

UNDER THE PATRONAGE OF HIS HIGHNESS SHEIKH MANSOUR BIN ZAYED AL NAHYAN,
VICE PRESIDENT, DEPUTY PRIME MINISTER, AND CHAIRMAN OF THE PRESIDENTIAL COURT



GlobalRail

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2024 STRATEGIC CONFERENCE REPORT

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Foreword

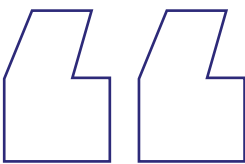
“Rail offers a sustainable, seamless, and smart means of addressing climate, economic, and mobility challenges.”

In an age where urbanisation, climate change, and population growth are challenging the way we think about the movement of people and goods, sustainable and innovative solutions are imperative. To address this pressing need, the Global Rail Transport Infrastructure Exhibition and Conference (Global Rail) 2024, held under the patronage of His Highness Sheikh Mansour Bin Zayed Al Nahyan, Vice President, Deputy Prime Minister, and Chairman of the Presidential Court, has emerged as a landmark event for the mobility sector.

With than 162 speakers over three impactful days, our shared mission was clear: To foster integrated transport, stimulate economic growth, and drive investment towards sustainable mobility. As H.H. Sheikh Theyab bin Mohamed bin Zayed Al Nahyan, Chairman of Etihad Rail, aptly put it, “Purposeful investment drives robust infrastructure for future generations.”

This report shares key trends and insights from the Strategic Conference at Global Rail 2024. Experts, including policymakers, network operators, transport authorities, financiers, technology pioneers, developers, and OEMs, led discussions around unlocking rail’s potential for community, climate, and economic transformation through global collaboration, innovative policies, and digital advancement.

Under the theme “Setting Transport Infrastructure and Global Connectivity in Motion”, keynote speakers, including His Excellency Jasem Mohamed AlBudaiwi, Secretary General of the Cooperation Council for the Arab States of the Gulf, and His Excellency Óscar Puente, Spain’s Minister of Transport and Sustainable Mobility, highlighted rail’s transformative power. Panel discussions explored infrastructure resilience and AI applications in future transport networks, while fireside chats delved into hydrogen and battery fleets and generative AI’s place in the ecosystem.



"Currently, the Middle East is witnessing a remarkable boom in the rail sector, encompassing both conventional railways and metro systems. PwC is proud to be at the heart of this transformation, working hand in hand with rail companies to help them achieve their ambitious goals and drive sustainable growth across the region. Together, we are shaping the future of mobility."



Alexander Kondrat
PwC T&L Middle East
Rail Team Lead

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Executive summary

The Strategic Conference at Global Rail 2024 brought 162 key industry leaders and policymakers to explore the future of rail transport and its impact on global connectivity. Focusing on sustainability, technological innovation, and cross-border integration, the event emphasised the need for rail systems to adapt to rising demand for both passenger and freight services. The 43+ discussions covered digitisation, green technologies, automated operations, and challenges like financing and regulatory hurdles, highlighting rail's role in driving economic growth and sustainability. This report summarises the nine key themes shaping the future of rail, including emerging opportunities and challenges.

- Government and policymaking:**
Governments shape the future of rail by setting regulatory standards, providing funding, and leading infrastructure planning to ensure safety, sustainability, and economic growth in rail networks. Policy plays a vital role in guiding the development of rail systems.
- Strategy, planning, and operations:**
Strategic planning is critical for aligning rail projects with future demands, economic conditions, and technological advancements. Operational efficiency hinges on capacity management, maintenance scheduling, and maximising both passenger and freight services.
- Infrastructure, construction, and engineering:**
Rail infrastructure development depends on engineering innovation and sustainable construction practices. Modular construction, automated building techniques, and smart infrastructure are being adopted to enhance project efficiency and reduce environmental impacts.
- High-speed rail:**
Development of high-speed rail is essential for modernising passenger and cargo transportation, offering faster, more reliable, and sustainable alternatives to road and air travel. It reduces travel time, lowers carbon emissions, alleviates road congestion, and integrates seamlessly with existing transport networks. It promotes energy efficiency, enhanced safety, regional connectivity, and economic growth, while supporting the rapid and secure movement of goods and people.
- Finance and governance:**
Securing funding and ensuring effective governance are key challenges for large rail projects. Public-Private Partnerships (PPPs) and innovative financing help address high upfront costs and long payback periods. Transparency and aligning investor and public interests are also critical for success.
- Customer experience:**
Improving customer experience is key for both passenger and freight services. The adoption of digital ticketing, real-time tracking, and personalised services enhances convenience and satisfaction. In freight, real-time tracking improves transparency and reliability for cargo owners.
- Technology:**
Advancements such as AI analytics, automation, and cybersecurity are transforming rail systems, boosting safety and efficiency. However, integrating these into existing infrastructure and ensuring cybersecurity remain operational challenges.
- Legal and regulatory frameworks:**
Navigating the complex legal and regulatory landscape is critical for ensuring rail safety, compliance, and cross-border operability. Regulatory standardisation across countries is particularly important for international rail systems.
- Sustainability and the environment:**
Integrating green energy sources, like solar power and electrification, into rail infrastructure to reduce reliance on fossil fuels is gaining traction in the region. Several new projects have a major sustainability component, aligning with individual countries' decarbonisation goals.



Introduction and overview

The inaugural Global Rail was held in Abu Dhabi from 8-10 October 2024, hosted by Etihad Rail. This landmark event brought together key industry leaders, government officials, and technology innovators from around the world to discuss and showcase advancements in rail infrastructure, sustainability, and multimodal transport solutions.

Inspired by the opportunity to significantly advance their transport and logistics agendas, various Middle Eastern countries have recently intensified their railway infrastructure development efforts, including the UAE (Etihad Rail and Hafeet Rail), Saudi Arabia (Landbridge, North-South), and Oman (Oman Rail, Hafeet Rail), in addition to cross-border projects such as the GCC Railway. Governments are pursuing ambitious projects, committed to increasing the modal share of rail in freight and passenger transport. Railways offer an environmentally friendly and reliable means of transportation, both domestically and across borders, and can accelerate economic development.

Railways will connect the region, enabling the transportation of millions of tons of goods and the mobility of thousands of citizens. However, as countries build their national networks, they must also consider how to connect rail systems across borders to create an integrated regional network. This integration begins with connecting tracks but goes far beyond that, requiring the establishment of an efficient and reliable rail ecosystem to unlock the full potential of this mode of transport. Building such a system poses several challenges, from regulatory alignment to technical interoperability.

Global Rail 2024 focused on the future of rail transport in the Middle East and beyond, highlighting the region's pivotal role in connecting global trade routes. Participants engaged in discussions about sustainability, digitalisation, and the integration of rail networks with other transport modes like road, sea, and air to create seamless logistics ecosystems. With over 100 exhibitors and a series of high-level agreements signed, the event emphasised the importance of collaboration in developing smart, eco-friendly, and resilient rail systems.

The event served as a strategic platform to drive investments in rail projects, showcasing how rail transport can lead the way in fostering economic growth, improving connectivity, and addressing environmental challenges in the global mobility sector.



Key insights:

a) Government and Policymaking

“Establishing financial feasibility and effective institutional resources is critical to the successful implementation of railway projects.”

– H.E. Mothanna Gharaibeh, Minister of Investment, Jordan

Government and policymakers set and enforce regulatory standards, provide funding, and ensure compliance to support safe, sustainable, and efficient rail systems.

This year’s rail conference highlighted how governments and policymakers can drive the future of rail by collaborating with the private sector, financing infrastructure, and developing regulatory frameworks to facilitate the cross-border movement of passenger and cargo.

1. Public-private sector collaboration:

Collaboration between the public and private sectors is vital for the successful implementation of rail projects. As seen in initiatives like the Elizabeth Line in London, private sector support can drive innovation and effective project delivery. The involvement of private investors in the Sydney Metro project underscores the importance of public-private collaboration in achieving successful outcomes.

2. Investment in rail infrastructure:

Substantial investment in rail infrastructure and rolling stock is critical for a sustainable transport system. Underinvestment in Europe has led to significant challenges, underscoring the need for proactive planning and investment in the GCC region. The EU’s Connecting Europe Facility (CEF) has been pivotal in addressing funding gaps and enhancing rail infrastructure across member states.

3. Regulatory frameworks:

Effective regulatory frameworks are essential for fostering innovation and ensuring fair competition. Harmonising regulations across multiple regions prevents operational disruptions and supports the development and implementation of advanced technologies. The European Union Agency for Railways (ERA) has been instrumental in harmonising rail regulations across the EU, facilitating smoother cross-border operations.

Challenges

• Regulatory alignment and standardisation:

Countries must overcome the lack of uniform regulations and standards that can hinder cross-border rail connectivity, especially in areas like safety protocols, operational procedures, crossing cross-border asset management and technical specifications.

• Funding and investment:

Securing long-term financing for large-scale rail projects is a significant challenge, requiring public-private partnerships and sustainable financial models to maintain and expand rail networks.

Way forward

Governments and policymakers are central to the development of efficient and sustainable rail systems, and a strategic way forward requires a multifaceted approach that addresses existing challenges while leveraging opportunities for growth. Public-Private Partnerships (PPPs) are a cornerstone of successful rail infrastructure projects. Governments should establish clear PPP frameworks that define roles, responsibilities, and accountability measures to attract private investment.

Investment-intensive projects are being developed in the region, opening opportunities for various construction, rolling stock, ticketing, train systems, operations, and maintenance players. Some of the most significant projects include GCC Rail (~US\$250bn), Riyadh Metro (~US\$25bn), Saudi Landbridge (US\$7bn), and Bahrain Metro (~US\$2bn). With reliance away from oil-based economies, new funding options for these projects are being explored. Multilateral agencies and sovereign wealth funds are expected to take up a larger role going forward.

Further, rail operations require a cross-border **regulatory framework** to standardise technical requirements, streamline customs procedures, and ensure security compliance. In addition, cross-border rail operations expose rolling stock owners and financiers to risks like confiscation and expropriation, making asset protection a critical business need for their owners. For example, the Luxembourg Rail Protocol, developed under the Cape Town Convention, can be considered because it addresses the business need mentioned above by establishing an international legal framework that safeguards ownership and financial interests. It allows rolling stock to be registered in a global registry, ensuring ownership rights are recognised across jurisdictions. This protocol reduces financial risk, encourages cross-border rail investments, and supports the growth of international rail networks.

The region’s largest rail infrastructure project, **GCC Rail**, will connect all six countries through a single line, making passenger and goods transport easier. In line with this, the UAE and Saudi Arabia are working on policies that streamline customs and immigration processes, allowing for quicker clearance of goods and passengers. Standardising rail specifications and safety regulations across the GCC is critical for the success of such projects.



Key Insights:

b) Strategy, planning, and operations

“Focusing on operational efficiency alongside construction costs is essential to maximise long-term benefits. Failing to optimise undermines future gains.”
– **Alaa AbuSiam, CEO of Egis for the Middle East and South Asia**

A well-defined strategy sets long-term goals and aligns investments with demand while planning ensures rail systems integrate with other transport modes and future capacity needs. Effective operations optimise schedules, maintain infrastructure, and ensure safety, driving performance and passenger satisfaction. Several emerging trends in strategy, planning, and operations are shaping the future of rail transport:

1. Strategy and planning:

Emerging trends in railway strategy highlight the growing importance of consulting in operations. Firms are increasingly collaborating with experts to adapt to industry demands. This adaptive approach includes hiring and upskilling talent while integrating specialised skills through multidisciplinary consulting. A notable example is the London North Eastern Railway, which enhanced its operational strategies by engaging digital ticketing experts, resulting in a 15% increase in ticket sales.

2. Partnerships and innovation:

Forming strategic partnerships has become a cornerstone of innovation in the railway sector. Collaboration with specialised entities not only enhances operational capabilities but also creates an environment that encourages creative thinking and experimentation. The partnership between Hitachi Rail and Trenitalia on the Frecciarossa 1000 high-speed train project exemplifies how strategic alliances can drive technological advancements, demonstrating the vital role of innovation in adapting to industry challenges.

3. Multimodal integration:

The integration of railways with other modes of transport is pivotal for boosting global trade, particularly in the UAE, with DP World handling 10% of global container trade. Multimodal coordination requires robust infrastructure and stakeholder alignment to ensure seamless logistics and supply chain efficiency. The Port of Rotterdam’s rail network integration is an example of successful multimodal integration enhancing trade efficiency.

Challenges

- **Regulatory hurdles:** Regulations often obstruct the path to sustainable rail operations, particularly in cross-border initiatives. Proactively engaging with regulators and fostering collaboration among stakeholders can streamline compliance.
- **Capacity utilisation and congestion:** As demand for rail services grows, managing capacity constraints becomes increasingly difficult. Overcrowded rail lines can lead to delays and inefficiencies, particularly in urban areas or major freight corridors.

Way forward

The way forward for rail strategy, planning, and operations lies in adopting a proactive, integrated, and innovation-focused approach that aligns with both current demands and future growth. A well-defined strategy must serve as the backbone of rail development, aligning investments with evolving market needs while ensuring that systems are scalable and integrated with multimodal networks. Consulting expertise will play an increasingly critical role.

The **UAE Railway Program** is a US\$13.6bn initiative that aims to link the UAE’s seven emirates. The Dubai **Roads and Transport Authority’s Strategic Plan 2024-30** seeks to transform the emirate into a 20-minute city — where 80% of daily services are accessible within 20 minutes. At a national level, Saudi Arabia’s **Vision 2030** is a critical driver for expansion of the Kingdom’s existing rail network to more than 8,000km, making KSA the leader in the rail network size in the region.

Partnerships are pivotal in advancing the rail industry, offering transformative benefits across technology, operations, and financial viability. Strategic alliances foster innovation, reduce risks, and enable resource sharing, making large-scale rail projects feasible and efficient. The importance of partnerships in the rail sector is underscored by their ability to blend diverse expertise, align stakeholder objectives, and create shared value across public and private entities.

One compelling example is the **partnership between Siemens Mobility and Egypt’s National Authority for Tunnels**, which is delivering a state-of-the-art high-speed rail system spanning **2,000km**. This collaboration has positioned Egypt as a regional leader in sustainable transport, with Siemens bringing advanced rail technologies and expertise in digital solutions, while the government ensures regulatory alignment and local integration. The partnership is projected to reduce **70% of car travel emissions** along the routes, directly supporting Egypt’s climate goals.

Efforts are underway for **multi-modal integration** in the region. The upcoming **India-Middle East-Europe Economic Corridor (IMEC)** will be the first **sea-rail-road** connecting countries within the region with Europe and India. By establishing a direct, multi-modal transport link, the project is expected to **streamline logistics, reduce transit times, and lower transportation costs**, thereby boosting trade volumes across these regions while also enhancing connectivity.



Key insights:

c) Infrastructure, construction, and engineering

“Railways are the backbone of a sustainable and competitive transport system.”
– H.E. Óscar Puente, Minister of Transport, Spain

The creation of efficient and sustainable infrastructure while incorporating cutting-edge technologies to improve safety and performance is crucial to the future of rail. As networks expand globally, the focus is on innovative materials, automated construction processes, and environmentally friendly practices to meet growing demand for connectivity.

1. Energy efficiency and technological advancements:

Digital technology and data analytics are revolutionising railway operations, with real-time data analytics optimising train speed and maintenance needs. Hydrogen and battery-operated rail transport systems are promising, though caution will be required around their implementation. Germany’s Alstom Coradia iLint, the world’s first hydrogen fuel cell passenger train, showcases the advancements in energy-efficient rail technology.

2. Emerging materials and new construction techniques:

The use of eco-friendly materials, such as recycled steel and low-carbon concrete, is growing as part of the rail sector’s commitment to sustainability. These materials help reduce the carbon footprint of rail projects and promote long-term environmental goals. In addition, new techniques such as modular construction reduce on-site construction time, minimise disruptions, and improve overall project efficiency.

3. Sustainability and competitiveness:

There is an emphasis on the interlinked nature of sustainability and competitiveness, with railways being the backbone of a sustainable and competitive transport system. The Spanish railway model, which has developed an extensive network at a low cost, serves as an example of how sustainability and competitiveness can be achieved simultaneously.

Challenges

- **High initial costs:**
Adopting automation, robotics, and digital twin technology requires significant upfront investment in technology and workforce training. Many projects may face budget constraints or reluctance to embrace these technologies due to the high cost of entry.
- **Skilled workforce shortage:**
The shift toward automated and smart construction technologies necessitates a workforce with specialised skills, with the rail construction sector potentially facing a shortage of professionals trained in areas like robotics and digital systems.

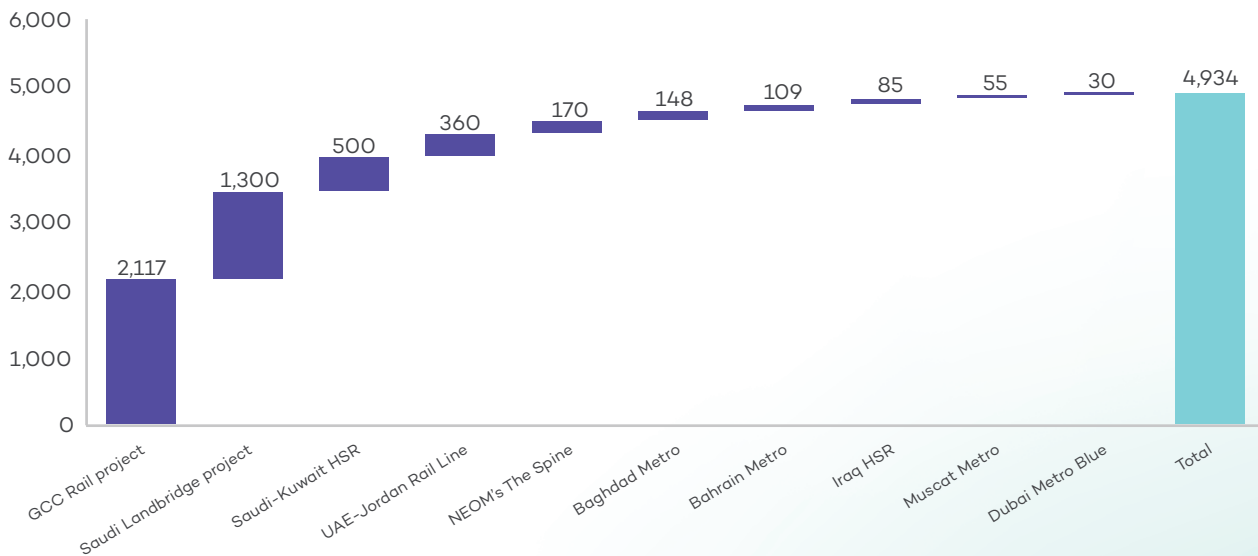
Way forward

The future of rail lies in its ability to deliver efficient, sustainable, and technologically advanced infrastructure that meets growing demands for connectivity while addressing environmental imperatives. As global rail networks expand, the sector must embrace cutting-edge technologies, innovative materials, and sustainable practices to ensure long-term competitiveness.

Several major rail projects in the region are currently in various stages of development, with construction yet to commence on some of the most significant initiatives. This creates a wealth of opportunities for companies involved in construction, rolling stock, rail systems, and technology solutions.

The top 10 rail projects in the region encompass over 4,900km of planned rail network, signaling substantial prospects for industry players in the near future.

The top 10 upcoming rail projects in the region (km)



Source: Publically available data

The Middle East is increasingly incorporating energy-efficient technologies and advanced digital solutions in rail projects. One of the most prominent examples is **Etihad Rail in the UAE**, which integrates state-of-the-art systems to optimise energy consumption and enhance operational efficiency. These technologies reduce energy consumption and operational inefficiencies. For global rail operators, this highlights the importance of prioritising digital infrastructure early in the planning stages.

Similarly, Saudi Arabia’s Haramain high-speed railway, which connects Mecca and Medina, employed low-carbon concrete and recycled steel during its construction, aligning with sustainability goals. These materials not only reduced the project’s carbon footprint but also ensured durability and reduced maintenance costs.

The Middle East’s rail projects provide actionable insights for stakeholders globally. They illustrate that energy efficiency, innovative construction, and sustainability are not just idealistic goals – they are essential strategies for building future-ready rail systems. By leveraging digital technologies, sustainable materials, and integrated networks, rail operators and governments can deliver projects that achieve environmental targets, economic growth, and social impact.

Key insights:

d) High-speed rail

“Urbanisation rates are increasing rapidly. Connecting capitals is the next chapter, especially in MENA region.” – **Andrew DeLeone, President, Africa, Middle East, and Central Asia, Alstom**

High-speed rail (HSR) is among the fastest-growing rail infrastructures globally, driven by its economic and social advantages for nations. It expands commuter catchment areas, enabling city businesses to tap into a broader talent pool while providing workers with access to more affordable housing options. Moreover, significant environmental benefits make HSR systems highly appealing.



1. High-speed rail developments:

The expansion of HSR networks is a global trend, with significant developments in countries like China, Japan, Spain, France, Germany, and Italy. New entrants such as Morocco, Turkey, and Indonesia also illustrate the growing interest in HSR. China’s commitment to expanding its high-speed rail network to 38,000km by this year highlights the substantial investment and strategic planning in this sector.

2. Economic and environmental benefits of HSR:

High-speed rail offers numerous benefits, including cost efficiency and reduced environmental impact. For example, in Egypt, a single high-speed train can replace approximately 25,000 Electric Vehicles (EVs), significantly reducing costs and emissions. Additionally, high-speed rail systems are more energy-efficient, using only 10% of the energy compared to EVs. France’s TGV network has been instrumental in reducing domestic flight carbon emissions by 20%, showcasing the environmental benefits of high-speed rail travel.

3. Passenger experience and connectivity in HSR:

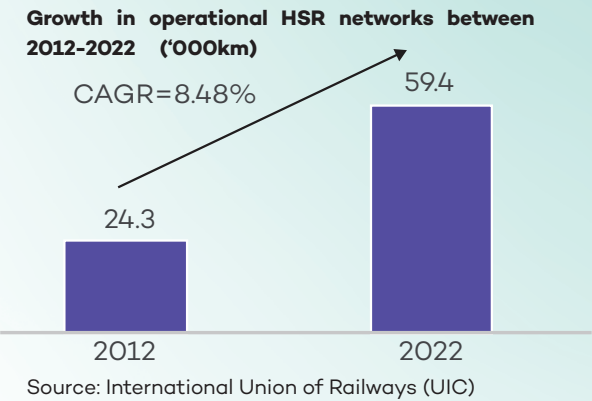
Passenger experience is a critical focus, with enhancements in comfort, aesthetics, and connectivity leading to increased ridership. Italy’s high-speed rail system saw passenger numbers surge from 6.5 million in 2008 to almost 60 million by 2019, demonstrating the positive impact of well-designed rail services. Spain’s AVE high-speed trains have also been praised for their punctuality and exceptional passenger services, contributing to a growth in ridership.

Challenges

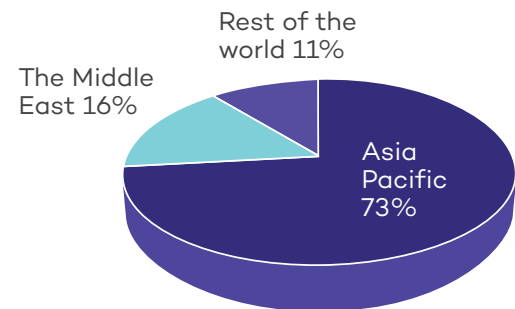
- Energy demand:** High-speed trains require more energy per passenger-kilometre than conventional trains. Maintaining these speeds over long distances demands a significant amount of electricity, often sourced from national grids, which can strain energy supplies and increase operational costs.
- Ridership and revenue generation:** Ensuring sufficient ridership to justify the high costs can be challenging. In regions where air and road travel are more established or cost-competitive, convincing people to switch to high-speed rail may take time.

Way forward

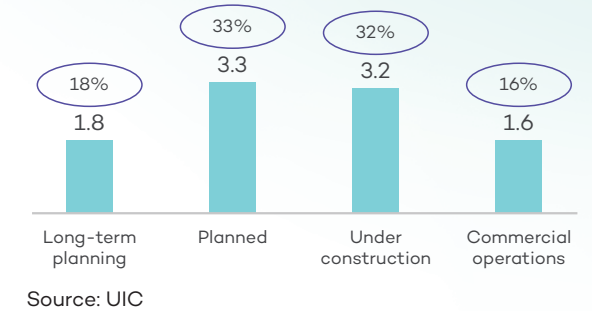
Globally, HSR grew at a CAGR of 8.5% between 2012 and 2022. In the Middle East, however, HSR development has gained momentum only recently. The region now boasts the second-largest upcoming HSR network, with over 3,000km under construction and an additional 5,000km in the planning stages. These projects are set to drive the next wave of rail growth, enhancing connectivity across GCC countries.



ME's share of under-construction projects (2022)



ME HSR projects under various stages of development, 2022 ('000km)



Regional governments' aggressive push towards expanding the HSR network and the subsequent investment to construct new rail lines to enhance consumers' traveling experience is driving the growth of HSR in the region. High-profile projects include:

- The largest HSR construction project underway in the Middle East and North Africa (MENA) region is in **Egypt**, with a 2,000km mainline and freight rail network. **Siemens Mobility** will deploy 41 Velaro trains, 94 Desiro regional trains and 41 Vectrons on the network, specifically designed to withstand the climatic and sandy conditions of Egypt.
- The **UAE's HSR** project will be developed in four phases, with the first phase slashing travel time between Abu Dhabi and Dubai to 30 minutes.
- KSA and Kuwait** will also be connected with a 700km HSR line, with 100-minute travel time.

HSR is poised to play a transformative role in global infrastructure, offering compelling economic, environmental, and social benefits. However, its success hinges on strategic planning, robust financial models, and addressing operational challenges. For the MENA region which is rapidly expanding its HSR network, the challenge lies in its ability to capitalise on these opportunities while navigating the associated complexities.

Key insights:

e) Finance and governance

“Integrating ESG principles into rail infrastructure projects is crucial for attracting financing and de-risking long-term investments.” – **Javier Pérez Fortea, CEO, Globalvia**

Railway infrastructure projects are critical for economic development and connectivity. These projects require substantial investment and careful planning to ensure long-term financial sustainability. Diversified funding sources, the role of international banks, and the integration of advanced technologies are key trends shaping the financing landscape for these projects.

1. Diversified funding sources:

A diversified mix of funding sources, including Public-Private Partnerships (PPPs), sovereign funding, and project finance, is essential for mitigating risks and ensuring financial sustainability. Blended financing models that combine public and private funding may offer a sustainable solution for rail projects, especially in low- and lower-middle-income countries. This approach leverages the strengths of both sectors to achieve financial viability.

2. Long-term financial sustainability:

Ensuring long-term financial sustainability for rail projects involves a combination of passenger ticket revenue and long-term financing arrangements. Proper risk allocation and high-quality sponsors can enable successful deals, even in lower-income countries. Indian Railways’ semi-high-speed Vande Bharat Express project has set an example by maintaining financial sustainability through effective ticket pricing and long-term investment strategies.

3. Role of international banks:

International banks play a crucial role in closing the funding gap for railway infrastructure projects. Aligning with international standards and effectively managing risks is essential for securing project financing. The African Development Bank’s involvement in funding the Standard Gauge Railway in Kenya is an illustration of how international banks can support large-scale rail infrastructure projects.

Challenges

• Complex financing models:

Funding railway projects often involves complex financial structures – a result of blending public funds, loans, and private investments. Securing these various funding streams can be complicated, especially in regions.

• Uncertain Return on Investment (ROI):

Rail projects typically have long payback periods, and the ROI is not always guaranteed, particularly in regions where rail demand is uncertain.

Way forward

Railway infrastructure projects are pivotal for driving economic growth, enhancing connectivity, and enabling sustainable development. However, the success of these projects relies heavily on securing diversified and sustainable financing mechanisms, ensuring robust governance structures, and effectively managing risks. The emerging trends in financing and governance offer critical insights into the path forward, while the associated challenges highlight the need for innovative solutions.

In the Middle East, Public-Private Partnerships (PPPs) are increasingly being used to harness private capital, technical expertise, and operational efficiency in rail development. With rail projects gaining traction, PPPs distribute risks and responsibilities, accelerating timelines and raising operational standards. First-time developers such as Iraq are leveraging the PPP model for significant projects like the HSR and Baghdad Metro, highlighting the model’s growing appeal. Over 20% of rail projects in the Middle East now use PPPs, compared to just 8% globally, according to the World Bank.

Financial sustainability remains a critical challenge given long payback periods and high upfront costs. Lessons from India’s Vande Bharat Express show the value of effective ticket pricing and long-term investment planning in maintaining financial health. Passenger-centric pricing models and freight services can help Middle Eastern rail projects balance accessibility and revenue generation. The International Finance Corporation reports that private participation in transport infrastructure in the Middle East totaled US\$7 billion in 2022, with a significant share directed toward rail projects.

Furthermore, high-quality sponsorship and proper risk allocation are key. Rail projects must attract credible stakeholders with the capacity to absorb risks and provide the technical and financial expertise necessary for long-term success. Strong governance and transparent risk-sharing arrangements are indispensable for securing sustainable financial outcomes.

Despite these advancements, complex financial structures and uncertain ROI remain significant hurdles. Rail projects often involve blending multiple funding sources, which can result in prolonged negotiations and potential delays. Additionally, uncertain demand in emerging markets heightens the risk of low ridership or insufficient freight volumes, undermining financial returns. Financial and operational risk management must be at the core of rail project planning. Middle Eastern governments and stakeholders must proactively conduct detailed demand analyses and feasibility studies to build confidence among investors. By adopting innovative financing mechanisms such as green bonds or value capture financing, they can diversify revenue streams while addressing ROI uncertainties.



Key insights:

f) Customer experience

“We will continue to enlarge product portfolio and service offerings while introducing systems for new and existing customers that will provide better visibility to flow and inventory.”

– Gunther Ferk, CEO, Etihad Rail Freight

Customer experience in rail is increasingly becoming a central focus as operators strive to improve service quality and efficiency for passengers and freight customers. As competition with other transport modes grows, delivering a seamless journey is essential for attracting and retaining customers, making customer experience a critical factor in the success of modern rail services. Key emerging trends include:

1. Digitisation initiatives:

The rail sector is increasingly adopting digital ticketing, cargo tracking, and operational management platforms. For passengers, this includes seamless mobile ticketing and real-time updates on journeys. In freight, digital solutions enable real-time tracking of cargo, streamlining logistics and improving supply chain transparency. Automation in both sectors enhances efficiency and reduces manual errors, providing faster, more reliable services.

2. Enhanced connectivity and integrated services:

Rail operators are improving connectivity by integrating rail systems with other modes of transport, creating more seamless intermodal options. This translates into easier transfers between trains, buses, and other transit modes for passengers. In freight, integrated services provide smoother transitions between rail, road, and sea, allowing for more efficient multimodal logistics that enhance overall supply chain reliability.



3. Safety and security enhancements:

Both passenger and freight rail systems are increasingly focused on enhancing safety and security using advanced surveillance technologies, AI-driven monitoring, and real-time safety updates. For passengers, this translates into safer journeys with better response systems in place for emergencies. In freight, enhanced security measures help protect goods from theft or damage, ensuring that high-value cargo reaches its destination safely.

Challenges

• Consistency in service quality:

Maintaining consistent service levels across different regions and operators can be difficult. Variations in customer service and safety standards can lead to inconsistent passenger and freight experiences.

• Balancing cost with innovation:

Enhancing customer experience through innovations like contactless payments, smart infrastructure, and sustainability measures requires significant investment.

Way forward

Customer experience is rapidly becoming the cornerstone of competitive differentiation in the rail sector. As passenger and freight operators face rising expectations and increasing competition from other modes of transport, a seamless, integrated, and reliable service will be essential. The future of rail lies in leveraging emerging technologies, rethinking connectivity, and embedding safety as a core component of operations to meet the needs of tomorrow's customers.

Digitisation is set to revolutionise the rail industry, offering unparalleled opportunities to enhance customer experience. Real-time updates, mobile ticketing, and predictive maintenance will redefine how passengers and freight customers interact with rail systems. For instance, digital ticketing, which eliminates queues and offers seamless travel, is projected to account for over **65% of global rail ticket transactions by 2030**. Freight operations are also evolving, with real-time cargo tracking improving supply chain transparency and reducing delays. Automation, enabled by AI and the Internet of Things (IoT), will further enhance operational efficiency, enabling faster and more reliable services. Looking ahead, the integration of digital tools into rail systems will not only enhance customer satisfaction but also reduce costs, helping operators balance innovation with profitability.

Integrated transport systems will define the next era of rail. The ability to provide seamless intermodal connections—such as between trains, buses, and urban transit systems for passengers or between rail, road, and sea for freight—will be critical. For example, rail systems integrated with urban mobility networks could reduce commuter travel times by **20-25%**, making rail a preferred mode of transport. Freight operators stand to benefit from smoother multimodal logistics, which are projected to enhance supply chain reliability by **40%** by reducing bottlenecks at transfer points.

Safety and security will increasingly become non-negotiable aspects of customer experience in rail. Advances in AI-driven monitoring systems and real-time safety updates are paving the way for safer passenger journeys and more secure freight operations.

To fully capitalise on these opportunities, rail operators must overcome challenges such as maintaining service consistency across regions and balancing the costs of innovation with long-term value. Consistency in customer experience requires adopting universal service standards and integrating technologies that can be scaled across networks. Investment in innovations such as smart infrastructure, sustainability measures, and contactless payment systems must also align with strategic goals to ensure financial viability.



Key insights:

g) Technology

“Technology plays a transformative role in rail transport, driving improvements in operational efficiency, safety, and sustainability.”
– **Ayman Ashour, CEO, Siemens Middle East**



The integration of digital solutions, data analytics, and innovative energy systems such as hydrogen and battery technologies is transforming the rail industry to meet both operational and environmental demands. At Global Rail 2024 discussions highlighted how these advancements can optimise operations, improve train speed, and enhance maintenance efficiency, positioning the sector for significant technological growth while addressing sustainability challenges.

1. Strategic adoption of automation:

The strategic implementation of automation technologies is essential for enhancing operational efficiency and minimising human error in the railway sector. For instance, South Korea’s CS2 safety and KTCS3 wireless signal systems illustrate a forward-thinking approach to creating a safer and more efficient rail network. Additionally, Japan’s automated train operation systems on its Shinkansen network have led to substantial reductions in delays and improvements in safety.

2. Hydrogen and battery innovations:

Exploring hydrogen and battery technologies is crucial for achieving sustainable rail transport. These energy systems help reduce carbon emissions while improving operational efficiency. Rail operators are piloting hydrogen-powered trains and battery-electric systems, demonstrating a commitment to clean energy without sacrificing performance.

3. Cybersecurity in rail automation:

As automation progresses, cybersecurity has become a critical focus area. Significant investments in data-centric trains and adherence to global standards and national security frameworks are essential. Measures like ethical hacking and advanced encryption technologies are necessary to protect rail systems from evolving threats. The EU Agency for Cybersecurity (ENISA) plays a vital role in establishing guidelines and standards to bolster rail cybersecurity, ensuring robust operations across the sector.

Challenges

- **Skilled workforce shortage:** The shift towards digital and automated rail systems demands a skilled workforce with expertise in emerging technologies like AI, big data, digital twins, and autonomous systems, which many regions lack.
- **Infrastructure compatibility:** Upgrading existing rail infrastructure to support advanced technologies often requires extensive retrofitting, which can be costly and time-consuming, particularly for older networks.

Way forward

The integration of digital solutions, advanced energy systems, and cybersecurity measures is driving a paradigm shift in the rail industry, enabling it to meet both operational and environmental demands. The Middle East rail sector holds a unique advantage in leveraging global best practices to develop advanced technological capabilities. By learning from other regions, the sector can enhance operational efficiency across existing networks while seamlessly integrating state-of-the-art solutions into new sections under construction, positioning itself as a leader in modern rail innovation.

The strategic adoption of automation technologies offers transformative benefits for rail operations. Automation reduces human error, streamlines processes, and enhances safety, as demonstrated by South Korea’s CS2 safety system and KTCS3 wireless signals. Japan’s Shinkansen network, with its automated train operations, has set global benchmarks by achieving near-zero delays and unprecedented safety records. Looking ahead, the global rail automation market is expected to grow at a CAGR of 8.5% through 2030, driven by increasing demand for operational efficiency.

For the Middle East, where rail networks are rapidly expanding, automation presents a key opportunity to build systems that are modern, efficient, and resilient from the outset. Implementing predictive maintenance technologies, autonomous train operations, and automated signaling can significantly reduce operational costs while enhancing reliability and customer satisfaction. The focus must now shift toward aligning automation strategies with the region’s growing infrastructure needs.

Advanced technologies will play a crucial role in advancing rail projects in the Middle East. Projects such as the **GCC Railway Network**, designed to link GCC member states, require harmonised Signal and Telecom (S&T) systems to ensure seamless cross-border train operations. This integration offers opportunities for standardising signalling protocols and telecommunications infrastructure across countries. The region is embracing cutting-edge technologies like the European Train Control System (ETCS) and Communication-Based Train Control (CBTC). For example, **Siemens Mobility** and **Hassan Allam Construction** are implementing **ETCS Level 2 signaling on the Abu Dhabi–Sohar railway link**, marking the first cross-country railway network in the Middle East.

As rail systems increasingly rely on data-driven operations and automation, cybersecurity has become a critical concern. Cyber threats targeting rail systems can disrupt services, compromise safety, and incur significant financial losses. **The European Union Agency for Cybersecurity (ENISA)** is leading the way by establishing global standards and guidelines to fortify cybersecurity in rail.

Middle Eastern rail operators must take a proactive approach by embedding cybersecurity into the design phase of digital systems. Investments in advanced encryption technologies, ethical hacking, and AI-powered threat detection are essential to safeguard operations.

The future of rail technology lies in a balanced approach that integrates innovation with practical implementation strategies. For the Middle East, the focus must be on automation, cybersecurity, workforce development and infrastructure modernisation. By embracing these priorities, the Middle East can position itself at the forefront of global rail innovation, delivering sustainable, efficient, and secure rail systems that meet future demands. This transformation will not only elevate the region’s transport infrastructure but also contribute to broader economic and environmental objectives.

Key insights:

h) Legal and regulatory frameworks

“Risk allocation and long-term strategic planning must be front of mind for commercial teams.”
– **Elliott Sawford, Partner – Energy and Infrastructure Projects, Allen & Overy**

Legal and regulatory frameworks are vital to ensuring safety, efficiency, and compliance in rail operations, setting standards for everything from infrastructure to environmental impacts. They govern cross-border interoperability and technological integration, ensuring rail systems operate smoothly.

1. External legal support:

External legal counsel plays a pivotal role in the implementation of transport infrastructure projects. Early planning, diversified funding, and collaborative stakeholder engagement are essential for transforming potential hindrances into enablers of success. The successful legal navigation of the Channel Tunnel project demonstrates the importance of comprehensive legal support in overcoming regulatory and operational challenges.

2. Regulatory compliance:

Regulatory compliance is critical for supporting autonomous technologies. Ethical hacking and encryption are essential measures to safeguard rail systems against evolving threats. The implementation of the European Train Control System (ETCS) illustrates the importance of regulatory compliance in ensuring seamless and secure rail operations.

3. Dispute management:

Structured dispute resolution mechanisms can pre-empt and resolve conflicts efficiently, maintaining project momentum. Early engagement with legal counsel and structured processes are crucial for avoiding long-term disputes and ensuring seamless project execution. The dispute resolution framework used in the construction of the Gautrain project in South Africa exemplifies the effectiveness of proactive dispute management.

4. Risk allocation and funding strategies:

Effective risk allocation and clear exit strategies are fundamental in managing complex funding arrangements. Early consideration of exit strategies and flexibility in refinancing are essential for preventing future bottlenecks and ensuring project viability. The Crossrail project’s risk management strategies highlight the importance of thorough planning and flexible funding arrangements in navigating complex infrastructure projects.

Challenges

- **Cross-border regulation:**
Different countries have varying legal frameworks and standards for rail safety, operations, and technology. Harmonising these regulations for cross-border interoperability is a major challenge.
- **Funding and PPP regulations:**
Structuring PPPs for rail projects within existing legal frameworks can be challenging.

Way forward

Early legal planning and external counsel are essential in navigating the complex legal and regulatory landscape of rail infrastructure. The Channel Tunnel project serves as a prime example of how comprehensive legal guidance can overcome operational and regulatory challenges, ensuring smooth execution. Globally, legal disputes contribute to delays in 30-40% of infrastructure projects, emphasising the value of legal expertise in mitigating risks.

Efficient dispute resolution mechanisms are critical in maintaining project momentum and mitigating delays. The Gautrain project in South Africa illustrates how structured legal processes can preempt conflicts and resolve disputes without derailing progress. In the rail sector, disputes contribute to cost overruns in more than 25% of projects, highlighting the importance of proactive legal frameworks.

For the Middle East, embedding robust dispute resolution frameworks from the outset can ensure that disagreements over funding, timelines, or operational strategies are resolved efficiently. This will be particularly important in Public-Private Partnerships (PPPs), where multiple stakeholders with differing priorities are involved.

Effective risk allocation and flexible funding arrangements are central to the success of large-scale rail projects. The Crossrail project in London demonstrates how thorough planning and adaptive funding mechanisms can navigate complex infrastructure challenges. Notably, risk-sharing strategies can reduce cost overruns by up to 20%, according to industry studies.

In the Middle East, where PPPs are increasingly being used to fund rail projects, early consideration of risk allocation and exit strategies will be vital. Governments must establish clear guidelines for PPP contracts to ensure risks are equitably shared between public and private stakeholders, fostering investor confidence while ensuring project viability.

The UAE’s Railway Law is widely regarded as one of the most advanced legal frameworks for rail operations, offering a model for countries seeking to establish efficient, safe, and future-ready rail systems. Introduced to regulate the development and operation of the UAE’s growing rail infrastructure, the regulations integrate international standards, emphasising interoperability and safety while fostering innovation through clear guidelines for adopting advanced technologies.

Harmonising cross-border regulations is a critical challenge for international rail networks. Differences in safety standards, operational protocols, and technological requirements can delay projects and increase costs.

The success of rail infrastructure projects in the Middle East depends on the development and implementation of robust legal and regulatory frameworks. Key actions include proactive legal engagement, strengthening compliance and enhancing dispute management. By addressing these priorities, the Middle East rail sector can navigate the complexities of legal and regulatory landscapes while ensuring projects are delivered efficiently, safely, and sustainably.

Key insights:

i) Sustainability and the environment

“While hydrogen holds promise, its implementation must be balanced with economic feasibility.”

– **Armando Fombella, General Manager and Project Director, Renfe KSA**

Sustainability is becoming a core focus in the rail transport sector, with an increasing emphasis on reducing environmental impact and promoting cleaner energy solutions. The integration of sustainable practices and technologies, such as hydrogen and battery-operated systems, aims to foster a greener future for rail transport. Three key areas emerged as vital to advancing sustainability in rail transport:

1. Incorporation of ESG principles:

Integrating Environmental, Social, and Governance (ESG) principles into rail infrastructure projects is crucial for attracting financing and de-risking long-term investments. Transparency in reporting and setting clear sustainability goals are essential for evaluating projects and showcasing sustainable paths. The UK's HS2 project exemplifies this approach by incorporating ESG principles into its planning and execution, thereby establishing a benchmark for future rail initiatives.

2. Environmental considerations:

From the outset, environmental metrics should be integrated into rail projects, emphasising a zero-emissions framework and ensuring balanced environmental impacts during both construction and operational phases. Long-term management of ESG factors, such as biodiversity, is vital for sustainable infrastructure. The Swiss Federal Railways' 'Green Class' initiative stands as a model, as it successfully incorporates environmental considerations into its operations, promoting sustainability throughout the rail network.



3. Sustainable transport solutions:

Rail transport provides cost-effective, high-quality, and environmentally friendly solutions. Integrating rail systems can significantly reduce road congestion, lower maintenance costs, and offer a more sustainable alternative to road transport. Japan's JR East highlights these advantages through its investments in green technologies and eco-friendly rail services, showcasing how the railway sector can lead the way in sustainable transport.

Challenges

• Energy transition viability:

While there is robust customer demand for sustainable solutions driven by aggressive ESG targets, transitioning requires meticulous planning and significant investment.

• High initial costs:

Implementing sustainable solutions, such as transitioning to electric or hydrogen-powered trains, requires significant upfront investment in new technologies.

Way forward

Decarbonising the transport sector is essential for addressing climate change. Currently, transport contributes 20% of global greenhouse gas (GHG) emissions. Over the past 50 years, emissions from transport have increased at a faster rate than any other sector and are projected to rise by up to 60% by 2050 unless significant mitigation measures are implemented.

Rail moves passenger and goods traffic that would have otherwise travelled by more carbon-intensive modes. In typical circumstances, approximately 80% of the potentially achievable savings come from modal shifts. Attracting a passenger from a two-person car to a mainline diesel train would save about 84 grams carbon dioxide (CO₂) per kilometre, while shifting one ton-kilometre of freight from heavy truck to diesel bulk rail would save approximately 55 grams CO₂.

Electrifying rail movement would save an additional 13 to 19 grams CO₂ per passenger-kilometre or ton-kilometre, assuming an overall emissions factor of the electricity grid of 400 or 200 grams CO₂ per kilowatt-hour respectively.

Realising the benefits of rail decarbonisation, advancements are underway to adopt sustainable clean practices in the sector. In the Middle East, significant developments are underway:

- In the UAE, **Etihad Rail** launched its **sustainable finance framework**, a comprehensive guide that aims to link the company's future financing to its ESG strategy in relation to clean transportation, green buildings, and pollution prevention and control.
- Saudi Arabia is developing the **world's longest battery-powered, catenary-free tramway** line in AIUla.

Rail systems inherently provide a more sustainable alternative to road and air transport. Japan's **JR East** exemplifies the sector's leadership in sustainable mobility, leveraging green technologies to improve energy efficiency while reducing costs and environmental impact. Rail's ability to reduce road congestion and maintenance costs offers a compelling argument for expanding its role in urban and interurban transport.

For Middle Eastern cities grappling with urbanisation and environmental pressures, rail can be a cornerstone of sustainable urban planning. Expanding passenger rail networks and integrating freight systems with seaports and logistics hubs can reduce reliance on road transport, cutting emissions and improving efficiency. Rail transport already emits **75% less CO₂ per ton-kilometre** compared to trucks, making it a key enabler of regional sustainability goals.

By aligning these priorities with global sustainability goals, the Middle East rail sector can lead the charge in green mobility, ensuring long-term environmental, social, and economic benefits. Rail has the potential not only to transform regional transport systems but also to set a global standard for sustainable infrastructure development.

Key actions for the rail sector in the Middle East

Transformative trends in infrastructure

- **Adopt a fresh approach:**
The energy transition and automation are redefining the infrastructure sector. Projects must embrace innovative structuring and stakeholder engagement strategies to stay ahead.
- **Leverage PPP laws:**
The introduction of Public-Private Partnership (PPP) laws in the GCC has paved the way for more integrated projects. Utilising these frameworks can help streamline project integration.

Regulatory navigation

- **Proactive planning:**
Use regulations as a supportive framework rather than a hurdle. Proactive planning can leverage regulation to facilitate project integration.
- **Harmonise regulations:**
In countries like the UAE, harmonising regulations across multiple emirates and borders is crucial to prevent operational disruptions.

Funding challenges

- **Plan diligently:**
Meticulous planning from the outset is crucial to avoid contract renegotiations. Structuring funding deals with a focus on risk allocation is paramount.
- **Diversify funding sources:**
A mix of conventional, Export Credit Agency (ECA), and Islamic bank funding can add complexity but also increase contract provisions, making projects more robust.

- **Consider exit strategies early:**
Flexibility in refinancing and early consideration of exit strategies can prevent future bottlenecks and ensure smoother project transitions.

Choosing the right legal counsel

- **Align expertise with project needs:**
Select legal firms with specific transport sector expertise. Lawyers should be able to effectively communicate with technical advisors and subcontractors to ensure seamless collaboration.
- **Prioritise effective communication:**
Strong communication skills are essential for legal counsel to bridge the gap between various project stakeholders.

Dispute management

- **Integrate teams early:**
Combining project, financial, and legal teams from the beginning is essential to prevent disputes. This integrated approach helps identify potential conflict areas early.
- **Structured dispute resolution:**
Establishing early engagement and structured dispute resolution processes is vital to maintaining project continuity and ensuring rapid resolution of any issues.

Strategic risk management

- **Innovative solutions:**
Continued innovation in project structuring, funding, and dispute resolution is necessary to navigate the evolving landscape of the rail sector.
- **Collaborative stakeholder engagement:**
Foster a collaborative environment among all stakeholders to transform potential hindrances into enablers of success.

Looking ahead

The future of the rail sector is brimming with promise, poised to act as a catalyst for economic transformation both within the GCC and on a global scale. The strategies and innovations discussed at Global Rail 2024 set the stage for a resilient and adaptive industry, ready to tackle the challenges of tomorrow with ingenuity and foresight.

The rail sector can navigate complexities with agility and confidence by embracing flexibility in financing, proactive regulatory planning, and early integration of multidisciplinary teams.

The harmonisation of regulations, particularly in the diverse countries of the GCC, will smooth operational paths and link a seamless network that transcends borders.

Innovation remains at the heart of progress. As we continue to explore novel solutions in project structuring, funding, and dispute resolution, the rail sector will not only overcome existing hurdles but also pave the way for new opportunities and advancements. Collaborative engagement among stakeholders will transform potential obstacles into building blocks for success, ensuring that the sector thrives and evolves.

Ultimately, the rail sector's dynamic growth is an indispensable driver of economic development. It holds the potential to reshape the GCC economy and extend its influence globally, creating a more connected, efficient, and prosperous world. The journey ahead is bright, and with a shared vision and concerted effort, we can harness the full potential of rail to inspire progress and innovation across the globe.





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