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Beyond Compliance: Elevating Process Safety Consciousness in Mining and Minerals Processing

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ABSTRACT

Mining and minerals processing continue to suffer catastrophic failures—tailings dam collapses, toxic releases, structural failures, hydrometallurgical upsets—that mirror the worst disasters in oil, gas, and chemical industries. Yet the sector still relies on personal-safety metrics and compliance checklists as proxies for catastrophic-risk control. This is scientifically indefensible. The industry cannot credibly claim to be safe while repeating preventable, system-level failures that destroy lives, communities, ecosystems,

and trust.

Elevating process safety consciousness is now a strategic imperative. It requires a fundamental shift in leadership mindset: from counting injuries to understanding energy, barriers, and failure modes. This shift must integrate the Centre for Chemical Process Safety (CCPS) Risk Based Process Safety (RBPS) framework, the IChemE Safety Centre's Seven-Element Framework, and the International Council on Mining and Metals (ICMM) Critical Control Management Framework (CCMF) across the entire lifecycle.

Leadership must prioritise catastrophic-risk exposure—not Lost Time Injury Frequency Rate (LTIFR), Total Recordable Injury Frequency Rate (TRIFR), or isolated lagging indicators such as Loss of Primary Containment (LOPC). Mining

Comparative Focus for the Webinar

	Mining & minerals		Oil, gas, chemical, pharma
Typical major hazards	Tailings dams, tailings lines, dust, toxic metals, confined spaces fires/explosions in plants	Tailings dams, tailings lines, dust, toxic metals, fires/explosions in plants	Catastrophic fires, explosions, toxic gas releases explicitely
Historical incident pattern	Catastrophic fires, explosions, toxic gas releases; explicitly framed as "process safety" failures		
Process safety maturity Improving. but uneven: CCM, engineering, and geotech often not fully integrated with RBPS	Improving but uneven: CCM, engine-eering, and geotech often not fully in-tegrated with RBPS	Catastrophic fires, explosions, toxis gas releases explicitely framed as "process	Decades of structured RBPS, standards, KPIs and learning cultures (still imperfect)
Regulatory expectations	Often fragmented by mining, environment and work	Typically, more codified major hazard regulations and PSM	Typically, more codified major hazard regulations and PSM frameworks
Opportunity	Embed RBPS and critical aontrol thinking across lifecycle	Continue strengthening but also export lessons and	Continues strengthening but also export lessons and tools into mining

must embrace inherently safer design, rigorous hazard analysis, human factors science, consequence modelling, barrier-health monitoring, and digitalisation as a tool for predictive assurance, not as a technology fad.

Other high-hazard industries transformed only after disasters forced codified Process Safety Management (PSM), HAZOP/LOPA/SIL methodologies, and robust leading indicators. Mining's hazards are equivalent in energy and consequence; what is missing is discipline, integration, and accountability.

This paper calls for urgent action:

- *Adoption of RBPS-aligned frameworks tailored to mining.*
- *Independent verification of safety-critical elements, including tailings facilities.*
- *Mining-specific process safety indicators elevated to board-level oversight.*
- *Cross-sector collaboration between IChemE, ICMM, CCPS, regulators, and practitioners for which the M-Cube Monograph may be a strong foudnation.*

The cost of waiting is measured in lives lost and trust destroyed. The industry must move beyond compliance and embrace scientifically grounded, systemic process safety, now

KEY WORDS

Mining Process Safety; Risk Based Process Safety; Critical Control Management; Human Factors; Digitalisation; Tailings Governance; Leadership.

BIOGRAPHY

Adjunct Professor Michael Akindeju is Chair of the Institution of Chemical Engineers (IChemE) Mining and Minerals Special Interest Group and a distinguished engineering leader whose expertise spans mineral processing, engineering biology, advanced process design, and innovation in complex industrial systems. He is Principal Consultant at MKPro Group, where he delivers high-impact solutions across biotechnology, energy, and manufacturing sectors, and Adjunct Professor at the Institute of Innovation, Science, and Sustainability, Federation University Australia.

A Fellow of both IChemE and the Royal Australian Chemical Institute (RACI), Chartered Engineer, and Registered Professional Engineer, Professor Akindeju is widely recognised for integrating scientific insight with practical engineering to drive sustainable, technology-enabled transformation. His work bridges industry and academia, with a strong commitment to strengthening sector capability, advancing research translation, and mentoring the next generation of engineers through his professional and educational contributions.

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