VIEW POINT

WORKFORCE SAFETY

Abstract

Mining enterprises are keen, but often struggle, to ensure worker safety amidst dangerous environmental conditions. To protect the human resource, their most precious asset, mining organizations must consider implementing solutions that enable granular visibility, real-time information, and remote operations. This paper explores how cloud, along with emerging technologies like AI and IoT, present a transformative opportunity for the mining industry to improve its safety, efficiency, and sustainability.

Infosys®
Navigate your next

Introduction

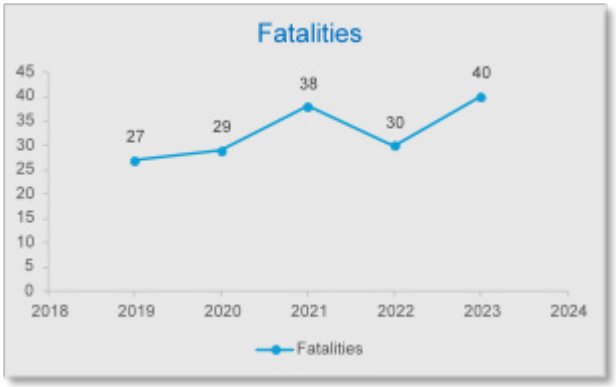
The mining industry has long been one of the cornerstones of our civilization. Mining supplies essential materials that support various industries, from construction to technology, that enable the economy – and the human race – to grow and thrive.

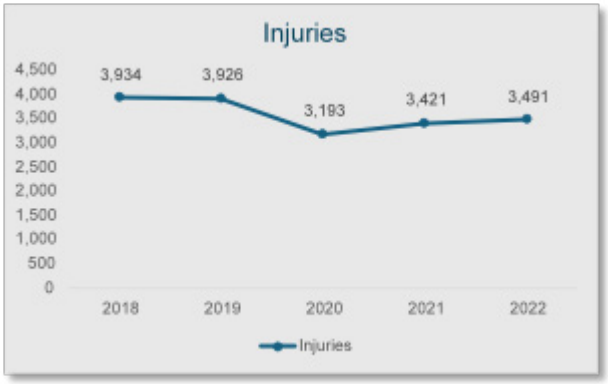
$ 2825.81 B In Revenue

The mining industry is projected to reach USD 2825.81 billion by 2028, growing at a compound annual growth rate (CAGR) of **5.5%**. This growth is driven by increasing demand for essential minerals that support global energy transitions, urbanization, and infrastructure development.

At the heart of the mining industry lies its workforce. Miners enable innovators across the globe to create sustainable solutions such as electric vehicles (EVs) and advancements in artificial intelligence (AI) chips. However, the industry itself is plagued by safety hazards and inefficiencies.

Over the last few years, there have been nearly 3,500 reported injuries and an alarming increase in fatalities in the mining industry[2].





Technologies such as cloud, AI, and the Internet of Things (IoT) present a transformative opportunity to improve safety measures and mitigate risk across mining operations.

The Importance of Workforce Safety in Mining

~20% of the Citations and Orders issued are marked as Significant and Substantial (S&S) for US Operated Mines

Mining remains one of the most hazardous industries globally, with workers being routinely exposed to dangerous conditions such as cave-ins, explosions, and exposure to toxic substances. Ensuring the safety of the workforce is not only a moral obligation but also a legal requirement for mining companies. Effective safety measures can significantly reduce accidents, improve productivity, and foster a culture of well-being.

Technology in Mining

Technology plays a pivotal role in enhancing efficiency, safety, and sustainability in the mining industry. Mining itself has evolved significantly since the early days of manual labor. Most mining enterprises are already using machinery, adopting automation, and establishing safety protocols to improve operations and secure their workforce. Now, with the advent of Industry 4.0, mining enterprises will witness further transformation through cutting-edge technological advancements, namely, IoT devices, AI, and cloud.

1. IoT sensors and drones – Data gathering devices

Mining operations generate large amounts of data through IoT devices that are used for monitoring environmental conditions, machinery performance, and personnel safety. These devices include:

- Environmental sensors that measure air quality, temperature, and humidity to ensure safe working conditions
- Wearable devices that track the location and health metrics of miners to adhere to safety protocols
- Equipment sensors that monitor the operational status and efficiency of machinery to predict maintenance needs and prevent failure
- Drones that perform real-time monitoring, provide accurate surveys and maps, and ensure safety through remote inspections and hazard detection

Such IoT devices can bring significant automation and real-time monitoring into mining operations, leading to improved safety and efficiency.

2. AI – Applications for assisted decision-making

AI is poised to help asset-heavy industries, such as mining, become safer as well as more efficient and sustainable by processing vast amounts of data in real-time. Some of the areas in which AI is driving transformation are:

Predictive maintenance – Machine learning models can analyze sensor data and predict equipment failure, thereby reducing downtime, optimizing repair costs, and extending machinery lifespan.

Resource optimization – Machine learning algorithms can analyze geological data to determine efficient techniques and identify high-yield areas. This helps optimize resource extraction and minimize waste, leading to more efficient resource use and reduced environmental impact.

Hazard detection – Analyzing sensor data to detect hazards like gas leaks and structural weaknesses can provide early warnings to the workforce.

3. Cloud – The integrator

The success of AI models depends on the quality, validation, and accessibility of data. This is where cloud technology plays an integral role. Cloud offers computing services such as servers, storage, databases, networking, software, etc., over the Internet or 'the cloud.' It provisions resources on-demand, thereby delivering scalability, flexibility, and cost-efficiency. This makes cloud enablement a core capability for addressing key challenges in the mining industry.

Cloud centralizes all the data on a single platform, making it easy for mining enterprises to institute and follow data quality rules, thereby assuring users that the data is relevant and readily available. Moreover, since the data is captured from different applications, users get access to a holistic view, which can generate powerful insights for smarter decision making. Consider how IoT sensors and drones deployed across mining sites can collect data on various parameters such as air quality, temperature, equipment status, and worker location. This data can then be securely stored on the cloud and analyzed in real time.

In fact, the integration of cloud technology with advanced analytics enables the application of predictive models to anticipate potential safety hazards. By analyzing historical and real-time data, mining companies can identify patterns and trends that may indicate an increased risk of accidents. For instance, they can quickly assess the state of the mine and identify potentially hazardous scenarios before sending miners in. Information from wearable devices such as watches and helmets can be collected, stored on the cloud, and analyzed in real-time to track miner health and generate timely alerts, thereby averting any adverse incidents.

Cloud-driven Worker Safety Solution

Technologies such as cloud, IoT, and AI equip mining enterprises with cutting-edge data management, analytics, and predictive capabilities to prevent workplace accidents and workforce injuries. Some of these use cases are discussed below:

Connected workers – Wearable devices such as IoT-enabled watches and helmets can be integrated to cloud to determine the location of each worker. These can also continuously monitor worker health, allowing leaders to make swift decisions such as issuing an alert or timely evacuation in case of any safety risk.

Remote operations – Cloud can support remote operations and automation of mining equipment. This reduces the need for an operator to be physically present in hazardous situations, thereby increasing worker safety.

Predictive maintenance – Mining equipment produces large amounts of data that can be collected over time and stored in the cloud. Patterns can be analyzed using AI models to predict when any machinery is likely to fail, allowing for timely maintenance and reducing the risk of equipment-related accidents.

Connected mines – Similar to connected workers, a network of sensors and IoT devices can be installed throughout the mine. These devices can periodically read and record environmental data such as air quality, temperature, and the structural integrity of mining tunnels. When analyzed in real-time, such data provides insights that can help build early warning systems for workers, thereby preventing accidents.

Training and knowledge – Online libraries and 'how to' videos can help workers stay updated at any time and on any device, thereby keeping them alert and prepared for potential issues.

The above list is not exhaustive. Numerous such use cases can be developed around the power of cloud, AI, and IoT in enhancing worker safety in the mining industry.

Case Studies

Several mining companies have successfully integrated AI, cloud, and IoT technologies into their operations. Some examples are listed below:

- **Rio Tinto**, a leading British-Australian mining group, implemented an autonomous haulage system using AI and IoT, achieving significant operational cost savings and improved safety.
- **BHP**, an Australia-based mining and metals company, leveraged AI-driven predictive maintenance to reduce equipment downtime by 20%, thereby enhancing overall productivity.
- **Anglo American**, a British multinational mining company, deployed IoT sensors to monitor environmental conditions. This has helped them comply with safety standards and reduce safety incidents by 30%.

These case studies underscore the tangible benefits of adopting advanced technologies in the mining sector.

Conclusion

As the mining industry continues to evolve, embracing cloud technologies will be essential in driving safety innovations and achieving sustainable success. By facilitating real-time monitoring, predictive analytics, remote operations, and automation, cloud solutions provide the first step to enhancing worker productivity and efficiency. With a mature cloud strategy, mining enterprises can confidently leverage other technologies such as AI and IoT to create a safer work environment for their most precious asset, the mining workforce.

About the Author

Avik Sarkar

Avik Sarkar is a Director of Cloud Economy and Industry Clouds for the SURE Segment with over two decades of experience. He has been pivotal in driving digital initiatives across Media, Finance, Energy, and Resources industries, guiding clients through digital transformation and accelerating digital adoption. He has led innovative initiatives in Sustainability Analytics, Carbon Calculation in Metal Procurement, Workforce Analytics, Cloud Adoption Roadmap Planning, Digital Maturity Assessments, and establishing Analytics Centers of Excellence. Throughout his career, he has demonstrated a unique ability to explore the art of the possible.

References

1. Mining Technology Insights (2025 & Beyond) | StartUs Insights
2. MSHA At A Glance | Mine Safety and Health Administration (MSHA)
3. The Impact of Industry 4.0 on the Mining Industry - Engineeringness
4. The Value of Smart Mining: Fuelling Innovation and Supporting the Canadian Economy - CENGN

For more information, contact askus@infosys.com

Infosys®
Navigate your next