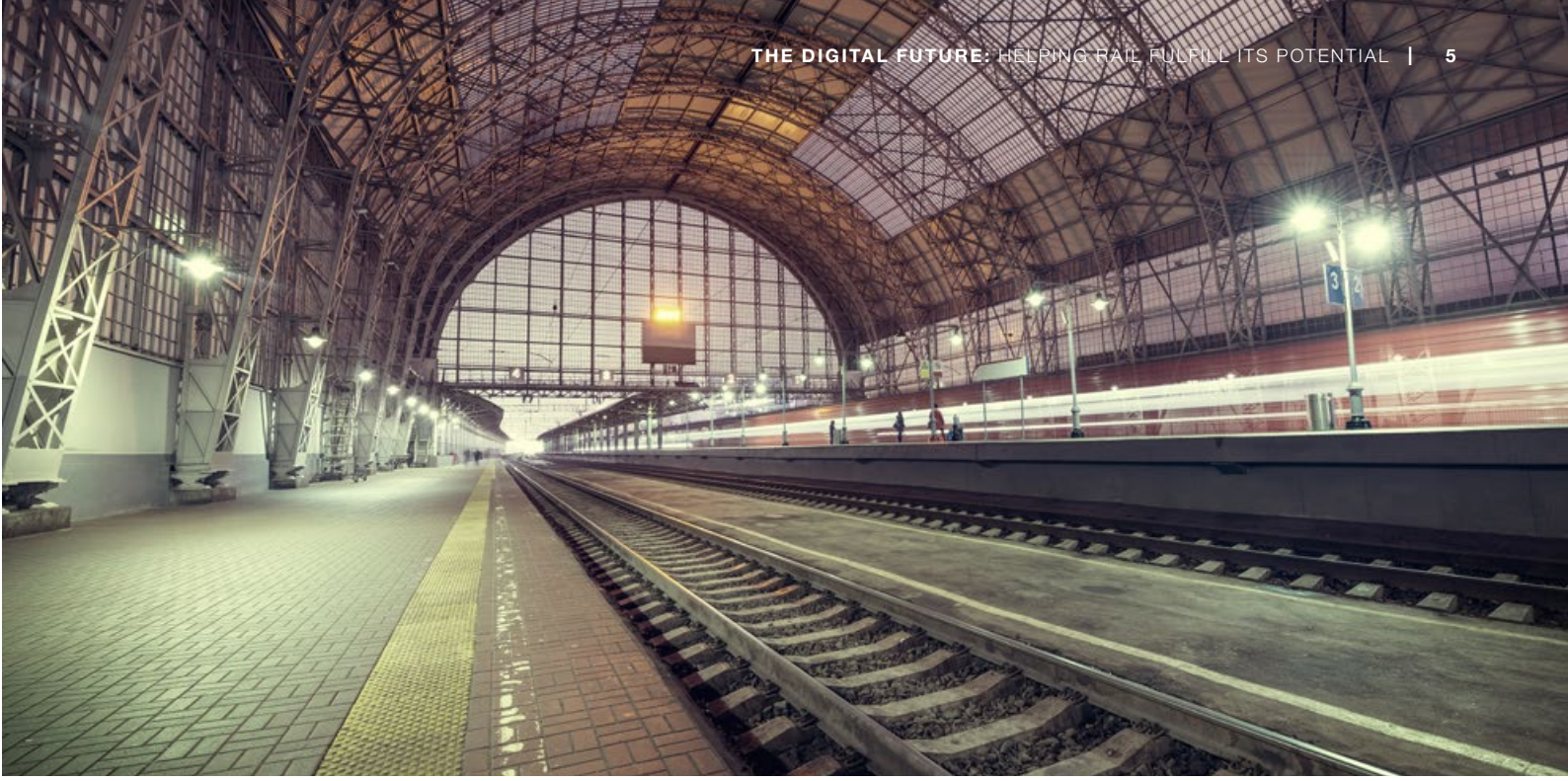
The improvements in this area were proven after Network Rail Consulting was engaged to audit ARTC maintenance standards and compliance. ARTC operates more efficiently with its new workforce management capabilities and their field crews are much less likely to be put in harm's way. Network Rail Consulting's audit report noted that "ARTC's use of the system, particularly with respect to managing defects, is world-leading."

3. Maintaining a secure infrastructure: cybersecurity is key

Railways around the world must counter digital as well as physical threats to their assets and operational locations. Cybersecurity risks are an inevitable downside of the digitalization process, and investment in state-of the-art mission-critical communications systems is essential to protect against these threats.

The tools offered by Hitachi Energy focus on providing the right communication to support the many applications in today's operating environments, including signaling, operational telecoms, or the latest generation of SCADA for traction power supplies, security access, and data services to support passenger-facing tools such as information displays or ticketing. A key advantage here is the ability to supply vital communications technology that can operate in a hybrid fashion, integrating with legacy telecoms and data networks as well as modern packet-based applications.

Reflecting this capability, Hitachi Energy is working with the Saudi Railway Company to enhance a core element of the communications network used on its North-South Railway. When complete, the mission-critical communications network of the 2750 km long mixed-traffic railway in the Kingdom of Saudi Arabia will be predominantly based on the company's fully hybrid multi- service platform, XMC20. The communication network will not only support the complete range of critical railway signaling and data communication needs, but also offer a high level of security against cyberattacks with the help of innovative quantum-safe encryption technology.



4. Operating efficiently: ensuring availability, reliability

Advanced power management and automation technology is supporting the increase of metro networks in some of the world's most rapidly growing cities. Hitachi Energy has worked extensively with the Delhi Metro Rail Corporation in the Indian capital to help support efficient energy use as its urban rail system has grown exponentially over the last decade. Hitachi Energy's technology is also being deployed across a host of other Indian cities as they expand their metro systems and are well poised as the government completes electrification of India's remaining 27,000 km of railway track by 2023. Elsewhere in Asia, the company has supplied and installed SCADA and remote terminal units (RTU) equipment to help power Bangkok's first two monorail lines. The monorails will carry up to 56,000 passengers per hour and operate for a minimum of 18 hours a day, seven days a week. Hitachi Energy is designing and supplying bulk auxiliary and traction substations, including critical power equipment and the MicroSCADA system that will control and monitor the power network for both routes. RTUs will be deployed as part of the distribution automation architecture; these units connect with the SCADA system to provide continuous real-time data so that any type of disruption that could cause power interruption can be identified and rectified quickly.

Hitachi Energy offers the rail industry a balanced technology-driven portfolio, anchored around products, systems and services and supports the wide array of challenges railways operators face. Not all are focused on physical assets – as outlined in the case studies below.

Yet in the future, it will be essential to support not just new and growing networks, but also legacy railways that are facing an increasingly complex operating environment. This could be caused by a number of factors — from a fragile national power supply grid through to aging legacy assets and the threat posed by extreme weather events. As we explore below, the installation of a first-of-its-kind digital substation on the commuter rail network operated by one of the largest public transportation companies in the USA is a case in point: This novel technology is playing a key role in aiding the railroad's recovery from the damage caused by Superstorm Sandy.

Beyond Coronavirus to Net Zero

As we look beyond the coronavirus pandemic towards the "Net Zero" emissions goals for mid-century, it is clear that rail will have a crucial role to play as a foundation of green mobility for both passengers and freight. That, in turn, will require committed investment, both in promoting new high-performance networks and in renewing and enhancing legacy railways – some of which will be more than 200 years old by 2050.

Digitalization of workflows and infrastructure will enable unprecedented levels of efficiency that will reduce workforce and operational costs, improve reliability and sustainability, preserve expert knowledge from an aging workforce and increase asset performance and maintenance.

Further, these digital insights will provide a transformational passenger and customer experience, with real-time network updates and data flows that will consolidate a preference for this mode of transport. Realizing the full potential of the rail mode in the 21st century will require an expert supply chain, experienced in a myriad of different operating environments around the world.

Wherever you are in the digital transformation journey, solutions and services must be optimized for a sustainable and efficient future. These case studies show that Hitachi Energy is a proven partner with a long legacy of innovation.

CASE STUDY 1

Field Service Management (FSM) and Enterprise Asset Management (EAM)

FSM can be leveraged to help railways operate e and optimize assets over vast areas, both physical and human. Australia's inter-state railway network, managed by ARTC, is a prime example. Hitachi Energy has had a long-standing partnership with ARTC to roll out FSM and EAM software, primarily to minimize the risk of human error during inspection and corrective maintenance across a workforce of more than 300 field maintenance staff working in some extremely remote geographical areas.

The company's Lumada FSM solution provides frontline teams with predefined workflows to standardize data and report input options, accessible with the touch of a screen on their mobile devices. "With the implementation of FSM, ARTC's mobile workers turned in their clipboards, paper and pens in exchange for tablets and phones, and they have embraced this change," reports Brian Glawson, senior project manager, asset systems at ARTC.

CASE STUDY 2

Digital substations

In the aftermath of 2012's devastating Superstorm Sandy, one of the largest regional passenger rail operators in North America, handling 270 million passenger journeys per year prior to the pandemic, saw most of the critical infrastructure at one of its most important junctions crippled by floodwater damage.

The junction was vital for the operator and served as the access point for its primary maintenance depot. The company recognized that the storm damage presented an opportunity to enhance its existing infrastructure to deliver an interoperable, reliable and future-proof traction power supply. As a result, the operator has replaced the power distribution substation with state-of-the art equipment from Hitachi Energy, including Relion RER670 intelligent electronic devices for rail applications and SAM600 merging units. This upgrade created the first IEC 61850-enabled digital substation of its kind for a major commuter railroad in the USA. The deployment also features Hitachi Energy's FOX615 solution for mission critical communication and protection of the power network.

Digital substations that communicate using the defined protocols incorporate advanced protection and control devices and modern communication technologies to drive dramatic efficiencies in monitoring, control and automation of energy systems. They can use real-time data processing from digital primary equipment to improve performance and reliability; Hitachi Energy is the global leader in this technology that is fast becoming the new standard in North American protection, control and automation systems.

CASE STUDY 3

Mission-Critical Communications

Hitachi Energy provided mission-critical communications solutions for two high-speed lines totaling approximately 500 km that opened in Europe recently. In order to digitalize and secure their communication network, an extensive and robust communications network to support the signaling system was critical, as it transported important applications such as a signaling, train-to-earth radio communications backhaul, maintenance and asset condition data, among others. The company faced a demanding specification, including very high reliability and availability requirements; high bandwidth and low latency; a long life-cycle with ongoing support; and smooth integration with the rail operator's legacy national communications network.

This latter element was especially important, and left Hitachi Energy needing to balance future-proofing without pushing to deploy unproven railway technologies. This was achieved thanks to a solution that is able to handle, on the same platform, both packet (Ethernet, IP routed) and synchronous digital hierarchy technologies that railway operators still use extensively. As part of the evolution of transport telecoms, packet-based technology will gradually replace the current time- division multiplexing-based options widely deployed in railway networks. A truly hybrid platform able to support both is essential for the smooth migration of safety-critical railway communications.

CASE STUDY 4

Protection & control

Railway protection RER670 intelligent electronic devices (IED) belong to the globally acclaimed and widely tested Relion protection and control product family. The Relion product family offers a wide range of products for the protection, control, measurement, and supervision of power systems. To ensure interoperable, reliable, and future-proof solutions, Relion products have been designed to implement the core values of the IEC 61850 standard.

With the Relion RER670, Hitachi Energy offers a single solution encompassing the entire scope of railway power including transmission, transformation and delivery. In a single device it supports single and two-phase systems in isolated, compensated or solidly earthed networks. Relion RER670 applications include protection, control and monitoring of AT and BT catenary systems, single and double phase power transformers, single and double phase transmission lines, and incorporate control and communication functionality based on IEC 61850 edition 2.

The Swedish Transportation Authority (Trafikverket) has signed a two-year extendable framework contract with Hitachi Energy to supply Relion RER670 intelligent electronic devices for transformer and line distance protection for close to 50 stations across the country.

Similarly, Swiss Federal Railways (SBB) has signed a five-year framework contract for the RER670 product for transformer protection and line distance protection.

CASE STUDY 5

MicroSCADA

Väylävirasto manages Finland's 5962-km main line network of which 3330 km is electrified. It has been a long-standing customer of Hitachi Energy, equipping its electrification assets with a? MicroSCADA system and RTU560 units to monitor and control the power supply. More recently, the infrastructure manager was looking for a contract to cover any faults that might occur, and the routine, preventive maintenance of the system to minimize the risk of failure. In response, Hitachi Energy provided the necessary monitoring and control equipment, but complemented the hardware with a deep understanding of the harsh climactic conditions faced on the Finnish network, where the winter temperature can drop to -35°C.

Väylävirasto was looking for a cost-effective solution that would meet the challenge of ensuring reliable monitoring and control of its power system. Hiitachi ABB Power Grids was able to provide that solution, including a service level agreement on the critical MicroSCADA system. As well as fixing faults, Hitachi Energy will carry out regular audits of the equipment, guide engineers in predictive maintenance programs, and advise Väylävirasto on the best way to keep the network functioning at optimal efficiency.

Hitachi Energy
marketing-update@hitachienergy.com
hitachienergy.com

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