

ABSTRACT

This study was motivated by the manual management of heavy equipment maintenance data at PT ANTAM Tbk UBPN Malut, which complicates unit condition monitoring and decision-making. This research aims to develop a web-based Computerized Maintenance Management System (CMMS) dashboard integrated with machine learning to support maintenance monitoring, automatic calculation of performance indicators (Physical Availability, Mean Time To Repair, and Mean Time Between Failure), preventive maintenance scheduling, and tyre remaining useful life prediction to support proactive component replacement decisions. The system was implemented using Laravel and MySQL, while the prediction model used Support Vector Regression (SVR), optimized in stages through manual tuning, GridSearchCV, and Focused Grid Search, integrated into the dashboard through Symfony Process. The best model on the Techking dataset achieved a coefficient of determination (R^2) of 0.6423, while on the Hilo dataset, Repeated K-Fold Cross Validation results showed an average R^2 of 0.5316, higher than the single test result of 0.3939, indicating stable model performance. Interface layout evaluation used the MoSCoW method, and uncertainty estimation was added to SVR predictions so users obtain an estimated range rather than a single value. The developed model was also used to compare reliability and cost-effectiveness between two tyre brands, demonstrating the model's practical benefit as a decision-support tool. The research resulted in a web-based CMMS system with unit data management, maintenance log, KPI calculation, plan schedule, and tyre life prediction, expected to support digitalization and maintenance decision-making.

Keywords: Computerized Maintenance Management System (CMMS), dashboard, machine learning, Support Vector Regression (SVR), tyre prediction.

INTISARI

Penelitian ini dilatarbelakangi oleh pengelolaan data pemeliharaan alat berat di PT ANTAM Tbk UBPN Malut yang masih dilakukan secara *manual* sehingga menyulitkan monitoring kondisi unit dan pengambilan keputusan. Penelitian ini bertujuan mengembangkan sistem dashboard *Computerized Maintenance Management System* (CMMS) berbasis *web* yang terintegrasi dengan *machine learning* untuk mendukung monitoring pemeliharaan, perhitungan otomatis indikator kinerja (*Physical Availability*, *Mean Time To Repair*, dan *Mean Time Between Failure*), penjadwalan *preventive maintenance*, serta prediksi sisa umur *tyre* guna mendukung keputusan penggantian komponen secara proaktif. Sistem diimplementasikan menggunakan Laravel dan MySQL, sedangkan model prediksi menggunakan *Support Vector Regression* (SVR) yang dioptimasi secara bertahap melalui *manual tuning*, *GridSearchCV*, dan *Focused Grid Search*, serta diintegrasikan ke *dashboard* melalui *Symfony Process*. Model terbaik pada *dataset* Techking menghasilkan koefisien determinasi (R^2) sebesar 0,6423, sedangkan pada *dataset* Hilo, hasil validasi *Repeated K-Fold Cross Validation* menunjukkan rata-rata R^2 sebesar 0,5316, lebih tinggi dari hasil pengujian tunggal sebesar 0,3939, menunjukkan performa model cukup stabil. Selain itu, dilakukan evaluasi tata letak antarmuka menggunakan *MoSCoW method*, serta penambahan estimasi ketidakpastian (*uncertainty*) pada hasil prediksi SVR sehingga pengguna memperoleh rentang estimasi, bukan hanya nilai tunggal. Model yang dibangun juga dimanfaatkan untuk membandingkan keandalan dan efisiensi biaya antara dua merk *tyre*, menunjukkan manfaat praktis model *machine learning* sebagai alat bantu analisis pengambilan keputusan. Hasil penelitian berupa sistem CMMS berbasis web dengan fitur pengelolaan data unit, *maintenance log*, perhitungan KPI, *plan schedule*, serta prediksi umur *tyre*, yang diharapkan membantu digitalisasi dan efektivitas pengambilan keputusan pemeliharaan.

Kata kunci: *Computerized Maintenance Management System* (CMMS), *dashboard*, *machine learning*, *Support Vector Regression* (SVR), prediksi *tyre*.