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TABLE OF CONTENTS

FOREWORD

Rail is no longer just a mode of transport — it is a catalyst for economic resilience, regional integration, and sustainable growth. As governments and industries confront climate commitments, supply-chain fragility, rapid urbanisation, and shifting trade patterns, the role of rail has never been more critical. Across passenger and freight networks, rail is increasingly becoming the backbone of a cleaner, faster, and more interconnected global transport system.

The Global Rail Transport Infrastructure Exhibition & Conference (GRTIEC) 2025 demonstrated this momentum clearly. Convened at a pivotal moment for the sector, the event brought together a record global audience of decision-makers shaping the future of rail.

- 11,600+ attendees from 100+ countries
- 200+ speakers across the Strategic and Technical Conferences
- 20+ ministerial and government delegations
- A sold-out exhibition floor showcasing next-generation rail, mobility, and infrastructure solutions

At the heart of GRTIEC 2025, the Strategic Conference focused on the imperatives defining the next era of rail development. Discussions explored how artificial intelligence and digital tools are transforming design, construction, and operations; how high-speed rail is redefining long-distance mobility; how capital discipline and delivery excellence unlock value; and how integrated, multimodal logistics networks position rail at the centre of global supply chains. Across regions and markets, one message was clear: success will depend not only on investment, but on collaboration, governance, and execution.

This report, produced with the support of our Knowledge Partner, McKinsey & Company, distils the essential insights shaping the global rail agenda. It highlights six priority themes — from accelerating AI adoption to enabling end-to-end supply chain integration — that together define a clear path forward for policymakers and industry leaders.

As rail networks expand and modernise worldwide, the opportunity is substantial. By aligning policy, capital, and innovation — and by treating rail as a strategic national asset — decision-makers can build infrastructure that delivers lasting economic, environmental, and societal value.

Global Rail Team
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A STRONG FOUNDATION FOR THE FUTURE

Rail infrastructure and services have had a profound effect on society and will continue to do so as cities and regions evolve to meet current and future needs.

Undergirding the past

Historically, rail has underpinned industrialization, trade, and urban growth around the world. For instance, in Sweden between 1860 and 1917, regions that gained access to rail saw nonagricultural incomes rise by about 120 percent cumulatively over three decades compared with similar regions without rail access. [1]

In the United States, early railroad investment significantly boosted GDP, and today, the Association of American Railroads estimates that every $1 invested in rail transportation drives $2.50 in economic activity.

New industries were birthed, thanks to rail. Railroads created or supercharged industries such as coal, communications, meatpacking, oil, steel, tourism, and real estate development—laying much of the foundation of the modern industrial economy.

Building modern railways, and modern cities

As rail embraces the digital era, its integration with other modes of transport has the potential to transform cities—and regions. Multimodal transport is a key part of future rail. Rail is becoming faster, more efficient, and more connected. For instance, high-speed rail (HSR) is transforming passenger rail, and is being used for freight, too.

[1] Erik Lindgren, Per Pettersson-Lidbom, and Björn Tyrefors, "The causal effect of transport infrastructure: Evidence from a new historical database," Research Institute of Industrial Economics, August 28, 2021.

Laying the track for the future

Around the world, rising regulatory and customer pressure to decarbonize makes rail a cost-effective solution. High-speed expansion, AI, and digital integration are transforming performance through predictive maintenance and real-time efficiency. Meanwhile, hydrogen and electrification are scaling rapidly, positioning rail as a key driver of the clean-energy transition and the backbone of a faster, smarter, and more sustainable transport system.

However, significant infrastructure investment will be required to make this future a reality. McKinsey estimates that a cumulative $106 trillion in investment will be necessary through 2040 to meet global needs for new and updated infrastructure. This projected investment varies considerably by region. Asia is expected to account for nearly two-thirds of all infrastructure spending through 2040—around $70 trillion—with significant rail development concentrated in China, India, and Southeast Asia, where demand is fuelled by rapid urbanization and industrial growth. Europe is expected to channel the bulk of its $13 trillion infrastructure spend into upgrading aging assets and accelerating decarbonization targets, including modernizing rail corridors and integrating high-speed networks. In the Americas, approximately $16 trillion is projected to be directed toward both renewal of legacy systems—such as the modernization of North America's freight backbone—and expansion of new digital and intermodal rail hubs. [2]

From foundations to future delivery

Bridging this transition from rail's historical foundations to its future role requires more than capital investment alone; it demands innovation that can be deployed at scale. This imperative was reflected at the Global Rail Transport Infrastructure Exhibition & Conference, where the Innovation Hub showcased 25 companies advancing practical solutions across digital systems, automation, smart infrastructure, and connected mobility. The focus was firmly on technologies already improving operational efficiency, safety, and environmental performance across rail networks.

This emphasis on applied innovation was reinforced through the Innovation Awards, which attracted 242 submissions and recognised solutions with clear pathways to implementation. Three awardees received AED 1 million grants to accelerate deployment, signalling how targeted funding, technology, and execution can converge to unlock productivity gains and support rail's expanding role in a decarbonising, multimodal transport system.

[2] Alastair Green, Ishaan Nangia, and Nicola Sandri, The infrastructure moment, McKinsey, September 2025.

Setting imperatives for action

There is urgency to act. If rail is to fulfil its potential as an efficient, clean, interconnected transport mode that can boost economic growth, several enabling factors need to be in place.

This report is centered around six critical themes that stakeholders can bear in mind while continuing to advance rail and the role it plays in countries around the globe. Stakeholders across the rail value chain can work toward the following imperatives:

- expanding AI to transform rail design, construction, and operations
- planning rail projects to boost regional connectivity and growth
- keeping high-speed rail fast, connected, and sustainable
- strengthening capital excellence across new and existing projects
- optimizing public–private partnerships to maximize investment and efficiency
- ensuring end-to-end integration to make rail the backbone of multimodal supply chains

INCREASING AI IN RAIL

New technological advances, AI in particular, have the power to transform how rail services are designed, built, and delivered. And adoption is already on the rise. Rail operators may need to embark on the AI journey now, if they haven't done so already, to ensure their offerings are future fit.

A late start

For years, the rail sector lagged behind other industries in digital transformation and AI adoption. While others embraced automation and smart systems, rail often relied on legacy infrastructure and processes. The European Commission's 2022 Digital Economy and Society Index (DESI) ranked transportation among the least digitally mature sectors.

Individual operators have voiced their hesitancy around adopting new digital solutions, too. Rail operators typically face adoption challenges due to limited data availability and quality, data regulatory considerations, and a lack of data standardization. [3]

> Technology will increase the efficiency of the entire model. Machine learning and AI will reduce costs and increase the speed of delivery for customers.

Aasim Siddiqui
CEO
Pakistan Intermodal Limited
Speaker at GRTIEC 2025 Strategic Conference

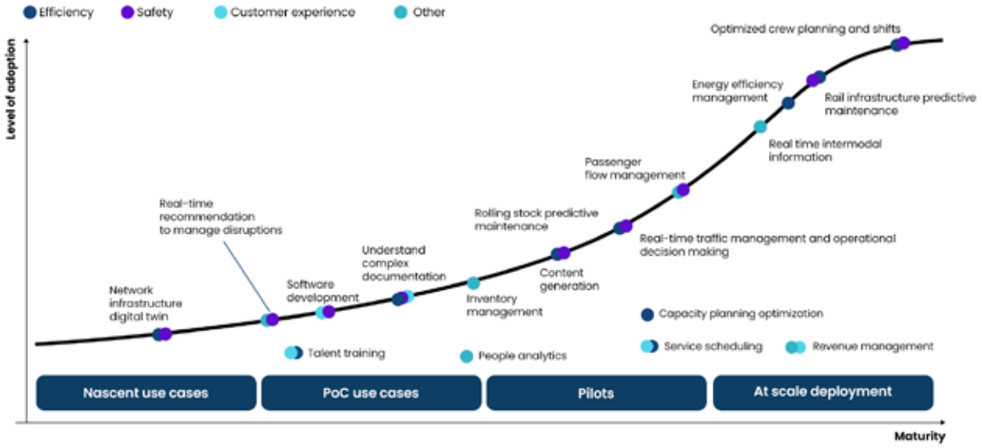
[3] The journey toward AI-enabled railway companies, a joint report by International Union of Railways (UIC) and McKinsey, February 2024.

A rapid shift

Rail may have lagged in AI adoption, but that's changing—fast. As competition for customers between transport modes intensifies, AI is no longer optional. It is becoming central to how railways operate, make decisions, and deliver value. In particular, AI may help to enhance the rail industry in three efficiency, safety, and passenger experience.

In fact, AI is already embedded in a wide range of use cases across rail. A 2023 survey of several major railways, globally, found around 20 AI use cases that were already being explored, in proof of concept, piloted, or deployed at scale.(Exhibit 1). [4]

More than 20 AI use cases being implemented in rail at varying levels of maturity.



[4] International Union of Railways (UIC) survey of 11 railway companies across Europe and Asia, and 15 interviews with railway companies and OEM vendors, worldwide, June to November 2023; The journey toward AI-enabled railway companies, a joint report by International Union of Railways (UIC) and McKinsey, February 2024.

Real-world impact

In freight rail, AI use cases tend to target business priorities that directly influence competitiveness and profitability: network reliability, asset utilization, service efficiency, and customer visibility. These factors are central to logistics customers when choosing between rail and other modes of transport, where decisions are driven by price, reliability, transit time, and capacity availability.

Joint research by McKinsey and the International Union of Railways (UIC) details several freight-relevant use cases and their reported impact. [5]

AI is transforming freight rail across multiple dimensions. Predictive maintenance has raised reliability by up to 15 percent, lowered maintenance costs by 20 percent, and reduced breakdowns by 30 percent, strengthening supply chain resilience. Driving-support systems cut fuel and electricity use by 10–15 percent through optimized acceleration, braking, and routing, as seen in VIA Rail Canada's EcoRail and similar European programs. AI also improves workforce efficiency by 10–15 percent through smarter crew and shift planning, boosts revenue by 3–8 percent via dynamic pricing, and enhances automation and multimodal connectivity through digital platforms that streamline cargo consolidation and scheduling.

[5] The journey toward AI-enabled railway companies, a joint report by International Union of Railways (UIC) and McKinsey, February 2024.

> There is a leapfrogging effect in technology … new agentic technologies are able to do much more, but operators need stability in their suppliers and processes … agile business is the way forward … being more and more agile every day.

Martin Yates
Government Technology Advisor
PreSight
GRTIEC 2025 Executive Committee Member & Speaker at the GRTIEC 2025 Strategic Conference

PLANNING RAIL FOR REGIONAL CONNECTIVITY AND ECONOMIC INTEGRATION

Rail has long been a cornerstone of regional development, and its role is becoming ever more critical as global trade continues to expand. The rate of expansion is remarkable: In 2004, global merchandise trade stood at around $9 trillion; by 2024, this figure had risen to $24 trillion. [6]

Rail's greatest strengths lie in its efficiency and sustainability. Compared with road and air transport, rail produces up to 80 percent lower carbon emissions per ton-kilometer, while offering the ability to move large volumes at competitive costs. [7]

Gaps remain, particularly in Africa, Eastern Europe, and Central and Southeast Asia, where new infrastructure and stronger governance are needed. Effective cooperation—especially through public–private leadership and customs alignment—is essential to prevent local optimization and ensure system-wide performance.

> Physical movement of goods in the GCC requires integration of networks.

Olivier Laurent
CEO
RailDirect
Speaker at GRTIEC 2025
Strategic Conference

[6] World Trade Statistical Review 2024, World Trade Organization, February 2024.
[7] "The future of rail," International Energy Agency (IEA), 2019.

Cross-border projects in motion

Cross-border rail corridors are among the most powerful drivers of trade integration, potentially enabling countries to unlock new economic opportunities by lowering transport costs, reducing transit times, and strengthening connectivity.

In the Gulf, Hafeet Rail, a project that was announced in 2023, is a joint Oman–UAE venture that will connect Sohar Port with the UAE's rail network through Al Ain. With an investment of more than $2.5 billion, the project is designed to carry both freight and passengers, enabling the efficient movement of bulk commodities and manufactured goods, while also improving labor mobility and tourism. [8] By strengthening Sohar's role as a logistics hub and directly linking Oman into the backbone of the Gulf Cooperation Council (GCC) member states, Hafeet Rail will help to reinforce the Gulf's position in global supply chains.

The GCC Railway represents the region's most ambitious transport initiative: a $240 billion, 2,100-kilometer system connecting all six GCC states. Once operational, it is expected to move 95 million tons of freight annually, significantly increasing intra-GCC trade, which today accounts for only about 10 percent of exports. [9] Beyond freight, the railway will provide a sustainable passenger alternative to regional air and road travel, supporting diversification strategies and environmental commitments.

[8] "During Global Rail 2024 His Highness Sheikh Theyab bin Mohamed bin Zayed witnessed the announcement of bank financing agreement for the Hafeet Rail network, valued at a total of USD 1.5 billion," Etihad Rail, October 2024.
[9] GCC railway progress report 2023, GCC Secretariat, 2024.

Measuring what matters

Historically, large rail projects have struggled to achieve positive internal rates of return (IRR). Yet their broader economic returns can be substantial. Rail Baltica, for example, has a negative financial net present value (NPV) but its economic NPV is estimated at approximately $31 billion due to wider benefits such as time savings, freight efficiency, and reduced carbon emissions. [10]

> One third of every ton of [construction] aggregates that come into Abu Dhabi comes from Etihad Rail. This has resulted in removing over 135,000 trucks per year, over 10 million gallons of fuel reduced, a huge reduction in CO2 emissions, a reduction in accidents, and improvements in safety all around.

Dr. Naser Al Bustami
CEO
Stevin Rock
Exhibitor & Speaker at GRTIEC 2025 Strategic Conference

[10] Rail Baltica is expected to contribute €15.5 to €23.5 billion to the GDP of the Baltic states; "Rail Baltica introduces the outcomes of the updated cost-benefit analysis," Rail Baltica, June 10, 2024.

> By broadening the evaluation lens beyond narrow financial returns, stakeholders can ensure that financing decisions reflect rail's full potential and impact. The Oman–UAE Hafeet Rail joint venture provides a clear example. As highlighted during the 2025 Global Rail Transport Infrastructure Exhibition and Conference, the project has already reached financial close with 18 banks joining forces to back its development. 'By moving freight from road to rail, [Hafeet Rail] is reducing emissions, easing congestion, and aligning with Oman's Vision 2040 and the OEE's Net Zero 2050 strategy.

Ahmed al Musawa al Hashemi
CEO
Hafeet Rail
Chairman of the GRTIEC 2025 Executive Committee
Exhibitor & Keynote Speaker at GRTIEC 2025 Strategic Conference

The value at stake

The evidence is clear. Rail is more than transport infrastructure, it is a strategic driver of competitiveness, regional integration, and sustainable growth. The value at stake is significant: For example, the World Bank estimates that improving rail corridors in Central Asia could reduce transit times by 30 to 40 percent and cut transport costs by up to 25 percent. [11] Such improvements in any region would undoubtably boost exporters' competitiveness and attract new investment along these trade routes. The dividends would extend beyond trade, too: stronger regional equity, sustainability gains from lower emissions, and enhanced resilience of supply chains

Unlocking this potential will require more than capital investment. Success depends on partnerships and governance models that align stakeholders across borders, ensuring interoperability, joint financing, and shared operating structures. These collaborative frameworks are essential to translate infrastructure into real economic outcomes.

For policymakers and investors, the imperative is threefold:

- accelerate completion of priority corridors to capture latent trade flows
- embed investment in economic return frameworks that capture full socioeconomic benefits, not just financial returns
- institutionalize cross-border collaboration through robust partnership and financing models.

[11] "Middle Trade and Transport Corridor: Policies and investments to triple freight volumes and halve travel time by 2030 ," World Bank, November 2023

SUPPORTING HIGH-SPEED RAIL

Pioneered by Japan's Shinkansen bullet train, high-speed rail (HSR) is now a global standard in fast, low-emissions transport that has the power to boost economic activity and shape cities for future needs (see sidebar, "What is high-speed rail?"). Stakeholders can work to ensure that HSR remains a faster, more connected, and greener transport mode of choice.

The pace of change

HSR has moved from flagship projects to a global backbone for fast, low-carbon intercity travel. In just the past few years, the length of operational HSR lines worldwide grew by more than 40 percent, from approximately 49,000 kilometers in 2015 to more than 65,000 kilometers in 2024, with another 16,600 kilometers currently under construction and planning. This brings the global total to roughly 81,000 kilometers across all project stages (operational, under construction, and planned). [12]

Countries around the world are planning or adopting HSR, and the Gulf region is no exception. For example, the Haramain line has created a reliable, highspeed spine between Mecca and Madinah, carrying around 7 million passengers in 2023 with 97 percent punctuality—an important regional proof point for service quality in demanding climates. [13]

> Confidential information must be treated appropriately for all players to feel comfortable to share with people who are partners in one supply chain and competitors in another.

Pablo Ruiz Del Real
Co-founder and
Managing Partner
Alhambra Infrastructure Advisor
Speaker at GRTIEC 2025
Strategic Conference

[12] "Atlas high-speed rail 2024," International Union of Railways (UIC), May 2025.
[13] "The high-speed service Mecca-Medina reaches 7 million passengers in 2023," Renfe, January 29, 2024

High-Speed Rail: Scaling Networks and Advancing Technology

At Global Rail 2025, high-speed rail was framed as a strategic lever for sustainable mobility, economic growth, and regional integration. Discussions highlighted how expanding and interoperable HSR networks — from Europe's cross-border corridors to Asia's rapidly growing systems — can reduce travel times, shift demand from air to rail, and support low-carbon transport targets. Experts underscored that success depends on coordinated investment frameworks, advanced signalling technologies, predictive maintenance, and governance mechanisms that enable seamless, cross-border operations.

Case scenarios presented at the conference demonstrated that HSR is no longer a series of flagship projects but a backbone for intercity connectivity, urban densification, and climate-aligned transport policy. Global Rail 2025 reinforced that strategic alignment across governments, operators, and technology providers is essential to scale networks effectively and unlock HSR's full potential as a catalyst for sustainable economic and social transformation.

[14] "Morocco launches $10 billion rail expansion plan," Reuters, April 24, 2025.
[15] "Thailand expects high-speed rail link to China to be ready in 2030," Reuters, January 29, 2025.
[16] "Vietnam seeking to learn from China with high-speed rail plan," Reuters, April 1, 2024.

The HSR pipeline is equally active:

- Morocco has launched a 430-kilometer HSR extension from Kenitra to Marrakesh to be completed by 2030 as part of its national rail expansion. [14]
- Thailand expects its 609-kilometer HSR link to China via Laos to open around 2030. [15]
- Vietnam is advancing a 1,545-kilometer HSR plan, aiming to develop a rail line running the length of the country. [16]

Defining the next frontier

The timing is right for HSR. Recent advances in technological capability, a surge in global infrastructure demand, substantial modernization requirements, and regulatory focus on low-emissions transportation all contribute to the opportunity for HSR construction globally. In Europe, the revised TENT regulation locks in targets for a seamless rail backbone, including higher minimum passenger speeds on core corridors by 2040 and deeper airport–rail integration. [17]

Time saved, emissions reduced

The HSR value case rests on two dimensions: reduced travel times and the sustainability imperative.

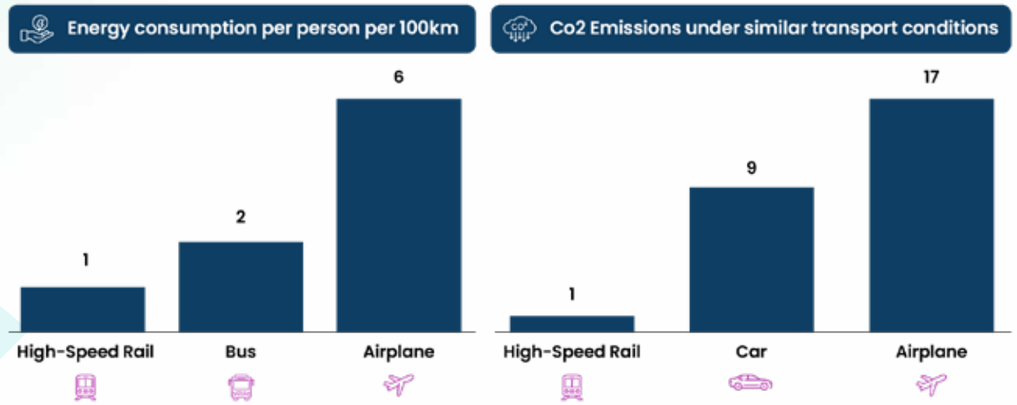
In terms of travel time, HSR shines where it shrinks endtoend time and delivers a citycenter to citycenter experience. For example, Trenitalia's Frecciarossa in Italy has become an alternative to short-haul flights between Milan and Rome, offering city-center to city-center speed and reliability.

And HSR has cost advantages, too. An evaluation of cost change due to HSR in Italy found that rails' modal share rose from 36 percent in 2008 to 74 percent in 2019, illustrating how frequency, reliability, and price can move passengers to rail decisively once the travel time advantage is locked in. [18]

[17] "Trans-European transport network (TEN-T): Council gives final green light to new regulation ensuring better and sustainable connectivity in Europe," Council of the EU, June 13, 2024.
[18] "Martina Farsi, Mario Tartaglia, and Lorenzo Vannacci, "Evaluation of external costs change due to high speed rail in Italy," Springer Nature, April 30, 2024.

The carbon case is equally strong. Rail is the least emissions-intensive passenger mode of motorized transport, where electrified rail represents more than 85 percent of passenger activity, generating no direct CO2. Additionally, rail's average emissions intensity is roughly one-fifth of air transport, on a passenger–kilometer basis, with absolute emissions from electrified rail falling further as power systems decarbonize (Exhibit 2). [19]

Carbon and energy savings make the high-speed rail sustainability case
High-speed rail performance normalized vs. alternative modes of transport



> There are very interesting technologies happening on the train side. Passenger comfort is not about leather seats, but whether they can relax and work. Connectivity on board is not easy at HSR speeds, you risk losing signal every km, but ensuring connectivity is key to passenger experience.

Léon Soulier
CEO
Siemens Mobility
Turnkey Business Unit
Exhibitor & Speaker at GRTIEC 2025 Strategic Conference

[19] "2023 Global rail sustainability report, UIC, October 2024.

Catalyst for transformation

When done well, HSR is not only a transport project; it is a platform for economic and spatial change. In China, for example, new research links HSR connectivity with gains in employment and economic development. Specifically, the study found that HSR facilitates high-quality economic development by enhancing capital and labor mobility, strengthening industrial chain resilience, and advancing industrial structure upgrading. [20]

Other industries and sectors benefit from spillover effects—for instance, HSR has a direct and positive impact on tourism. Peerreviewed analyses document higher visitor flows where rail accessibility and frequency rise, including in Italy and along French corridors. [21]
And real estate markets often follow

Taken together, the effects of HSR on existing rail networks, as well as on cities and communities, illustrate that HSR is an enabler. It is not a competitor to existing rail, but an enhancer of the rail sector, boosting modal share and ensuring a sustainable future.

Industry best practice and real-life examples highlight three considerations that executives could keep in mind and prioritize when planning HSR:

- **Anchor the case on time and carbon.**
  Prioritize corridors where HSR delivers subthreehour journeys and measurable emissions reductions. Regulators already seem to be moving in this direction, as supported by the example of the 2025 French decree.
- **Design for integration, not isolation.**
  For example, build airport and metro interfaces into the base scope; the productivity dividend sits in the interchange.
- **Resource procurement to succeed.**
  Run market engagement early, set clear risk positions, and fund the dialogue process to keep competition alive and timelines tight.

[20] "Xixi Feng, Jixiao Li, Yadan Liu, and Weidong Li, "The impact of high-speed rail on high-quality economic development: Evidence from China," MDPI, June 30, 2025.

[21] "Dante Di Matteo, "Does high-speed rail matter for tourism? Evidence from Italy," Research in Transportation Business & Management, Volume 48, June 2023; Aurelie Mercier, Nicolas Ovtracht, and Alain Bonnafous, "Analyzing impacts of a new rail line on tourist attractiveness using accessibility: The case of the Sud Europe Atlantique high-speed line," Transportation Research Procedia, Volume 82, 2025.

> Planning HSR routes and corridors is key to planning liveable housing and industrial zones.

Murathan Kalyancu
Chairman
Kalyon Group
Exhibitor & Speaker at GRTIEC 2025 Strategic Conference

FOSTERING CAPITAL EXPENDITURE EXCELLENCE

Countries need to invest in infrastructure. It is a critical enabler of long-term global economic growth and supports the creation of prosperous societies with elevated standards of living. And rail infrastructure is no exception. Capex excellence is vital for getting rail projects from planning to completion.

Investment is needed

Outdated assets, rapid urbanization, geopolitical shifts, and technological advancements are exposing the limitations of yesterday's infrastructure. McKinsey's recent infrastructure research estimates that a cumulative $106 trillion in investment will be necessary through 2040 to meet the need for new and updated infrastructure. The required investment spans seven critical infrastructure verticals, with transport and logistics requiring the largest share, at $36 trillion. In fact, the report notes that "the importance of the transportation and logistics vertical cannot be overstated." [22]

At the same time, the supply chain volatility experienced since 2020 has made the cost and schedule environment materially more difficult.

Given the pivotal role that rail can play in building and modernizing much-needed infrastructure, capex excellence—disciplined, stagegated, datadriven delivery—is not a nicetohave; it is the prerequisite for getting rail delivered on time and on budget while locking in longterm value.

> I think it goes without saying that infrastructure and economic growth and prosperity are intertwined.

H.E. Bilal Azhar Kayani
Minister of State for Finance and Railways and Head of the Prime Minister's Delivery Unit
Pakistan
Speaker at GRTIEC 2025 Strategic Conference

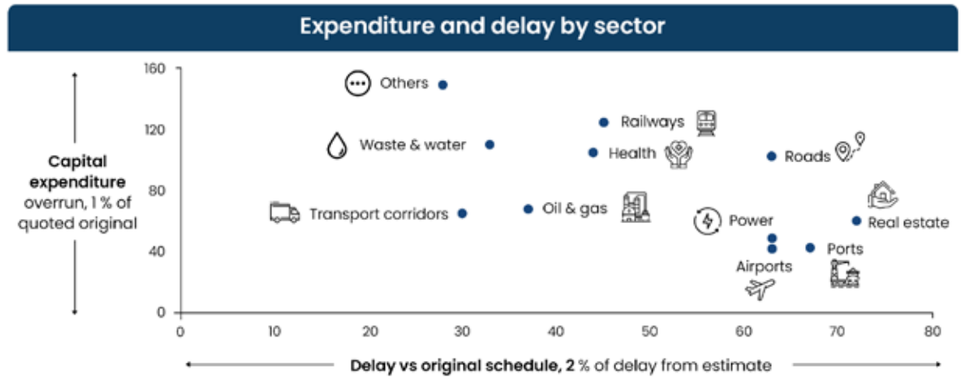
[22] "Alastair Green, Ishaan Nangia, and Nicola Sandri, The infrastructure moment, McKinsey, September 2025

The overrun challenge

Megaprojects often overrun—typically driven by scope creep, inaccurate demand forecasting, and underestimated geotechnical complexities. Such delays can be compounded by fragmented contracting structures and inadequate risk allocation.

Rail megaprojects are no exception. Based on McKinsey analysis of 442 projects completed between 2000 and 2022, rail capex projects, on average, overrun by 47 percent in duration and exceed the originally estimated capex by 36 percent. Frequent demand shortfalls on top of these cost overruns can turn thin investment cases into negative value unless they are actively derisked (Exhibit 3).

Capital project delivery is consistently late and over budget.



Land acquisition, planning and permitting, cross-border regulatory engagement, environmental concerns and utility diversion, terrain complexity, and the introduction of advanced complex technologies such as HSR magnetic rail can all add complexities and risk to rail capital projects. And multistakeholder management can exacerbate the situation, too. Taken together, these challenges highlight the need for rigorous governance from day one, where forecasts are refined and validated at each step, and stakeholder expectations are continually managed.

Key success factors across project stages

Ensuring capital excellence and efficient spend, in spite of various pressures, requires the careful implementation and management of key success factors across multiple stages.

Early stage: Decision quality and debiasing.

Thorough business case testing and demand validation are crucial to prevent optimism bias and scope misalignment. Success depends on a robust front end that integrates ridership or freight forecasts with life cycle costs and capital spend, recognizing the distinct drivers of each.

Ideally, the business case could be tested and retested through what McKinsey describes as decision gates with "teeth." In other words, the gates only allow capital to be allocated to cases that withstand independent challenge. [23] While this often looks like a go/no-go evaluation, practically, projects can be adapted to meet business case and demand criteria instead of being rejected outright. This type of stage-gate process is designed to systematically uncover and eliminate project risks and develop an increasing level of certainty on the project cost, schedule, and financial value. It also helps identify areas where focused optimization initiatives can boost project value. [24]

Similarly, adjusting for bias is in keeping with industry best practice. Appraisers can apply empirically based optimismbias adjustments to costs, benefits, and durations until robust, projectspecific evidence justifies reductions.

At this stage, frontend planning (FEP) pays for itself. Decades of Construction Industry Institute (CII) research finds that wellperformed FEP improves capital costs by approximately 10 percent, on average, and reduces schedule overruns by around 7 percent compared to poorly planned projects. This approach can also cut rework by up to 5 percent. [25]

Approvals depend on credible projections of ridership, freight volumes, and long-term economic benefit. Stage-gated discipline means acknowledging that early forecasts are less precise, but the approach allows for committing to refine them as new information emerges. Transparent communication of these refinements builds stakeholder alignment and prevents optimism bias from embedding itself into budgets and timelines.

Mid and late stage:

In the mid and late stages of delivery, value engineering, process planning, and supply chain resilience are vital to align design ambition with budget and schedule. Value engineering uses evidence-based redesign to maximize whole-life value—not just cut costs—by linking scope, constructability, and maintainability to reduce rework and lock in performance early. Standardization and independent review further improve outcomes. Process planning connects schedules, access strategies, and design through continuous risk analysis and live telemetry, helping prevent delays and enabling timely corrections.

[23] "Make milestones matter with 'decision gates'—stage gates with real teeth," McKinsey, June 20, 2017
[24] "Control capital project duration—and cost—with schedule optimization," McKinsey, June 19, 2020.
[25] "Front-end planning: Break the rules, pay the price," Construction Industry Institute, November 1, 2006; "Front-end planning: Your key to a successful project," Construction Industry Institute, July 1, 2014.

Rewiring thecapital operating system where it matters most

Industry best practice reveals several steps that rail stakeholders can take to rewire the capital organization, its capabilities, and its culture to pursue capex excellence.

> Global Rail 2025 serves as a vital platform for bringing together rail ecosystem partners, driving improvements in efficiency, resilience, sustainability, and profitability in our interconnected world. The agreements announced during the conference highlight the sector's commitment to embracing the transformative power of partnership and reflect the UAE's emerging leadership in global transportation as a hub where ideas are not only created but realised to deliver lasting impact.
>
> **His Excellency Shadi Malak**
> CEO
> Etihad Rail
> Exhibitor & Speaker at GRTIEC 2025
> Strategic Conference

Organization: Who leads, who integrates, and how the model scales

An effective capital organization requires clear ownership of outcomes and defined interfaces. Sponsors should drive benefit delivery, while an empowered integrator coordinates disciplines and suppliers across the life cycle. The structure should match the portfolio's size, asset commonality, and geography: centralized models leverage shared standards and scale; hybrid models combine central expertise with decentralized execution; and decentralized models give business units full delivery control, with the center focused on oversight.

Across all delivery models, three practices consistently drive success: integrating project teams early around shared goals, using independent review to test plans before they harden, and embedding transparency with a single source of truth for decisions. Centers of excellence further strengthen consistency by providing expertise in procurement, project controls, engineering, portfolio management, and sustainability. These centers can set standards, coach delivery teams, and step in when issues threaten value.

The organization should also reflect contracting strategy. Staffing levels and the mix of competencies should flex over time, peaking during execution and tapering through completion.

OPTIMIZING PUBLIC–PRIVATE PARTNERSHIPS IN RAIL INFRASTRUCTURE

Global infrastructure needs are surging, while public balance sheets are tight. Public–private partnership structures can allow public authorities to stretch limited budgets further while leveraging private sector efficiency and innovation, ensuring more kilometers of infrastructure for government funds. Getting these structures right leads to greater chances of success.

Sharing the risk, building the future: What public–private partnerships can (and cannot) do

Well-structured public–private partnerships (PPPs) can stretch budgets, bring expertise, and improve risk allocation but should be used selectively. They create the most value when unlocking capabilities or financing the public sector cannot provide efficiently. Availability-payment contracts align incentives with long-term reliability, while private partners contribute systems integration, maintenance expertise, and financing where user revenues fall short. However, when governments have low borrowing costs or tight timelines, public financing may be faster and cheaper. PPPs work best when they deliver skills or capital that the public sector lacks.

There is a variety of PPP models, and they vary substantially in the cost to the government, the responsibilities borne by each party, the expected IRR for the private sector, and crucially, in the nature of the risk borne by contract participants compared to the public sector (Exhibit 3).

Roles and responsibilities vary across different PPP models.

Public sector / Private sector	PPP model				
Responsibilities	Privatized	DBOM net contract	DBOM gross contract	OM net contract	OM gross contract
Define regulation and policy	Public	Public	Public	Public	Public
Set prices	Private	Private	Public	Private	Public
Design and construct PT	Private	Private	Private	Public	Public
Operate and maintain	Private	Private	Private	Private	Private
Collect revenue	Private	Private	Public	Private	Public
Example	Hong Kong Tramways	Sao Paolo Metro	Melbourne Metro	UK buses in rural areas	Sydney BRT

Increased risk on public sector

One comprehensive PPP model, design, build, operate, finance, and maintain (DBFOM) relies on the private entity handling all phases of the project, from initial design to ongoing operations and financing.

First, public capital typically funds the infrastructure (civil works) majority—often around twothirds or more of total capex—because tunnels, stations, and shafts dominate hard costs and are best financed at sovereign rates. The private partner then focuses financing on systems, rolling stock and, in some cases, station fitout and amenities.

Several examples illustrate this financing split. Dublin's MetroLink separates the large civils public package from an availabilitybased M500 DBFOM for systems and operations. [26] Rollingstock financing via PPP has also been used in Europe, for instance, the European Investment Bank (EIB) together with the German affiliate of UniCredit provided credit to Deutsche Bahn to procure 90 new trains for the Munich SBahn. [27]

Second, revenue demand risk typically remains with government under milestone and availabilitypayment regimes; the private partner is paid for asset availability and performance, not ridership. This approach was followed for the Silvertown Tunnel in London where traffic volume risk remained with the authority, while the private partner carried the construction and completion risk (or both). [28]

Advancing PPPs Through Strategic Finance Dialogue

Global Rail 2025's Finance Pavilion showcased how effective public–private partnerships can be structured and financed to deliver large-scale rail projects. Bringing together senior leaders from major banks and investment institutions, the Pavilion highlighted innovative approaches to risk sharing, availability-payment models, and blended financing — all central to optimizing PPP outcomes.

These discussions reinforced the conference's broader dialogue on how rail authorities and private partners can collaborate more effectively, aligning capital, expertise, and operational responsibilities.Insights shared at the Pavilion directly informed strategies for structuring PPPs that unlock private investment, accelerate delivery, and ensure long-term sustainability, illustrating how Global Rail is shaping the practical evolution of financing models for rail infrastructure.

[26] "Automated metro engineering: Dublin MetroLink advances with international consortium bid," Born to Engineer, September 16, 2025.
[27] "EIB and UniCredit finance new Munich S-Bahn trains," Post Online Media, August 3, 2023.
[28] "Lessons learned: Private finance for infrastructure," National Audit Office, March 25, 2025.

Commercialization mechanisms

For cases where PPPs are viable, incentive mechanisms and commercialization strategies will differ depending on whether the project is rural or urban, and whether it focuses on freight or passenger mobility. Where dense, urban, and passengerheavy corridors are in play, transitoriented development (ToD) can increase value—both in a fully public option and a PPP option.

Hong Kong's MTR is a successful example of ToD, with a unique model based on twin success factors of a high farebox recovery ratio and non-farebox revenue. Nonfarebox income from property development and station commercial activities materially supports the economics of the network and city livability. In its 2024 results, MTR reported a net profit of HK $15.8 billion (around $2 billon), primarily driven by property development bookings, and 2023 property rental revenue exceeding HK $5 billion (roughly $640 million)—underscoring the weight of nonfare revenues in its success. [29]

[29] "MTR Corporation posts 2024 results," MTR, March 6, 2025.

Conditions for success

Stakeholders considering PPPs could bear the following success factors and best practices in mind.

- Choose PPPs deliberately, not by default. Typically, PPPs are most veffective when the asset is large, separable, and stable, and when the public sponsor can run an efficient, competitive procurement and then manage the contract for decades to come.
- Plan the procurement calendar—realistically. A review of international case studies shows that PPP tendering periods are lengthy and vary by sector and deal size. Therefore, it would be helpful for authorities to stage the work—spanning premarket engagement, data analysis, approvals, and stakeholder interactions—and resource it heavily.
- Put supplyside realities at the center. Early market engagement, longlead item strategies (rolling stock, power, signaling), and certification pathways are best agreed before.
- Keep baseline information updated. Geotechnical issues or utilities act as examples. Competitive dialogue works best when data rooms are complete, otherwise bidders may face price uncertainty or walk.

ENSURING END-TO-END SUPPLY CHAIN INTEGRATION

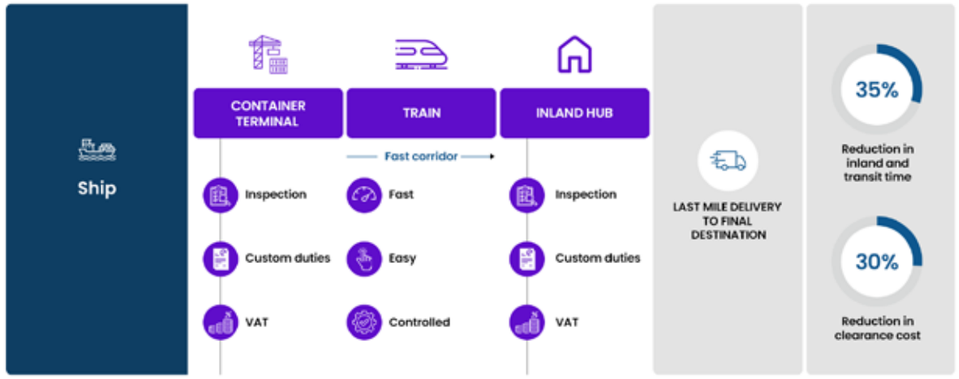
The global economy runs on supply chains that must be both fast and resilient, making seamless interconnectivity essential. Rail has a pivotal role to play.

From nice to have to must-have

Global supply chains are under more pressure than ever. Disruptions have multiplied—from geopolitical conflicts and trade wars to pandemics and natural disasters—and leaders are recalibrating. To illustrate, in McKinsey's 2023 Supply Chain Risk Pulse Survey, 95 percent of supply chain leaders reported major supply chain network challenges in the past year. To overcome this, many prioritized visibility: Nearly eight in ten implemented dashboards that provide end-to-end transparency across their supply chains. [30]

Integrated port–rail corridors show how synchronizing infrastructure and processes reduces costs and improves resilience (Exhibit 4).

Integrated port—rail corridors can reduce time and cost.



[30] "McKinsey Supply Chain Pulse Survey, April–May 2023, n=101.

Innovation at the core

Technology is reshaping rail's role in end-to-end logistics. Historically optimized for long-haul, heavy freight, rail is now becoming competitive on shorter routes and lighter loads because the cost and time penalties of intermodal transitions are falling away.

Collectively, these advances lower the friction of switching modes—reducing cost and cutting time loss—and expand rail's relevance into supply chains once dominated by trucks. As robotics, AI, IoT, and blockchain continue to mature, rail is best placed to be positioned not just as the backbone of long-haul freight but as the digital anchor of end-to-end, multimodal logistics networks.

Case studies in integration

The logic of integration is seen clearest in practice. Across continents, railways and logistics providers are building end-to-end ecosystems that deliver more than the sum of their parts. The following examples highlight the advantages.

Jebel Ali Port and Etihad Rail. The direct rail links from Jebel Ali's container terminals, combined with digital cargo systems, are designed to reduce truck dependence. The port currently handles over 15 million TEUs annually, and each freight train is expected to remove up to 300 trucks from roads. By cutting CO_2 emissions by up to 80 percent compared to road transport, Etihad Rail aligns with the UAE's Net Zero 2050 objectives. The system is expected to slash transport-related CO_2 emissions in the UAE by 21 percent annually. [31]

Why rail is central

Rail's role in supply chains lies not in competing with other modes but in providing the backbone of seamless connectivity. By linking ports, terminals, and production centers, it enables smooth, high-capacity flows across modes.

Operators are evolving from carriers to orchestrators—expanding intermodal hubs, partnering with ports and logistics providers, and using digital platforms to cut friction at transfer points.

Ultimately, rail delivers more than efficiency or lower emissions; it anchors end-to-end supply chain resilience in a world reshaping networks for greater stability.

[31] "Etihad Rail transforms UAE logistics for sustainable growth," Sustainability Magazine, August 5, 2025.

WHAT'S TO COME: PRIORITIES AND NEXT STEPS

Innovation, AI, regional connectivity, and sustainability are no longer emerging themes—they are the defining forces reshaping global rail. Together, they signal that the rail sector is moving from incremental upgrades to systemic transformation.

Rail's proven value

This report highlights rail's vital role in addressing global challenges—cutting emissions, easing congestion, strengthening trade and supply chains, and supporting economic diversification. Investments in rail infrastructure deliver wide socioeconomic benefits, from GDP growth and job creation to more livable, better-connected cities.

High-speed and cross-border projects will be central to shaping future mobility and regional development, but realizing their full value will depend on strong coordination, collaboration, and disciplined capital execution.

Priorities for the future

For rail to reach its full potential, stakeholders across the rail value chain can focus on three priorities for the coming decade:

- **greater innovation**, for example, through deploying AI, automation, and green technologies at scale
- **increased** , particularly in aligning on public–private models and cross-border integration
- **sustainable growth**, by ensuring investments deliver long-term economic and environmental returns

With these priorities as guiding principles for decision-making, rail can remain the backbone of global trade and a driver of economic growth and development.

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