INTISARI

Kegiatan penambangan berisi serangkaian proses eksploitasi sumber daya alam yang kompleks dan dinamis dengan metode tertentu. *Fleet Management System* (FMS) merupakan sistem mutakhir yang membantu pengelolaan armada unit tambang agar produktivitas dapat optimal dan terhindar dari berbagai permasalahan, salah satunya adalah *cycle time* (waktu siklus). Penelitian dilakukan di salah satu area kerja PT. Bukit Makmur Mandiri Utama, yaitu *job site* Lati. Penelitian ini bertujuan untuk mengetahui model pengaruh parameter meteorologis (10 parameter) dan kondisi jalan (jarak angkut dan *grade* jalan) pada waktu tempuh perjalanan *dump truk*, serta efektivitas dan tingkat validitas *machine learning* (ML) dalam prediksi waktu tempuh. Integrasi data dispatch, data meteorologis, dan data kondisi jalan menghasilkan dataset pemodelan untuk pelatihan prediksi waktu tempuh didasarkan tiga algoritma ML, yaitu *K-Nearest Neighbors* (KNN), *Support Vector Regression* (SVR), dan *Long-Short Term Memory* (LSTM). Proses *Exploratory Data Analysis* (EDA) dilakukan sebelum pemodelan prediksi ML, hasil EDA menunjukkan dari keseluruhan parameter yang dianalisis, Jarak Angkut (m) dan Intensitas Hujan (mm/h) memiliki pengaruh cukup kuat dengan nilai berturut-turut 0.41 dan 0.52 terhadap waktu tempuh *dump truck*.

Dataset di-*resampling* untuk menyeimbangkan data sebelum pemodelan. Dihasilkan dataset pemodelan berdimensi (8762, 16). Pelatihan model dilakukan pada 4 kuartal tahun 2023; Q1, Q2, Q3, dan Q4 dengan *hyperparameter* terbaik. Hasil menunjukkan bahwa model prediksi ML dengan parameter meteorologis dan kondisi jalan lebih efektif dari pada metode prediksi konvensional dengan peningkatan akurasi sebesar 9.18%. Model prediksi ML berdasarkan algoritma LSTM memiliki tingkat validitas 86.31%, lebih baik daripada algoritma SVR dan KNN yang berturut-turut memiliki akurasi 85.42% dan 85.50%.

Kata kunci: *Fleet Management System*, *K-Nearest Neighbors* (KNN), *Support Vector Regression* (SVR), dan *Long-Short Term Memory* (LSTM).

ABSTRACT

Mining activities contain a series of complex and dynamic natural resource exploitation processes using certain methods. Fleet Management System (FMS) is the latest system that helps manage the fleet of mining units so that productivity can be optimized and avoid various problems, one of which is cycle time. The research was conducted in one of the work areas of PT. Bukit Makmur Mandiri Utama, namely the Lati job site. This study aims to determine the effect model of meteorological parameters (10 parameters) and road conditions (hauling distance and road grade) on the travel time of dump trucks, as well as the effectiveness and validity level of machine learning (ML) in predicting travel time. The integration of dispatch data, meteorological data, and road condition data resulted in a modeling dataset for travel time prediction training based on three ML algorithms, namely K-Nearest Neighbors (KNN), Support Vector Regression (SVR), and Long-Short Term Memory (LSTM). The Exploratory Data Analysis (EDA) process was carried out before ML prediction modeling, the EDA results showed that of all the parameters analyzed, Transport Distance (m) and Rain Intensity (mm/h) had a strong influence with values of 0.41 and 0.52 respectively on dump truck travel time.

The resampling process is carried out to balance the data before modeling. The resulting modeling dataset is dimensioned (8762, 16). Model training was conducted on 4 quarters of 2023; Q1, Q2, Q3, and Q4 with the best hyperparameters. The results show that the ML prediction model with meteorological parameters and road conditions is more effective than the conventional prediction method with an increase in accuracy of 9.18%. The ML prediction model based on the LSTM algorithm has a validity rate of 86.31%, better than the SVR and KNN algorithms which have an accuracy of 85.42% and 85.50%, respectively.

Keywords: Fleet Management System, K-Nearest Neighbors (KNN), Support Vector Regression (SVR), and Long-Short Term Memory (LSTM).