Popelka - a tool for managing collection infrastructure and creating waste collection plans

Development status

Phase 3

Technology validation and implementing it in real environment. Testing the technology outside of the laboratory and its adjustment to external conditions.

IP protection status

know-how

Partnering strategy

Co-development, Collaboration, licensing

Institution

Brno University of Technology

Challenge

Waste collection planning represents a complex issue that evolves over time. Changes encompass the expansion of separately collected waste fractions, transitions to new collection systems, densification of collection networks, or the development of waste generation over time. As a result, these changes also impact the collection frequency, which is also influenced by the type of housing (single-family and apartment buildings) and, where applicable, the season (organic waste production). Furthermore, it is necessary to consider the legislative framework within the system. An example is the possibility of applying a landfill fee discount for municipalities based on waste generation, which limits the economic feasibility of transporting waste to the nearest landfill for a certain portion of the municipal waste. These mentioned constraints and the evolution in the field of waste management prompt the utilization of an automated tool for waste collection planning.

Description

The computational tool Popelka is designed as a web application, eliminating the need for users to install any software. A regular PC is sufficient, as all calculations run on a powerful server. Currently, Popelka is divided into two computational modules. The first module focuses on defining the collection infrastructure in individual municipalities that are part of the inter-municipal collection plan. This module allows for the registration of individual producers - addresses, companies, etc. - to which existing collection containers are linked, along with their parameters (waste type, collection frequency, container size, unloading technology). In case the user does not have exact information about the collection infrastructure (e.g., only the number of collection containers is known or no data all), the collection containers can be generated regarding the shortest walking distance. Data processing for the collection infrastructure is based on statistical and optimization models that provide all required parameters for the waste collection module (estimates of container service time and

collection time within a street, clustering into coherent areas based on vehicle capacity constraints and working hours). The second module focuses on the planning of inter-municipal waste collection. The user defines the set of serviced municipalities, the vehicle fleet, and its parameters. Important parameters include working hours and the possibility of overtime, the location of depots, and processing facilities for various waste fractions (up to several locations). For each municipality and waste fraction, allowed collection days and numerous exceptions can be defined to model real collection plans using the tool. Collection planning can be constructed entirely automatically, or this calculation can be combined with manual interventions. The user enters a portion of fixed collection routes manually as additional input and let the tool automatically complete the remaining routes. The calculation results are displayed on a map, in a schedule, and in tables, including key statistics, for ease of use when conveying the route to the vehicle crew. Considering the planned collection route between municipalities, it is possible to optimize servicing order of collection points within each municipality (the entry and exit sides of the municipality are already defined). Additional functionalities enable the automated generation of vehicle operation records for each day or the creation of collection calendars for individual municipalities (producers).

Commercial opportunity

The utilization of Popelka tool brings several benefits. The most significant advantage is the optimization of collection plans and the associated reduction in costs for servicing collection points. Another benefit is the automation of the entire system, leading to a significant simplification of planning activities. Partial benefits include speeding up daily administrative tasks when creating reports, route planning for specific agglomerations, and more. Currently, we are collaborating with four waste collection companies (Technické služby Malá Haná s.r.o., KTS EKOLOGIE s. r. o., EKO servis Zábřeh s.r.o., and Technické služby města Příbrami p.o.) to test the Popelka tool in real operations. The goal is to continuously develop the Popelka tool based on the needs of our partners and expand its scope to other locations in the Czech Republic. At the same time, we also offer collaboration in the development of optimization tools for other logistics areas. We believe that we have the necessary experience for the rapid development of new applications in this field.