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Optimizing Fuel Distribution: A Queuing Theory Analysis and Strategy for Industrial Truck Queue Management at Batu Licin Terminal

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ABSTRACT

This study addresses chronic operational inefficiencies at the Batu Licin Fuel Terminal (TBBM), PT Multi Trading Pratama, characterized by prolonged industrial fuel truck queues. Applying a sequential explanatory mixed-methods design, the research collected quantitative data from 120 service events and qualitative insights from operational staff. Analysis using the M/M/c queuing model revealed system instability (ρ=1.37), an average queue length (Lq) of 8.41 trucks, and an average waiting time (Wq) of 68.9 minutes during peak hours. Root causes identified through thematic analysis include schedule non-compliance, high service time variability, and inefficient pre-loading procedures. Simulation of optimization scenarios demonstrated that adding a third loading arm (server) was the most effective intervention, stabilizing the system (ρ=0.91) and reducing waiting time by 89.8%. This research contributes to operational management literature by providing empirical evidence for applying Queuing Theory in the downstream energy sector and offers actionable, prioritized recommendations for terminal managers to enhance throughput, reduce costs, and improve customer satisfaction.

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