ABSTRAK

Industri manufaktur di kawasan Karawang sangat bergantung pada ketersediaan *spare part* untuk menjaga keberlangsungan operasional mesin produksi. Data PT XYZ menunjukkan bahwa 58,3% dari 2.026 item *spare part* berstatus tidak bergerak (*non-moving*), sementara komponen kritis pernah mengalami kekosongan stok, yang berimplikasi pada *downtime* mesin dan pemborosan modal kerja. Penelitian ini bertujuan membangun sistem prediksi kebutuhan *spare part* berbasis data untuk menentukan level stok optimal guna mencegah *overstock* dan *stockout* secara bersamaan. Metodologi yang diterapkan mengintegrasikan dua pendekatan: perhitungan MTBF (*Mean Time Between Failures*) dengan *threshold* otomatis berbasis metode *percentile* untuk mengklasifikasikan pergerakan komponen, serta algoritma *Random Forest Regressor* untuk memprediksi level stok minimum dan maksimum berdasarkan data historis pemakaian dan *lead time* aktual dari *Purchase Order*. Hasil penelitian menunjukkan bahwa model mencapai $R^2 = 0{,}9877$, MAE = 0,53 unit, dan MAPE = 9,96%, di bawah batas toleransi industri sebesar 15%. Sistem *website* yang dikembangkan menggunakan Flask dan React.js memperoleh skor *System Usability Scale* (SUS) rata-rata 74,32 (kategori *Good*). Sistem ini terbukti menghasilkan rekomendasi pemesanan yang lebih objektif dibandingkan metode konvensional, sehingga membantu perusahaan meminimalkan risiko *downtime* sekaligus mengoptimalkan penggunaan modal kerja.

Kata Kunci: *machine learning*, manajemen persediaan, MTBF, prediksi stok, *random forest*, *spare part*

ABSTRACT

The manufacturing industry in the Karawang region heavily depends on spare part availability to maintain production machine continuity. Data from PT XYZ reveals that 58.3% of 2,026 spare part items are classified as non-moving, while critical components have experienced stockouts, resulting in machine downtime and wasted working capital. This study aims to develop a data-driven spare part demand prediction system capable of automatically determining optimal stock levels to simultaneously prevent overstock and stockout. The proposed methodology integrates two approaches: MTBF (Mean Time Between Failures) calculation with an automatic percentile-based threshold to classify component movement, and a Random Forest Regressor algorithm to predict minimum and maximum stock levels based on historical usage data and actual lead time derived from Purchase Order records. Results demonstrate that the model achieved $R^2 = 0.9877$, MAE = 0.53 units, and MAPE = 9.96%, below the industry tolerance threshold of 15%. The web-based system, developed using Flask and React.js, obtained an average System Usability Scale (SUS) score of 74.32 (Good category). This system produces more objective ordering recommendations compared to conventional methods, thereby helping companies minimize downtime risk while optimizing working capital utilization.

***Keyword**: machine learning, inventory management, MTBF, stock prediction, random forest, spare parts*

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