

EQUIPMENT TIMES

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INNOVATION UNDERGROUND

HOW TECHNOLOGY IS
TRANSFORMING MINING SECTOR

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At Vedanta, **TECHNOLOGY** is a transformative catalyst for enhancing **PRODUCTIVITY, SAFETY,** and **EFFICIENCY.**

How do you view the role of technological transformation in reshaping the mining industry in India?

India is transforming rapidly, with technology driving efficiency, sustainability & global competitiveness and Vedanta is proud to be at the forefront of this evolution. As demand for critical minerals surges, the metals and manufacturing sector must scale responsibly. At Vedanta, we see digital transformation as the foundation of this shift, leveraging automation, AI, predictive analytics, cloud platforms, IoT, and real-time data to boost productivity, optimize resources, and enhance safety, all while aligning with global environmental and social standards.

To catalyze innovation, we launched V-Spark Deeptech Ventures, a corporate accelerator designed to integrate startups in deep tech directly into Vedanta's core businesses. Through this, we are collaborating with over 150 startups on more than 250 technology-driven projects.

The program including technology, product development and commercial partnerships empowers startups to create scalable, sustainable impact, both within Vedanta's operations and beyond. Solutions from V-Spark are already operational in Vedanta Aluminium and Hindustan Zinc Limited, driving measurable improvements in safety, productivity, and sustainability.

By pairing digital innovation with a future-ready culture, Vedanta is strengthening India's self-reliance and global leadership in responsible mineral production.



Which technologies (automation, AI, IoT, digital twin, drones, predictive analytics, etc.) do you see as the most impactful for mining operations?

Vedanta places strong emphasis on advanced digital tools, with drones emerging as one of the most transformative technologies. Our digital strategy integrates these technologies across operations, decision-making systems, and organizational culture to drive performance and sustainability.

Drones now play a pivotal role in our mining ecosystem. At Vedanta Aluminium, drones are extensively used for high-resolution mine-mapping, aerial surveys, tailings dam monitoring, and environmental compliance, ensuring operational safety and reducing human-machine exposure. This complements our AI-driven predictive maintenance with over 1,500 sensors and AI-powered computer vision for safety and productivity. Further, drones support equipment inspections and logistics planning, working alongside our Digital Smelter solutions to optimize energy use and reduce waste.

These innovations work

alongside IoT networks, digital twins, and robotics, drones enhance situational awareness, operational efficiency, and safety, establishing new standards in responsible, future-ready mining.

Could you share specific examples/projects where technology has significantly enhanced productivity, safety, or efficiency?

At Vedanta, technology is a transformative catalyst for enhancing productivity, safety, and efficiency. Hindustan Zinc's tele-remote operations for underground mining enable surface-based control of underground loaders and drills via a high bandwidth optical fibre backbone infrastructure. At Rampura Agucha, the world's largest underground mine in Rajasthan, this innovation raised shaft hoisting capacity from 6,500 to 8,000 tonnes per day, eliminating the need for physical repositioning of operators underground. We've also deployed smart helmets, VR training simulators, and partnered with Epiroc to implement Collision Avoidance Systems, bolstering safety and automation in mixed traffic environments.

We have built end-to-end digital Logistics Control Towers for coal, alumina and bauxite with Machine Learning and OR (Operations Research) based mathematical modelling that have enabled Vedanta to do simulation-based planning, reduce costs and pilferages and improve efficiencies, impacting topline and enabling paperless operations.

AI, drones, digital twins, automation, and remote operations form an integrated tech ecosystem driving Vedanta's vision of safe, digital-first and sustainable mining.

How is your company leveraging technology to promote sustainability and reduce environmental impact?

At Vedanta, technology is central to our sustainability journey. We are advancing renewable energy integration with long-term power purchase agreements, aiming for 2.5 GW of round-the-clock clean energy by 2030.

Our digital tools optimize resource efficiency, reduce freshwater use, and drive circularity. In FY25, real-time effluent monitoring and Zero Liquid Discharge plants enabled us to recycle 86 billion litres of wastewater across our operations, enough to meet the annual water needs of nearly 400,000 Indian households. Biomass energy generation reached 650,000 gigajoules, powering around 50,000 homes annually.

Innovations like recovering battery-grade graphite from aluminium smelting waste, copper recycling pilots, and biodiversity restoration initiatives underline our ecological commitment. Hindustan Zinc's upcoming zinc tailings reprocessing plant at Rampura Agucha will recover valuable metals from tailings, advancing the circular economy.

IoT-based energy management systems at facilities like Lanjigarh refinery track



real-time energy consumption optimize power use and reducing greenhouse gas emissions. Tools like digital twins and predictive analytics improve resource efficiency by optimizing raw material use, reducing waste, and lowering water consumption

Through Vedanta Spark, we partner with startups to accelerate waste-to-resource and clean technology solutions, reinforcing our circular economy focus.

Do you see technological transformation as a catalyst in achieving carbon neutrality and ESG goals in mining?

Absolutely. Technology is a cornerstone of Vedanta's decarbonisation and ESG strategy. Our efforts are focused on expanding renewable energy adoption, accelerating digitalisation, and enabling clean fuel transitions across businesses.

For instance, advanced energy storage solutions are enabling stable renewable supply, while internal carbon pricing guides low-carbon project decisions. Innovation extends to Scope 3 emission reduction via battery-electric vehicles, LNG trucks, dry tailings tech, and partnering with global institutions for biodiversity management.

We have launched India's first low-carbon aluminium—Restora and Restora Ultra and Asia's first

low-carbon 'green' zinc, EcoZen. Vedanta's Hindustan Zinc was the first Indian metals company with climate targets validated by Science Based Targets initiative (SBTi) and is ranked the world's most sustainable metals & mining company by S&P Global for the second consecutive year. It's also the first Indian firm to join the International Council on Mining & Metals (ICMM), aligning with global ESG standards.

This blend of cutting-edge technology and strategic action powers Vedanta's mission to create lasting value while leading the transition to a low-carbon, responsible mining future.

How are digitalisation and automation helping in improving workforce safety in your mines?

Safety is non-negotiable at Vedanta, and digitalization is a key enabler of our "Zero Harm" vision. We use AI and IoT-enabled wearables, sensor systems, and predictive analytics to detect unsafe conditions in real time.

IoT-enabled predictive maintenance systems monitor equipment health in real-time and predict failures before they occur. Thermal cameras enable remote equipment monitoring, minimizing human-machine contact. Our Vihaan-Critical Risk Management program leverages technology for high-

risk task oversight, while the Suraksha Kavach initiative blends automation with behavior-based safety.

In underground operations, automated drilling and hauling boost productivity while keeping workers out of risk-prone areas. Digital emergency response systems ensure swift communication and action during critical events. Beyond mining, RFID inventory tracking and drone inspections improve visibility and reduce manual interventions. Together, these technologies reinforce Vedanta's unwavering commitment to a culture of safety.

What are the major challenges in implementing advanced technologies in mining operations?

The mining sector is undergoing rapid technological transformation. We do not see these as challenges, but as opportunities to further sustainable and efficient practices that use resources judiciously.

As technologies like automation, robotics, and AI mature, there is a growing industry imperative to minimise human intervention in high-intensity, process-driven environments - not only to enhance safety, but also to improve consistency, efficiency, and scalability.

However, implementing such systems at scale especially across complex, multi-site operations—requires robust digital infrastructure, seamless integration between equipment and platforms, and a workforce that is skilled in operating and interpreting intelligent systems. Technology adoption such as AI, robotics, or remote operations demands upskilling and reskilling that enables remote operation, autonomous decision-making, and predictive responsiveness, as well as builds a culture that embraces change. Regulatory updates and supply chain



resilience are crucial to support adoption.

At Vedanta, we partner with governments, academia, and technology providers to co-create solutions that ensure mining remains safe, sustainable, and future-ready.

How can the government, technology providers, and mining companies collaborate to overcome these challenges?

To unlock the full potential of metals and mining, India must prioritise domestic production and foster a collaborative ecosystem. Governments can enable this through supportive policies, strong infrastructure, fiscal incentives, and adaptive regulations for autonomous operations, renewables & circular practices and investing in critical infrastructure like digital connectivity and renewable energy in mining regions.

Technology providers must tailor modular, scalable solutions to local conditions and support workforce training, while mining companies pilot innovations, upskill talent, and share data to refine technologies. Partnerships with academia and startups can further localise innovation.

At Vedanta, we believe the way forward is collective, combining policy, technology, and operational expertise to make mining safer, greener, and future-ready.

As IME 2025 brings together global mining leaders and innovators, what are your expectations from the exhibition?

At Vedanta, we see IME 2025 as a valuable platform to exchange ideas, showcase innovation, and explore opportunities that will shape the future of mining. Our expectation from the exhibition is to engage with global leaders, policymakers, and technology providers to co-create sustainable and responsible mining practices. We look forward to discovering breakthrough solutions in digitalization, decarbonization, and safety that can further enhance efficiency while reducing our environmental footprint.

How significant is IME as a platform for showcasing and adopting new technologies for the Indian mining industry?

IME is a significant platform for India's mining industry as it brings global expertise, pioneering technologies, and innovative practices under one roof. By facilitating collaboration between industry leaders, policymakers, and technology providers, IME accelerates the adoption of sustainable practices and strengthens India's position in the global mining landscape. It is an opportunity to align innovation with responsibility and ensure that growth goes hand-in-hand with environmental stewardship. ■

- Vedanta Spokesperson