RETASTE Conference Abstracts
RETASTE-FWU-1487-In-person Oral
Rethymno, September 16-18, 2026
© Author(s) 2026 CC BY 4.0 License
DOI:10.5281/zenodo.23678261

An Edge to Cloud Platform for Data-driven Monitoring and Predictive Analytics of Municipal Waste Collection

Christos Panagiotou, Dimitris Karadimas and Katerina S. Karadima

PIKEI – New Technologies, Greece

ACCEPTED

Abstract

Efficient municipal solid waste collection depends on timely, trustworthy operational data that is seldom available to local authorities (Sosunova et al., 2022; Hussain, et al. 2024). We present FleetSense (PIKEI – New Technologies, 2026), a deployed cloud native Internet-of-Things (IoT) and cloud platform (Karadimas et al., 2025) that instruments a refuse-collection fleet of trucks, operated for a Greek municipality, with satellite positioning and on-board bin-weighing system installed with minimum intervention, so that every collection round yields a stream of geolocated weighing events.

On truck bin weighing is based on the pressure readings of a pressure sensor installed to the hydraulic lifting system along with IMUs (Inertial Measurement Units) installed on the truck platform (Karadimas et al., 2025). Sensor readings, geo locations and data coming from truck's (ECU Electronic Control Unit) are the telemetry data published over cellular network to MQTT (Message Queuing Telemetry Transport), stored to the data lake (managed time-series database), and exposed through a cached query layer to a real-time web dashboard. The dashboard offers to the end user live vehicle tracking and service status, per-vehicle routes segmented by working shift, collection-density heat maps, automatic identification of recurrently serviced bin locations, and statistics of collected mass and bin lifts aggregated per vehicle, per collection area and per day, week or month.

To address the raw pressure readings drift, an effective-dated calibration model and a reproducible, versioned correction pipeline recompute mass from stored raw values that are validated against weighbridge measurements, keeping reported quantities consistent across every view. On this quality-controlled data foundation the platform provides analytical and predictive services. Short-term generation forecasts are computed per vehicle, per collection area and for the whole fleet at daily, weekly and monthly horizons using Holt's double-exponential smoothing, with automatic detection of weekly seasonality and 95% prediction intervals that quantify uncertainty rather than reporting point estimates alone. Complementary components apply statistical anomaly detection to collected mass and sensor behaviour, flagging miscalibrated or failing pressure sensors, and monitor per-vehicle data quality to distinguish genuine non-collection from instrumentation loss.

The same foundation defines concrete opportunities beyond current practice: enriching generation forecasts with exogenous covariates such as calendar effects, local events and meteorological conditions; predicting area-level demand to enable demand-driven rather than fixed-schedule collection and prescriptive route optimisation; estimating container fill state from historical lift patterns; and constructing a digital twin of the collection network for scenario analysis. The platform couples a validated measurement pipeline with interpretable forecasting to give operators an evidence base for route optimisation, cost control and

transparent waste management, and establishes a reproducible basis on which more advanced predictive methods can be assessed.

Keywords: Fleet management, waste management, on-vehicle weighting, IoT, waste production forecasting, cloud native

References

Sosunova, I., Porras, J., 2022. IoT-Enabled Smart Waste Management Systems for Smart Cities: A Systematic Review, IEEE Access, 10, p.73326-73363. doi: 10.1109/access.2022.3188308

Hussain, I., Elomri, A., Kerbache, L., Omri, A.E., 2024. Smart city solutions: Comparative analysis of waste management systems using IoT and multi-agent simulation. Sustainable Cities and Society, 103, p.105247. doi: 0.1016/j.scs.2024.105247

PIKEI – New Technologies, 2026. FleetSense – Smart fleet and waste collection management, https://fleetsense.pikei.io/

Karadimas, D., Panagiotou, C., Karadima, K., Amaxilatis, D., Akrivopoulos, O., Gkrizis, C., Andriopoulos, K., 2025. Leveraging Cloud-Native IoT for Cross-Sector Smart City Intelligence, 2025 IEEE International Smart Cities Conference (ISC2), Patras, Greece, p.1-6. doi: 10.1109/isc266238.2025.11293265

Acknowledgments: AMBITIOUS (Advanced CoMputing Continuum Solutions for Boosting DigITalization across European RegionS) European I3 project (Grant Agreement No.101115116)

ACCEPTED