

Enablers of Intelligent Mining Systems: Evidence from South Africa's Hard Rock Mining Industry

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INTRODUCTION & AIM

METHOD

- ❖ The mining sector is experiencing rapid digital transformation through the integration of intelligent mining systems that enhance operational efficiency, safety, productivity, and sustainability.
- ❖ However, adoption within South Africa's hard rock mining industry remains uneven and insufficiently understood.
- ❖ Existing studies largely focus on technological capabilities and barriers, with limited empirical insight into the key enablers driving intelligent mining adoption in developing economy contexts.

Aim

To investigate the underlying factors enabling the adoption of intelligent mining systems in South Africa's hard rock mining industry.

Research Design: Quantitative research approach

Data Collection: Structured questionnaire

Respondents: Actively practising mining professionals in South Africa

Data Analysis: Exploratory Factor Analysis (EFA)
Identification of latent constructs (enabler clusters)
Factor extraction and reliability testing



RESULTS & DISCUSSION

Key Findings: Enabler Clusters for Intelligent Mining Adoption

1. Continuous Awareness & Knowledge Development

- Training and upskilling of the workforce
- Knowledge dissemination and digital literacy
- Organisational learning culture

2. Enabling Regulatory Framework & Public Acceptance

- Supportive policies and regulatory clarity
- Social licence to operate
- Stakeholder trust and acceptance

3. Governmental Incentives & Support

- Financial incentives and subsidies
- Infrastructure and institutional backing
- Public-sector commitment to digital transformation

- ❖ Intelligent mining adoption is multidimensional, requiring alignment between:

- Human capital development
- Institutional/regulatory systems
- Government-driven support mechanisms

- ❖ The factor structure demonstrates strong internal consistency and highlights that digital transformation is as much socio-institutional as it is technological.

CONCLUSIONS

FUTURE WORK/ REFERENCES/ACKNOWLEDGMENT

- ❖ Intelligent mining adoption is driven by clustered enablers rather than isolated factors
- ❖ Awareness, regulation, and government support are central to successful implementation
- ❖ Empirical evidence confirms the complexity of digital transformation in developing mining contexts

Recommendations

- ❖ Policy Level
 - Develop clear, adaptive regulatory frameworks for intelligent mining
 - Introduce targeted incentives to accelerate technology adoption
 - Promote national digital mining strategies
- ❖ Industry Level
 - Invest in workforce training and continuous learning
 - Foster organisational readiness for digital transformation
 - Engage stakeholders to enhance public acceptance

- Validate the factor structure using confirmatory factor analysis (CFA)
- Conduct longitudinal studies to assess adoption over time
- Explore technology-specific case studies (e.g., automation, AI in mining)
- Extend research to other mining sectors and global contexts

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