

WasteIQ

The open waste management platform. Enabling seamless data flow, improved user experience and new business models in the waste handling value chain.

Background

WasteIQ is a continuation of the BossID framework, developed by internal developers in BIR – the renovation company in the Bergen area, in the period 2009–2017. The inter-municipal public company was an early adopter in the use of modern connected waste solutions, including user identification, buried containers and in-city vacuum system. This created a need for trace waste flow and securing usage transaction, managing access and gathering data across different technical solutions. In a complex, digitized reality, it was important for BIR to log the waste streams in the form of structured, consistent data about fractions and usage of different facilities.

At the same time, BIR needed a framework to think about the business model where it was desired to incentivize more environmentally-friendly behaviour. Regulatory and technological transformation increase the need for quality data. Traceability and data management are becoming more important for public waste companies. New technical architecture and higher levels of standardisation is necessary to ease data exchange, both upstream and downstream in the value chain.

Structured data is the very basis for digital service development in complex value chains. This is especially important if you want to innovate on a systemic level. For the waste industry, this includes the cooperation that happens in practice all the way from the kitchen to the combustion plant. BossID has succeeded in "normalizing" data from different suppliers, while ensuring a system with digital "keys" to the individual household, and a ledger for all waste transactions.

In sum, this becomes an "accounting system" and a ledger for the use of buried solutions and underground vacuum pipe system in Bergen. The data can be used for invoicing purposes, serve as raw data for logistics planning, and precise statistics to analyze how the waste system can be improved. By linking individual, fractions and infrastructure enables a possibility of innovation on a business model level. Both Bergen and Kristiansand has introduced PAYT-fees and experienced increased recycling as results. At the same time, automated back office processes in technology contribute to significant administrative savings. The mandatory identification solution also reveals "freeriders" (unregistered customers) – which increases the revenue base for public waste companies.

BossID has enabled dynamic pricing in the private market, and settlement / cost sharing system in the corporate market. There has been a noticeable change of behavior after Bergen went over to PAYT / dynamic price model, and the BIR organization has experienced significant efficiency gains. The platform has a huge potential to further simplify infrastructure monitoring and optimize logistics.

WasteIQ: A cloud based service run by an independent company

For the last years, the system has been hosted and maintained by BIR on local servers. Increasingly, other waste companies has showed interest in both the technology and best practises. WasteIQ is established as an independent company to enable this sharing, to upgrade the solution to a multi-tenant cloud architecture. We have gathered a highly skilled team of developers, with knowledge of everything from mechanical solutions, sensor technology, business models and digital user experiences.

The primary target group for the framework is municipal waste facilities and public inter-municipal enterprises, that today operate in a complex business, characterized by fragmented technology standards and many time-consuming manual processes. It's crucial to achieve better integration between operating systems and customer management systems. With WasteIQ, the goal is to normalize data across different vendors, ensure consistent formatting of data and ensure safe storage compliant with regulatory requirements. By creating an ecosystem of clients and partners we want to increase the rate of innovation and put the waste companies in a lead position while sharing costs and experiences. Structured data is the foundation of efficient and user-friendly waste management. The importance of data security and data quality has been emphasized. The framework comes with a well-documented APIs (application programming interfaces), that eases the integration with both vendor software, ERP and CRM systems.

The proof-of-concept in Bergen is the integration with ISY ProAktiv CRM system from Norconsult, and selected suppliers of buried container solutions. The ambition for the next year is to establish a rich portfolio of approved "adapters" and certified extensions to a wide range of systems. We want to reduce the number of integration hurdles, to make room for innovation on value chain level.

Documented effects of the solution

By using the system in Bergen, a number of positive effects have been documented.

Behavioural change. Testing with incentive fee / dynamic pricing has created a substantial and lasting change in the amount of residual waste, and a corresponding increase in recycled waste. Calculations from BIR show 4000 tonnes of reduced residual waste annually and increase in all recyclables, including 25 per cent increase in plastic waste.

Improved data quality. The system has given BIR far better overview of consumer behavior, higher data quality and better data protection. More structured data has contributed to increased opportunities for operational analysis. It has revealed a large percentage of "freeriders", estimated at 2.5% of users, and it's brought in accumulated 25 million NOK in lost revenue.

Better workflow. Many administrative processes in the waste industry is basically about manually moving data between systems. Significant efficiency gains have been recorded, estimated at 1–2 man-years in BIR.

Subcontractor savings. Better data control on waste levels and predictive analytics makes planning easier, and enables new and more dynamic ways of dealing with subcontractors, based on actual real-time needs, not scheduled plans. BIR calculates the value of this to around NOK 17 million annually.

More accurate analytics. BIR has significantly gained an overview of the use and impact of the vacuum pipe system in the city center. This contributes to improved capacity calculations, load balancing, and also enables research projects with accurate data capture.

Innovation. The framework is built on open architecture that opens up that infrastructure providers and manufacturers of specialized systems (e.g. CRM systems) to develop new services. By building the service as a SaaS, upgrading the code base and creating networks of user to share experience, the level of innovation is likely to accelerate.

The upgraded framework

The transition to WasteIQ has required upgrading and partly rewriting the code to a microservice architecture in line with best practices. We have now a system that provides multi-tenancy support and that can be configured to serve different organisational structures. The ambition is to make it possible for more cities to easily use the system without having to change roles. In the process we have built scalability in the solution, and enabled well-documented interfaces. We will continue the robustness and data security that characterize the current BIR

ledger.

Technical architecture:

The new solution continues a lot of the principles and parts of the external links in today's system, but the MSSQL kernel has been replaced with NoSQL. In the new solution, we have built up a high degree of modularity. Microservices will make it easy to further develop parts of the system and add functionality required by users. A new GraphQL API enables complex queries both for reports and third party applications. A deterministic test environment – a simulator – enables thorough testing and validation. This can also be used as a “sandbox” for new cities.

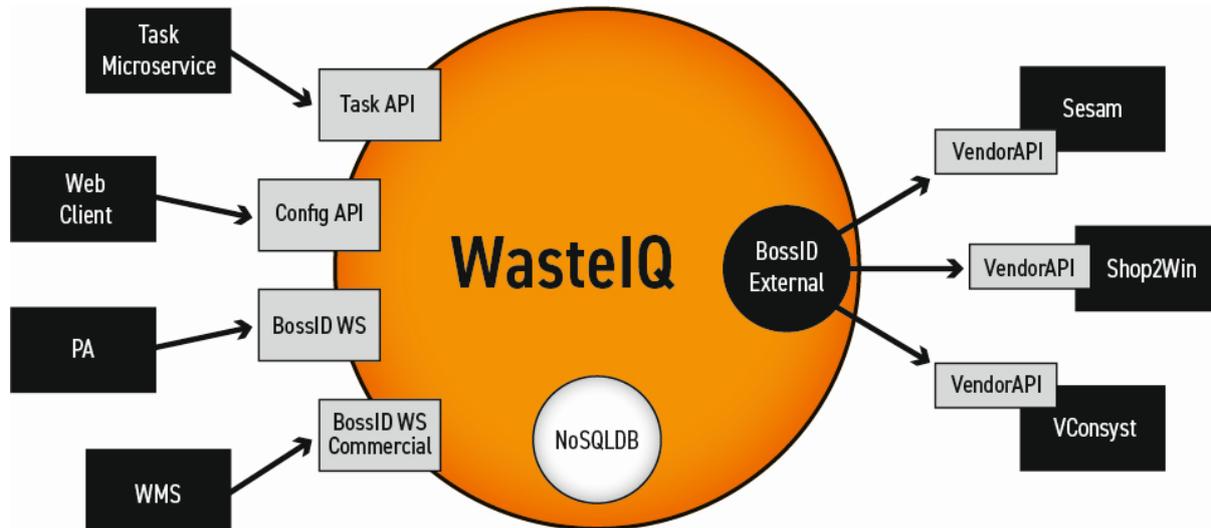


Illustration: Revised architecture for WasteIQ. The solution is developed with a NoSql database at the core, and APIs facing both ERP systems, CRM system and different software connected to physical infrastructure.

Technical objectives

The following objectives have been established for the technical project:

Robustness. The gathered data must be quality assured, and data consistency and integrity is assured.

Traceability. The data should flow seamlessly all the way from infrastructure and to systems. The system should support version management.

Easy for new developers. The code is written in English, follow best practices and is well documented. All components should be unit tested. The system should not require qualifications that are uncommon in today's industry.

Continuous deployment. We need to establish a effective development environment and support for changes in short develop-deploy cycles. The platform comes with a lasting and customized test environment that provides predictable states and results given different scenarios.

Organisational adaptivity: The system should support the development of role-sensitive client, both for business and logistical operations. Support for quick setup with multiple customers, with signage and optional modules and dedicated testing environment for each client.

The open process

Over the years, there has been a high level of knowledge exchange in the project, between the waste company in Bergen and various suppliers. In an industry that is characterized by fragmentation, WasteIQ has promoted standardization and best practice. In the recent transition to a cloud-based platform, we have initiated conversations with several waste companies, to start building a culture of sharing and higher level of transparency. In recent months we have researched needs in different organisation in order to create modules

and solutions that can be used across different installations, but managed and further developed in a uniform manner. In this way we enable code-sharing, less duplication and we reduce the need for costly integration projects. The goal is to do this as openly as possible, also for third party developers.

In the process we have also initiated meetings where inter-municipal waste companies have met each other, which have given great value to the participants involved. We want to establish an early user forum for all players who use WasteIQ, and facilitate training in the system. By standardizing data across cities, WasteIQ will in the future be able to create aggregated analyzes of the differences between user behavior in different cities. We can involve researchers in small pilot projects that provide the basis for systematic acquisition of knowledge. Thus, the framework will not only contribute to more modern technology, but also an innovation culture in the industry.

Features

WasteIQ is designed as a middleware, sometimes referred to as a platform, or ecosystem, normalizing data across infrastructure and seamlessly integrating with other systems – such as CRM fee calculation and logistical planning. The goal is to contribute to smarter operations, greater cost efficiency and good user experiences that optimize resource friendly behavior. Embedded in the service lies in important customer-facing services. The first version of WasteIQ will include the following basic services:

Service	Established features	Planned features
<i>Access management for public infrastructure</i>	<ul style="list-style-type: none"> • Uploading of RFID keys • Mapping keys to public household registry • Define access to infrastructure for individual keys. 	<ul style="list-style-type: none"> • Homeowner client that enables tracking / reporting of tenants. • End-user mobile client that provides access to infrastructure • Mobile key system
<i>Infrastructure registry</i>	<ul style="list-style-type: none"> • Register new facilities • Receive data from new facilities • Overview of facilities, status and error messages 	<ul style="list-style-type: none"> • Certification of facility type • Custom Configuration Client • Role Sensitive Alert System in case of failure.
<i>Waste transaction ledger</i>	<ul style="list-style-type: none"> • Overview of usage of buried containers and vacuum system, related to user, fraction and facility. 	<ul style="list-style-type: none"> • Integration with system for traditional waste bin collection and facilities for special waste.
<i>“Waste-in API”, interface for data from physical infrastructure</i>	<ul style="list-style-type: none"> • A well documented interface for data exchange with infrastructure. 	-
<i>“Waste-out API” interface for CRM, ERP and other systems.</i>	<ul style="list-style-type: none"> • A well documented interface for data exchange with other applications. 	
<i>Developer API</i>	<ul style="list-style-type: none"> • A well documented GraphQL API for data exchange with other applications. 	<ul style="list-style-type: none"> • A custom end-user client • Real time map showing the status of facilities • Business intelligence dashboard

Pricing and services

When the platform is made available to several cities, the application and related service will be offered in a way that reflects the needs technical in the individual city, both technically and organisatorically. The price

model is under review and will be developed to reflect the value and incentives created from the system.

WasteIQ will break the platform into modular services, including access control, waste log, integration with CRM systems, and integration with different types of infrastructure. The price model and service portfolio will be developed in close cooperation with the waste companies and suppliers themselves. We want a price model that scales in line with size of organisation, technical complexity and number of transactions. It should also be possible for small waste companies to make use of the service.

We plan for a model where the pricing is divided into three:

Basic license

Basic gives access to the basic functions of the system. The license consists of a fixed cost for access to the platform and a dynamic cost related to the facilities and each transaction in the system.

Extensions

We are committed to developing a range of optional services that provide access to enhanced functionality. These additional services we will create in dialogue with the clients who use the core system. We also want to offer a premium support service.

Development projects

We want to establish a team of professionals that combines technological insights with domain knowledge about the waste sector. We will offer this team, and related partners, to deliver custom solutions into projects for different waste companies, based on agreed estimates.

The organisation

The company WasteIQ has now taken over the operational responsibility and further development of the platform. Before summer 2018 we are ready with a tested, upgraded and cloud-based version of the framework, which allows more cities to connect. The solution will be put into production in the autumn of 2018 and will take over as a core application for the operation of the Waste Infrastructure in Bergen. From fall 2018 on, we will open for pilot projects in other cities, and work systematically to get technical approval of most suppliers.

We will build the organisation according to needs in the project. The current team in WasteIQ consists of highly experienced technologists and business developers, with experience from developing cloud-based solutions from other sectors, including finance and logistics. The goal is to create a robust academic environment that combines expertise in digital infrastructure, user-oriented service development and the special challenges in the waste industry. This team will be able to contribute efficient project development and digitization processes to municipal agencies and inter-municipal waste companies. Technical openness and standard development will be important for the solution. It is desirable to have close dialogue with different system vendors. All integrations will be offered as ready-made "adapters", so we will achieve a reuse benefit.

Roadmap

WasteIQ has identified a number of unmet needs and technical possibilities. In the future, increased efforts will be made to integrate with software and also build "native" clients, including a configuration client that simplifies usage and setup of new facilities. It is important that the goal is a modern technological framework that structures and enriches data, and simplifies work processes in waste companies and municipal agencies. This can be done partly through integration with professional systems, partly through the development of new functionality in systems through automation or client development. In the process, we have noted the following development opportunities:

Phase 1
<i>February 1st - June 31th 2018</i>
Main objective: Establish a cloud based, multi tenant “core system” that can be installed by multiple waste handling organisations.
First stage in the project resulted in an application that passed tests on functions and data security. The platform is production ready, given upgraded external interfaces that work in terms with the documentation. The platform will replace existing BIR solution in early fall 2018.

Phase 2
August 1st - June 1st 2019 (estimated)
Main objective: Get the platform up and running for selected pilot clients. Develop clients and extension identified in phase 1. Enable a certification program, and increase number of certified facility types. Build a team that combines digital expertise with understanding for the waste management value chain.
Phase 2 will start out with replacing existing solution with cloud-based solution, and run pilot installations with selected cities. We will enable dialogue with end users within the different organisations, to improve workflow connected to access management (key system), customer dialogue and invoice routines. We will, using agile methodology, develop the features and extensions of the system. We will create an annual summit where technical personnel across the value chain can meet to discuss system challenges and share knowledge.

Phase 3
June 2019 -
Main object: Establish an organisation capable of running and scaling the framework for several cities, and develop more features based on continuous deployment. International network.
Phase 3 will start when we have a proven solution that creates high value for the first 5–8 clients, and established robust data transfer from major infrastructure providers. Then we will seek international markets and help circular data driven business models spread to public waste organisations worldwide.