AI, AR, & Robots: How Cutting-Edge Tech Is Powering India's Bullet Train Project

ETV Bharat / technology

L&T is using advanced tech—including AI, ML, AR, VR, LiDAR, drones, and robotics—to speed up the construction of the bullet train project.

The bullet train in India will operate at a speed of 320 kmph (ETV Bharat Creative with input from IANS and L&T)

By Mohammad Faisal
8 Min Read

Hyderabad: The Mumbai Ahmedabad High Speed Rail (MAHSR) Project is rapidly progressing towards completion, driven by innovative construction methods and technological advancements, such as AI (artificial intelligence), ML (machine learning), LiDAR (Light Detection and Ranging), AR (augmented reality), VR (virtual reality), robotics, drones, and more.

Popularly known as India's first Bullet Train Project, the 508 km-long corridor will connect Mumbai in Maharashtra with Gujarat's Ahmedabad, reducing travel time between the two cities from 7-8 hours to around 2-3 hours. In addition to redefining intercity travel with a super-fast, safe, and reliable mode of transportation, the project is expected to act as a catalyst for growth, investment, and regional development in Ahmedabad.

Japan’s role: Technology and train

Japan is playing a key role in India's bullet train project by providing both financial assistance and technical expertise. In a recent announcement, it confirmed the delivery of two Shinkansen train sets (E5 and E3 series) as inspection vehicles to India at no cost. Currently undergoing trials in Japan and scheduled to arrive in India in early 2026, these vehicles will allow India to test the MAHSR corridor once construction is complete and gather essential operational data, particularly addressing India's distinct environmental challenges, such as high temperatures and dust.

The Shinkansen bullet train races past the Mount Fuji in Japan (File Photo: IANS)

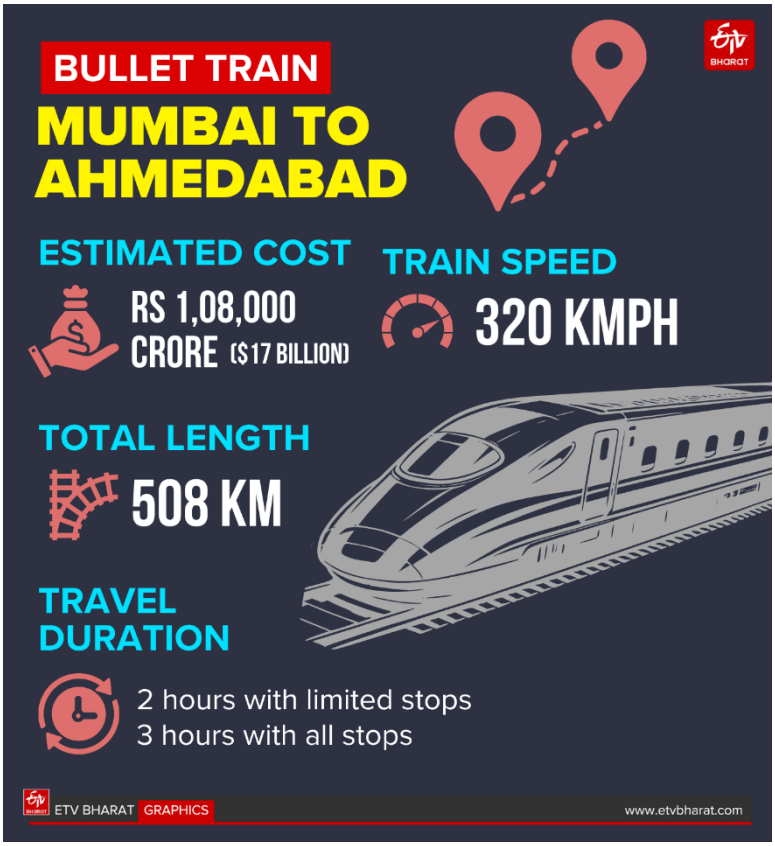
This data will also help guide India’s eventual production of the next-generation E10 series Shinkansen trains under the “Make in India” initiative. Meanwhile, Bengaluru-based defence PSU (public sector undertaking) Bharat Earth Movers Limited (BEML) is set to manufacture indigenous trainsets by September 2025, slated for speed testing on the Mumbai-Ahmedabad corridor by December 2026.
The adoption of Japan's Shinkansen track technology allows India to build a high-speed rail system that offers a fast, stable, and safe travel experience. In Japan, this technology has been the backbone of their rail network for decades, and India is leveraging its proven efficiency. This system incorporates seismic design standards, aerodynamic features, and measures to reduce noise and vibration to ensure a smooth and reliable journey.

Indian conglomerate executes track construction

Larsen & Toubro (L&T) is a key player in delivering India's first high-speed rail corridor and is implementing Japanese Shinkansen technology here, including the precast slab track system for high-speed train operation. Known for its specialisation in large industrial and infrastructure projects, the Indian multinational conglomerate is handling a significant portion of the bullet train project via multiple key contracts that cover civil construction, electrification, trackworks, and depot development across Maharashtra, Gujarat, and Dadra & Nagar Haveli.

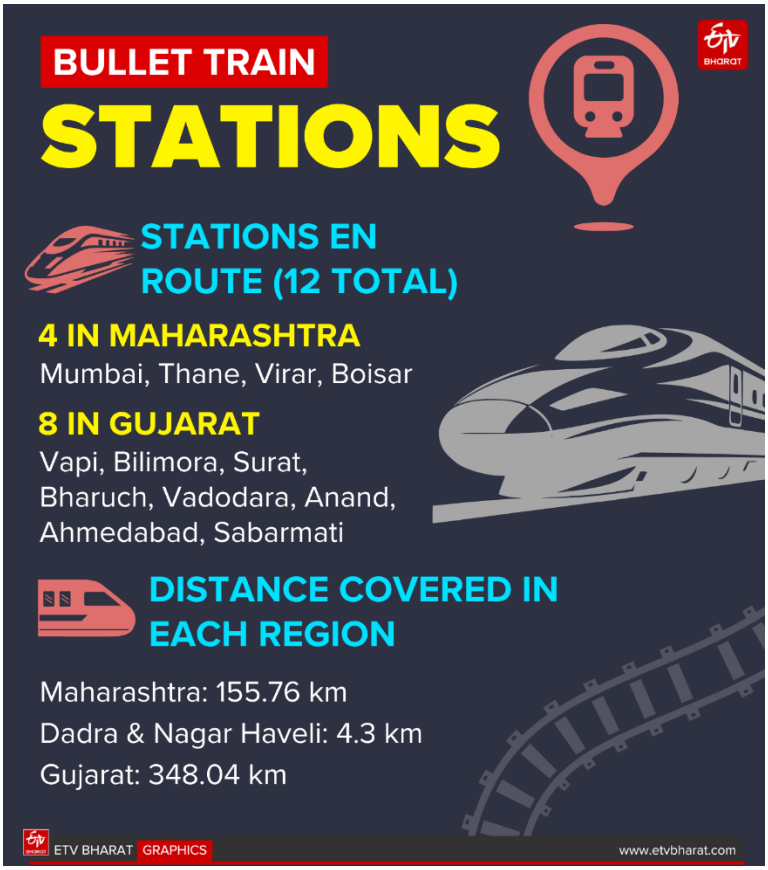
"L&T's scope of work includes construction of civil and building works for Double Line High Speed Railway involving viaducts, bridges, maintenance depots, tunnels, stations, etc., and finally handing over to other Interface contractors," SV Desai, Whole Time Director & Senior Executive Vice President (Civil Infrastructure), L&T told ETV Bharat.

"Out of the approximately 466 km of the MAHSR package being executed by L&T (around 331 km in Gujarat and 135 km in Maharashtra), we will be handing over approximately 318 km in Gujarat to other Interface contractors by December 2025," he added.



Bullet Train Project at a glance

Asia's biggest Full-Span Casting Yard (Image Credits: L&T Construction)



Bullet Train stations on the Mumbai Ahmedabad High Speed Rail Line

Use of digital technologies in the project construction

L&T is utilising digital technologies, such as AI, ML, LiDAR, AR, VR, drones, robots, and IoT-enabled sensors, to increase "efficiency, accuracy, and safety" throughout the construction and survey processes, Desai said. "*These technologies collectively enhance efficiency, reduce costs, and improve overall project outcomes by automating repetitive tasks, providing real-time insights, and ensuring high-quality standards*," he added.

Desai told ETV Bharat that aerial LiDAR technology, utilised for the first time in an Indian railway project, enabled the topographical survey of 118.55 square kilometres within just 15 days—a task that would have required 60 days using conventional methods. He highlighted that this geospatial technology provides several advantages, such as pinpoint accuracy, rapid data acquisition, reduced human dependence, independence from weather conditions, high data density, broad accessibility, and cost efficiency.

The 47km stretch from Bilmora to Surat (Image Credits: L&T Construction)

By using lasers mounted on a fixed-wing aircraft, supported by precise GPS (Global Positioning System) and INS (Inertial Navigation System), LiDAR captures point cloud data at 0.5 m intervals to derive detailed topographic features, DEM (Digital Elevation Model), and DSM (Digital Surface Model), providing a

comprehensive understanding of the surveyed area, Desai said while highlighting its environment-friendly aspect.

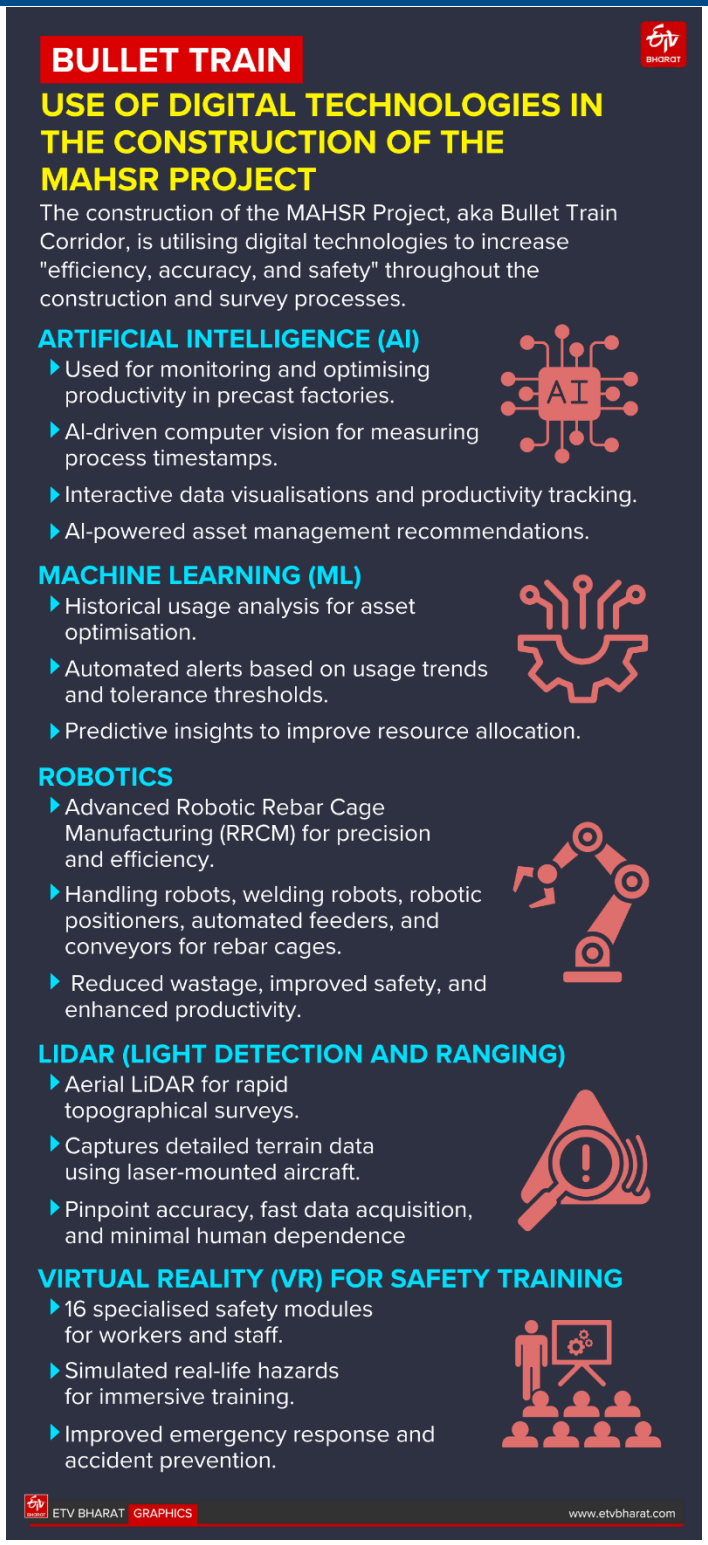
The executive said that the technologies employed aim to monitor and optimise the productivity and processes of a precast factory. “It includes tracking the start and end times of each activity, analysing the impact of labour and equipment on cycle times, and using AI (computer vision) to measure process timestamps for various components,” he explained.

Role of digital technologies in the construction of MAHSR Corridor

Additionally, he noted that the approach provided interactive visualisations of data points categorised by bay, shift, and subcontractor, along with options for downloading reports in Excel and PDF formats. The key parameters displayed included production count, mould ID and status, timestamps, duration between start and end times, vendor-wise productivity, mould-wise productivity, and asset utilisation.

Meanwhile, the utilisation of AR and VR is to train workers and engineers on Shinkansen-specific tasks, which include track installation and electrification systems, simulating real-world risks to improve preparedness and safety.

Desai highlighted the “crucial role” of this technology in safety training through 16 specialised modules, which help both staff and workmen understand the importance of safety across various activities, including working at heights, crane and lifting operations, excavation, and more, he said.



“VR provides an immersive, risk-free environment where users can experience real-life hazards and learn proper safety protocols. This hands-on approach enhances retention, improves emergency response, and reduces workplace accidents. By simulating real-world risks, VR ensures better preparedness, making safety training more effective and efficient for all workers involved in the project,” he added.

Desai also highlighted the importance of adopting advanced robotics to improve precision and safety in manufacturing. Speaking to ETV Bharat, he explained that the Advanced Robotic Rebar Cage Manufacturing unit (RRCM) integrates various robotic systems, including handling robots, welding robots, a robotic positioner, automated feeding stations, feeders, sorters, and conveyor systems, all managed by a central unit to streamline the production of rebar cages.

MAHSR to cut travel time between Mumbai and Ahmedabad to 2 hours

"This system ensures precise synchronisation of four robotic arms for flawless welds, uses pneumatic fixtures for gripping various rebar shapes, and employs automatic feeders for continuous production," Desai said, adding that the RRCM significantly boosts productivity, with a capacity to produce 25,000 rebar cages per month.

He noted that the unit enhances product quality by maintaining zero tolerance for errors, reduces wastage by 99.99 per cent, improves safety by minimising manual intervention, and lowers environmental impact by reducing carbon emissions.

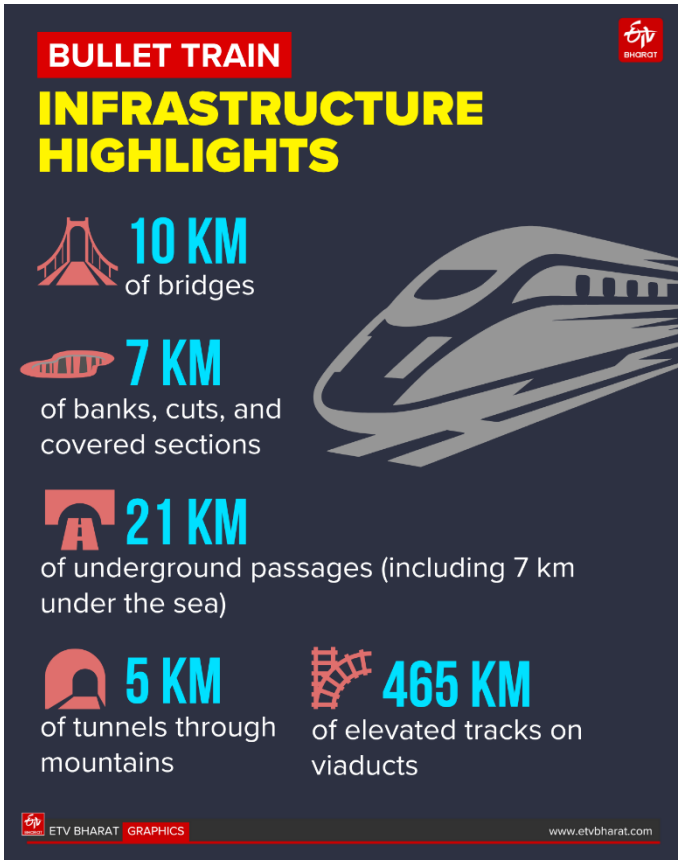
"These innovations collectively boost efficiency, reduce costs, and improve overall project outcomes," Desai said.

The integration of digital technologies into the construction of MAHSR Project is supported by L&T's other novel construction techniques to accelerate the project, which include the use of first full-span

erection method, straddle carrier to handle full span precast girders, ingenious full span launching method (FSLM) for rapid installation of precast segments, a new concrete supply system, and noise barrier casting—helping the National High-Speed Rail Corporation Limited (NHSRCL) achieve a major milestone of completing 300 km of viaducts along the 508 km route.

Project scope, timeline, and coverage

The MAHSR project, with an estimated cost of Rs 1,08,000 crore ($17 billion), will have 12 stations en route upon completion, including four in Maharashtra and eight in Gujarat—Mumbai, Thane, Virar, Boisar, Vapi, Bilimora, Surat, Bharuch, Vadodara, Anand, Ahmedabad, and Sabarmati. The corridor will span 155.76 km in Maharashtra, 4.3 km in Dadra & Nagar Haveli, and 348.04 km in Gujarat.



The bullet train on this line will operate at a speed of 320 kmph, covering the entirety of the distance in 2 hours and 7 minutes with limited stops and in 2 hours and 58 minutes with all stops.

The 508 km rail line will feature 10 km of bridges, 7 km of banks, cuts, and covered sections, 21 km of underground passages (including 7 km running under the sea), 5 km of tunnels through mountains, and 465 km of elevated tracks on viaducts.

Early operations likely in Gujarat

The first phase of the bullet train project—a 50 km stretch between Surat and Bilimora in Gujarat (two stations)—is supposed to become operational by 2026 for the trial run and begin commercial operations in 2027. New reports citing NHSRCL documents suggest that officials are eyeing a commercial run of the bullet train from Sabarmati to Vapi in Gujarat, covering all eight stations in the state, by 2028. The report does not clarify whether this plan expands upon the previous one or represents a complete revision.

Initially, commercial operations for the entire 508 km stretch between Sabarmati and Mumbai were projected to begin by 2028. However, delays due to the COVID-19 pandemic, land acquisitions, and other challenges in Maharashtra have seemingly pushed the timeline further. According to new estimates, the bullet train—already expected to be operational in Gujarat by 2028—will gradually extend its service to Mumbai by 2030.

More high-speed corridors in the pipeline

While the bullet train project is still under construction, the Ministry of Railways has identified seven high-speed rail corridors as part of the National Infrastructure Pipeline (NIP). These proposed routes include:

- Delhi–Varanasi: 813 km
- Delhi–Ahmedabad: 872 km
- Mumbai–Nagpur: 767 km
- Mumbai–Hyderabad: 671 km
- Chennai–Bengaluru–Mysuru: 464 km
- Delhi–Chandigarh–Amritsar: 476 km
- Varanasi–Howrah: 752 km

These corridors are part of India's broader plan to develop a high-speed rail network, similar to the MAHSR Project. The NHSRCL has been tasked with preparing Detailed Project Reports (DPRs) for these proposed routes.

Read it online: https://www.etvbharat.com/en/!technology/ai-ar-and-robots-cutting-edge-tech-is-powering-india-bullet-train-mahsr-project-enn25060402101