The REThinkWASTE Big Data Platform

The REThinkWASTE Big Data Platform has been designed to offer public companies that work in the waste management field a plug-and-play governance system based on PAYT (Pay As You Throw) and KAYT (Know As You Throw) models. The goal is to encourage more responsible waste management, boost separate waste collection, decrease the amount of waste sent to disposal, and improve recovery efficiency. As part of this effort, ETRA, in partnership with DataRiver, sought to enhance its waste collection services by utilising advanced data analysis to optimise logistics and monitor user behaviour.

"An advanced data integration and analytics platform for intelligent waste management"

Laboratory	DATARIVER
Specialization Area	Digital, Energy and Sustainability
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Fig. 1: Use Scenario (by AI using Microsoft Copilot)

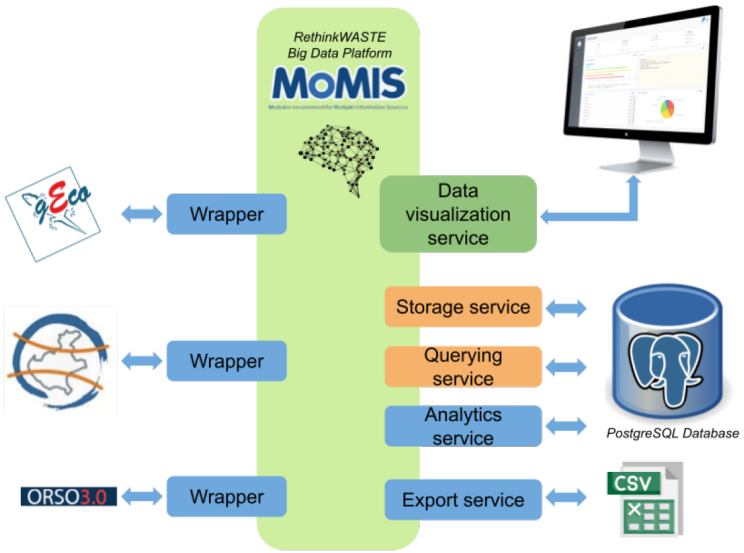

Fig. 2: REThinkWASTE Big Data Platform: architecture

Description

The REthinkWASTE Big Data Platform aims to implement a technological ecosystem for the optimization of waste management services that would offer environmental and economic benefits.
The platform is designed for the companies operating in the waste management context that want to leverage the large amount of data collected through IoT technologies to increase service efficiency.
To evaluate the goodness of the waste collection service, a list of KPIs (Key Performance Indicators) has been developed in order to measure how different important parameters impact the overall performance.
These KPIs were validated within the platform through correlation analysis and AI algorithms, which proved their accountability.
The REThinkWASTE Big Data platform enables the integration and analysis of waste management data, making it possible to standardise data from a large number of heterogeneous sources. The platform enables continuous integration and monitoring of:

- Information on user behaviour on waste exposure
- Waste collection routes with the door-to-door system
- The emptying of vehicles at the collection points
- The waste nature and composition

Innovative aspects

The REthinkWASTE Big Data Platform is an innovative platform based on IoT and Big Data Integration technologies to provide a unified view of the waste heterogeneous data sources. Based on the MOMIS Data Integration system developed by DataRiver, it adopts a semantic approach for the integration of new data sources and exploits the modularity of microservices to ensure interoperability with other systems. The platform provides advanced services for:

- **Big Data Collection:** Efficiently gathering large-scale data from sensor networks and information systems.
- **Big Data Integration:** Using semantic integration methods to standardize data from various formats and protocols.
- **Data Visualization:** Providing data representation at multiple levels of abstraction and granularity, including temporal resolution.
- **Hybrid Storage:** Utilizing data lakes with both NoSQL technologies for historical analysis and relational databases for real-time processing.
- **AI and Machine Learning:** Leveraging AI and machine learning for continuous performance monitoring, real-time analysis, and examination of historical data.

Potential applications

The REThinkWASTE platform has the potential to enhance operational efficiency for both public and private companies involved in waste collection by offering improved control over the scheduling and management of their collection fleets. The implications extend beyond cost reduction associated with waste collection shifts, contributing to a lower environmental impact as well.

Fig. 3: REThinkWASTE Big Data Platform objectives

Involved partners
- DataRiver S.r.l.
- ETRA S.p.A.

Implementation Time
6 persons months

Technology Readiness Level
TRL7 - System prototype demonstration in operational environment

Exploitation
The REThinkWASTE big data platform is an advanced data integration and analytics platform, useful for waste management private and public companies to get the maximum out of heterogeneous data and to understand and improve services for large communities.

Application example

Tested on real-world data from ETRA's databases containing data about the waste collection system in a vast area in Veneto region.
The REThinkWASTE platform was presented during the "BDCat 2023 : International Conference on Big Data Computing, Applications and Technologies"

The project data about waste collection shifts and dump truck emptyings in 22 municipalities in the Veneto region collected by ETRA for over 3 years. Thanks to ETRA and DataRiver cooperation, two main results were achieved. The first was the realisation of a clean and integrated database, which could be used by ETRA as a basis for the construction of a more robust monitoring system for their services. The structure of the Data Platform was also designed to improve the efficiency of KPI analyses, which was the second result.
These analyses helped ETRA to better understand the real efficiency of its collection service and, thanks to the correlations found between the indicators and the territory-specific variables, it was possible to make corrections where necessary. In some cases, however, the assumptions made by ETRA even before knowing the results were confirmed, indicating that in these cases the collection service was well organised and in line with the company's plans.
These results were used by ETRA to align with the transition of involved municipalities towards the PAYT-KAYT paradigm goals set by the REThinkWASTE Life project.

DATARIVER

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DataRiver Srl is an innovative SME accredited as an Industrial Research Lab of the High Technology Network of the Emilia-Romagna Region. DataRiver is one of the founding partners of Clust-ER – Service Innovation and Clust-ER – Life Sciences and Wellbeing of the Emilia-Romagna Region.

Founded in 2009 as a Spin-Off of the University of Modena and Reggio Emilia, the company is Associate Member of the European Big Data Value Association, and is also a technology provider of the Industry 4.0 Competence Center BI-REX (Big Data Innovation & Research EXcellence). It is also self-certified as Contract Research Organization (CRO) at Italian Medicine Agency (AIFA).

DataRiver provides innovative services and consulting in the areas of Industry 4.0, Big Data Integration & Analytics, IoT, Location Intelligence, Semantic Search and Data Cleaning to both manufacturing and service companies as well as public administrations.

The services offered include the creation of web platforms for the collection and integration of heterogeneous and distributed data, as well as data analysis through Artificial Intelligence and Machine Learning techniques to help improve decision-making, production and predictive processes.

In the health sector, DataRiver deals with data management, data integration and data analysis to design and implement pathology and rare disease registries, investigational drug and medical device clinical trials, and remote patient support and monitoring programs for pharmaceutical, biomedical and homecare companies, and Scientific Institutes for Research, Hospitalisation and Health Care as well as hospitals.