# DESIGN AND PROTOTYPING OF MINE MIND: A PRODUCT DEVELOPMENT APPROACH TO AI-DRIVEN MINING PERFORMANCE MANAGEMENT

**THESIS**

**Submitted as one of the requirements to obtain**

**Magister Manajemen**


**By**

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## FACULTY OF BUSINESS

## MASTER OF TECHNOLOGY MANAGEMENT STUDY PROGRAM

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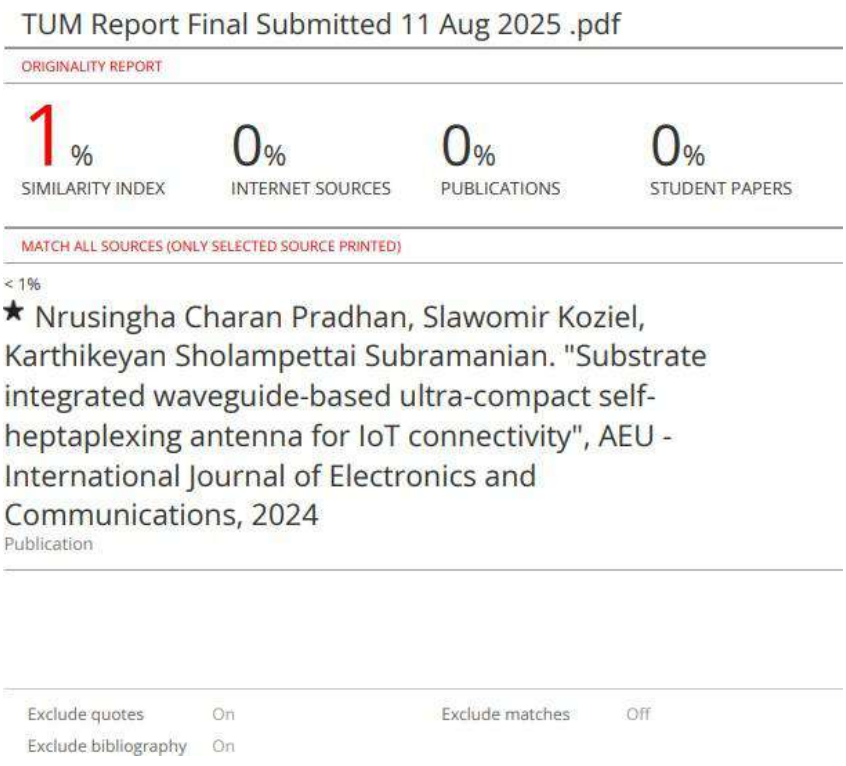

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# ABSTRACT

The mining industry still finds it difficult to turn large streams of operational data into decisions that are both fast and useful. At times the reports or dashboards arrive too late. By the time the numbers are available, the people on site may already need to act. This delay can bring production losses, extra safety concerns, and higher costs (Rojas et al., 2025). Artificial intelligence seems to help in some areas, such as predictive maintenance and equipment reliability (Sahoo et al., 2019; Abdi et al., 2008). Even so, its role in mining is not very broad. In many cases the data is noisy, systems fail to connect smoothly, and the models can be difficult for people to trust or explain (Landre Júnior et al., 2022). In this study we put forward MineMind, an AI-based model for performance management in mining. The idea is not only to monitor or report but also to support decisions that should be more proactive and adaptive. To develop the model, the work follows two paths. One path looks at benchmarking. It reviews how AI has been used in other industries, with energy being the main point of reference, and pulls out lessons that could make sense for mining. The other path turns to product development. Here the focus is on building MineMind with elements like real-time monitoring, natural language interaction, and AI-driven recommendations. For guidance, the research makes use of the Digital Transformation Pyramid (Westerman et al., 2014). Yet the framework is not taken as is. It is adapted to fit the mining setting. The results suggest that combining benchmarking with product development may help MineMind support mining companies in strengthening control, improving safety, and running operations more efficiently. On a wider note, this study also adds to technology management by showing one possible way to apply AI to mining performance management. It does not aim to close the discussion but rather to provide direction.

**Keywords:** Mining, Artificial Intelligence, Performance Management, Benchmarking, Product Development, Digital Transformation

# ABSTRAK

Industri pertambangan masih menghadapi tantangan fundamental dalam mentransformasikan aliran data operasional yang masif menjadi keputusan yang tepat waktu dan efektif. Laporan serta dasbor kerap disajikan dengan jeda, sehingga ketika informasi tersedia, tindakan di lapangan sering kali telah diambil secara terpaksa. Fenomena ini berimplikasi pada kerugian produksi, eskalasi risiko keselamatan, dan peningkatan biaya operasional (Rojas et al., 2025). Kecerdasan buatan telah memperlihatkan kontribusi signifikan pada sejumlah domain, antara lain pemeliharaan prediktif serta peningkatan keandalan peralatan (Sahoo et al., 2019; Abdi et al., 2008). Namun demikian, penerapannya di sektor pertambangan belum meluas. Permasalahan utama meliputi kualitas data yang bising, keterbatasan integrasi sistem, dan tingkat keterpercayaan model yang masih rendah karena kompleksitas penjelasan (Landre Júnior et al., 2022). Kondisi ini memperlambat akselerasi pemanfaatan AI dalam skala industri. Kajian ini mengemukakan MineMind, sebuah model manajemen kinerja berbasis AI yang dirancang tidak hanya untuk fungsi pemantauan dan pelaporan, tetapi juga sebagai instrumen pendukung pengambilan keputusan yang proaktif dan adaptif. Pengembangannya dilakukan melalui dua pendekatan strategis. Pertama, benchmarking dengan mengidentifikasi praktik penerapan AI di sektor lain, khususnya industri energi, yang relevan bagi pertambangan. Kedua, pendekatan pengembangan produk dengan mengintegrasikan fitur pemantauan waktu nyata, interaksi berbasis bahasa alami, serta rekomendasi yang dihasilkan oleh algoritme AI. Kerangka konseptual penelitian ini mengacu pada Digital Transformation Pyramid (Westerman et al., 2014), yang selanjutnya diadaptasi untuk memenuhi karakteristik unik pertambangan. Temuan awal mengindikasikan bahwa kombinasi benchmarking dan pengembangan produk memungkinkan MineMind memperkuat kendali operasional, meningkatkan keselamatan kerja, dan mengoptimalkan efisiensi. Secara konseptual, studi ini juga memperluas diskursus dalam ranah manajemen teknologi dengan menunjukkan jalur aplikatif AI pada manajemen kinerja pertambangan. Kajian ini bukanlah titik akhir, melainkan sebuah kontribusi awal yang membuka ruang penelitian lebih lanjut.

**Kata kunci**: Pertambangan, Kecerdasan Buatan, Manajemen Kinerja, Benchmarking, Pengembangan Produk, Transformasi Digital

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