

ABSTRAK

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Judul : Penerapan *Improved Ant Colony Optimization* (IACO) dalam Masalah *Split Delivery Vehicle Routing Problem* dengan *Time Windows*

Operasi logistik distribusi, terutama di sektor ritel besar seperti Alfamart, menghadapi tantangan kompleks yang dikenal sebagai *Split Delivery Vehicle Routing Problem with Time Windows* (SDVRPTW). Masalah ini penting untuk menekan biaya operasional dan menjaga ketersediaan produk melalui rute yang efisien. Meskipun *Ant Colony Optimization* (ACO) telah terbukti efektif, masih terdapat ruang untuk peningkatan kinerja. Penelitian ini mengusulkan *Improved Ant Colony Optimization* (IACO) yang dihibridisasi dengan *Tabu Search* (TS) dan *Simulated Annealing* (SA) untuk mengatasi SDVRPTW. Hibridisasi ini dirancang untuk meningkatkan eksplorasi solusi dan membantu algoritma menghindari *local optima*. Tujuan utama penelitian adalah meminimalkan total biaya yang mencakup biaya distribusi, emisi karbon, dan penalti keterlambatan. Hasil pengujian pada Dataset Solomon dan data Alfamart menunjukkan bahwa IACO secara konsisten menghasilkan solusi dengan total biaya yang lebih rendah dibandingkan ACO, dengan peningkatan kinerja hingga 57,81% pada kasus 50 pelanggan. Meskipun waktu komputasinya sedikit lebih lama, peningkatan kualitas solusi yang signifikan ini dianggap sepadan, sehingga IACO menjadi pendekatan yang unggul untuk optimasi rute distribusi.

Kata Kunci: *Vehicle Routing Problem* , *Split Delivery* , *Time Windows* , *Improved Ant Colony Optimization*

ABSTRACT

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Title : **Implementation of Improved Ant Colony Optimization (IACO) for the Split Delivery Vehicle Routing Problem with Time Windows**

Distribution logistics, particularly in large retail sectors like Alfamart, face the complex challenge of the Split Delivery Vehicle Routing Problem with Time Windows (SDVRPTW). This problem is crucial for reducing operational costs and ensuring product availability through efficient routes. While the Ant Colony Optimization (ACO) algorithm has proven effective, there is still room for performance improvement. This study proposes an Improved Ant Colony Optimization (IACO), hybridized with Tabu Search (TS) and Simulated Annealing (SA), to solve the SDVRPTW. This hybrid approach is designed to enhance solution exploration and help the algorithm avoid local optima. The primary objective is to minimize total costs, which include distribution, carbon emission, and late penalty fees. Tests on the Solomon Dataset and Alfamart data consistently show that IACO generates solutions with significantly lower total costs compared to ACO, with performance improvements reaching up to 57.81% for 50 customers. While IACO has a slightly longer computation time, the substantial improvement in solution quality is considered a worthwhile trade-off, making IACO a superior approach for optimizing distribution routes.

Keywords: Vehicle Routing Problem , Split Delivery , Time Windows , Improved Ant Colony Optimization