

**COMPARATIVE EVALUATION OF LOADING AND
UNLOADING OF CRANE OPERATIONS USING DIESEL OIL
AND ELECTRICITY SUPPLY IN THE PORT AREA**

FINAL PROJECT REPORT

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PADANG
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of Bachelor in the Department of Industrial Engineering, Faculty of Engineering,*

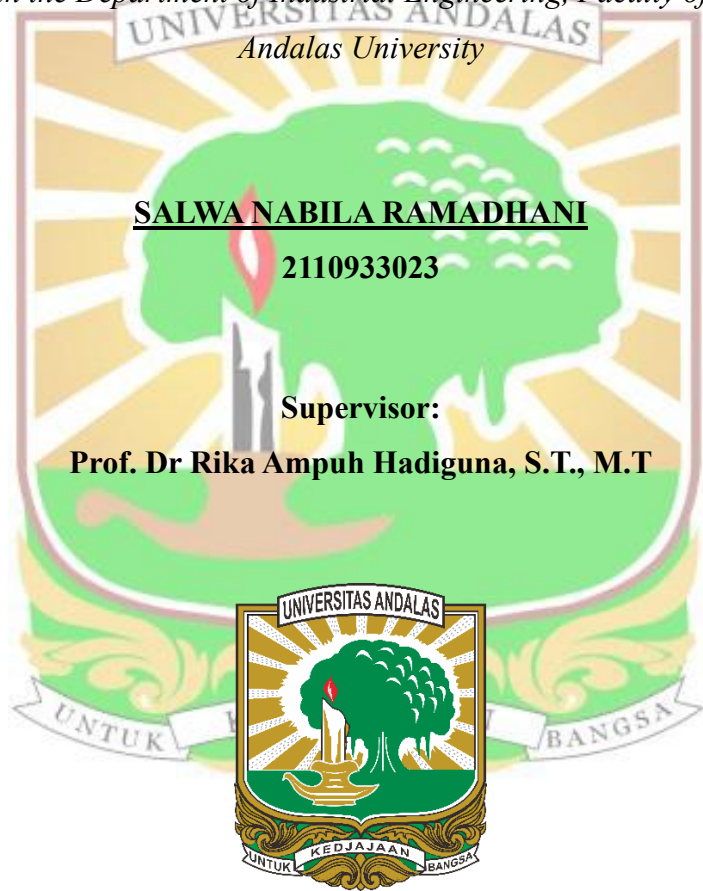
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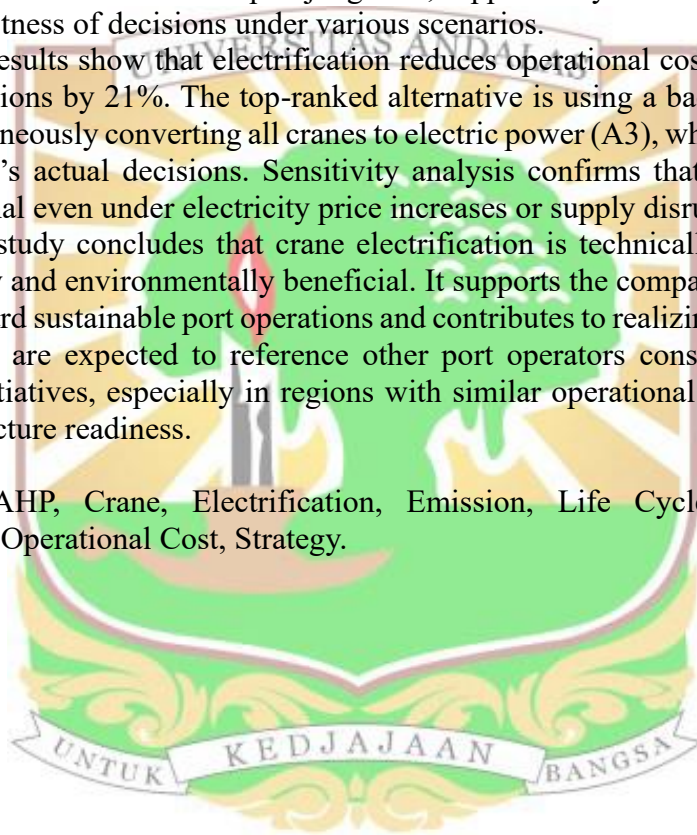
ABSTRACT

Teluk Bayur Port has implemented crane electrification to improve operational efficiency and reduce environmental impact. This study aims to evaluate the feasibility of the electrification program by comparing operational costs and carbon emissions before and after implementation. The Life Cycle Assessment (LCA) method with a gate-to-gate system boundary assesses environmental impact. In contrast, the Straight-Line Depreciation (SLD) method calculates the depreciation of electrification investment over its economic life. Additionally, the Analytical Hierarchy Process (AHP) is applied to prioritize strategic alternatives based on expert judgment, supported by sensitivity analysis to test the robustness of decisions under various scenarios.

The results show that electrification reduces operational costs by 16% and carbon emissions by 21%. The top-ranked alternative is using a backup generator (A1), simultaneously converting all cranes to electric power (A3), which aligns with the company's actual decisions. Sensitivity analysis confirms that these choices remain optimal even under electricity price increases or supply disruptions.

This study concludes that crane electrification is technically feasible and economically and environmentally beneficial. It supports the company's long-term strategy toward sustainable port operations and contributes to realizing a green port. The findings are expected to reference other port operators considering energy transition initiatives, especially in regions with similar operational characteristics and infrastructure readiness.

Keywords: AHP, Crane, Electrification, Emission, Life Cycle Assessment, Operational Cost, Strategy.



ABSTRAK

Pelabuhan Teluk Bayur telah menerapkan elektrifikasi crane untuk meningkatkan efisiensi operasional dan mengurangi dampak lingkungan. Penelitian ini bertujuan mengevaluasi kelayakan program elektrifikasi dengan membandingkan biaya operasional dan emisi karbon sebelum dan sesudah implementasi. Metode Life Cycle Assessment (LCA) dengan batas sistem gate-to-gate digunakan untuk menilai dampak lingkungan, sementara metode Straight-Line Depreciation (SLD) digunakan untuk menghitung depresiasi investasi elektrifikasi selama masa ekonominya. Selain itu, metode Analytical Hierarchy Process (AHP) diterapkan untuk menentukan prioritas alternatif strategi berdasarkan penilaian pakar, yang didukung oleh analisis sensitivitas untuk menguji ketahanan keputusan dalam berbagai skenario.

Hasil penelitian menunjukkan bahwa elektrifikasi berhasil menurunkan biaya operasional sebesar 16% dan emisi karbon sebesar 21%. Alternatif terbaik adalah penggunaan genset cadangan (A1), diikuti oleh konversi seluruh crane ke listrik secara simultan (A3), yang sesuai dengan keputusan aktual perusahaan. Analisis sensitivitas menunjukkan bahwa pilihan tersebut tetap optimal meskipun terjadi kenaikan tarif listrik atau gangguan pasokan.

Penelitian ini menyimpulkan bahwa elektrifikasi crane tidak hanya layak secara teknis, tetapi juga menguntungkan secara ekonomi dan ramah lingkungan. Temuan ini mendukung strategi jangka panjang perusahaan menuju pelabuhan berkelanjutan dan berkontribusi pada pencapaian status green port. Hasil penelitian ini diharapkan dapat menjadi referensi bagi operator pelabuhan lain yang mempertimbangkan inisiatif transisi energi, khususnya di wilayah dengan karakteristik operasional dan kesiapan infrastruktur yang serupa.

Kata kunci: *AHP, Biaya Operasional, Crane, Elektrifikasi, Emisi, Life Cycle Assessment, Strategi.*