AI-powered road infrastructure transformation - Roads 2047

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Executive Summary

India aspires to become a Viksit Bharat by 2047, the centenary of our independence. The path to this future is expected to be paved, by the road network that connect citizens of the country, markets, ideas, and opportunities.

Roads have always been the arteries of economic growth. They carry the very pulse of progress by enabling social equity and global competitiveness. Yet, the challenges of the 21st century i.e. rapid urbanisation, climate change, congestion, road user safety, growing logistics costs, and the sheer scale of infrastructure required, demand that we think beyond conventional construction. The roads of tomorrow must not only be stronger, but also smarter, safer, and sustainable.

AI (Artificial Intelligence) offers an opportunity to redefine how roads are conceived, built, and managed across the entire project lifecycle. When integrated with emerging technologies such as digital twins, IoT (Internet of Things) enabled sensors, GIS (Geographical Information System), BIM (Building Information Modelling), computer vision, AI can become a multiplier, transforming roads from static infrastructure into dynamic, intelligent systems that can learn and adapt in real-time.

This PoV explores:

1. **India's growth story:** Why is India's road network central to the country's Viksit Bharat 2047 vision?
2. **The transformational power of AI:** How AI-driven technologies can accelerate construction, cut costs and improve safety and efficiency?
3. **The case for intelligent roads:** The urgent need for smart, adaptive, and sustainable road network.
4. **Policy and governance framework:** The roadmap India must adopt encompassing data governance, PPP (Public Private Partnerships), skilling, and institutional reforms to unlock AI's full potential.

The stakes are high. With the full realisation of an AI-enabled infrastructure vision, India has the potential to reduce logistics costs from 14 per cent of GDP to below 8 per cent by 2047 bringing them in line with, or even below, the global average. Road fatalities, currently among the highest in the world can be dramatically reduced with predictive AI-driven safety systems[1]. Construction delays and cost overruns, long considered universal, can be minimised through digital transparency and automation. Further, the carbon footprint of our roads can be aligned with India's Net Zero 2070 commitments.

The message is clear; **By 2047, India's roads must be celebrated not just for their vast reach in kilometres, but for their intelligence, resilience, and purpose – standing as a beacon of the nation's progress and ambition.**

1. India's road safety crisis: Over 15 lakh fatalities in a decade signal alarming gaps – A detailed analysis, FE News Desk, December 2024.

1. Infrastructure goals for a developed India by the year 2047 with road sector at its core

By 2047, India envisions to become a global economic powerhouse[2]; one that is **globally competitive, technologically advanced, socially inclusive, and environmentally sustainable**. To meet this goal, India must achieve 8-10 per cent growth over the next two decades[3]. But growth is not just about numbers; it is about building fast and last mile connectivity, enabling industries and business to thrive with lower logistics costs and ensuring **safe, efficient, sustainable** mobility for citizens. Roads play a pivotal role in all three.

India has made remarkable progress in the past two decades. From 2000 to 2024, the national highways network has more than doubled, with flagship projects like the Golden Quadrilateral, East-West and North-South corridors, and high-speed corridors such as Delhi-Mumbai Expressway and Raipur-Visakhapatnam Expressway redefining connectivity. Today, India boasts of the second largest road network in the world (~66 lakh km.)[4].

But this scale comes with its share of challenges. Persistent issues such as traffic congestion, air pollution, rising accident rates, and inefficiencies in construction and maintenance continue to hinder progress. Logistics costs remain stubbornly high at 13-14 per cent of GDP, well above the global benchmark of 8-9 per cent[5]. As India looks to **build infrastructure** that is **future-ready**, the **road sector must evolve, not only in terms of quantity, but in terms of resilience, quality and intelligence of assets being built**.

This calls for a paradigm shift in the approach:

1. From manual planning to **AI-driven forecasting and design.**
2. From traditional construction to **Automated and Intelligent Machine-aided construction; reactive maintenance to predictive asset management.**
3. From conventional traffic management systems to **real-time, adaptive mobility solutions.**
4. From one-time construction to **lifecycle sustainability.**
5. From reactive and conventional project management to **AI agent-based real-time performance monitoring and reporting.**

The impact of roads on economic growth is measurable. Studies indicate that every rupee spent on highway construction leads to INR3.21 increase in GDP growth[6]. Faster connectivity reduces logistics costs, increases industrial competitiveness, and attracts foreign investment. In rural India, roads directly translate into better access to healthcare, education, and employment.

As India urbanises, the demand for mobility is expected to multiply. The number of vehicles on Indian roads is expected to triple by 2040[7]. As we stand at this crossroad, it is evident that **Viksit Bharat needs future-ready roads that are intelligent, adaptive, and sustainable.**

1.India sets ambitious target to become a US$ 30 trillion economy by 2047, Ministry of Economic Affairs, July 2024.
2.How India can achieve rapid growth to achieve 'Viksit Bharat 2047' goal?,Charan Singh,Business Standard, February 2025.
3.Highways in India, Explore India's National Highways | IBEF, May 2025.
4.India needs to halve logistics cost from 14% of GDP to 7% to bridge competitiveness gap of USD180 billion, CII-Arthur D. Little report – Motorindia, August 2025.
5.GDP Growth Increase: 'Every rupee spent on highway construction leads to Rs 3.21 increase in GDP growth', ETInfra, January 2025.
6. India's Vehicle Ownership Set to Double by 2050: A Shift Towards Electric Mobility, Saurav Anand, ETEnergyworld, June 2025

2. The transformational power of AI in road infrastructure

Inherently complex in nature, road infrastructure development is multifaceted comprising of multiple inter-connected systems, dynamic interactions and scale. It interfaces with sectors such as railways, utilities, environment, and logistics, requiring synchronization, and is shaped by dynamic data inputs like traffic patterns, weather conditions, and population growth. This complexity is further amplified by the scale of development that spans across urban megacities to remote rural areas. **AI is poised to transform road infrastructure, not as a mere tool but as the intelligence layer on how roads are conceived, planned, built, managed and optimised**.

India's challenge is unique with a vast population, rapid urbanisation, increasing climate risks, and the ambitious vision of accelerating economic growth over the next two decades. To leapfrog constraints, we need to shift from **'hard'** infrastructure to building **'smart'** infrastructure – systems that are **connected, data-driven, and capable of predictive and prescriptive decision-making with AI its core.**

2.1 AI-driven integration across the project life cycle

Unlike traditional construction, operation and maintenance processes, where workflows are disconnected and decisions are static and reactive, AI introduces a layer of integration, continuous learning and adaptability.

Key applications of AI across project life cycle include:

- **AI in planning and design:** By analysing satellite imagery, LIDAR and 3D mapping, traffic simulations, and demographic growth patterns, AI can predict future mobility needs for new road infrastructure development or augmentation of existing ones. AI-enabled simulation tools can run scenario analysis and route iterations to arrive at optimised and efficient road alignments. Further, AI can be leveraged for generating road designs tailored to specific site requirements such as topography, land use, traffic patterns and ecological considerations. By embedding data into planning, design and decision-making, the foundation is being laid for a transport network that is smart, efficient and adaptive to future needs and challenges.

  In India, the apex government authority overseeing national highways has adopted a data-driven strategy to shape the future of road infrastructure. By integrating cross-sectoral datasets such as GDP projections, toll transaction records, and rail freight statistics and layering them with existing infrastructure assets on the PM Gati Shakti platform, big data is being harnessed to align network planning with the nation's development vision for 2047[8]. This approach can be further enhanced using ML (Machine Learning) algorithms for infrastructure mapping via the PM Gati Shakti platform. Such integration could enable precise forecasting of traffic trends and infrastructure requirements, supporting the creation of a robust origin-destination matrix.

  From upstream capital planning to asset operations, AI-enabled digital twins can be used to drive better infrastructure decision-making by providing more intelligent scenario planning and options analysis. For example, a digital replica of a roadway with sensors to monitor road traffic, could help operators identify existing traffic bottlenecks, enabling future decisions that help reduce traffic, wait times, and redundant investments.

- **AI in construction:** Data collected from drones, robotic equipment, and project management information systems/tools form a rich foundation for intelligent decision-making. When layered with AI capabilities, this data can be leveraged for automated project scheduling, resource optimisation, real-time quality control, compliance monitoring and predictive analytics. Leveraging this integrated approach enables more efficient, timely and high-quality infrastructure development.

8.Vision 2047 Master Plan: MoRTH has adopted a big data driven approach to infra planning, says Nitin Gadkari, Anoop Verma, ET Times, February 2025.

High-resolution image data collection through drone surveys have been mandated on national highways in India, for remote monitoring and management of highway assets. This is further strengthened by the data analysed through an AI-powered analytics platform, that utilises ML algorithms applied to orthomosaic imagery. The platform delivers automated feature extraction, actionable insights on road construction progress, and pavement maintenance conditions, serving as a centralised dashboard, for enhanced portfolio visibility and data-driven decision-making[9].

- **AI in operations and maintenance:** Intelligent traffic management, toll automation, pavement condition assessment, and predictive maintenance systems ensure roads remain efficient throughout its design life. AI systems are being trained to interpret data from IoT-based sensor devices, helping detect pavement, structural issues early. From maintenance point of view, AI-powered image analytics can identify defects on the road such as potholes, cracks, other pavement distress, faded road markings, or damaged signboards. AI models can also help forecast future maintenance needs by analysing large datasets, to predict how infrastructure could deteriorate over time.

  Several private sector organisations in the road sector have already begun adopting, and many government authorities are actively exploring to adopt AI-enabled smartphones/360-degree cameras/dashcam-based pavement surveys to assess the condition of roads in compliance with IRC (Indian Road Congress) guidelines and help relevant authorities prioritise repairs leveraging GIS, AI and predictive analytics. This is a low-cost mode to conduct faster surveys, inventorisation of geo-tagged assets including street furniture. This enables data-driven predictive maintenance, digital twin integration, proactive and informed maintenance budgeting, improved transparency, safety, and life cycle cost efficiency.

  However, large-scale deployment can face device inconsistency, lack of standard capture protocols, and integration issues with existing systems. Data-heavy uploads, skill gap in this area and privacy risks could add to the complexity. A policy/national level protocol defining hardware specs, SOP for the survey including standard data formats, and distress classification aligned with IRC can ensure uniformity.

2.2 Harnessing data and AI for productivity and system efficiency in road development

Infrastructure projects in India have been grappling with cost overruns, project delays and suboptimal quality owing to inefficiencies in planning, execution and maintenance as one of the key contributors. Data-backed digital technologies coupled with AI could improve construction productivity by 20 per cent[10], a game-changer for Indian infrastructure industry, where delays often cost billions. Data and AI-driven analytics serve as a powerful enabler in enhancing productivity, improving system efficiencies, and driving better outcomes across the road development life cycle.

For example, engineers can monitor kilometers of roads laid against planned schedules by monitoring data from IoT-aided construction equipment, and proactively forecast potential productivity lapses before they become critical bottlenecks through deep learning techniques. AI predictive maintenance tools also help maintain machinery, reducing the likelihood of downtime, or accidents that can affect productivity. New robotic systems with AI can also help. For example, when semi-autonomous bulldozers are used to prepare jobsites, workers are freed for other tasks.

Beyond productivity tracking, AI-enabled analytics can enable predictive planning helping anticipate material requirements, reducing time spent on material selection and quoting, streamlining supply chain through inventory assessment and optimisation, assess labour demand, and equipment cycles with greater accuracy, thereby reducing wastage and cost overruns.

9. NHAI Policy guidelines/ Miscellaneous/2024 Policy Circular No. 18.98/2024, October 2024.
10. Construction Safety: 5 Statistics Everyone in the Industry Should Know, Grace Ellis, April.2024.

Some of the innovative AI-driven technologies for productivity enhancement in road sector are:

- **Automated and Intelligent Machine-Aided Construction (AI-MC) system for increased productivity and quality:** An authority of the Government of India responsible for national highways development and maintenance has implemented AI-driven construction quality assurance technology, AI-MC system, that integrates GPS-guided machinery, real-time data analytics, and digital twin technologies to ensure precision and accountability. Key technologies in AI-MC include use of GPS-aided motor graders, intelligent compactors, stringless pavers along with the integration of digital twin.

  The authority has recently introduced this technology through an AI-MC policy for ensuring efficiency and quality of construction in highway projects[11] after carrying out pilot projects. Typically, premature pavement failure in newly constructed roads is primarily contributed by workmanship issues (79 per cent) and material related factors (21 per cent)[12].

  Traditional compaction testing methods cover less than 1 per cent of the actual compacted roadway area, whereas intelligent compaction (IC) technology enables real-time measurement across 100 per cent of the compacted surface, ensuring more comprehensive and consistent quality control. The benefits are multifold, assured quality, consistent compaction to design standard, real-time compaction map and measurable records.

- **Digital twins for collaboration and communication:** Virtual replicas of roads enabling real-time monitoring of progress and resources that continuously learn from real-world data, improve collaboration and communication within the project teams. Once operational, digital twins support predictive maintenance by continuously monitoring road conditions, assets, traffic flow, and structural health, thereby reducing downtime and enhancing safety of road users. It also supports in improving efficiency by integrating the gathered data with AI-based simulations, optimising the traffic flow, and reduction of congestion hotspots.

  An example of application of digital twin-based AI application during maintenance phase can be seen in the U.K., where a leading authority is developing digital twin-based road network as a part of U.K.'s Digital Road Strategy 2025, for utilising the real-time data for predictive maintenance, thereby reducing the frequency and impact of disruptions on road networks[13].

  Additionally, the U.K. government along with a globally renowned university established a dedicated centre of excellence for technology-enabled infrastructure. This interdisciplinary collaboration among industry experts, academics, and policymakers laid the foundation for a Digital Built Britain framework, offering both policy and practical insights to harness digital twin technologies for smarter infrastructure management[14].

  The State of Victoria, Australia created a coalition of the willing and invested AU USD37.4million to set-up the digital foundation and enable collaboration between the government, industry and community through shared open data, technology and algorithms[15].

- **Equipment and fleet optimization:** Telematics and AI models can analyse usage patterns, failure history, fuel consumption, and idle time to improve equipment productivity and reduce costs. Predictive maintenance for machinery minimises breakdowns and downtime by identifying early signs of wear and tear.

  A leading global mining company has established a maintenance centre of excellence to analyse data from its machinery to predict equipment maintenance needs, improving the maintenance of trucks at several of its sites, saving USD5.5 million in costs at one mine alone. It uses ML algorithms to analyse equipment component-level failure history and analyse the wear and tear on engine components in real-time, enabling it to better predict failures and to plan maintenance in advance, with greater degree of accuracy and improved efficiency[16].

11. Adoption of Automated Intelligent and Machin- aided Construction (AI-MC) in National Highway Projects, June,2025.
12. Adoption-of-Automated-Intelligent-Machine-aided-Construction (AI-MC)-16122024 -hoisted.pdf, MoRTH,,December 2024.
13. National Digital Twin Programme, DigitaL Road Strategy, National Highways U.K, August 2025.
14. Gemini Papers | Centre for Digital Built Britain completed its five-year mission and closed its doors at the end of September 2022, Joe Daye, October 2022.
15. Digital Twin Victoria, Victoria State Government: Department of Transport and Planning, August 2025.
16. BHP saves $5.5M by predicting mining truck maintenance requirements with machine learning, Best Practice Artificial Intelligence Ltd., August 2025.

- **AI agents** in the form of copilots, chatbots or voice-enabled virtual assistants can be used to help road construction professionals automate repetitive tasks such as preparing daily progress reports, or maneuver complex workflows like coordinating multi-agency permit approvals. Further, these agents can also perform more intuitive roles such as extracting critical activities from schedules and devising mitigation strategies or managing resource allocation across dispersed project sites.

2.3 AI for enhanced road safety

India records over 5 lakh road accidents every year[17], and nearly 29,000 fatalities have been recorded due to accidents on national highways in just the first half of 2025[18]. AI can make roads safer by identifying root causes and addressing the issues upfront. Integrating AI with existing platforms like all-in-one road user mobile apps, helpline, and e-DAR (e-Detailed Accident Report) into a unified integrated data source can create a faster, smarter incidence response management system.

For example, AI can process distress calls or app alerts, combine them with live traffic and location data, identify grey spots, hotspots (accident prone zones) and automatically dispatch the nearest patrol or ambulance, sometimes even before congestion builds up. This approach turns data into action, ensuring quicker help, fewer accidents, and safer roads for everyone. Further, the road user safety can be ensured by AI-enabled collision avoidance and lane keeping assistance[19].

Some enabling technologies to aid rich data capture from projects are:

- **Computer vision:** Drone/dashcam/CCTV camera feed (images/videos) powered by AI can detect missing road furniture, erratic driving pattern, and lane indiscipline, helping issue real-time alerts.
- **Smart IoT sensors:** Embedded IoT sensors in roads can detect structural weaknesses, underlying pavement condition, weather condition impacting road safety and feed data into predictive AI models.

This fusion of AI and infrastructure can help India target its ambitious goal of halving road fatalities by 2030 under the UN Decade of Action for Road Safety[20].

2.4 AI for enhanced customer experience

In the digitally connected world, customer expectations around mobility and infrastructure services are evolving faster. Traditional approach of user engagement one-size-fits-all is no longer sufficient to meet the demand of the modern road users who expect real-time information and seamless experience.

AI offers a transformative opportunity to shift from static service delivery to dynamic, data-driven engagement. By harnessing real-time data from vehicles, mobile devices, sensors, and infrastructure, AI can anticipate user needs, optimise travel experiences, and proactively address issues before they impact the customer. Enabling technologies for data aggregation and near real-time experience are as follows:

- **Smartphones and mobile applications for crowdsourcing relevant user data:** Several government departments in India have developed and implemented mobile applications that source data on quality and condition, congestion, user facilities etc. on roads tagged by road commuters. AI algorithms applied on this data can then assess maintenance requirements on road, integrate re-routing/most optimum routing based on road condition or even produce more complex outcomes like estimate how road condition shall affect user's fuel consumption[21] .
- **AI powered sentiment analysis:** Data on user feedback, grievances and sentiment is available for consumption on multiple platforms. Aggregation tools can gather feedback from diverse channels such as social media posts, official forums, emails and public comments on specific roads with AI-based sentiment analysis for targeted response, actions to address public pain points. Further, the loop can be closed with personalised automated communications crafted to meet the expectations of the users using interactive virtual assistants.

17.Road accidents cause more than 3 per cent loss in GDP, says Nitin Gadkari, Annapurna Rai, The Week, April 2025.
18.In first six month of 2025, over 29,000 die in national highway accidents, more than 50% of last year: Govt data, Dheeraj Mishra The Indian Express, August 2025.
19.Artificial Intelligence in the Road Sector: A PIARC Special Report, PIARC, February 2024.
20. Nitin Gadkari Reaffirms India's Commitment to Drastically Reducing Road Accidents by The Year 2030, PIB, February,2020.
21.A system approach to implementation of predictive maintenance with machine learning, Ye Chen, Massachusetts Institute of Technology, 2018.

2.5 AI for sustainability and Net Zero goals

India has pledged Net Zero by 2070. Roads, being carbon-intensive, must contribute to this vision. AI can drastically reduce the environmental impact by minimising wastage of material such as concrete, steel, and asphalt, green route planning while alignment finalisation that reduce deforestation, energy-efficient mobility by enabling traffic flows that cut idle time, reducing fuel consumption and emissions, integration with EVs and renewables, smart charging corridors and solarised highways can transform transport into a greener ecosystem. Some enabling technologies can be:

- **Building Information Modelling (BIM):** For life cycle carbon modelling using BIM-based platforms for simulating carbon emission across the project life cycle and evaluating embodied carbon in construction materials and low-carbon alternatives.
- **Smart energy and water management sensors:** For renewable energy integration such as solar-powered lighting, smart water meters for tracking water usage, and detect leaks during construction, and maintenance.
- **Satellite and remote sensing technology:** For data on land use, vegetation cover to assess ecological impact.

2.6 Citizen-centric governance

Roads are built to serve citizens. Embedding public trust in data governance requires a strong focus on transparency, safety, data privacy, user rights, and user-centric responsiveness. Some of the broader measures to drive this could include:

- AI systems must have mechanisms for user grievance redressal. For example, if congestion feels unfair, users must have a way to share the feedback instantly and responded to with due justification and action on ground.
- Accessibility matters for citizen centric applications such as AI tools must support regional languages to ensure that every citizen, regardless of literacy level or language preference, can engage meaningfully and confidently.
- Regular independent audits of AI systems to ensure they serve public interest, not just commercial efficiency.
- Policies supporting citizen rights around data privacy, safety, and transparency in AI decisions must be rolled out.

Making AI work for India's roads – from vision to action

India's roads and highways sector stands at a pivotal moment in its economic journey, poised to enter a transformative era defined by AI-powered decision-making, smart mobility solutions, and digitally connected infrastructure corridors.

To fuel this momentum, an ecosystem of enabling policies, institutional frameworks, strategic alliances and partnerships that can steer, regulate and scale innovation effectively are the need of the hour. AI is no longer just a technological tool; it is emerging as a lever for national development. Recognising AI as a transformative force and a new factor of production in infrastructure development, the government is also embracing AI, evident in initiatives like the 'IndiaAI Mission' with budgetary allocation approved by Union Cabinet, and the establishment of centres of excellence for AI.

In a nutshell, the Government must take a lead in creating a **collaborative digital and data ecosystem** – one that cultivates market trust, and is underpinned by common policies, standards and legislations. This effort also requires upfront investments and centralised coordination to provide the platform and AI use cases that unlock shared value. Since **individual organisations may currently lack the incentive, capacity, or authority to drive the systemic reforms needed, government leadership is essential to catalyse and sustain this transformation.**

This section delves into the imperatives necessary to translate the vision of AI into actionable outcomes for India's road sector. It outlines the strategic steps and interventions required to operationalise this transformation.

3.1 Governing AI enablement on roads

India's road infrastructure ecosystem is vast including central and state authorities, logistics ministries, and private concessionaires. Without a clear data framework and digital strategy in place, AI deployment risks could be fragmented.

A strong institutional model could include:

- **Dedicated national AI CoE** for road sector under the apex body to be tasked with standard-setting, monitoring, and ensuring interoperability across ITS components, AI algorithms, and traffic management platforms.
- **Sandbox/development environment** for startups and private players to conduct testing of AI tools under the aegis of IndiaAI mission.
- **State-level data and AI mobility cells** to empower and guide state governments to adapt AI frameworks for regional needs aligned to the overall AI vision for the sector.
- Define **AI-enabled roads framework** (sensor enabled corridors, digital twins, V2X backbones such as vehicle-to-vehicle, vehicle-to-infra, vehicle-to-network etc.) as critical infrastructure enabler ensuring government oversight.
- **Ramp-up data center infrastructure** in the country with the rising demand in AI workloads and government focus on localisation of data.

3.2 Data governance and unified data library

AI-enabled roads can constantly interact with project professionals, engineers and road users including the service providers on roads.

Key elements that can be prioritised to foster a responsive road ecosystem include:

- **Data governance** with clear rules on ownership of data.
- AI algorithm and outputs must be explainable and auditable.
- **Streamline data aggregation and integration** initiatives to develop datasets tailored to the Indian context, ensuring they are readily accessible for AI research, training, and modeling. **Whitelisting of AI stacks** can significantly accelerate India's AI mission by ensuring interoperability, trust and security.
- **Robust cyber security** must be embedded in the **intelligent infrastructure** for zero exposure of data to adversary situation.
- **Institutionalise real-time AI-driven compliance audits** across projects to enhance transparency, reduce leakages, and improve efficiency.

3.3 Financing the smart and intelligent AI-enabled roads

Promoting AI in the roads sector demands sustained investment in technology, data systems, data storage and associated infrastructure. This effort must be backed by innovative financing models, attractive government schemes, and initiatives to incentivise and accelerate AI adoption. Government's commitment to this cause is evident through dedicated schemes and programmes launched that offer financial and technical support to start-ups working on cutting-edge technologies such as IoT, AI/ML, blockchain, and robotics.

Policy enablers can include:

- **Public Private Partnerships** like toll concessions, can evolve to include **private players managing technology services** including AI systems, sensors, and analytics. This model can democratise access to AI and accelerate innovation.
- Establishing **incubation centers that finance and mentor ecosystem** of contractors, consultants innovating AI-led systems, and technologies to address key business challenges in the road sector.
- **Skill-linked incentivisation programmes** for infrastructure owners, contractors, start-ups, OEMs for AI-enabled solutions in the road sector to promote quality execution, safety compliance, and innovation adoption.
- **Green financing instruments** such as infrastructure bonds for digital roads, and highways.
- A government-backed **corpus dedicated for innovation for startups** for affordable AI-based road solutions.
- **AI-incentivisation clauses** in contracts to prioritise vendors who use AI to improve service delivery, such as faster turnaround.

3.4 Building an AI-ready workforce

To accelerate the integration of AI into India's roads and transport infrastructure, it is essential to build institutional capacity and foster collaboration. Some of the strategic actions that can support this cause are:

- Introduce **specialised AI-in-infrastructure degree programs, certifications, and fellowships** in collaboration with leading national technical and management institutes, along with AI-in-roads initiatives through dedicated training academies and research institutions in the road sector, aimed at equipping engineers, planners, and policymakers with expertise in AI applications.

  A leading global university in U.K. has launched a fellowship programme which will explore how digital twins, smart materials, data science, and robotic monitoring can work together to develop a connected physical, and digital road infrastructure system.
- Establish a **national centre of excellence for AI-in-infrastructure, jointly led by government, academia, and industry**, to promote Research & Development, best practices, and standards.
- Mandating **AI labs** at all premier **technical education institutes, research centres, Central and State authorities,** and dedicated funds for Research & Development.
- **Industry-academia collaboration** to run **capstone programme** on AI use cases and carrying out pilots.

3.4 Building an AI-ready workforce

Developing an AI-ready workforce is not just an academic imperative, it is a strategic necessity for organisations across the infrastructure value-chain. Organisations need to cultivate a workforce equipped to design, deploy, and manage AI technologies in infrastructure contexts through investing in targeted capacity building initiatives.

Some of the actions that can be taken include:

- Invest in **industry-led training programmes** that can equip teams with **practical AI skills**.
- Encourage **experiential learning opportunities**, such as **embedding AI-driven pilot projects** that address real-world business challenges. These can be conducted with leading technology partners in the AI ecosystem.
- For infrastructure organisations whose core operations do not traditionally involve AI, establishing **dedicated AI champions or specialised teams (AI CoEs)** can be instrumental. These internal advocates can lead the charge in identifying use cases, fostering innovation, and ensuring that AI adoption aligns with organisational goals and operational realities.

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Pooja Patel

KPMG in India contacts:

Akhilesh Tuteja
Head – Client and Markets
E: atuteja@kpmg.com

Sushant Rabra
Partner, Business Consulting
Digital Solutions – Strategy & Insights
E: srabra@kpmg.com

Suneel Vora
Partner, Business Consulting
Lead – Major Projects Advisory,
Co-lead Industrial Automation Intelligence
and Digitalisation
E: suneelvora@kpmg.com

Ashutosh Kapoor
Partner, Business Consulting
Major Projects Advisory
E: ashutosh@kpmg.com

Chinmayee Pradhan
Director, Business Consulting
Major Projects Advisory
E: chinmayee@kpmg.com

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KPMG Assurance and Consulting Services LLP, Lodha Excelus, Apollo Mills Compound, NM Joshi Marg, Mahalaxmi, Mumbai – 400 011 Phone: +91 22 3989 6000, Fax: +91 22 3983 6000.