

Safety and the human dimension



Mining has historically been one of the most hazardous industries, a reality that has shaped the sector's reputation for high risks and low margins of safety. Despite decades of progress in mechanisation, automation, improved ventilation, and the widespread adoption of personal protective equipment, accidents and occupational diseases remain serious and persistent concerns. Underground mining poses unique challenges because workers are confined to narrow spaces where they are exposed to unpredictable geological conditions, poor visibility, high temperatures, and dangerous gases. Beyond these acute risks are chronic health conditions that develop over time, including silicosis from prolonged inhalation of respirable dust, occupational hearing loss from exposure to high levels of noise, and musculoskeletal disorders resulting from heavy manual handling. The persistence of these problems highlights the complexity of mining safety and health, showing that technological improvements alone cannot eliminate them.

What is particularly striking is that many of these hazards are not new. Historical records show that mine heat stress, for instance, was a well-recognised occupational hazard in South African gold mines by the mid-twentieth century, where deep-level mining exposed workers to extreme geothermal heat. Decades later, despite significant research into mine cooling systems, refrigeration, and ventilation optimisation, heat stress remains a major challenge in ultra-deep mines worldwide. Likewise, dust-related diseases such as silicosis and pneumoconiosis were documented as early as the nineteenth century, yet miners in jurisdictions with strict regulation, including Australia and the United States, continue to suffer from such conditions. In some coal mining regions, cases of "black lung" have even re-emerged after being thought nearly eradicated. This persistence suggests that while engineering controls and medical surveillance programmes are critical, they cannot succeed without rigorous enforcement of standards, strong occupational health policies, and most importantly, a cultural commitment to safety.

Indeed, the evidence shows that accidents and diseases in mining often result from organisational and systemic failures as much as from technical limitations. For example, lapses in enforcement, inadequate training, or production pressures can undermine the effectiveness of safety measures. Worker participation is therefore vital; miners must not only be protected by technology but also empowered to identify risks, report unsafe practices, and influence decision-making without fear of reprisal. A culture of safety must be nurtured at every level, from corporate leadership down to the underground face worker. Without this cultural shift, even the most advanced safety systems risk becoming superficial or poorly implemented.

The rise of automation and digital technologies in mining presents a new chapter in this long struggle between hazard and safety. On one hand, the deployment of autonomous haulage systems, remote-controlled drilling equipment, and advanced real-time monitoring systems offers unprecedented opportunities to remove workers from high-risk zones. Technologies such as wearable sensors can track miner fatigue, monitor gas levels, and even detect hazardous movements, thereby reducing accidents. Drones and robotic inspection devices can be sent into dangerous areas before humans, minimising exposure to unknown risks. These developments, if integrated with strong safety systems, have the potential to revolutionise mining health and safety.

On the other hand, these same technologies introduce new challenges. Automation can displace traditional jobs, leading to unemployment or underemployment in mining-dependent communities. The shift toward digital mining requires new skill sets, including expertise in programming, data analysis, and systems management, which many mining regions, especially in developing countries, are not equipped to provide. Without adequate reskilling programmes and community investment, technological advances may exacerbate social inequality, leaving behind the very workers they were meant to protect. Furthermore, automation can introduce new categories of risks, such as cybersecurity vulnerabilities in mine control systems or over-reliance on complex technologies that can fail under certain conditions.

Safety in mining, therefore, cannot be considered in isolation from broader social justice concerns. Protecting workers underground must go hand-in-hand with protecting the wellbeing of mining communities on the surface. Social sustainability to ensure that workers have meaningful employment, access to healthcare, education, and economic opportunities remains central to the true advancement of mining safety. Ultimately, while technology can reduce exposure to hazards, it is strong regulatory enforcement, cultural transformation, and inclusive community engagement that will determine whether the mining industry can overcome its long history of danger and fulfill its responsibility to both workers and society.

M. Onifade