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From Drills to Digital Twins: A Mining 4.0 transformation

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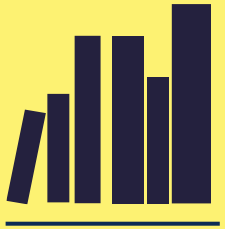

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Introduction:
A journey into Mining 4.0

A mid-sized mining company in Western Australia has undergone a sweeping digital transformation.

Initially implementing automated drilling systems, the company gradually expanded into autonomous haulage, IoT-enabled monitoring, and AI-driven decision-making.

Within three years, The project achieved:

- **22**% reduction in operating costs
- **15**% improvement in ore recovery rates
- **18**% reduction in CO_2 emissions
- **0**% safety incidents in its automated operations.

Background For a Bold Decision

01

The company already operated **three underground gold mines and one open-pit site**. Employing more than **1,200 people**, the company had long been recognised for its reliable production but was facing increasing challenges.

02

- **Labour shortages** in skilled mining roles
- **Safety risks**
- Rising **operational costs**,
- Pressure from regulators and investors to **demonstrate sustainable practices**

03

The leadership team concluded that conventional methods were insufficiently efficient and chose to **embrace a broader Mining 4.0 strategy** that would embed digitalisation, robotics, and artificial intelligence into the core of its operations.

Operational Challenges Led to the Choice of an Integrated Solution

- **Heavy reliance on manual labour** for drilling, blasting, and haulage, which drove up costs and created vulnerability to workforce shortages.
- **Safety concerns**, particularly in underground drilling and transport operations, where workers were exposed to hazardous conditions.
- **Inefficient haulage operations**, with diesel trucks contributing to high costs and carbon emissions.
- **Lack of real-time visibility into mine conditions**, limiting the ability to make fast, data-driven decisions.

A Four-Phase Road Map

Automation of Drilling

Expanded the use of **autonomous drilling rigs.**

First piloted in 2022, across all three mines.

Data, AI, & Digital Twins

Deployed a digital twin of underground operations, enabling scenario modelling and predictive maintenance.

Used AI analytics to optimise drilling patterns, haulage routes, and energy use.

Established a centralised 5G control room.

Robotics & IoT Integration

Introduced autonomous haulage trucks and Autonomous Mobile Robots (AMRs).

Robots deployed for both haulage and hazardous drilling/blasting activities.

IoT sensors monitored fuel use, wear, and environmental conditions.

Sustainability Initiatives

Began transition of haulage fleet from diesel to electric and hydrogen-powered trucks.

Leveraged IoT to track emissions, water use, and tailings management in real time.

A Three-Year Implementation Journey

"*Workforce training was critical to the transformation's success. One of the toughest challenges was upskilling drill operators and truck drivers for the new technical environment.*"

While initial scepticism was high, employees ultimately embraced the shift as it improved safety and created new career pathways.

01

The pilot mine

Piloted 2 autonomous haul trucks and expanded automated drilling at one mine.

02

Robotics put at work

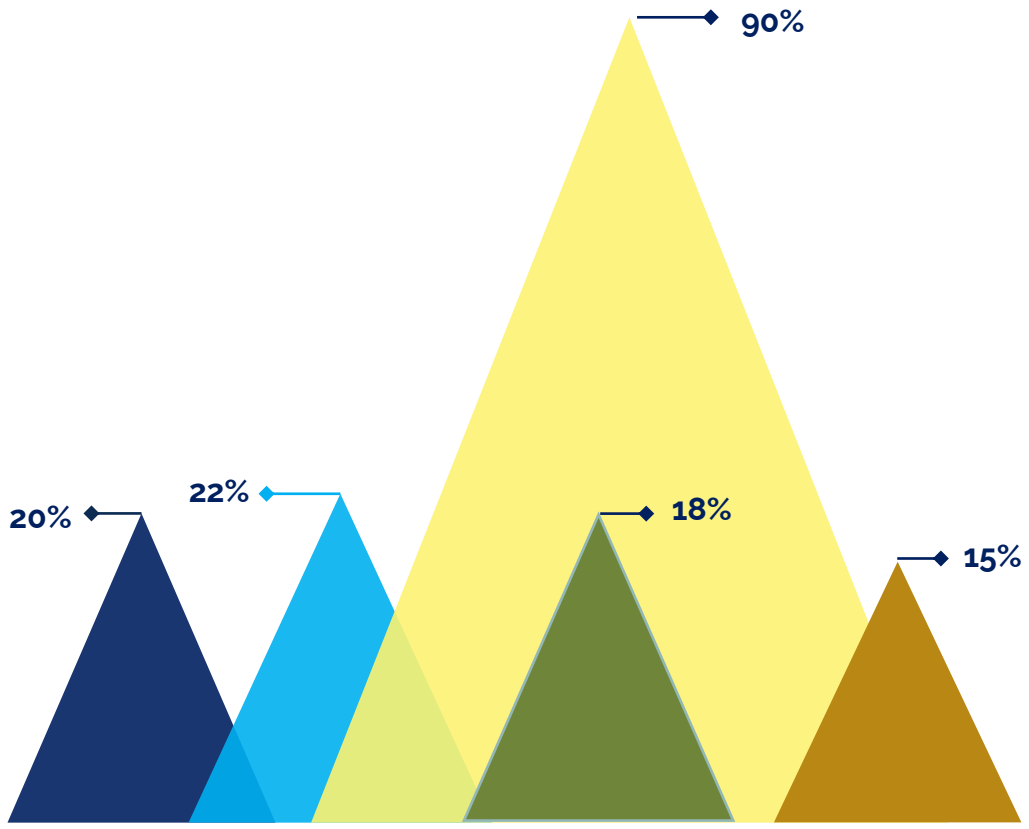
Rolled out 20 autonomous haul trucks and introduced robotic exploration drones for unsafe zones.

03

Digital tech at test

Final integration of IoT systems, digital twin, and transitioned part of the fleet to electric haulage.

ROI for a mid-size mining site transformation



KPIs reflect performance after 12 months of operation

1

Ore Transport +20%

Increased volume of ore transported per shift due to optimised haulage scheduling.

2

Operational Costs -22%

Equivalent to annual savings of approximately $30 million, driven by automation and energy optimisation.

3

Drilling Accuracy +90%

Enhanced targeting precision through AI-optimised drill pattern algorithms.

4

Ore Recovery +15%

Improved extraction rates through better drill-and-blast control and real-time geodata feedback.

5

Greenhouse gas -18%

Resulting from partial fleet electrification and real-time energy consumption monitoring.

0% safety incidents in automated operations

Take Away for the Industry

Mid-sized players can achieve outsized returns
This transformation shows that even a mid-sized mining operator can unlock significant ROI through cost savings, productivity gains, and decarbonisation by adopting Mining 4.0 technologies.

Automation drives measurable gains
The use of robotics, IoT, AI, and digital twins led to improvements in safety, operational visibility, and ore recovery, delivering quantifiable value within three years.

Success depends on people and partnerships
Progress was enabled by strong technology partnerships, a phased implementation roadmap, and an inclusive retraining programme to upskill legacy roles.

Cybersecurity and capital investment are strategic enablers
An upfront investment (~$70M) and robust IoT security frameworks were key to ensuring continuity and resilience across connected operations.

About this case study

This case study is based on a real digital transformation led by a mid-sized mining company in Western Australia. For confidentiality reasons, identifying details have been anonymised.

It forms part of a broader research initiative by Indusights, focused on automation, data integration, and operational performance across industrial sectors.

To learn more about our research or explore collaboration opportunities, visit **www.indusights.com** or contact **info@indusights.com**