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Analisis Strategi Operasi Melalui Integrasi House of Risk dan Green Lean Six Sigma: Studi Kasus Proyek Jalan Tol Solo-Yogyakarta-NYIA
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ABSTRAK

Penelitian ini bertujuan menganalisis strategi operasi melalui integrasi *House of Risk* (HOR) dan *Green Lean Six Sigma* (GLSS) pada Proyek Jalan Tol Solo-Yogyakarta-NYIA, khususnya Seksi 2 Paket 2.2. Fokus penelitian diarahkan pada pekerjaan tanah, beton, dan baja untuk mengevaluasi mutu, pemborosan proses, estimasi emisi akibat kondisi *idle*, serta profil risiko operasional proyek. Penelitian menggunakan desain studi kasus dengan integrasi analisis kuantitatif deskriptif dan analisis kualitatif. Data diperoleh melalui penelaahan dokumen pengendalian mutu, observasi proses, wawancara semi-terstruktur, kuesioner validasi ahli, dan diskusi validasi tindakan mitigasi. Pengukuran *Six Sigma* dilakukan terhadap 600 unit inspeksi beton, 979 unit inspeksi baja, dan 703 unit inspeksi tanah. Hasil pengukuran menunjukkan bahwa pekerjaan baja memiliki nilai sigma tertinggi sebesar 4,43, diikuti beton sebesar 4,16, dan tanah sebesar 4,09. Berdasarkan *snapshot Value Stream Mapping*, pekerjaan baja memiliki *Process Cycle Efficiency* sebesar 87,50 persen, beton sebesar 81,25 persen, dan tanah sebesar 76,92 persen. Pada observasi lapangan pekerjaan tanah tercatat waktu tunggu selama 45 menit dengan estimasi emisi *idle* sebesar 5,36 kg CO2e per truk. Nilai emisi baja tidak dibandingkan secara langsung dengan beton dan tanah karena menggunakan unit pelaporan berbeda, yaitu per siklus alat internal. Analisis HOR Fase 1 mengidentifikasi empat agen risiko prioritas, yaitu rendahnya konsistensi kepatuhan pekerja terhadap SOP, fluktuasi cuaca ekstrem, kemacetan rute distribusi, dan ketidakseimbangan kapasitas alat berat. Pada HOR Fase 2, tindakan mitigasi dengan prioritas tertinggi adalah implementasi *Visual Poka-Yoke* dan *Behavior-Based Quality Control*, diikuti penerapan *Service Level Agreement* berbasis indikator kinerja bagi subkontraktor. Hasil penelitian memberikan dasar terstruktur bagi perusahaan untuk menentukan prioritas perbaikan mutu, efisiensi, risiko, dan keberlanjutan operasional.

Kata kunci: *House of Risk, Green Lean Six Sigma*, Strategi Operasi, Manajemen Risiko, Proyek Jalan Tol, Keberlanjutan

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ABSTRACT

This study analyzes operations strategy through the integration of House of Risk (HOR) and Green Lean Six Sigma (GLSS) in the Solo-Yogyakarta-NYIA Toll Road Project, specifically Section 2 Package 2.2. The analysis focuses on soil, concrete, and steel work to evaluate quality performance, process waste, estimated emissions from idle conditions, and the operational risk profile. The study applies a case study design that integrates descriptive quantitative analysis and qualitative analysis. Data were obtained from quality control documents, process observations, semi-structured interviews, expert validation questionnaires, and a mitigation action validation discussion. The Six Sigma assessment was conducted using 600 concrete inspection units, 979 steel inspection units, and 703 soil inspection units. The results show that steel work achieved the highest sigma level at 4.43, followed by concrete at 4.16 and soil at 4.09. Based on a Value Stream Mapping snapshot, steel work achieved a Process Cycle Efficiency of 87.50 percent, concrete achieved 81.25 percent, and soil work achieved 76.92 percent. During the observed soil work episode, a waiting time of 45 minutes was recorded, resulting in an estimated idle emission of 5.36 kg CO2e per truck. The steel emission estimate was not directly compared with those of concrete and soil because it used a different reporting unit based on an internal equipment cycle. HOR Phase 1 identified four priority risk agents, namely inconsistent worker compliance with standard operating procedures, extreme weather fluctuations, traffic congestion along distribution routes, and imbalance in heavy equipment capacity. HOR Phase 2 identified the implementation of Visual Poka-Yoke and Behavior-Based Quality Control as the highest- priority mitigation action, followed by the implementation of performance-based Service Level Agreements for subcontractors. The findings provide a structured basis for prioritizing quality, efficiency, risk, and operational sustainability improvements.

Keywords: *House of Risk, Green Lean Six Sigma, Operations Strategy, Risk Management, Toll Road Project, Sustainability*