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**Pengembangan Model Decision Support Tools untuk Pemeliharaan dan Rehabilitasi Perkerasan Runway di
Bandara Internasional Soekarno-Hatta**
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INTISARI

Bandara Internasional Soekarno-Hatta sebagai bandara tersibuk di Indonesia menghadapi tantangan besar dalam pengelolaan perkerasan *runway* akibat volume lalu lintas pesawat yang tinggi, sehingga struktur perkerasan menerima beban operasional besar yang berisiko mempercepat laju kerusakan. Pengelolaan perkerasan *runway* yang efektif memerlukan sistem manajemen perkerasan yang mampu memberikan gambaran kondisi secara akurat sekaligus mendukung pengambilan keputusan pemeliharaan yang tepat waktu dan efisien dari segi biaya. Penelitian ini bertujuan mengevaluasi kesesuaian *Airport Pavement Management System* (APMS) eksisting terhadap ketentuan peraturan PR-DJPU 3 Tahun 2026, mengembangkan model *decision support tools* berbasis *life-cycle cost analysis* (LCCA), serta merumuskan rekomendasi pengembangan APMS.

Penelitian ini menggunakan data inventori perkerasan, kondisi fungsional historis, biaya tindakan pemeliharaan, dan riwayat penanganan yang telah dilakukan. Kesesuaian sistem eksisting dinilai melalui matriks pembanding berbasis kerangka kerja peraturan yang berlaku. Model *decision support tools* dikembangkan dengan mengintegrasikan evaluasi indeks kondisi perkerasan, kurva kinerja deteriorasi, kuantifikasi manfaat berupa luas area di bawah kurva, nilai sekarang biaya siklus hidup, dan indeks efektivitas biaya, kemudian disimulasikan terhadap empat alternatif strategi pemeliharaan dan rehabilitasi selama periode analisis dua puluh tahun.

Hasil penilaian menunjukkan bahwa sistem eksisting bersifat deskriptif-historis dan belum memenuhi ketentuan terkait analisis prediktif kondisi perkerasan, penetapan tingkat layanan, serta analisis biaya siklus hidup formal. Simulasi keempat alternatif menghasilkan indeks efektivitas biaya sebesar 1,57 (*business as usual* dengan *overlay* 5 cm), 1,55 (tindakan preventif berupa *seal coat*), 1,36 (penundaan rehabilitasi mayor (*overlay)* hingga tahun ke-12), serta 1,00 satuan PCI-Tahun per Miliar Rupiah (rekonstruksi total). Alternatif 1 *business as usual* dengan overlay korektif memiliki efektivitas biaya tertinggi, mengindikasikan bahwa efektivitas strategi preservasi bersifat spesifik-kasus tergantung karakteristik struktural perkerasan. Penelitian ini menghasilkan modul dokumen tambahan mencakup penetapan *trigger level* dan kerangka analisis biaya siklus hidup, sebagai rekomendasi bagi pengelola bandara untuk mentransformasi sistem menuju sistem prediktif dan analitis sesuai regulasi terbaru.

Kata kunci: *Airport Pavement Management System*; *decision support tools*; *life-cycle cost analysis; cost-effectiveness index;* perkerasan *runway.*

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ABSTRACT

Soekarno–Hatta International Airport, as the busiest airport in Indonesia, faces significant challenges in runway pavement management due to the high volume of aircraft traffic. The intensive operational demand subjects the runway pavement structure to substantial loading, thereby increasing the risk of accelerated pavement deterioration. Effective runway pavement management requires an Airport Pavement Management System (APMS) capable of accurately assessing pavement conditions while supporting timely and cost-effective maintenance decision-making. This study aims to evaluate the compliance of the existing APMS with the provisions of PR-DJPU Regulation No. 3 of 2026, develop a decision support tool model based on Life-Cycle Cost Analysis (LCCA), and formulate recommendations for APMS enhancement.

This study utilizes pavement inventory data, historical functional condition data, maintenance cost records, and maintenance history. The compliance of the existing system was assessed using a comparative matrix based on the applicable regulatory framework. The proposed decision support tool was developed by integrating pavement condition index evaluation, pavement deterioration performance curves, benefit quantification through the area under the performance curve, life-cycle cost present value analysis, and a cost-effectiveness index. The model was subsequently applied to simulate four alternative maintenance and rehabilitation strategies over a twenty-year analysis period.

The assessment results indicate that the existing system is primarily descriptive and historical in nature and does not yet comply with the regulatory requirements regarding predictive pavement condition analysis, service level determination, and formal life-cycle cost analysis. Simulations of the four alternatives yielded cost-effectiveness indices of 1.57 (Business-as-Usual with a 5 cm overlay), 1.55 (preventive maintenance using a seal coat), 1.36 (postponement of major rehabilitation through overlay until the twelfth year), and 1.00 PCI-years per billion Indonesian Rupiah (full-depth reconstruction). Alternative 1, namely the Business-as-Usual strategy with corrective overlay, demonstrated the highest cost-effectiveness, indicating that the effectiveness of pavement preservation strategies is case-specific and highly dependent on the structural characteristics of the pavement. This study also produces supplementary APMS documentation modules, including trigger level determination and a life-cycle cost analysis framework, as recommendations for airport authorities to transform the existing system into a predictive and analytical APMS in accordance with the latest regulatory requirements.

Keywords: Airport Pavement Management System, Decision Support Tools, Life-Cycle Cost Analysis, Cost-Effectiveness Index, runway pavement