ABSTRACT

OPTIMIZATION OF VEHICLE ROUTING PROBLEM (VRP) WITH CAPACITY CONSTRAINTS USING GENETIC ALGORITHM

By

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This study investigates the optimization of the *Vehicle Routing Problem* (VRP) with capacity constraints using a Genetic Algorithm (GA). The case study data were obtained from a distribution company in Bandar Lampung serving 20 customers with varying demands measured in kilograms and motorcycle engine capacity (cc). All distribution routes are assumed to be feasible for land transportation, including routes crossing water areas via connecting routes such as bridges or ferry crossings. The problem is formulated using *Integer Linear Programming* (ILP) with the objective of minimizing total travel time, driver rest time, and penalties for capacity violations. The Genetic Algorithm implementation includes population initialization, selection, *crossover*, mutation, and fitness evaluation. The results show that the Genetic Algorithm produces efficient distribution routes with a fleet allocation of three Colt Diesel vehicles (2000 kg), one Double Diesel vehicle (5000 kg), and two towing vehicles. The best solution yields a total travel time of 16 days 22 hours 4 minutes with routes: Colt Diesel 1: depot–9–13–15–14–12–5–7–8–depot, Colt Diesel 2: depot–6–4–2–3–1–10–depot, Double Diesel: depot–20–depot, and Towing 1: depot–17–19–16–18–depot, while Towing 2 and Colt Diesel 3 are not operated because all demands have been optimally satisfied.

Keywords: Vehicle Routing Problem, Capacity, Genetic Algorithm, Route Optimization.

ABSTRAK

OPTIMASI PERMASALAHAN *VEHICLE ROUTING PROBLEM* (VRP) DENGAN KENDALA KAPASITAS MENGGUNAKAN ALGORITMA GENETIKA

Oleh

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Penelitian ini membahas optimasi *Vehicle Routing Problem* (VRP) dengan kendala kapasitas menggunakan Algoritma Genetika (AG). Data penelitian berasal dari perusahaan distribusi di Kota Bandar Lampung dengan 20 pelanggan yang memiliki permintaan bervariasi dalam satuan kilogram dan kendaraan bermotor (cc). Seluruh rute distribusi diasumsikan feasible bagi kendaraan darat, termasuk rute yang melintasi wilayah perairan melalui jalur penghubung seperti jembatan atau penyeberangan. Permasalahan dimodelkan menggunakan *Integer Linear Programming* (ILP) dengan fungsi tujuan meminimalkan total waktu perjalanan, waktu istirahat pengemudi, serta penalti pelanggaran kapasitas. Implementasi Algoritma Genetika meliputi inisialisasi populasi, seleksi, *crossover*, mutasi, dan evaluasi *fitness*. Hasil penelitian menunjukkan bahwa AG menghasilkan rute distribusi yang efisien dengan alokasi armada tiga unit Colt Diesel (2000 kg), satu unit Double Diesel (5000 kg), dan dua unit towing. Solusi terbaik memberikan total waktu perjalanan 16 hari 22 jam 4 menit dengan rute Colt Diesel 1: depot–9–13–15–14–12–5–7–8–depot, Colt Diesel 2: depot–6–4–2–3–1–10–depot, Double Diesel: depot–20–depot, serta Towing 1: depot–17–19–16–18–depot, sementara Towing 2 dan Colt Diesel 3 tidak dioperasikan karena seluruh permintaan telah terpenuhi.

Kata-kata kunci: Vehicle Routing Problem, Capacitated VRP, Algoritma Genetika, Optimasi Rute, Logistik.