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New tool to make waste collection routes more efficient

Significant savings on mileage and vehicle costs can be achieved by using computer optimisation to plan waste collection routes, new research suggests. When applied to a case study of cooking oil recycling in Portugal, it was found that the technique could lead to a reduction of 13% in annual distance travelled and a fleet hiring cost reduction of 11%.

The increased interest in recycling has led to the growth and development of collection services which recover and transfer recyclable materials to a variety of depots for processing. However, transport routes themselves carry an environmental and financial burden.

Optimising route planning in waste management is a complex problem. Vehicle route planning typically has to consider many factors, including vehicle capacity, drivers' working periods and multiple depots where routes should start and finish. In addition, independent vehicles are sometimes contracted to collect waste, incurring a cost per vehicle and per kilometre travelled.

A real-world problem, based on the weekly delivery and collection of waste cooking oil containers by a company in Portugal, served as the basis for this study. In this example, some vehicles begin and end their journeys at different depots (open routes), while others begin and end their journey at the same depot (closed routes). The problem involved a total of 303 collection sites and three depot sites.

A computational tool using 'Mixed Integer Linear Programming' (MILP) was used to find the optimal solution, in this case, the solution that minimised the total routing cost. The MILP was formulated to take into account all possible depots, closed and open routes between depots, collection of full and distribution of empty containers for waste cooking oil, as well as associated vehicle hire and mileage costs, among others.

The new vehicle routing results suggest that, if implemented, an annual 13% reduction in total mileage travelled and an 11% reduction in vehicle fleet hiring cost could be achieved compared to currently used routes.

The research demonstrates that computational optimisation strategies can potentially provide significant savings in waste management transport costs. If applied at the national level to waste management policies, the financial savings could be used for other social services, such as infrastructure. In addition, the reduced travel distances from optimised vehicle routes results in lower vehicle emissions, reducing the environmental impact of waste collection systems.

The study's authors note that the approach can also be used to support decision makers by assessing the impact of proposed changes to waste collection systems, such as collection frequency or number of collection sites.

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