

**DEVELOPMENT OF GEOTHERMAL OPERATIONS OPTIMIZATION,
RELIABILITY, AND EFFICIENCY THROUGH MACHINE LEARNING
TO ACHIEVE PRODUCTION TARGET**

By

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STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.


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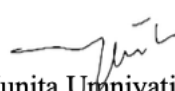
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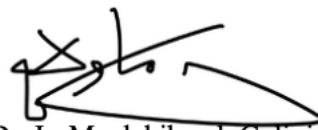



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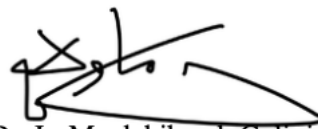
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ABSTRACT

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This research enhances geothermal power plant operations through digital transformation, addressing inefficiencies in manual data handling, delayed reporting, and reactive decision-making. A digital framework—Geothermal Operations Optimization, Reliability, and Efficiency through Machine Learning (GOOREMALE)—was developed to enable faster, data-driven decision-making and improve production outcomes. The development follows a multi-phase implementation from 2022 to mid-2025. Initial work digitized and centralized operational data with Business Intelligence (BI) dashboards, followed by real-time data acquisition using historian systems. Machine learning was then applied to support predictive maintenance, anomaly detection, and operational simulations. Analytical tools include Locality Sensitive Hashing (LSH), OPTICS clustering, and Root Mean Square Error (RMSE) analysis to capture equipment behaviour and detect deviations. In 2025, development advanced to deliverability curve recalibration, aligning sensor readings with simulations and preparing for automated corrections using machine learning. The results indicate that from 2022 to 2024, production increased by 8.1%, with 2024 surpassing the annual target for the first time in four years and achieving the highest output in company history. Decision-making cycle time was reduced by about 50%, while operational costs were consistently maintained below target. GOOREMALE demonstrates the potential of digital transformation and machine learning to deliver sustained improvements in geothermal operations.

Keywords: digital transformation, machine learning, anomaly detection, geothermal, decision-making.



DEDICATION

I dedicate this works to my beloved wife and sons, hopefully one of them will attractively contribute for digitalization or artificial intelligence in future. Also, this research dedicates to the era of digital transformation and the geothermal industry especially in Indonesia.



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