EIT HEI Initiative

Innovation Capacity Building for Higher Education

European Institute of Innovation & Technology

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Mining industry & Intelligent Technologies

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T. 5.1.5 Embedded Intelligent Technologies for the mining and raw material sector

26th April 2023

Content:

Mining at a glance

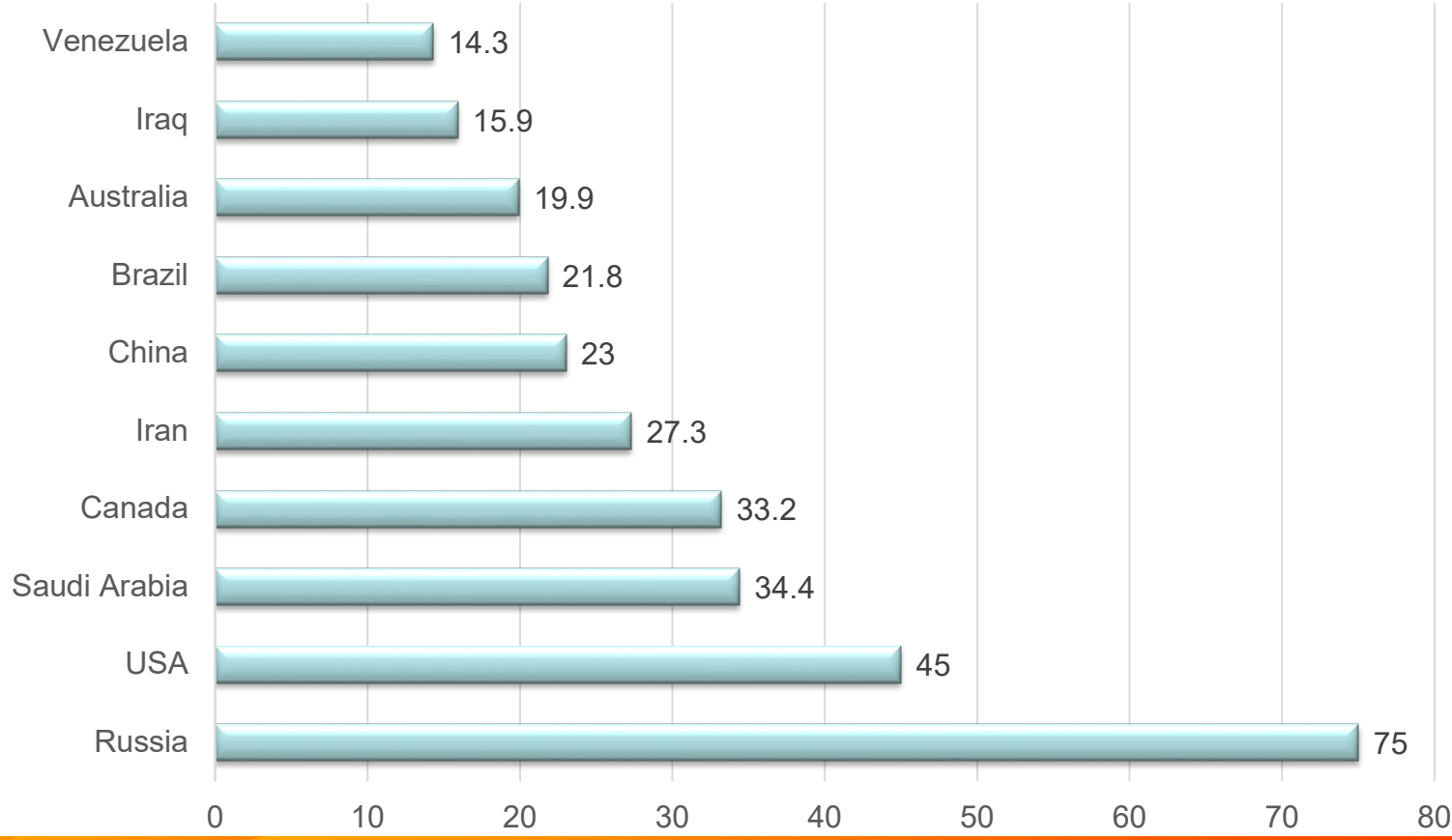
- What's under the ground is a national asset
  Resulted with: state ownership of mining companies; more-than-usual involvement of the state in the licensing of mining companies; the regulation of the sector; fiscal and financial matters; taxation, fees, and investments in supporting infrastructure

- A "footprint industry"
  Environmental, Social, Economic impact

- A priority area for foreign direct investment
  Many developing countries pose high risks for foreign investors. Mining operations in these countries, with their export orientation and dollar-based cost and revenues, are often the first ones to present an acceptable risk reward formula to investors

- A large source of government revenues
  In some mining countries, up to 25 or 30 percent of fiscal revenues rely directly on the mining sector

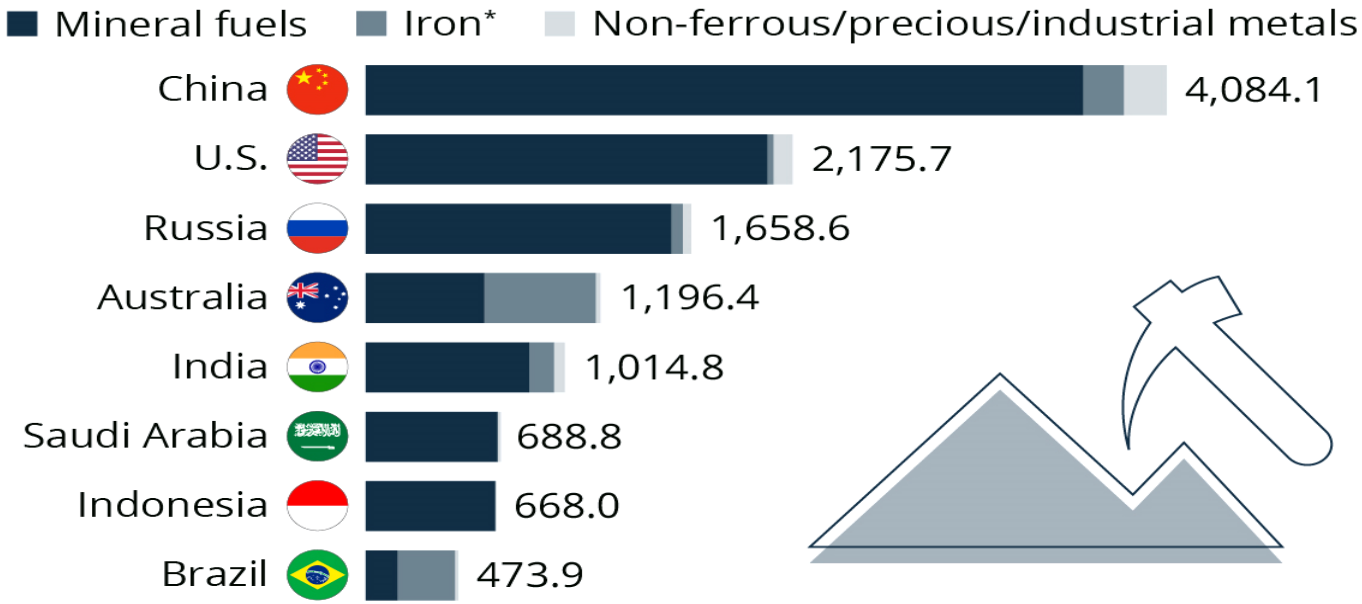
Countries by natural resources value in trillion US$



Source: Mining

The Countries that are the Biggest Miners in the World

Extraction of mining products in 2018 (in million metric tons), by country



* Including ferro-alloys

Source: International Organizing Committee for the World Mining Congresses

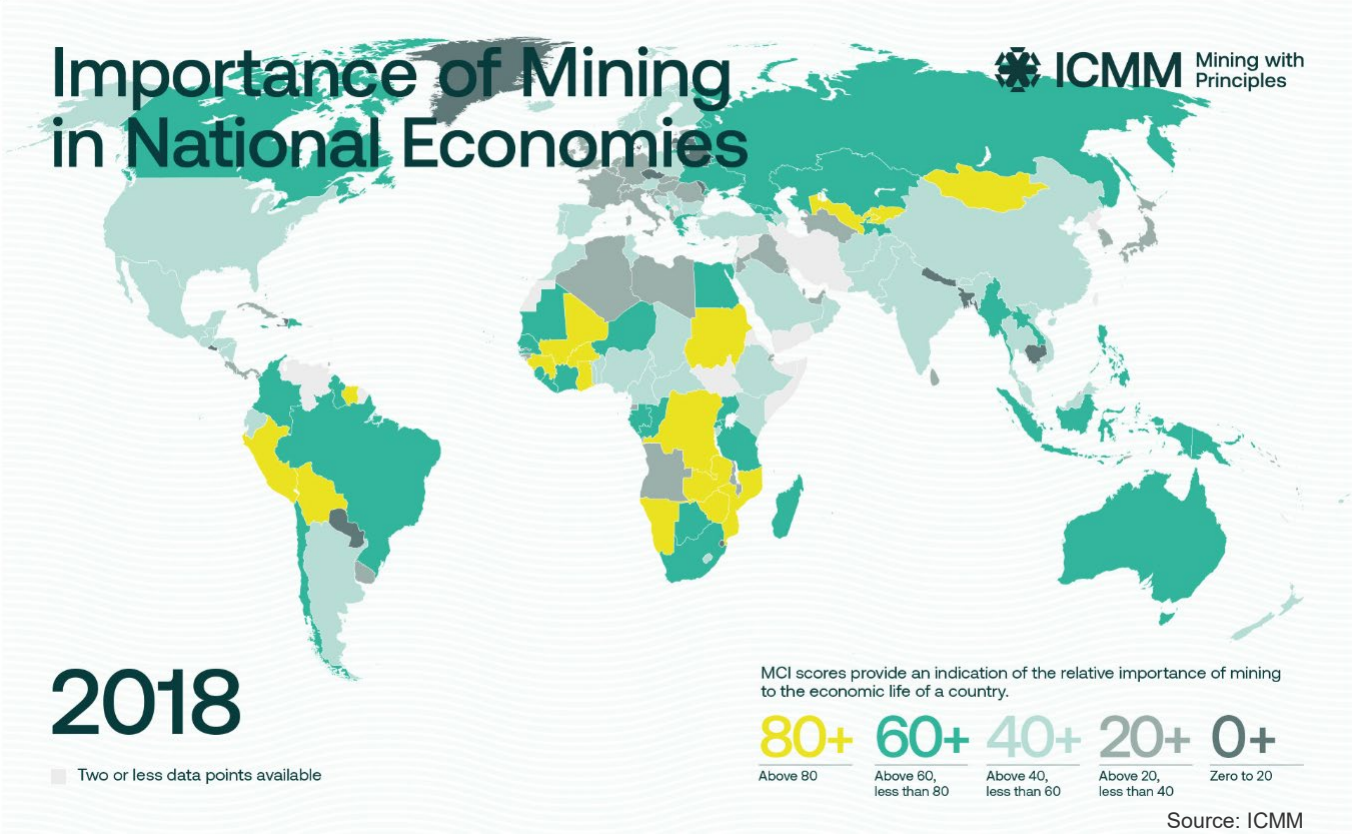
statista

Mining Contribution Index (MCI) to Country Economies

ICMM's Mining Contribution Index (MCI) synthesizes into a single number – and an associated ranking – the significance of the mining sector's contribution to national economies.

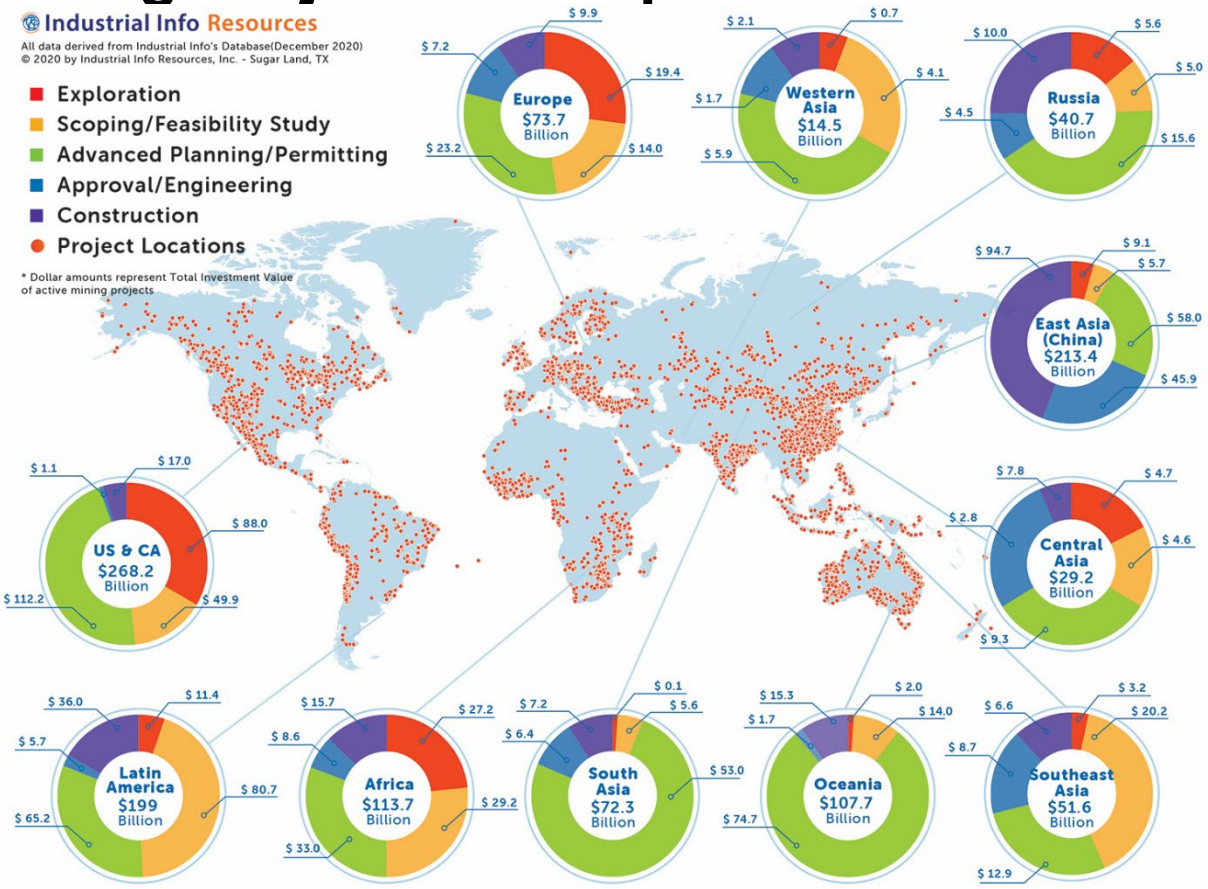
This provides an indication of the relative importance of mining to the economic life of a country based on four indicators:

1. exports of minerals including coal as a share of total merchandise exports
2. the total production value at mine stage of metallic minerals, industrial minerals, and coal, expressed as a percentage of GDP
3. mineral rents as a percentage of GDP
4. exploration expenditure.



Source: ICMM

Global Mining Project Development

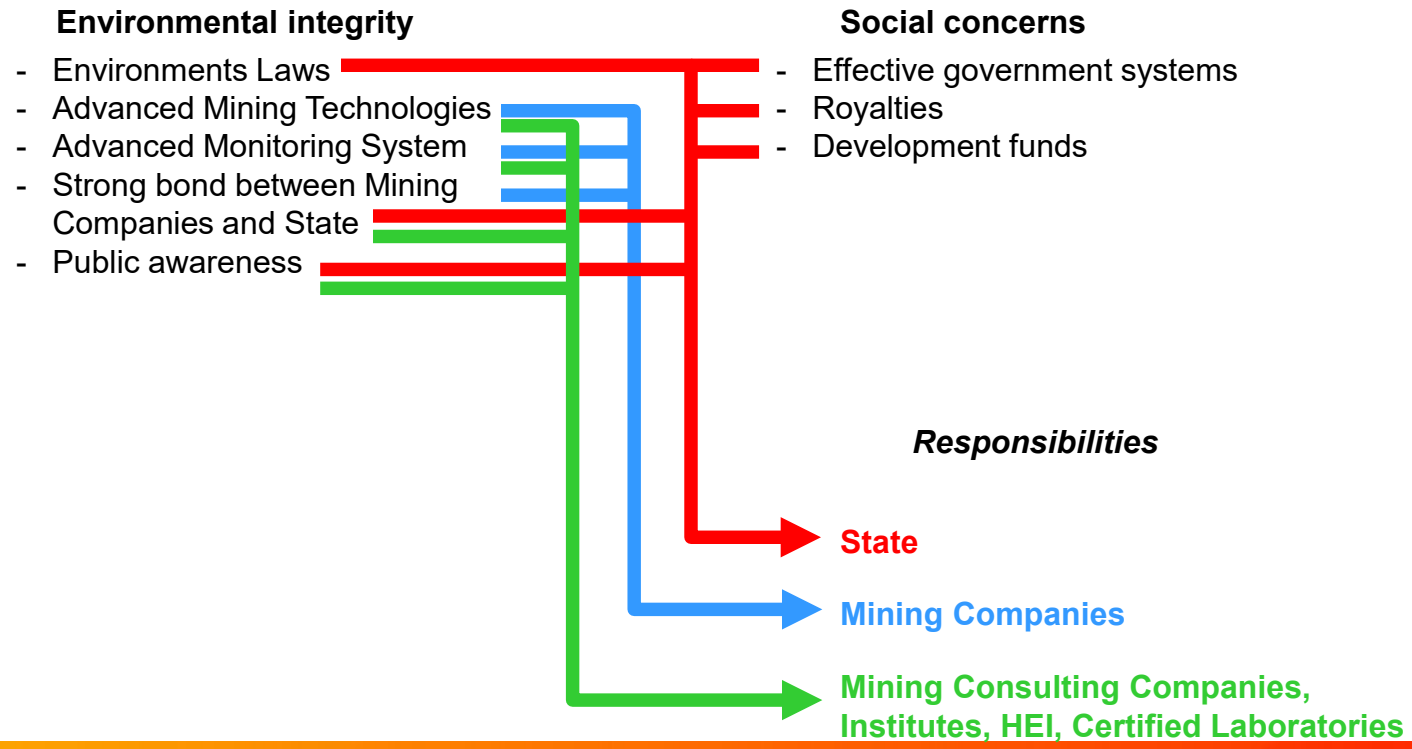


Source: E&MJ

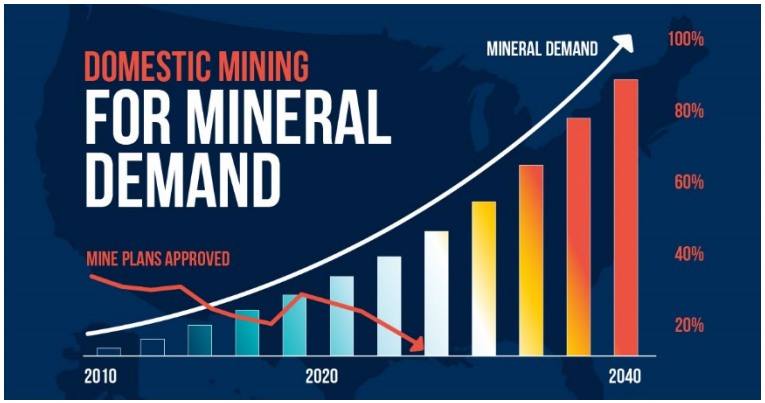
Mining Sustainability

Sustainability - development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Principles - Integrated economic mining activity based on instruments of:



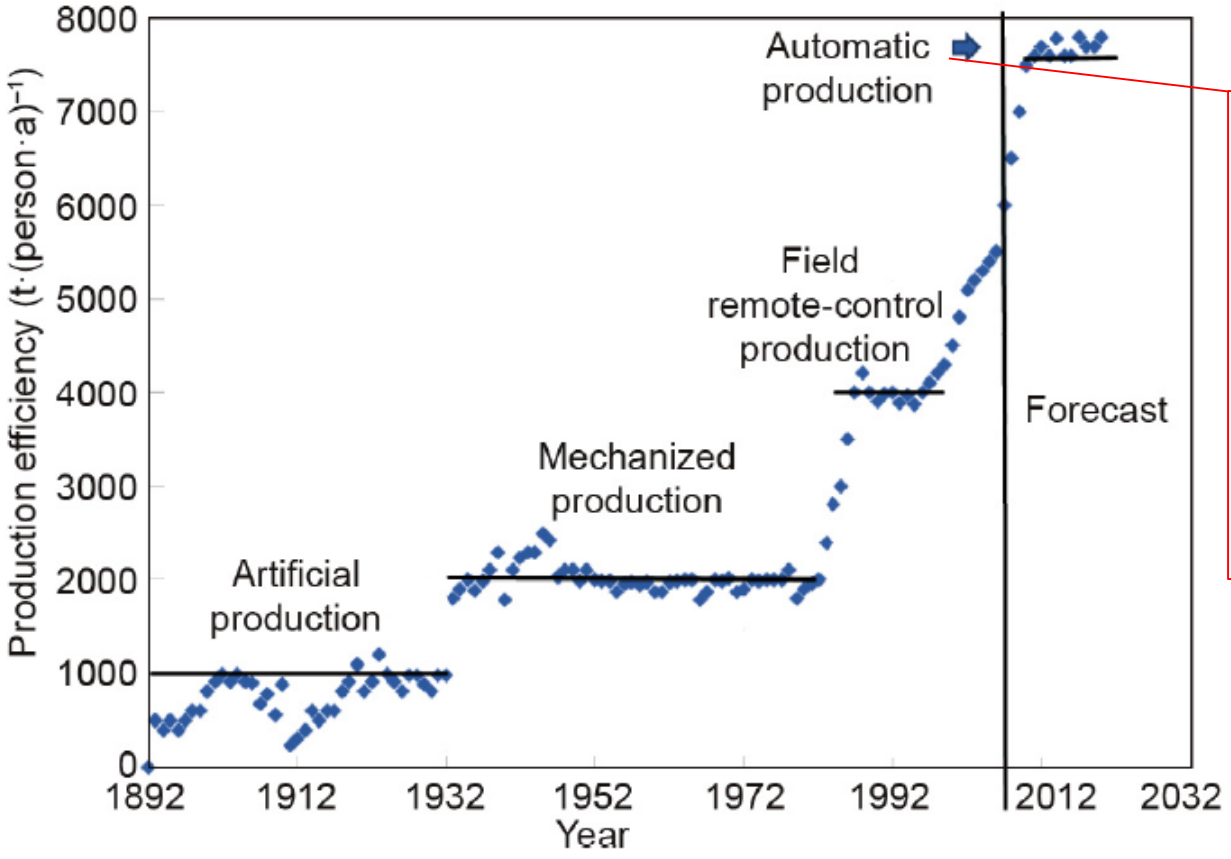
Mining Industry Status



Source: NMA

- Advanced Mining and Mineral Processing Technologies implementation
- New Workforce Profiles
- Intelligent Technologies implementation for Planning and Operations
- Advanced Monitoring System
- Strong bond between Mining Companies, Institutes, HEI, Entrepreneurs
- Public awareness

Intelligent Technologies in Mining & Production

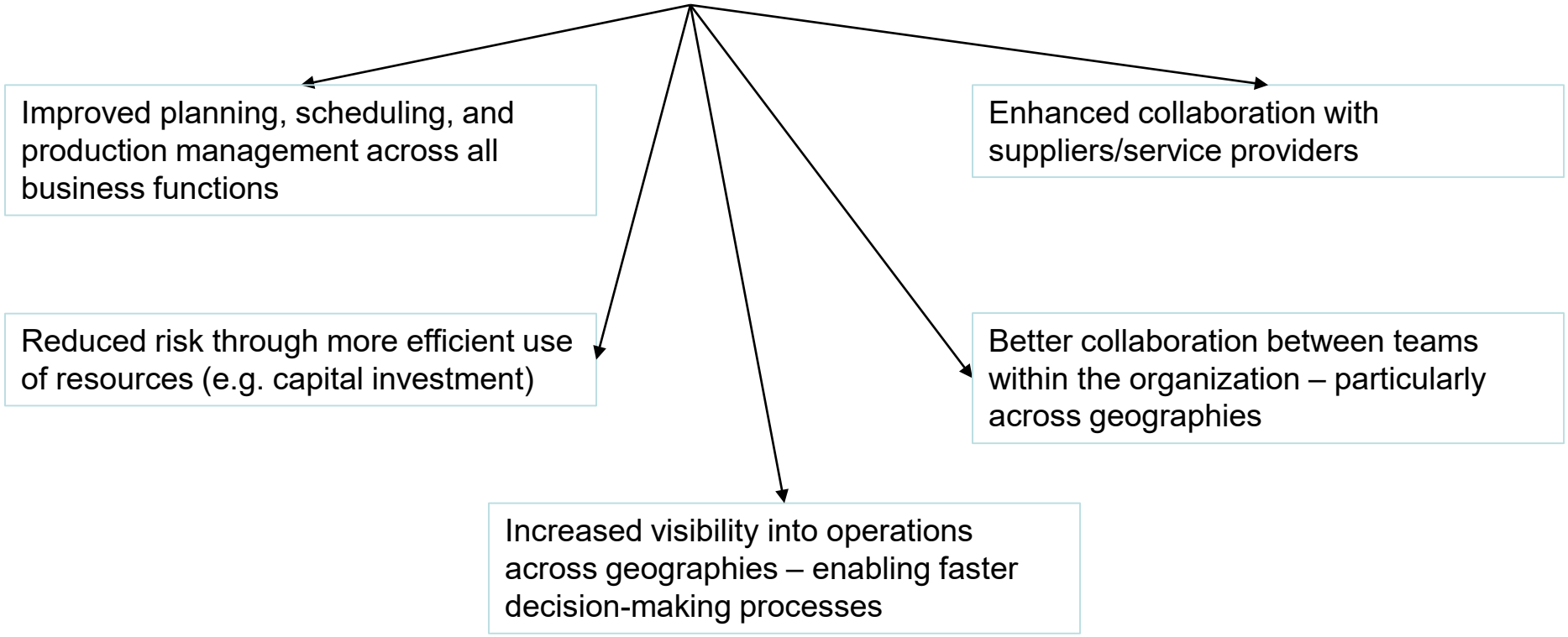


Technologies based on:

- Precise, reliable, and accurate decision-making
- Production process management through real-time monitoring
- Mine production maintained at the optimum level
- Improved mining efficiency and economic benefits
- Green and safe mining

Source: Jian-guo Li, Kai Zhan, Intelligent Mining Technology for an Underground Metal Mine Based on Unmanned Equipment

Global digitalization impacts on mining industry



Challenges in mining digitalization

Comprehensive change in entire value network including all players involved in producing, processing and supplying minerals. The huge diversity means that it must be open to new technologies and solutions from various providers. This will facilitate collaboration on developing solutions for digitalization, including standards for data exchange between systems, which are necessary for integration within an end-to-end digital value chain.

Additional staff training, new experts profiles or support services

Comprehensive change in mine planning processes, operations and mining management systems, supply chain management systems, corporate governance frameworks, investor relations processes, risk management frameworks, internal controls, remote monitoring applications and workforce safety practices

Modifying business models: fostering ecosystem-wide collaboration, creating strategic alliances, and investing in multi-tiered talent development and research activities

Complying with regulatory requirements such as security and privacy standards

Management processes need to be adapted so that they can take full advantage of the opportunities offered by digitization. While technology offers ways to overcome barriers and unlock opportunities for operational efficiency, it also introduces new challenges

The initial cost can be prohibitive

Intelligent Technologies in Mining - Most Important Benefits

1. Reducing operational costs

- Wireless monitoring → Smart Mines
- Key assets are digitized through embedded sensors that relay data to a central system via a wireless network
- Saving money on human labor
- Operators use an Operational Intelligence (OI) solution and are able to better predict incidents and more consistently maintain their sites
- Saving a lot of money by avoiding incidents which can entirely halt operations for weeks or months
- Higher ROI (Return of Investment) and more competitive than traditional mines

Intelligent Technologies in Mining - Most Important Benefits

2. More easily automate operations

- Static and moving assets remote control
- Automated interaction between connected assets
- Continuous processes monitoring
- Momently response and adjustment of process parameters
- Easy upgrading and changing of assets

Intelligent Technologies in Mining - Most Important Benefits

3. Keep the workforce safe

- Removes the need for humans onsite, especially on dangerous locations
- Predictive analysis and insights through OI solutions, allow better foresee and prevent dangerous incidents
- Workforce-tracking, through wireless-connected wearable devices, helps to coordinate workers more effectively and, for example, warn them not to go to certain areas of the site if there has been, or is expected an incident
- Hugely reducing the possibilities for human harm in mining processes in the long-term, diminishing the rate of mining incidents through using new technologies as a primary predictive-maintenance tool

Intelligent Technologies in Mining - Most Important Benefits

4. Monitor operational assets

- Allow predictive maintenance and fast reactions
- Remotely and constantly monitor of operational assets through OI
- Replacing of costly manual readings of critical operational data which may have a huge effect in short period of time with real-time digital data capturing

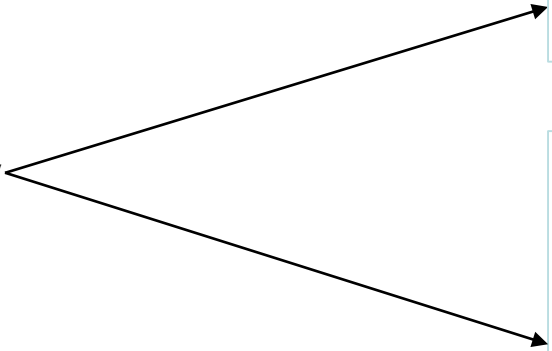
Intelligent Technologies in Mining - Most Important Benefits

5. Ensure long-term maintenance of critical assets

- Many components, such as wireless embedded sensors and GPS trackers, are both easy to install and to maintain
- Recording units for wireless monitoring are generally classified as “ultra-low-power”, meaning that their batteries can provide long continuous operation
- Digital mining components, notably geophysical sensors, are designed to withstand the often extreme physical working conditions of mines without being damaged or degraded
- Long-lasting and hardy, saving mining operators both time and money on technology systems maintenance

Intelligent Technologies in Mining - Most Important Benefits

6. Ensure data security



Protective of data in case of an incident or accident

Protecting of data through employing on-premise data acquisition systems, which help to avoid a breach because wireless network of geophysical sensors is concentrated in an area on the site being monitored. By this way hackers cannot reach the network and that the crucial data that operators need to monitor remains within close reach.


Coffee Break

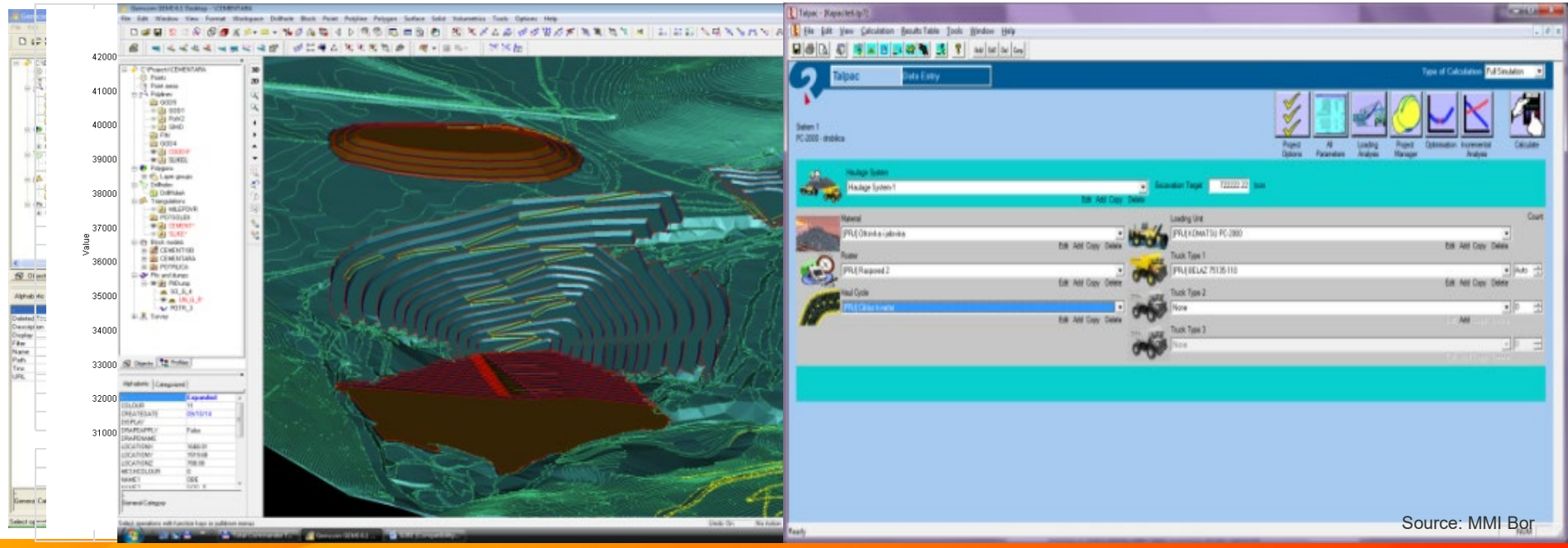
Examples of Intelligent Technologies in mining

- Underground monitoring systems
- Autonomous Smart Mining Vehicles
- Remote-controlled Drills
- Unmanned Aerial Vehicles (UAV)
- 3D Laser Scanning in Smart Mining
- Geographic Information Systems (GIS)
- Image Recognition Technology
- Smart PPE (Personal Protective Equipment)

Intelligent Technologies use cases in mining

Automated production scheduling and execution

Increases productivity by 5-10% and enables mine planners to react to disturbances in seconds using software to automatically reschedule interconnected tasks, minimize delays and idle times.

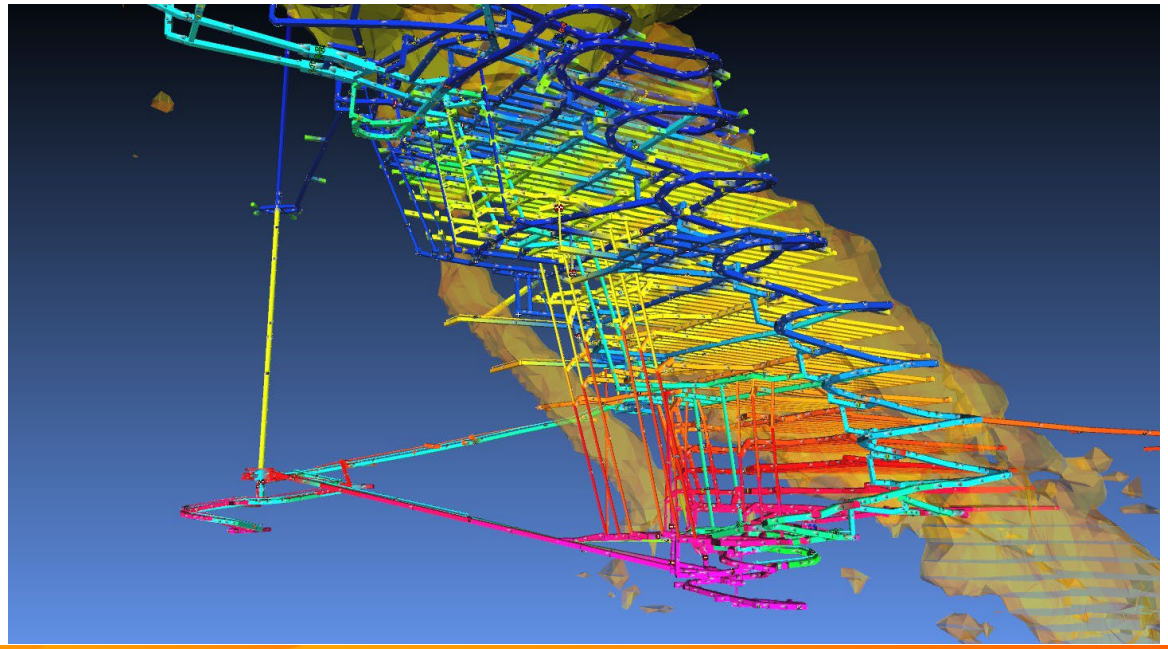


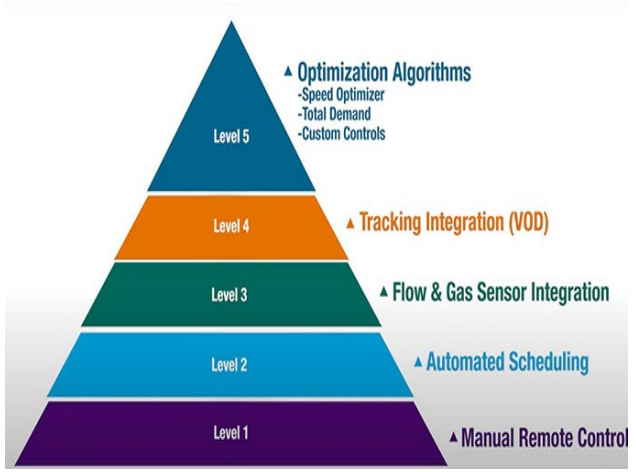
Source: MMI Bor

Intelligent Technologies use cases in mining

Ventilation on demand

Ventilation on demand improves safety and saves up to 50% energy per year, creating healthy working conditions in the mine 24/7, and enabling energy saving targets to be reached thanks to AI-assisted optimization models.





Source: Ventsim™, Howden

Intelligent Technologies use cases in mining

Remote hoist monitoring

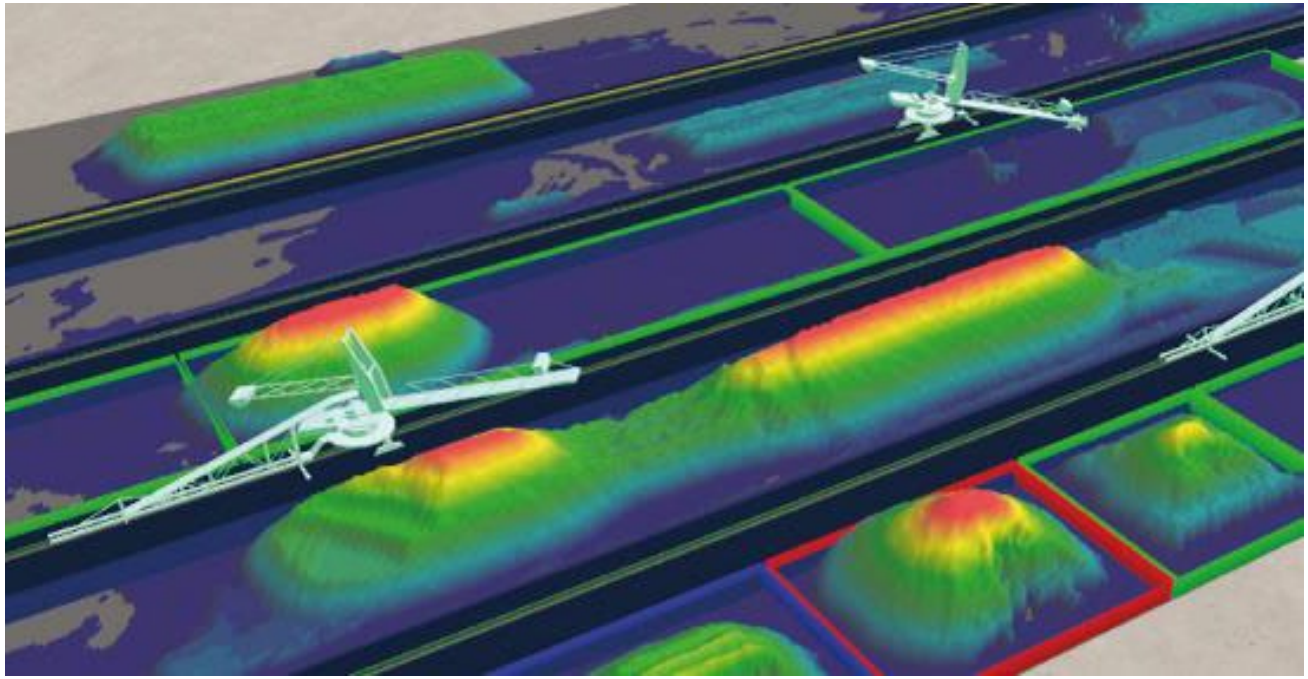
Remote hoist monitoring helps optimize production capacity, enabling operations managers to be notified about performance issues, and quickly get the hoist back on maximum capacity.

Source: VerveTronics

Intelligent Technologies use cases in mining

Material flow monitoring and stockyard optimization

Material flow monitoring can increase stockyard productivity between 5-10%, providing contracted materials much faster and more reliably.

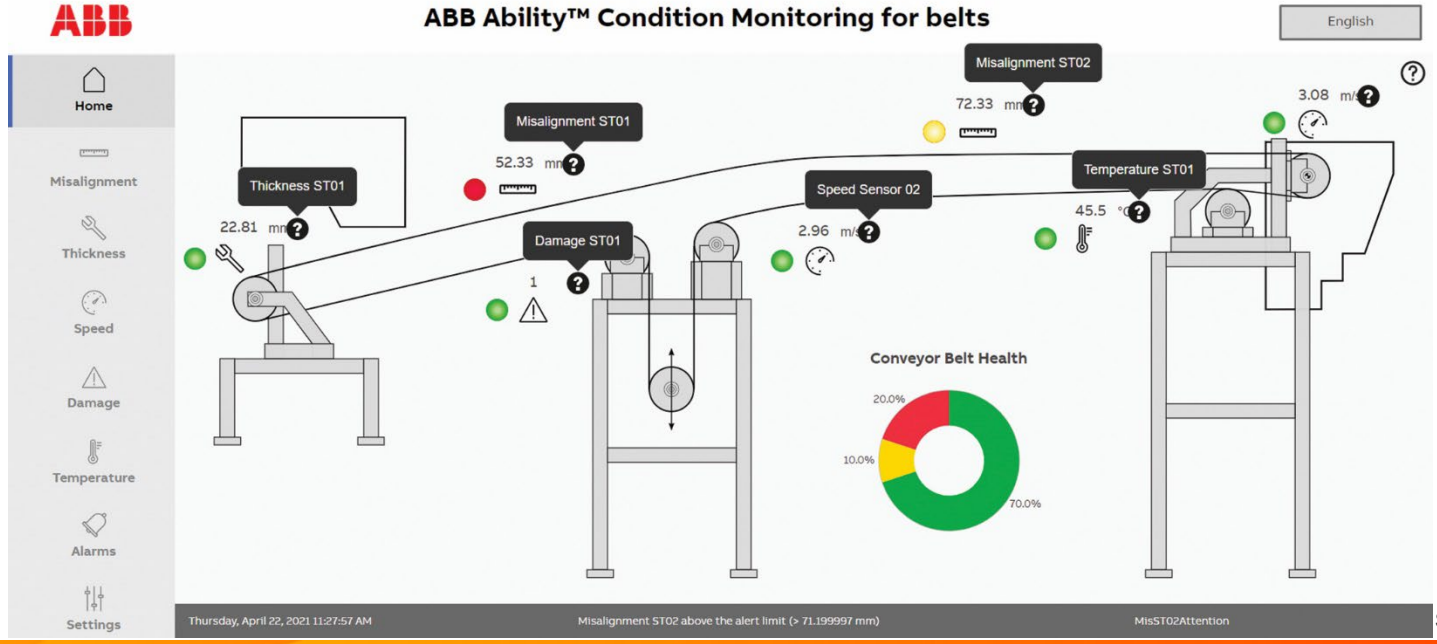


Source: ABB Ability™

Intelligent Technologies use cases in mining

Remote monitoring of conveyor belt fleet

Remote monitoring reduces the need for manual intervention in risk areas. It helps catch misalignment or speed issues online, and avoid falling material, energy waste, excessive belt wear, rupture or fire.

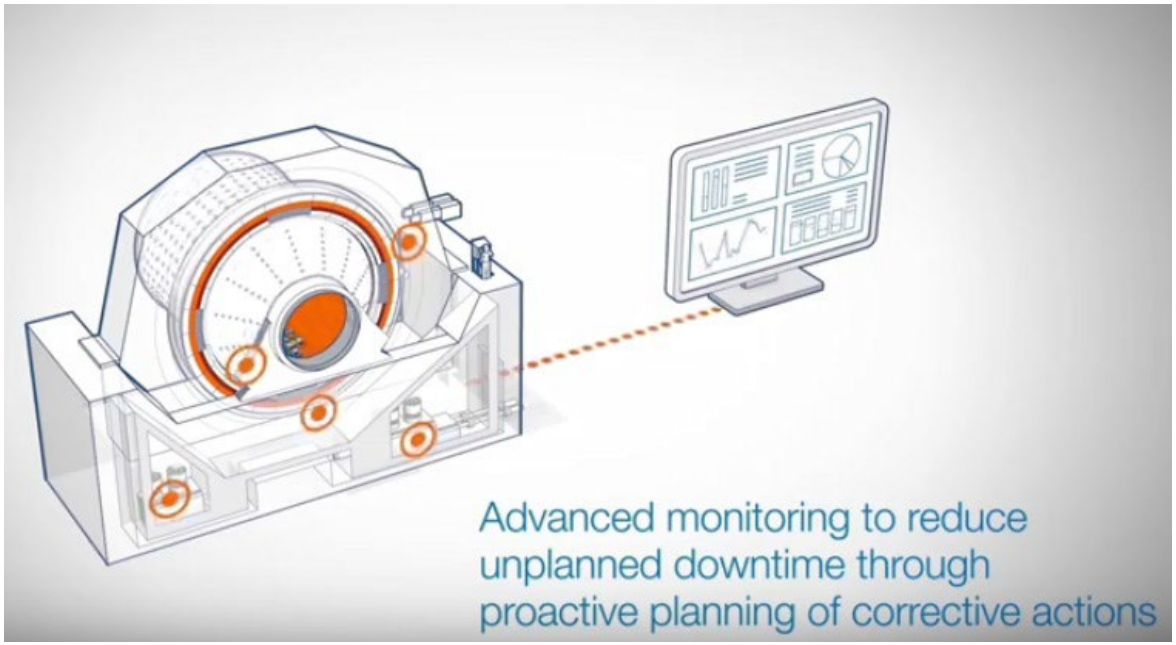


Source: ABB Ability™

Intelligent Technologies use cases in mining

Predictive maintenance for grinding

Predictive maintenance for grinding avoids mill down time, and saves at least 100 hours per year. Operations managers can predict critical situations, prevent damage to expensive gearless mill drive equipment and avoid costly downtime.

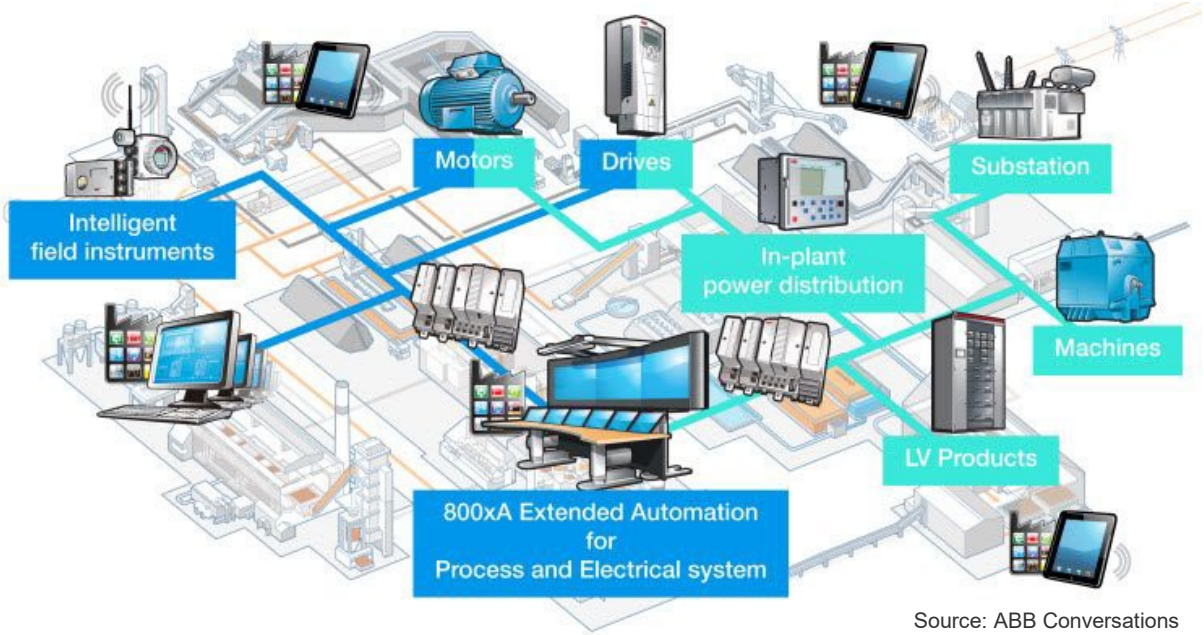


Source: ABB Ability™

Intelligent Technologies use cases in mining

Integrating process and power control

Integrating process and power control can simplify troubleshooting, increase safety and save 20% on training costs. Operators can be less burdened and centrally supervise larger areas and speed up remote troubleshooting.

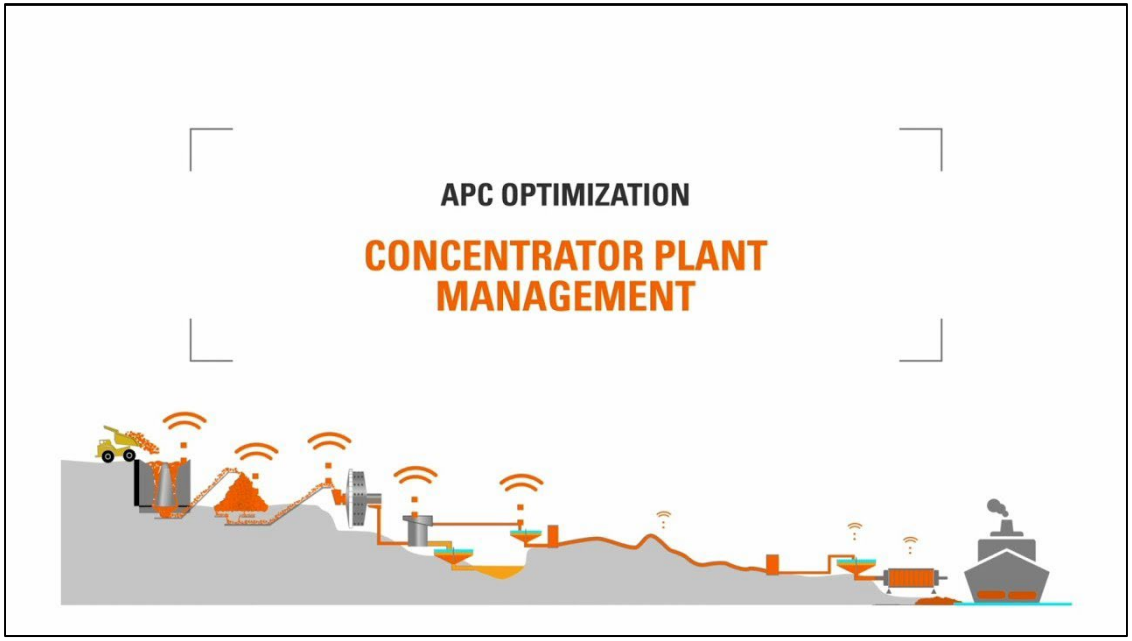


Source: ABB Conversations

Intelligent Technologies use cases in mining

Advance process control (APC) and analytics

Advances process control and analytics can increase mineral recovery by 1-2% while reducing consumables. Manual controls can be replaced by smart automatic process adjustments, which can sustain production at the optimum level.



Source: SGS

Intelligent Technologies use cases in mining

Asset management and condition monitoring

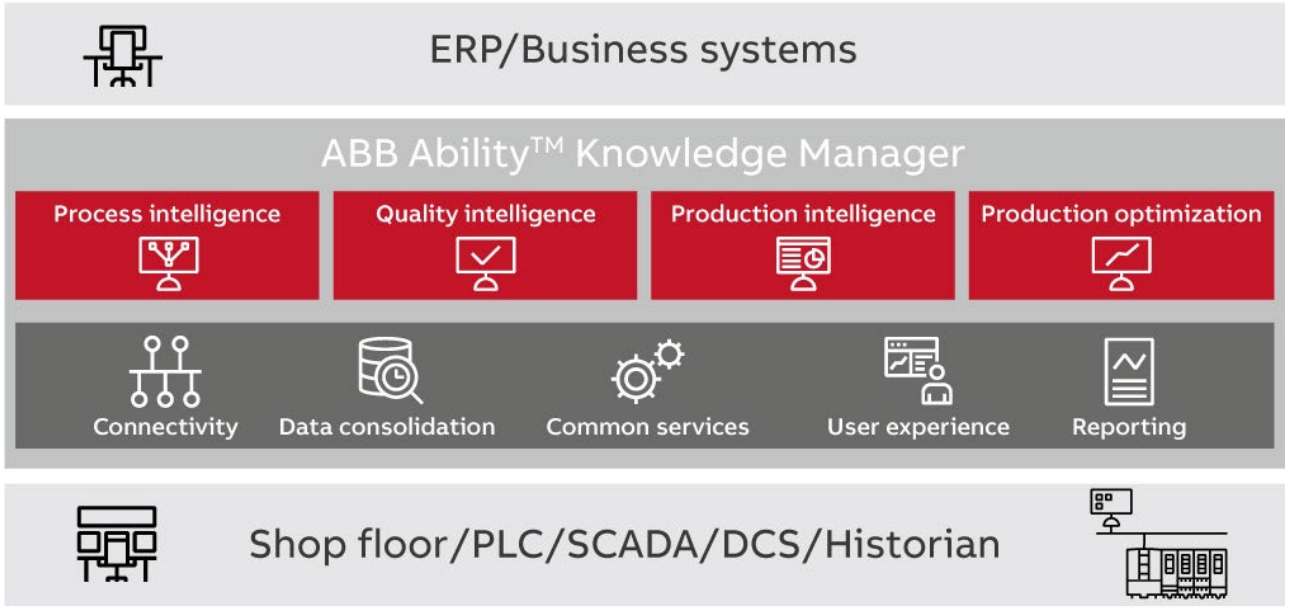
Asset management can save millions in costs by eliminating needless maintenance, predicting faults before DCS alarms, and providing recommendations for more proactive plant asset management strategies.

Source: ABB Ability™

Intelligent Technologies use cases in mining

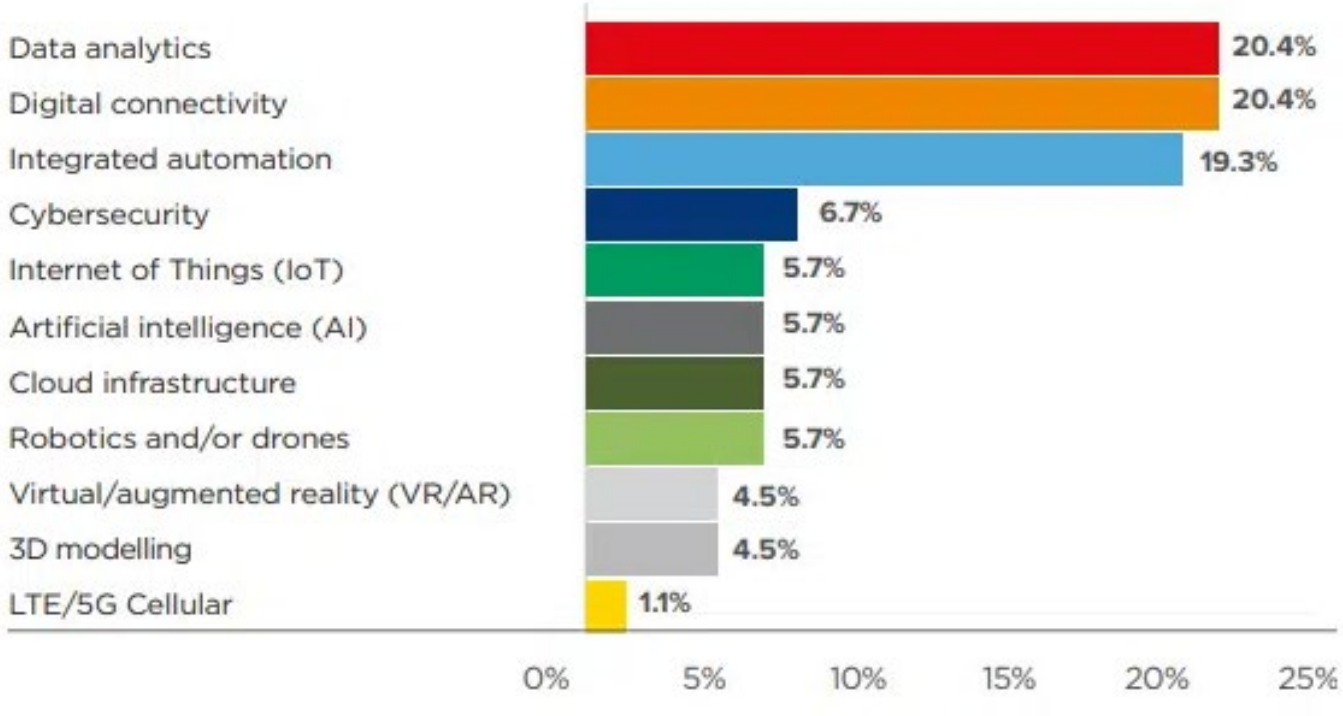
Information management

Information management enables real time visibility and optimization across multiple sites. It can help with scenario based planning, and help focus on production and environmental targets.



Source: ABB Ability™

Most important investments in mining in near future

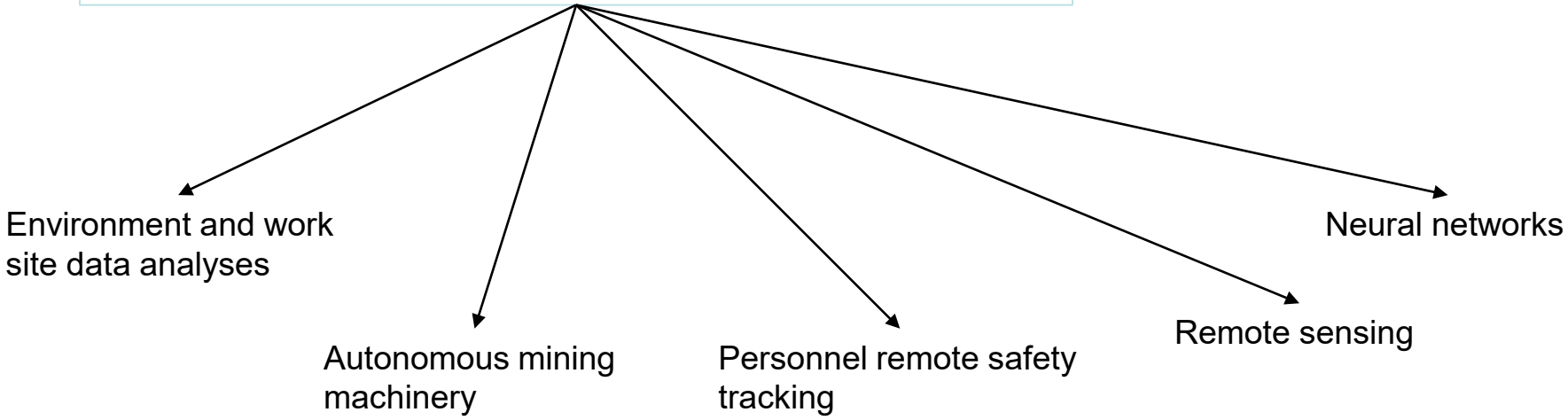


Source: Equinix

Intelligent mining components

Artificial Intelligence (AI)

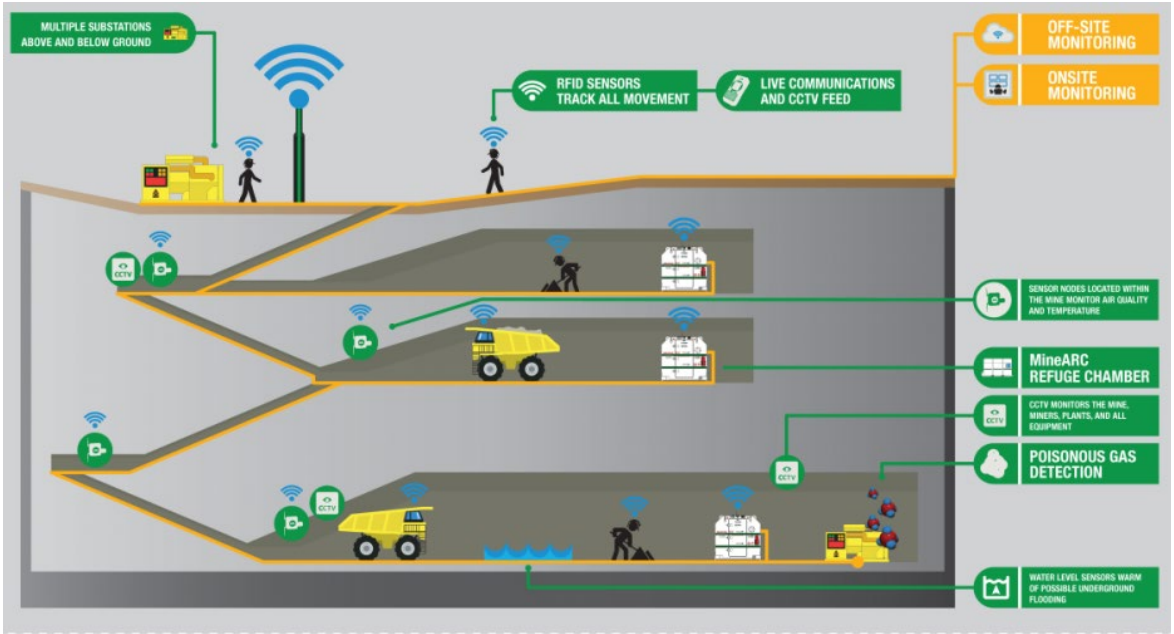
Artificial intelligence is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings, such as learning from past experience.



Intelligent mining components

The Internet of Things (IoT)

The Internet of Things (IoT) describes the network of physical objects — “things” — that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.



Source: Australasian Mine Safety Journal

Intelligent mining components

Virtual Reality (VR)

Virtual reality VR is a computer-generated simulation that artificially recreates a real-life situation or environment. Through hearing and vision, VR users are immersed in the virtual world and they feel like they are enveloped in the reality first-hand.

Health & Safety — Developing Intelligent Data Mines — Increased Productivity

Source: Talgat Takiyev, How Virtual Reality Enhances Productivity and Safety in the Mining Industry

Intelligent mining components

Gamification

Developed firstly for mining education by creating a virtual learning environment with a variety of scenario-based exercises.

Source: Lapin AMK

Intelligent mining & Environmental protection

Green technology refers to technology that limits or reverses the effects of human activity on the planet.

Transition to low-carbon emissions technologies such as solar panels or wind power.

A new World Bank Group report, "Minerals for Climate Action: "The Mineral Intensity of the Clean Energy Transition," finds that the production of minerals, such as graphite, lithium and cobalt, could increase by nearly 500% by 2050, to meet the growing demand for clean energy technologies. It estimates that over 3 billion tons of minerals and metals will be needed to deploy wind, solar and geothermal power, as well as energy storage, required for achieving a below 2°C future.

While the growing demand for minerals and metals provides economic opportunities for resource-rich developing countries and private sector entities alike, significant challenges will likely emerge if the climate-driven clean energy transition is not managed responsibly and sustainably.

The Climate-Smart Mining Initiative will help resource-rich developing countries benefit from the increasing demand for minerals and metals, while ensuring the mining sector is managed in a way that minimizes the environmental and climate footprint.

Source: World Bank

Intelligent mining & Environmental protection

Transition to low-carbon emissions technologies such as solar panels or wind power.

The Climate-Smart Mining Initiative

Climate-Smart Mining (CSM) supports the sustainable extraction, processing and recycling of minerals and metals needed to secure supply for low-carbon technologies and other critical sectors by creating shared value, delivering social, economic and environmental benefits throughout their value chain in developing and emerging economies.

The World Bank's Climate-Smart Mining Initiative is a public-private partnership led by the World Bank and IFC with the aim of achieving more sustainable mineral supply chains by providing technical and policy advice, direct investment financing, leveraging private sector financing, providing risk mitigation instruments, and helping countries define and craft tangible solutions for decarbonizing and improving ESG standards for climate action minerals.

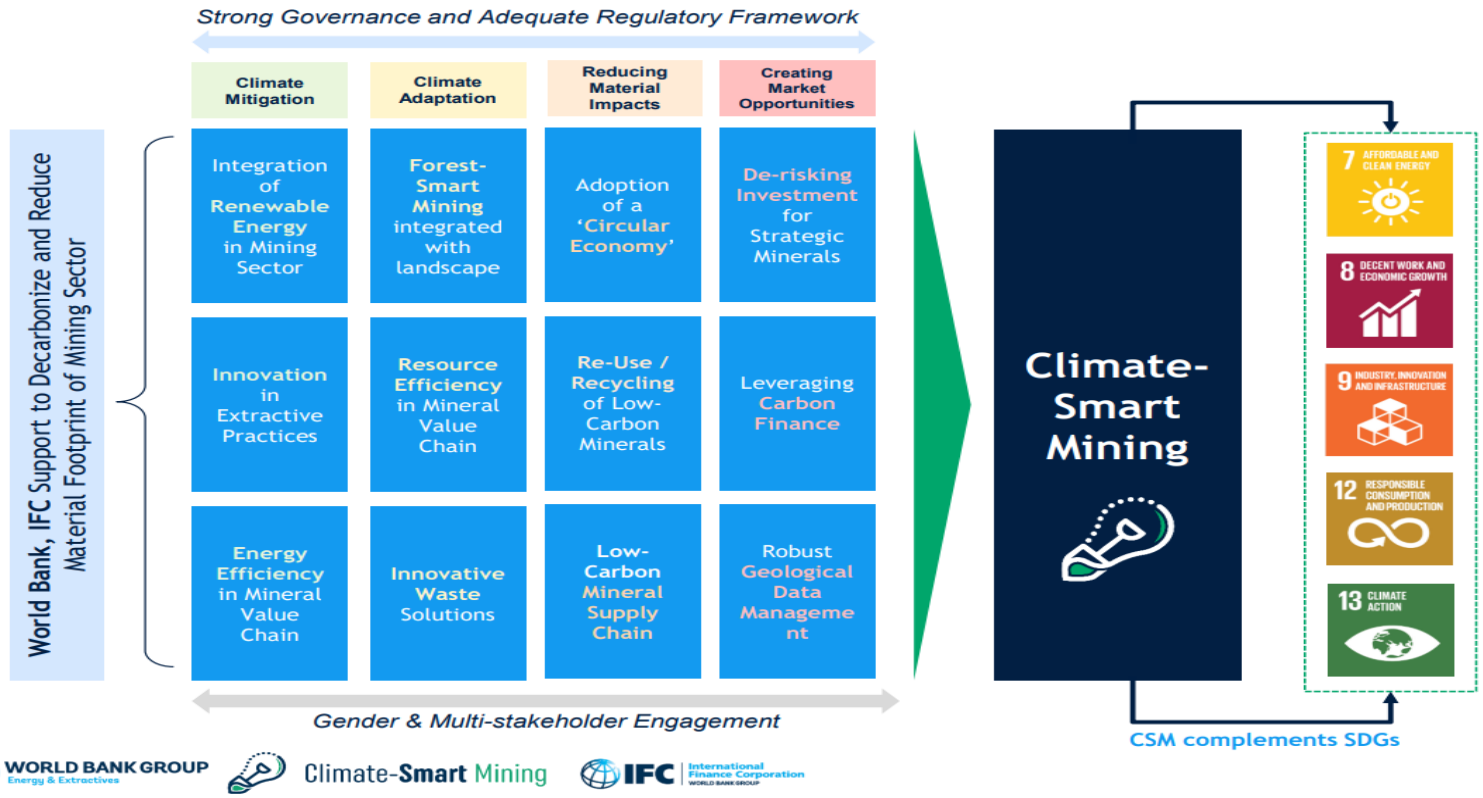
CSM achieves this objective by focusing its activities on a framework developed in consultation with key stakeholders in government, industry, and civil society, serving as guidance to help developing countries integrate climate-smart approaches through four pillars:

Climate Mitigation; Climate Resilience; Circular Economy; Creating Market Opportunities.

Source: World Bank

Intelligent mining & Environmental protection

The Climate-Smart Mining Initiative



Source: World Bank

Intelligent mining & Environmental protection

The Climate-Smart Mining Initiative → **Important?** → **Why?**

Includes:

- Implementation of Intelligent technologies
- Deliver social, economic and environmental benefits throughout entire value chain
- Public-private partnership led by the WB and IFC providing technical and policy advice, direct investment financing
- Mining Companies, Institutes, HEI, Talent labs

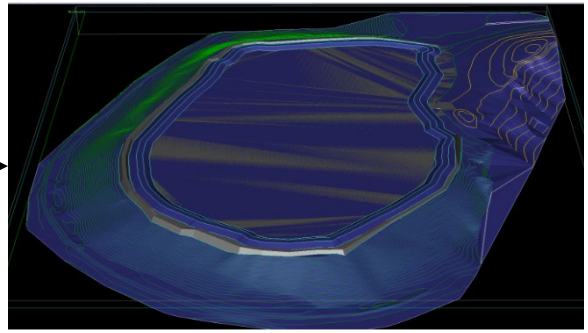
Intelligent mining & Environmental protection

Recovery & Waste management

Reducing waste in technology processes →

Source: IISD

More efficiently tailings processing →



Source: MMI Bor

Renewable resources using →

Source: Sustainability

Intelligent mining & Safety

- Improved underground communication
- Automation
- Remote control
- Sophisticated transportation
- Robotics operating machinery
- Real time monitoring
- Emergency response measures
- Simulations at design stage to test different solutions before implementation

Intelligent mining & Inclusive work with different sectors

Universities, Institutes	Valuable research and insight
Government	Incentives
Suppliers	Innovative offers
Buyers	Expressing of needs
IT Industry	New experts profiles

EIT HEI Initiative

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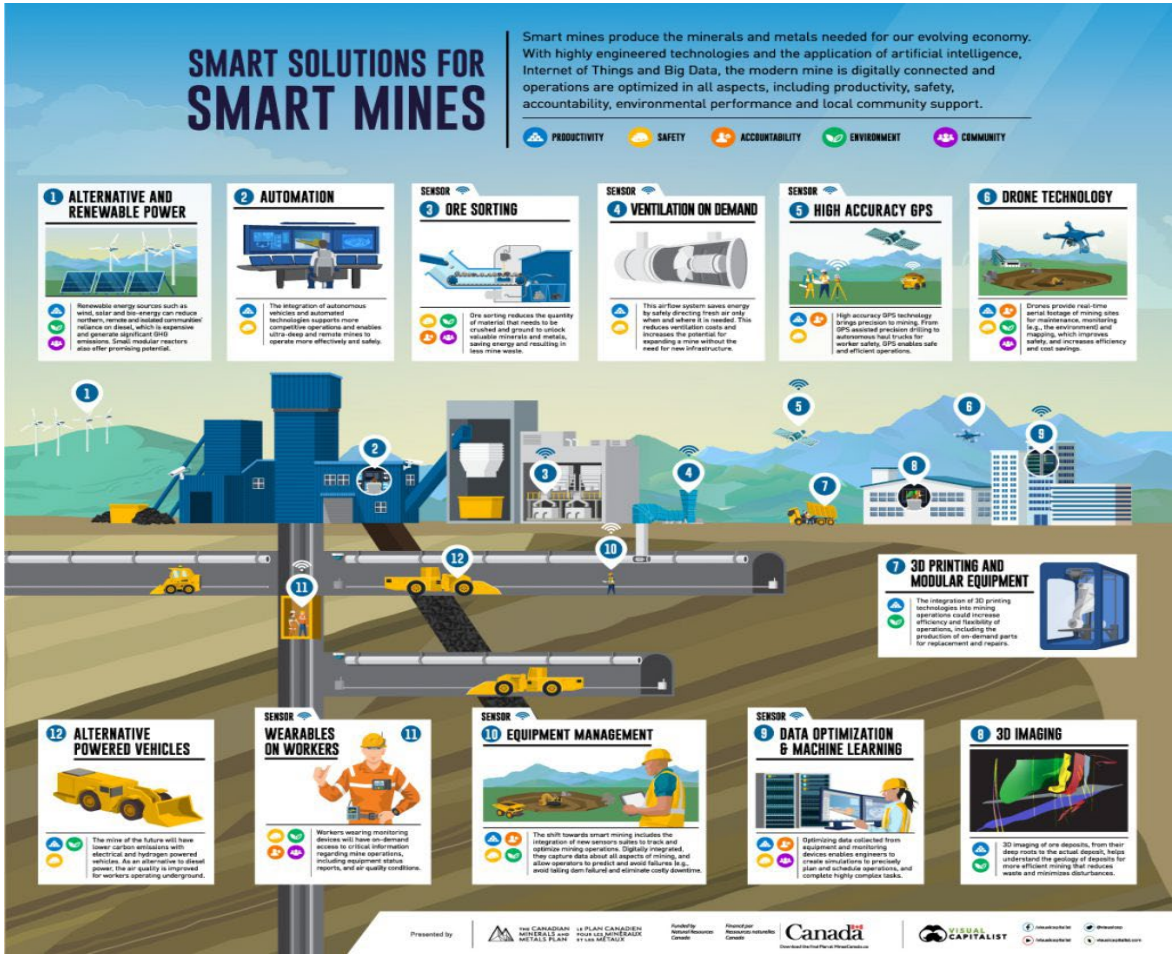

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