Contents

Subject of the Contract:

- Contract Name **“Digitization of the 180-vehicle fleet + Waste collection planning system + Electronic logging and discharge confirmation system”**
- Contract Type: Service
- A Framework Contract will be signed with the successful tenderer for the delivery of the subject matter of the contract.

Internal Analysis:

The implementation of a digitised vehicle and planning system is expected to allow for more efficient planning through the use of contemporary data collecting and evaluation techniques. The solution consists of 2 main parts

a. Hardware - devices mounted on waste management equipment that will gather data from the vehicle and deliver it to a central system for processing. The aim of OLO is to gather data from vehicles; it requires the supplier to deliver the devices and their operation as an IaaS service, i.e. the supplier of the solution manages the devices to assure data collection from vehicles and delivers the acquired data to the System for further processing.

b. System - a software platform that will be utilised to collect data from vehicles as well as other data that will be used to evaluate, plan, and optimise waste management activities. This mechanism is also one of the four essential inputs for electronic STAS record. This method is critical to creating an unambiguous log of discharging confirmation against which fees can be assessed as part of the upcoming Pay as You Throw overhaul.

The aims of the solution are:

For the management of the company:

- improving waste collection efficiency;
- lowering fleet operating expenses;
- gaining the ability to plan targeted maintenance based on real vehicle usage;
- achieving declared goals of the shareholder;
- getting data inputs for BI and management.

For the workforce and process management:

- immediate access to important data;
- long-term data collection and processing for planning;
- KPIs for driver evaluation;
- tracking vehicle fuel usage;
- selecting the appropriate vehicle (CNG/Diesel) based on fuel consumption in a given Section/Region;
- refuelling comparison - filling station and vehicle fuel tank;
- avoiding fuel leakage;
- logbook digitization;
- data synchronisation with OLO systems;
- output simplification.

For the system workflow:

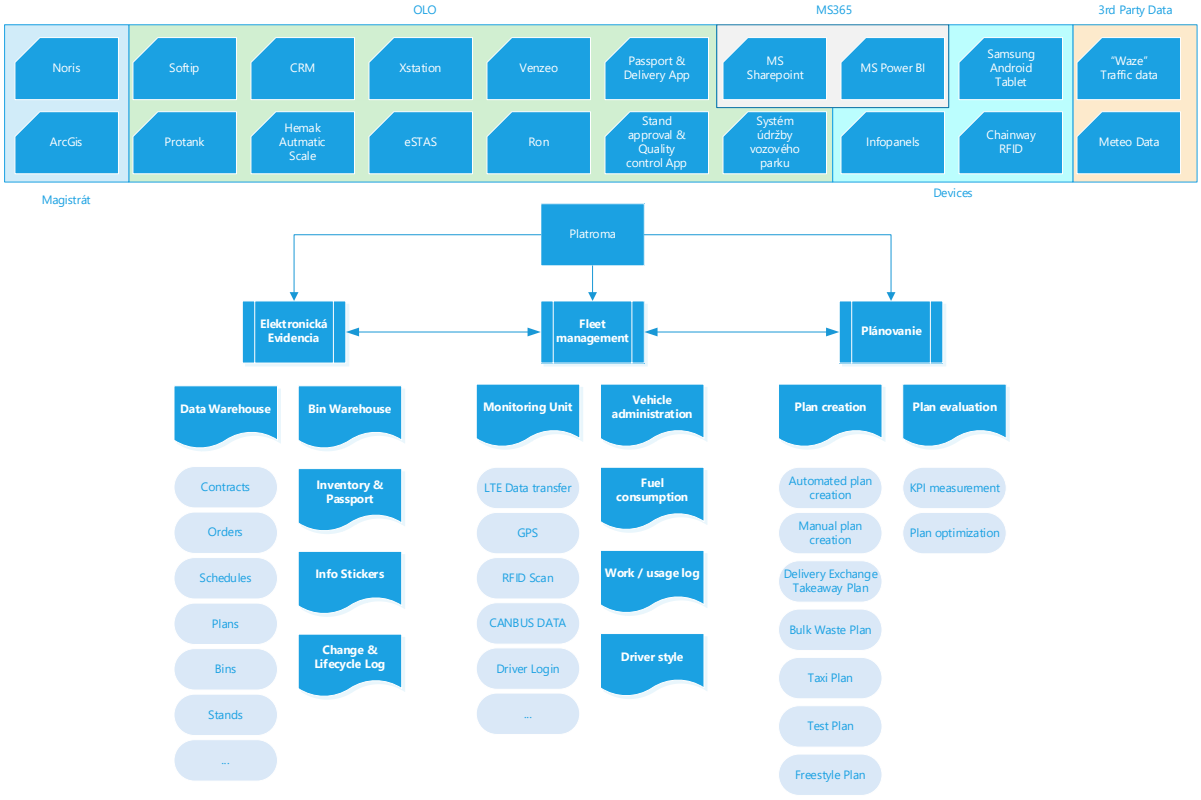
- centralised vessel service data processing;
- centralised vehicle data processing;
- centralised waste collection plan processing.

0.0 Solution description:

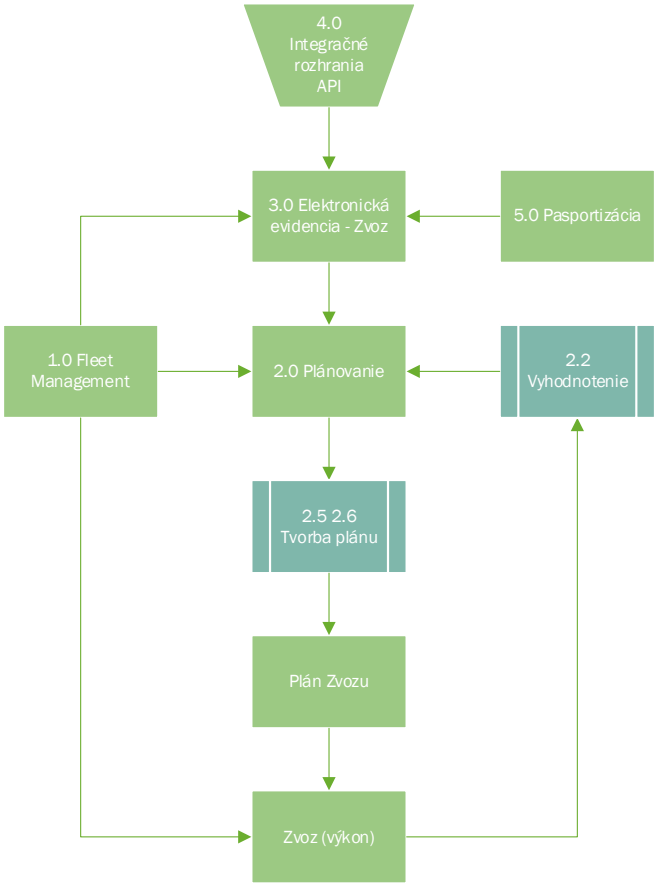
The Contracting Authority anticipates delivering a comprehensive solution in IaaS-PaaS mode, i.e. *Infrastructure as a Service* and *Platform as a Service*.

0.1 Logical plan of the solution

The plan does not provide a comprehensive description of all the inputs listed in the technical specification. Sections 4.0 and onwards of this document contain a complete list of the inputs.



0.2 Logical plan of the modules interaction



0.3 Platform

General description:

The platform will be developed using a modular system. Data from the various modules described in this document will be processed using big data, artificial intelligence, machine learning, Business Intelligence, Data modelling, Data lake, and cloud technologies such as AWS, Data Bricks, and MS Power BI (the Contracting Authority provides technologies as examples in this paragraph; it is not important to the Contracting Authority which exact technology the provider will use to deliver platform features).

General PaaS service requirements:

- Providing initial system configuration and training.
- Possibility of exporting all measured and processed data from all listed modules and submodules to XLS, CSV, or PDF formats.
- The platform shall include a central database (big data) that is available to all individual modules; each module processes its own data in the database and individual modules can process data from the central database independently.

The Customer expects the PaaS Provider to define user access to the system.

The Customer requires creation of the following access permissions within the platform:

- Administrator Role

- role allows for the creation of users and the assignment of permissions;

- the ability to grant individual users authorization to utilise each platform feature and specific modules individually;
- the ability to create and modify user groups based on individual organisational components (all users in the group will have the same permissions).

- Super User Role
  - role grants access to all system functions and comprehensive system operation.
- User Role
  - role allows for the creation and viewing of reports and data.
- Planner
- Driver
- Master
- Crew Delivery-Collect-Passport

Examples of approaches to features in the departments of the Contracting Authority

Department	**Main features utilised**
Planning Department	Logging and Planning
Waste Collection Masters ZKO and TZ	Logging and Fleet management
Traffic Department	Fleet Management
Large Capacity Container Department	Large Capacity Container Planning
Delivery and Collection Department	Delivery and Collection Planning, Taxi
Customer Service Department	Logging, Reports

0.3.1 Resident App

Residents can use this app to view active contracts, services, orders, and the collection schedule. Reporting complaints. Order new services, Pay for service

The app is available for both Android and iOS.

0.4 GUI Requirements

0.4.1 Web GUI

The proposed system shall feature a web graphical interface with a responsive design. The interface must be user-friendly, clear (functions accessible via icons in a clear menu), and localised in the Slovak language.

The Contracting Authority shall require the tenderer to include a basic interface design in its bid. The interface will be examined by a panel appointed by the Contracting Authority.

The graphical look of the feature must be designed in accordance with the OLO design manual.

Work with data using forms and parameter editors (described in detail in individual utilities) for each type of processed data based on module, feature, and type.

The user interface must include map documents in the form of layers for displaying the location of collecting locations and address points of containers in real time with a maximum variance of 5 m. (see section 0.4.2. for a more detailed description).

It must feature the ability to track entities on various types of map bases (in the form of layers), preferably with the option to convert to Street View mode.

At the same time, we require that one of the map layers include the traffic load on the routes in the last max 10-15 minutes in the area of Slovakia in addition to the above data.

Further special requirements:

a. The user functions of the information system shall be accessible via a secure web interface (SSL certificate).
b. Instant real-time (online) overview of the position of vehicles or groups of vehicles on the map, with additional vehicle information (registration number, type, time, position, speedometer status, speed, direction, altitude and fuel status of trucks, work activity inputs of truck bodies) from any computer connected to the Internet (also in printed form) or using a mobile application, with automatic position refresh.
c. Accurate rendering of the route on the map with graphic indication of speed and direction using map data ("Google Maps, mapy.cz, or others)" with payment of licence fees for their use (road network, satellite view), display of individual runs by sections (for cars and trucks), including complete updating throughout the entire period of use of the monitoring system within the required licence.

0.4.2 Map data

- WEB GUI must be able to display map layers (Google Maps, Mapy.cz, Bratislava GIS - Cadastral map...), location of containers, collecting points, and current vehicle location.
- Individual layers must be able to be displayed separately as well as combined, with the option to change the opacity for each layer separately on a scale ranging from 0% (opaque) to 100%. (invisible).
- The option to search the map data within the modules using associated parameters (address, parcel number, owner's name, etc.) is a requirement.

0.4.3 Reporting module

Report creation tool. Full integration with PowerBI.

Report type examples:

- Vehicle alerts
- Vehicle operation costs
- Container servicing evaluation
- Fuel usage evaluation
- Vehicle operation evaluation
- Mandatory vehicle stops
- Weight tickets and weight display
- Waste collection by
  - Container servicing
  - Working time pool
- Error reporting
- Vehicle utilisation

- Timesheet
- Faults
- Inspections

0.4.4 Tablet App for crew members

- Displaying the plan and route on the map
- Displaying the route progress on the map
- Numerical display of the plan progress
- Navigation
- Option to expand address points for additional information
- Alert and notification display
- Display the tasks assigned to the crew by the master/scheduler.
- Crew competition, displaying the top 5 in performance indicators in tablet (best fuel consumption, number of services, time)
- Total rankings
- Online master information
- Pac Man
- Online Data - acquired from current online platforms and used by the collection vehicle crew on the day of waste collection while on the scheduled route and to display alerts and recommendations on the tablet.
    - Traffic density (historical data, online data);
    - Traffic density prediction based on historical data;
    - Restrictions;
    - Weather;
    - Influence of weather on traffic;

1.0 Electronic logging module

A database system that is designed to process massive amounts of static and dynamic data from various sources (sources are listed in the Integrations section). The system must provide data processing responses both during processing the data from electronic logs by other modules of the platform and when the user manually works with the data. The system must be scalable automatically as the amount of data increases, without limiting the maximum capacity of electronic logs.

Data will be processed in structured relational, unstructured heterogeneous form and in their combinations.

Data logging shall allow for the interconnection of individual logical units within the platform in such a way that detailed parameters, including contexts, are available for bulk processing and display (solution parameters described within this specification). The contractor shall design data maps on the basis of which the interconnection shall be implemented within the framework of the scheduled operations.

E.g. the container is located concurrently on a Contract, a Stand, a District, a Collection Point, etc.

A large amount of heterogeneous data is expected to be processed, in particular in the Waste Collection Planning and Waste Collection Evaluation modules, where data from vehicles (vehicle parameters, GPS movement, speed, fuel consumption, rpm, engine temperature, exterior temperature, RFID sensors) will be processed, as will traffic data, seasonal data, weather data, and manually added field data - i.e. the data detailed under the article “Fleet management.”

A fundamental requirement of the data structure is that the parameters of the entity are automatically applied to the set in which it is placed.

Registry units or features that are logically ordered, group relevant parameters, and are database and functionally linked are listed below (sessions). Parameter visualisation and user customization in specific registry units or feature must be allowed. The data from the software incorporated into the platform, as stated in article 4 of this document, will be used by the individual units.

List of registry units:

1.1 Contract

The obligation to collect waste in accordance with the Generally binding legal regulations arises by signing the contract at the Tax Department “OMDPaL” of the Municipality of the Capital City of Bratislava.

The registry unit contains the following data: The first registration is performed in the NORIS application, where a citizen is registered as a customer with whom a contract is signed (a unique contract number is provided), and the following contract-related data is registered:

- Customer identification
- Customer contact information
- Contract parameters
    - Contract No.
    - Contract status
    - Contract changelog
    - Contract validity period (From, To)
    - Contract source (Noris, Softip)

    - Name and surname of customer
    - Customer type
    - Customer address/borough/Postal code
    - Tel./e-mail/
    - Commodity
    - Logical container
    - Container type
    - Container capacity
    - Average weight per volume/container type in a given borough for each month of the year, parameters can be manually entered and automatically calculated based on data from a given collection (collection weight/number of containers served proportionally per type)
    - Collection interval
    - Collection point
- Container (multiple containers can be allocated to each contract) - Logical entity based on OMDPaL (department of the capital city of Bratislava), which contains contract parameters, container type, and collection interval + physical container parameters
- Sui generis ID number of a container – common UID Municipal authority + OLO
- Stand
- Collection point

Contract data will be shared via CRM and ERP system interface..

1.2 Order

Data will be collected from customer orders placed through the mobile application or web site. Softip orders integration.

1.3 Price list

Price list of services available for customers through the mobile application or web portal. Softip-approved price list of services integration

1.4 Additional services

Services that the customer can or must include in their contract through a purchase order. Container Pulling, Container Access, Key Service, and Stairs are examples of additional services. Additional service information must be linked to a specific container; the scope of the additional services is determined by the main frequency of the container. The system calculates the overall value of the order by calculating the quantity of services.

The data is transmitted to the invoicing system using Softip integration.

1.5 Containers

A so-called logical container is generated when a contract is first registered.

When a contract is generated, a logical entity is created in the Noris system, and once the data is flipped, a physical container is created that has parameters like RFID, GPS, Stand address etc.

Concurrently, additional critical data is being generated in the database.

- District (manual district assignment by the relevant department)
- Waste type
    - Biodegradable
    - Food waste
    - Biodegradable food waste
    - Street cleaning waste
    - ZZ waste
    - Paper
    - Plastic
    - Glass
    - Mixed waste
- Container volume
    - 0l (bags)
    - 20l
    - 110l
    - 120l
    - 240l
    - 500l
    - 700l
    - 1000l
    - 1100l
- Container condition (manually update container condition)
    - Next
    - New
    - To be delivered
    - Delivered
    - Active/Current
    - To be collected
    - Collected
    - Previous
    - To be replaced
    - Replaced
    - Suspended
    - Repaired
- Container No. (Container serial No.)
- Original container No. (historical parameter)
- RFID (ID No. of documentation)
- UID Mag. OLO - contract No.
- Customer's department (person/department responsible for waste collection)
- Container material
    - Plastic
    - Sheet metal
- Stand No. (Stand ID)
- Stand name (ID + Stand address)
- EU name (EU=End User)
- EU e-mail
- EU telephone
- EU city
- EU city borough

- EU city district
- EU street
- EU land registry No.
- EU house No.
- EU postal code
- Customer (name and surname of the customer)
- Customer - address (customer address)
- Container code
    - 10 (110l Mixed municipal waste)
    - 101 (5000l Semi-underground paper waste container)
    - 102 (2500l Glass waste container)
    - 105 (5000l Semi-underground plastic waste container)
    - 17 (120l Mixed municipal waste)
    - 18 (240l Mixed municipal waste)
    - 20 (1100l Mixed municipal waste)
    - 201 (500l Composter)
    - 202 (700l Composter)
    - 203 (1000l Composter)
    - 204 (120l Biodegradable waste)
    - 205 (240l Biodegradable waste)
    - 25 (5000l Semi-underground mixed municipal waste container)
    - 3000 (3000l Semi-underground mixed municipal waste container)
    - 3001 (3000l Semi-underground paper waste container)
    - 3002 (3000l Semi-underground glass waste container)
    - 3005 (3000l Semi-underground plastic waste container)
    - 31 (120l Biomedical waste and infectious waste container)
    - 32 (240l Biomedical waste and infectious waste container)
    - 33 (1100l Biomedical waste and infectious waste container)
    - 5000 (5000l Semi-underground mixed municipal waste container)
    - 5001 (5000l Semi-underground paper waste container)
    - 5005 (5000l Semi-underground plastic waste container)
    - 51 (120l Paper)
    - 52 (120l Glass)
    - 55 (120l Plastic)
    - 61 (240l Paper)
    - 62 (240l Glass)
    - 65 (240l Plastic)
    - 71 (1100l Paper)
    - 72 (1100l Glass)
    - 75 (1100l Plastic)
    - 82 (1200l Bell-shaped for glass)
    - 92 (1800l Bell-shaped for glass)
    - V51 (Bags for paper)
    - V55 (Bags for plastic)
- Price type (Family house, Business, Invoicing, Apartment, Collection centre, School, Owner, MHD stop)
- Container count (always 1)
- Valid from (Date)
- Valid to (Date)
- Frequency of service - The number of services required by the customer per time unit (1x/week, 1x/4 weeks, etc.).
- Service Term - tool to record a frequency request (W = Weeks, 103[24,24] = District 103 pickup Tuesdays and Thursdays)

    - T1
    - T2
    - T3
    - T4
- Notes for drivers
- Area description
- Created by (name of employee that created the record)
- Created on (time and date stamp)
- Edited by (name of employee that edited the record)
- Edited on (time and date stamp)

The data from the Noris application shall be synchronised to the central database via the integration API. The automated scheduling system must suggest assignment of containers obtained from Noris to certain districts, collection points, and stands. OLO employees will review the suggestion, amend it, and insert it into the database.

1.6 Digital delivery note

This object is a consolidated summary of NORIS system records including the necessary information for the specified task (e.g., add, collect, replace container). This is considered as an electronic request for services.
This object is the link between the logical and physical containers.
In addition to the container parameters, the delivery note includes the GPS coordinates of the point of delivery, photographic documentation of the container, the delivery point, the standing area, and the waste collection point.
Tasks associated with this module require desktop/web and mobile interfaces.

1.7 Stand

A stand, as defined by regulation ***VZN BA 6/2020***, is a physical location where a container is positioned.

- Address
- GPS
- Plus Codes
- edits the planning module only
- (*) link to the stand takeover system-application
    - parameters similar to those found in the takeover system (dimension and capacity of the stand, metres stairs keys throughput lighting OHS chargeable services)
    - hydraulic arm parameter
    - possibility converting to PPK in the future
- Stand admins

It is also important to identify the Temporary Shared Stand (TSS), which is a point specified by the OLO/MAG where consumers must make containers available for collection. If the customer does not make the containers available at the specified time, the collection will be cancelled.

One common stand may have multiple allocated addresses, such as Stand Sadová 1 = Sadová 1 + Vajnorská 29 27 31 + Mestská 2 4 6 + Tehelná 1

(*) Is is required to make an integration with the Application in order to carry out the stand takeover. The application will connect to the central database in order to interact with or add data. An application used to take over newly created stands or that are not taken over through a

procedure of approval for taking over the relevant stand. Changes and modifications must be stored in a central database.

1.8 Collection point

A collection point is defined as a physical site accessible to the garbage collection vehicle where the container is emptied.

- Data recorded:
- Address
- GPS
- Plus Codes
- Accessibility for the collection equipment
  - Road gradient
  - Road width
  - Paved/unpaved road
  - Crossing height
  - Seasonal parameters
  - Suitable for the vehicle type
- Time parameters/restrictions
  - Hospital
  - School
- Restrictions on passing
- Noise restrictions (e.g. glass)
- Warning from drivers about a temporary problem
  - Earthwork
  - Landslide

1.9 EUA End User Address

A group of one or more residential building entrances to which a certain collection point belongs. They are typically identified by the first and last entrance numbers. E.g. Stavbárska 1-7 (Entrances 1,3,5,7) There is always one property manager assigned to each EUA.
If residents agree, there may be more EUAs at the stand.
For various property categories, a single EUA may have multiple stands assigned to it.
The EUA data is used to contact OLO customer service and administrators. This is an unambiguous indicator describing the site including additional data required to settle discrepancies or new item orders.

1.10 Employee

- Relevant person – Personal ID number
- Occupation (Driver, Driver's assistant, Substitute worker)
- Personal parameters
- Working time pool, vacation, sickness absence
- Maximum physical load parameters (the system automatically counts and monitors the number of services and the total workload per person and displays a notification in case it is exceeded)
  - Age = maximum permitted workload
  - Single load weight
  - Total daily load weight (counter)
  - Distance driven (km)
  - Timekeeping - Observance of safety breaks
- Monthly examination of the worker’s measured values to ensure proper classification.

    - Replacement at lighter workload position due to advanced age
    - Replacement at lighter workload position due to medical condition/injury
    - Measurement in the case of an accident in order to fill an OHS declaration that no overload has occurred

- District or borough knowledge (determined by a weighting of 1.0)
    - Initially filled in manually, the system identifies knowledge of the area over time based on its type(Staré mesto complex, Vajnory simple) and the quantity of collections made in the area in a continuous series.

1.11 Crew

Crew capacity is calculated from the personnel and vehicles in the Planning module based on the recorded parameters.

It contains

- Number of workers (Driver + 1,2 or 3 assistants)
- parameters assembled using data from several workers
- staffing (number of members, actual vehicle attendance)
- pool of time available (workload, break, lunch)
- vehicle parameters
- assigned to a specific vehicle

1.12 District

This module is an overview of the geographical and functional requirements for the waste collection. It is the end outcome of planning tasks.

An area or group of areas containing certain crews' scheduled waste pickups, collection points, stands, containers, and all of their parameters and limits.
District planning as a whole based on inputs.
Determine the greatest possible distance between the 2 collection points (to avoid the crew collecting waste from several containers on the opposite side of the city).
Show the context and borders of two neighbouring districts inside the district planning (1 street, 4 lanes, 2x2). A street with a distinct side collection or a street with a combined side collection.

1.13 Vehicle

- Key FMS data
- Vehicle dimensions
- Vehicle body
    - by container type (e.g. hook, rack, hydraulic arm)
    - discharge speed
- Weight
- Capacity
    - Litres
    - Tonnes
    - by container type
- Load capacity
- Transit parameters (vehicle width, clearance)
- Historical performance parameters and consumption of a specific vehicle
- The availability of vehicles as determined by the fleet maintenance system.

1.14 Waste collection schedule

This module includes a dynamic algorithm (RRULE) with the following input requirements:

- Contract parameters: frequency, area
- Containers
- Stands
- Collection points

The algorithm output is a waste collection schedule for the consumer as well as collection.

1.15 Waste collection

The specific performance of servicing a set of containers in order to ensure the most efficient provision of collecting activities and utilisation of available resources.

The system assesses the input parameters automatically and makes recommendations for adjustments.
Waste collection plan preparation that includes a 10% reserve to ensure that any changes in the number of service crews in a specific collection do not exceed the permitted limits. Display recommendation to alter the waste collection in case of exceeding the capacity.
A tool that allows employees to see the daily shifts (delivery and collection) of containers on the collections.

Measurement of the time required to service a certain container (complete, vehicle docking, stabilization, braking/unbraking of 1100l containers, travel time between stations, manipulation with containers, opening, closing, etc.). Parameters automatically recognised by the system based on historical data for a specified area, a specific location, and a combination of contract parameters. How many containers of what type and commodity can fit in one working day in a given type of vehicle.

Waste collection plan contains

- containers
- stands
- collection points
- waste collection schedule
- crew
- vehicle
- offline data
- online data

1.16 Waste collection plan

The waste collection plan generated in 2.0 Waste Collection Planning Module is transferred to 3.0 Electronic Logging - Waste Collection Module, where it serves as a static basis for waste collection performance and is transferred to the Tablets in the vehicles. This plan allows to browse and adjust the waste collection depending on the categories listed below. The feature to review the prepared plans and accurately upload them to the tablets is also required.

- Static - long-term, capacity with reserve
- Dynamic - a daily plan that is based on the most recent inputs (orders, complaints, replacement collection *[vehicle blocked the collection point in the morning])*
- Ad Hoc - individual tasks for the crew (additional collection, cleaning up, checking the location...), the Master can assign the task to the crew, which is subsequently displayed on the Tablet.

Type of waste collection by type of container

- Containers
- Bell-shaped containers
- PPK
- Large Capacity Container
  - Regular
  - Irregular (one-time orders)

Waste collection type by shift

- early morning
- morning
- afternoon

Waste collection type by plan

- regular
- irregular (paid/free)

Task type

- Waste collection
- Delivery/Collection/Replacement
- Bag delivery
- Stands clean-up

1.17 Container storage system Module

The module ensures that container storage, receipt, and dispensing from the warehouse are all registered.

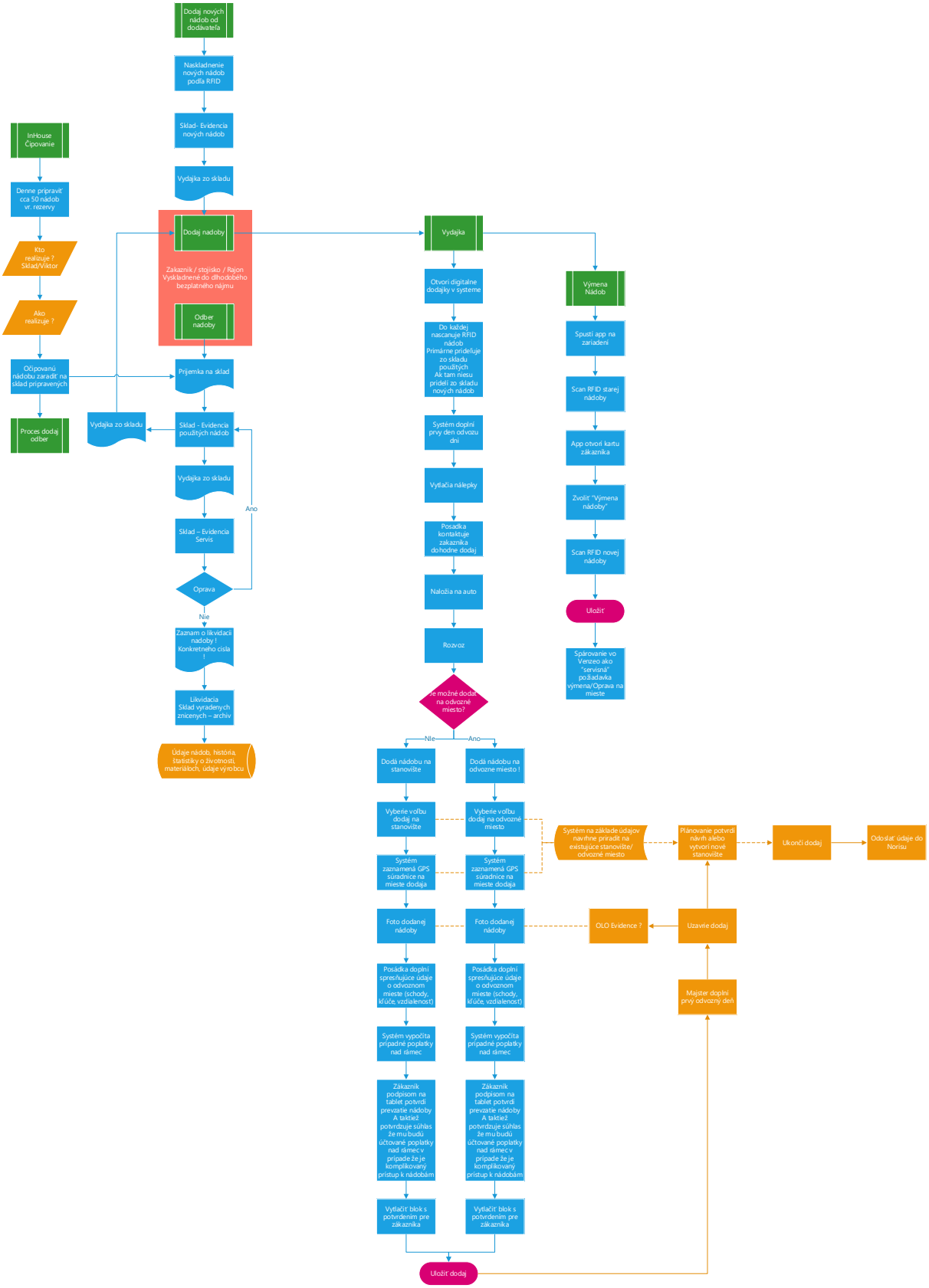
- new storage
- used storage
- maintenance storage
- discarded containers storage

The module will be linked to the Documentation programme, and inventory movements will be processed automatically based on delivery, collection, and replacement.
The warehouse worker is in charge of verifying inventory levels, acquiring and stacking new containers, tagging new containers with RFID tags, and maintaining system records of tagged containers.
It allows tracking the entire life cycle of the collection container:

- New container receipt, date, manufacturer, supplier, container type, container material
- Container maintenance - service, spare parts, type of container damage, cleaning, disinfection
- Container movements, warehouses, and customer time stamps
- Service count per container

709

710 *Flowchart of container movement in the warehouse*



711

712

1.18 Inventory and Documentation

Registry feature that connects the documentation application to the database. The purpose is to inventory containers and stands in the field. Tracking, accurately identifying, and tagging them with an RFID tag, as well as resolving any discrepancies discovered in the field. Discrepancies are manually resolved based on reports generated by the application by joint effort of planning department personnel, contracts, and foremen Most of the time, the solution is implemented for the given container or stand by adjusting their specifications as needed.

The platform is necessary to connect with the application and view the data obtained for the application.

The flowchart below depicts the full documentation and inventory procedure.

OBJ

1.19 Stickers printing

A feature enabling the printing of formatted technical and informational labels. The ability to create and update print reports and settings is required. Individual and batch print options must be available based on parameter selection.

Example of a sticker; the design will be altered during implementation.

1.20 Changelog and lifecycle log

An automatic data change logging feature allowing to follow the long-term evolution of changes, tracking the lifetime of containers by commodity parameters, district, vehicles, and crews. Monitor the quality of the containers by noting Container problems and maintenance.

2.0 Fleet Management Module

The module covers the vehicle data collection feature using IaaS monitoring units installed on vehicles, the delivery and operation of monitoring units and the provision of GPS monitoring services of the vehicles of the Contracting Authority, measurement of vehicle fuel consumption and other operational variables, the creation of an electronic logbook and reports.

General description of the service parameters for Module 1:

1) **Monitoring unit operation and vehicle consumption measurement**

The service includes:

a. Supply of truck and car monitoring units;
b. The Tenderer shall provide a Technical Data Sheet of the offered monitoring unit;
c. Provision of capacity probes for measuring the fuel level in the tank;
a. The Tenderer shall provide a Technical Data Sheet of the offered capacity probe;
b. Installation of monitoring units in vehicles at the Contracting Authority's headquarters in accordance with the approved schedule that will form an annex to the contract;
c. CAN BUS or FMS connection of the monitoring equipment (according to the technical possibilities of the vehicle);
d. Installation of capacity probes in fuel tanks on equipment according to specification;
e. On-line collection and transmission of the data described in item 2 (including ensuring a GSM connection to the mobile operator - the contract price includes the provision of SIM cards and mobile data service, as well as the complete management of SIM cards);
f. Fully automated data processing from the monitoring unit into the database;
g. Maintenance and repair of monitoring units to ensure 100% data availability.

2) **Ensuring the collection and transmission of vehicle operational status and data to the Platform and Module.**

The service includes:

a. Data collection for a specified number of vehicle monitoring units;
b. GSM/GPRS data transmission security;
c. Connecting the Module and ensuring the flow of relevant data to other Platform modules and internal Contracting Authority systems (ERP, Waste Collection Management, BI);
d. Import of refuelling from fuel cards and automatic verification of the integrity of the refuelling data for all vehicles for passenger cars; import of refuelling via integration into fuel dispensers for trucks (item 4.0);

Data visualisation and management via web, SW, or application interface:

i. administration for all vehicles for which the service is provided: vehicle editing, creation of groups and subgroups of vehicles and drivers, vehicle creation and management, refuelling cards, names and lines of own locations - polygons (reporting entrances/exits from locations and notifications when leaving the location and transit speed), users, the ability to add and edit data on individual trips (refuelling, speedometer status, calibration);

ii. Vehicle records:
    1. Vehicle registration number;

2. Vehicle make;
3. Vehicle model;
4. Additional information (e.g. body type, tipping device type, etc.);
5. an overview of completed and upcoming vehicle service inspections;

iii. Driver records:
1. Name and Surname;
2. Personal ID number;
3. Statistics generated over time for further driver evaluation - acceleration, braking, mileage, current speed, current consumption;

iv. Ability to assign a Driver to a Vehicle;

v. Tracking all vehicle statistics in real time in various views (table, map documents...);

vi. Vehicle position;
1. GPS

vii. Vehicle status;
1. Ignition status;
2. Vehicle started;
3. RPM;
4. Speed;
5. Current consumption;
6. Braking;
7. Acceleration;
8. Time since start-up;
9. Travel time;
10. Stationary started vehicle;
11. Started + Body on;
12. Turned off;
13. Information about the battery voltage status of all vehicles and machinery;
14. Fuel loss measure with the engine turned off and comparison to the previous state;
15. Alternative parameters based on each vehicle's technical capabilities:
    a. Fuel level based on the fuel gauge of the vehicle;
    b. Ability to detect the number of passengers in the vehicle (only for certain vehicles: sensors in the seats);
    c. Engine temperature (for CAN BUS);
    d. Option to measure CNG consumption;
    e. Allowing for the measurement of CNG consumprion;

viii. Creation of a printable logbook for all cars for an adjustable period (basic and detailed - each stand/collection point). A summary of travelled distances acquired from truck work activity inputs (total distance travelled,

individually for each input, simultaneous switching on, distance travelled without work activity inputs switched on) and the number of routes travelled are included in the logbook/report (possibility to define the class of trip by number). The logbook must therefore contain:

1. Fuel consumption report for vehicle, route, driver;
2. Transfer of the Contracting Authority-defined points of interest POIs to the logbook;
3. basic information (registration number, vehicle type, departure/arrival time, trip/stop time, speedometer status, route, fuel status for trucks - depletion, refuelling, and consumption for particular portions);
4. information about the vehicle's current road number according to the road databank (with a record of any change that separates the route);
5. Special log of the working distance travelled (the vehicle is in working mode, i.e. the body and hydraulics are turned on) based on information from the connected external truck inputs (vehicle body and container feeder) (even when multiple inputs are simultaneously turned on,
6. Special logging (outside of the work mode) of driving without work activity inputs switched on);
7. Recording the position and time at which work inputs are turned on/off without stopping the vehicle;
8. Arrival on site;
9. Departure from site;
10. Kilometres driven;

ix. Creation of electronic STAS record - for trucks only

STAS record example

OLO a.s. Ivanská cesta 22, 821 04 Bratislava

Rajó 102 | **Stredisk 40** | Denný záznam výkonu vozidla - DZVV

číslo DZVV:	40143865
datum:	2.8.2022
ŠPZ:	BL-741GY/B19

Meno Priezvisko VODIČA	os. číslo
xxx yyy	1111
Meno Priezvisko ZÁVOZNÍKA	**os. číslo**
xxx yyy	2222
xxx yyy	3333

Záznam o údržbe vozidla:

prev. kvapaliny ☐ osvetlenie ☐

funkč. nadstavba ☐ pneumatiky ☐

umývanie ☐

podpis vodiča .....

Záznamy majstrov:

Podpis priamy nadriadený .....

Záznam vodiča o zdržaní sa na cestách, nevykonané odvozy

Prestávka - obed

Od: Do:

Hodina		Tachometer	
pri odchode		pri odchode	
pri príchode		pri príchode	
rozdiel		rozdiel/km	

Prebranie vozidla - popis závad:

Podpis vodiča

Odovzdávanie vozidla - popis závad:

Podpis garážmajstra

Technické závady, Poistné/Škodové udalosti

Podpis garážmajstra

Čerpanie	nafta	olej	iné
množstvo			
stav tachometra			

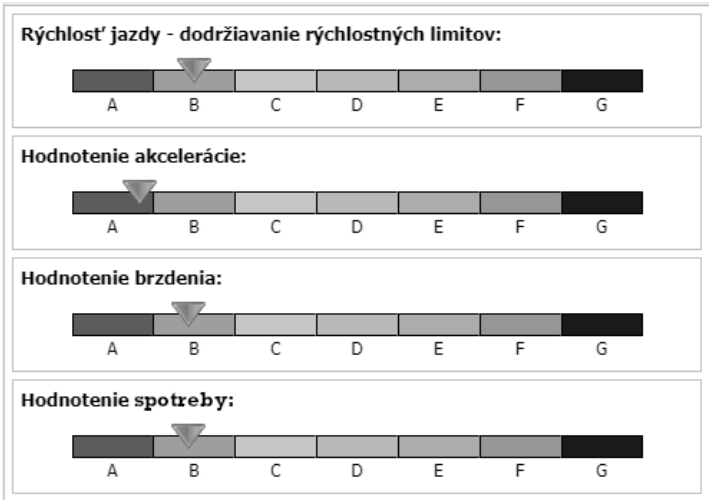
p.č.	odkiaľ		kam	Jazda/čas					km		Spolu KM	Poznámka
				zdrž. pri nakladaní	čas odchodu	čas príchodu	zdrž. pri vykladaní	čas jazdy	s nákl	bez nákl		
1												
2												komunál km spolu
3												plast km spolu
4												papier km spolu
5												sklo km spolu
6												
			Celkom:									

Podpis vodiča

typ nádob	počet obslúh	typ nádob	počet obslúh	typ nádob	počet obslúh	typ nádob	počet obslúh	typ nádob	počet obslúh	typ nádob	počet obslúh	typ nádob	počet obslúh	typ nádob	počet obslúh
55		75		3001		72		92		17	359	20	3		
65		51		5001		3002		102		18	49	31		204	
3005		61		52						3000		32		205	
5005		71		62		82		10	1	5000		33		LS10_19	

1. Data collection from multiple sources
    a. Waste collection management system;
    b. Attendance;
    c. Logbook;
    d. Weight, weight tickets;
    e. Vehicle maintenance;
2. Data processing in STAS format
3. Transferring completed STAS to the accounting system and archiving them;

x. Distance travelled in a single route;
xi. Speedometer status;
xii. Private and business mileage tracking (for cars only);
xiii. Current drive speed;
xiv. Refuelling;
    1. Date, Time;
    2. Quantity
    3. Speedometer status at the time of refuelling;
xv. Internal generation of reports, graphs, and statistics on vehicles and drivers in the module or via MS Power BI, with the number and type of reports set as part of the implementation;
    1. On a daily, weekly, monthly, quarterly, annual or individual basis;
xvi. Tracking driving style information;
    1. Speed;
    2. Acceleration and braking force;
    3. By segments and the maximum speed allowed on that segment;
    4. Exceeding the maximum speed limit;
    5. Draw polygons on the map with the ability to set the following polygon rules: Maximum speed;
    6. Marking a Point of Interest (Headquarters, Waste-to-energy facility, Waste collection point, Composting plant, etc.);
    7. No entry points;
    8. Time spent in the polygon;
    9. Polygon leave ban;
xvii. Assessment of Vehicle driving and Drivers;
    1. Mutual comparison;
    2. Top 10 Best Drivers compilation;
    3. Monitoring the driver's driving style in the vehicle - driving style based on accelerometer and GPS data, or real CAN BUS statistics - maximum speed, average speed, standing with the engine running, driving time in a particular section (by filter).



xviii. The effect of driving on vehicle wear and tear, as well as the quantification of expenses

An example 1 of a possible evaluation method

2.1 General technical requirements for the Fleet Management Module:

a. Supply and installation of monitoring units capable of connecting to CAN BUS/FMS or capacity probes as needed, according to the schedule in annex XY.

b. Delivery of user documentation for monitoring units that includes a thorough technical and protocol description, interconnections, and data flows;

c. Fleet management module installation and commissioning;

d. Data collection and processing success rate from monitoring units: 100% for all functional monitoring units;

e. Automated reporting:

i. daily and monthly reports on the operation of all vehicles;

ii. reports by driver;

iii. reports on fuel consumption, including an assessment of all cars and drivers' driving styles;

iv. driving economy assessment based on driving style;

v. feature for reporting on visited sites' history;

vi. statistics on vehicle utilisation are provided below (example reports);

vii. an overview of the operating costs of the vehicles;

viii. report on adherence to designated routes by individual drivers;

ix. comprehensive vehicle route log, year-round movement history with the option of showing it on a map;

x. average monthly consumption reporting;

f. Each authorised employee shall be able to send optional alarm conditions of measured and recorded variables to the control room, e-mail, mobile phone, and in-vehicle

tablet for the driver, with the option of selecting from the following alarm condition alternatives:

i. idle RPM at 0km/h for more than 5 minutes (adjustable);
ii. hydraulics activation outside of the planned collection point;
iii. 3% deviation from the planned route (adjustable);
iv. exceeding the maximum speed limit on the road or in a polygon;
v. driving in the opposite direction;
vi. excessive acceleration, braking, crash or accident;
vii. notification of vehicle owner in the event of certain occurrences (e.g. unauthorised driving);
viii. theft or towing indication;
ix. setting up fuel tampering notifications for trucks through email or SMS (sudden leakage of diesel in the tank);
x. notification when driving in reverse with assistant on footboard;

g. Graphical representation of measured variables in time within the Module (speed, vehicle fuel level);

h. Real-time vehicle display on various map layers (Google Maps), with filtering and customizable data sorting;

i. Custom GEO defining - custom-shaped zones and POIs, including administration;

j.

2.2 Technical specification of the monitoring unit:

a. Monitoring unit:
i. A small, mechanically durable device that is placed either within or outside the vehicle's cab and is protected from external disturbance. Used to track vehicle movement, gather data from the vehicle, data on container emptying and data on containers in the vicinity of the vehicle;
ii. Facilitates driver identification using employee RFID cards;
iii. When installing the monitoring unit in the vehicle's cab, it is necessary to equip the device with external antennas in order to achieve the availability of the GPS signal for vehicle movement in areas between high-rise buildings as well as the availability of the GSM signal for data transmission;
iv. Capability to detect and record excessive acceleration, braking, or overloading (by a sensor that records information on excessive braking, deceleration, and acceleration) as well as software that can detect a possible accident or crash and send information about it to pre-specified recipients (control room, emergency assistance, etc.);
v. Automatic self-diagnosis of malfunctions in the monitoring unit and all related interfaces (GPS, RFID antennas, attendance card reader) in the vehicle, with automatic malfunction notification to the provider (troubleshooting and support in accordance with the SLA document);

vi. If the monitoring unit is installed in the vehicle's cab, the accelerometer must be mounted on a fixed (unsprung) section of the vehicle to detect acceleration and braking in the Driving style calculation;

vii. The option to communicate with the device while the vehicle is turned off;

viii. Power outages, service intervention on equipment, and equipment connection shall be all recorded;

ix. Remote administration, the ability to remotely set operational parameters and monitor overall functionality (to be carried out by the provider under the terms and conditions set out in the Support and SLA document);

x. Time and speed data for each recorded point (maximum time delay between recorded points - 5 seconds);

xi. Ability to determine current location of the vehicle;

xii. Response on reaching a predetermined location or point within a specific polygon;

xiii. Complete record of the route that will be available on the platform throughout the duration of the contract;

xiv. In the event of a mobile operator signal outage or power outage, the backup battery and internal memory will record at least 5 hours of continuous data gathering shall be set up;

xv. RFID tag reading on UHF frequency 865 - 868 2W ERP; 916,1 – 918,9 4W ERP;

1. 2 short range external antennas during container emptying when the container is turned upside down;
2. 2 long range external antennas monitoring containers in the vicinity of the vehicle, roadside, etc. while driving/stopping the vehicle;

xvi. Technical preparation for the dynamic weighing system connection;

b. Sensor for driver and assistant identification by employee card, with data regarding the present vehicle crew sent to the Fleet management module, for attendance processing and registration in STAS and the logbook;

c. Roaming operation (for passenger cars);

d. In the case of roaming data transfer, the amount of data must be optimised while taking into consideration the charges, which must not be more than three times the price of data traffic in the Slovak Republic.

e. "Data buffer" mode - the device automatically sends waste connection data online; if the data connection fails, the device saves the data to internal memory and sends it when the connection is restored; After transmission, the device waits for confirmation from the server about the data receipt and quality; The device keeps data for the entire day/haul in its internal memory and sends it to the server in one batch at the when it arrives at the depot. This provides multi-level data security against loss or harm.

2.3 Specific requirements for the Module features:

a. Express arrival mode to record stopping without turning off the engine of the monitored vehicles, more comprehensive recordings (logs) for all vehicles;

3.0 Waste collection planning Module

A Geographic Information System that generates, processes, analyses, and maps all types of data. Using location data and all kinds of descriptive information, the system integrates data and map layers (meta data). The processing of data in the GIS system allows personnel to recognise patterns and linkages in the spatial environment, enhancing efficiency and improving management decisions. The system shall integrate with Power BI natively (as supported by the system maker).

The module is made up of two major interconnected parts that work together to produce a single functional unit.

The first plan will be prepared after the platform startup using data imported from the Protank Dynamics software (the requirement for integration of the platform with this software is mentioned and specified in more detail in article XX of this document).

Tool for creating plan drafts both automatically and manually. Data-driven planning.

Part 1. Planning

In addition to automatic plan generation and manual revision, the tool will allow for the manual development of a master plan based on base contract inputs and field parameters without previous collection information. The initial plan is prepared, for example, when a new commodity (e.g., biodegradable waste, Oil, biodegradable food waste, Bag collection) is introduced, or when the Company or Municipal Authority changes the waste collection planning and optimization strategy (e.g. combining or separating commodities within an area, cancellation of a collection day, crew workload, fuel costs).

Part 2. Waste collection evaluation

- Collecting data from the Fleet Management Module
- Trend Recognition, Evaluation and Visualization;
- Reporting;
- KPI performance monitoring;

Driver-level assessment:

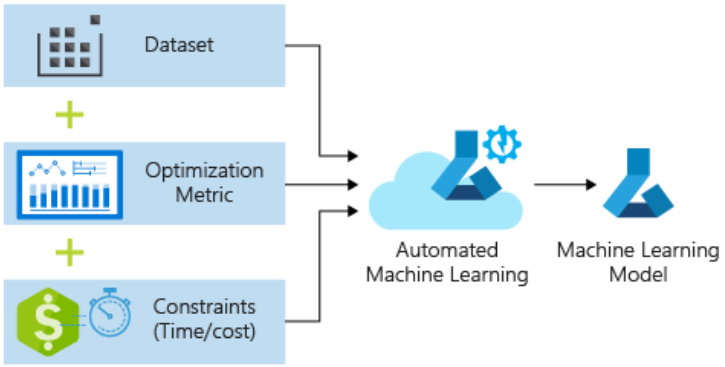
Analyse his/her current waste collection in the tablet in the form of a quick overview where he/she can see the number of containers, type of commodity, served and not served containers, container for which a change has been recorded in the last period, list of orders for a given collection, extraordinary and substitute collections, reference trajectory - this is the typical waste collection route; to some extent, it can replace navigation, especially if there is a driver is unfamiliar with the route.
The driver has the option to visually inspect his/her delivery at the end of the shift.
Possibility of adding a note to the containers, order, street, and entire collection route.

Master-level assessment:

The master assesses, comments on containers, and then concludes the waste collection.
When analysing a completed collection, the system sends a notification to the head of the customer department to prepare for complaints (OSZ capacity).

Planning-level assessment:

Development of trends and mathematical models, comparing, analysing, and selecting the best one as an input to plan and schedule development. Evaluation and adjustment of the precision of the chosen model following the collection.



Developing an optimal plan based on the Waste collection evaluation inputs entails, in particular, fine-tuning parameters to improve waste collection efficiency.
The planning system must allow for the generation of plan drafts (templates) based on input parameters (data from specific modules) and predicted outputs (defined by a user with permission to create plans). A plan draft depicts an estimation of plan parameters, savings, efficiency, etc. It is possible to run software simulations and visualise plan implementation on a map. On that premise, the planning officer chooses the best one and applies it to the collection route.

A District Plan as well as a Waste Collection Plan are required. The following will be prepared based on the partial district plan and the waste collection plan:

An overall plan comprised of districts and their parameters presented in table, line, and cascade formats.
Overall waste collection planning based on inputs and district factors
District planning and waste collection are linked; changes in one influence the other.
The inputs for both types of plans (districts and waste collection) are registered parameters - real numbers of crews, vehicles, collection points, etc. - that are detailed in the Records section. The module will allow for the automatic generation of plans based on arbitrary KPIs, parameters, and their combinations given by the user. The parameters can be obtained via a manual input in user interface of the planning module, a pick on the map layer, a selection from the Fleet module database, or Electronic records.

Total Time	Total Distance	Maximum Plan capacity
Employee Overtime	Missed Collections	Road Restrictions
Employee Workload	Seasonal planning	Speed limits
Mileage	Vehicle type/capacity	Area/territory constraints
Fuel cost	Waste type	Time constraints
CO2 emissions	Capacity vehicle/waste type	Cost profiles
Driver regulation	Customer based obstructions	Additional services

The resulting plan will be developed using the following KPIs:
- lowest fuel consumption;
- efficient use of the labour pool;
- fleet - number of motor hours, number of services, mileage;
- meeting the specified timetable;

The planning tool must support ad hoc schedule adjustments by adding and removing (including) containers depending on daily changes in client contracts. These adjustments are anticipated in the plan, which provides spare capacity.

Based on the specified parameters and KPIs, the planning module will, utilising AI and machine learning techniques, optimise the final plan based on data from the separate modules, and:
By input data analysis (machine learning), namely:

- Vehicle data collected from the Fleet Management module:
  - engine RPM;
  - engine temperature;
  - fuel consumption;
  - fuel level;
  - mileage (km);
  - vehicle speed (maximum, running speed);
  - status of attachments e.g. hydraulics - stroke, RFID - scan;
  - vehicle faults (fault messages, fault codes);
- Data collected by the system:
  - RON crew login with employee card;
    - Departure registration;
  - Electronic STAS (logbook);
    - Data collection (as in the STAS example above) for storage in the electronic STAS;
  - Vehicle position;
    - Display of vehicle position within the GUI system;

        - Vehicle route recording;
    - Discharge data;
        - Reading of QR codes or RFID containers at the moment of discharge;

Offline and History Data (Manually and automatically acquired historical data created internally in OLO and imported into the platform at the time of its implementation):

- City Parameters;
- Street map base;
- Passability - The algorithm automatically determines the type of vehicle that was able to drive the route;
- One-way streets;
- Dead-end streets that need reversing the car to the collection point (no U-turns).
- No entry for our vehicles;
- Regular traffic jams;
- Temporary restrictions;
- Regular restrictions;
- Maximum speed limit;
- Noise restrictions;
- Weather/Seasonality;
- Current weather status (including changes);
- Weather forecast;
- Weather history (using historical data);

- Route planning:
    - Task assignment:
        - District designation;
        - Crew designation;
        - Designation of street routes and address points;
    - Automatic re-routing in case of changes in online data;
    - Evaluating and displaying the difference between the actual and planned routes;
- Online Data - acquired from current online platforms and used by the collection vehicle crew on the day of waste collection while on the scheduled route and to display alerts and recommendations on the tablet.
    - Traffic density (historical data, online data);
    - Traffic density prediction based on historical data;
    - Restrictions;
    - Weather;
    - Influence of weather on traffic;
- Collecting data from glass containers (bell-shaped):
    - Online container fill data for tracking based on sensor fill level (waste level in the container);
    - A sensor is a device that is installed in the collection container;
    - It determines the level of waste by releasing an acoustic signal and measuring the time between transmission and return;
    - The recorded data are transferred to a central database through LPWAN (LoRaWan, SigFx, and others);

- The planning module analyses the recorded data and incorporates it into the waste collection plan based on the container fill level specified;
-

3.1 Additional requirements for the Planning Module:

Notifications/alerts feature;

- Sending and displaying error messages;
- Sending and displaying notifications for deviations from the proposed plan;
- Display of the realistic assumption of the proposed trip plan's execution, including measured/detected deviations;
- Expected crew return time - vehicle allocation for the next shift;

We require that the proposed system be able to work with external data that can/may affect the level of route planning optimization. The system will use this data, together with other data, to compute and evaluate the best route.

The system must include map base that depicts the location of vehicles, their planned route or deviation, and the location of stands or containers.

Stand and container data:

The system will employ all data that has an impact on the good outcome of the execution for route computation or optimization, with an emphasis on, for example, speed, consumption, or length, etc. The administrator must be allowed to customise the performance target for each plan. The administrator will define the performance target in terms of the factors listed under "Planning-level assessment."

Stand and container data will be gathered from external systems, Documentation, stand takeover application, and xls spreadsheet import. A single central database of data will be built over time.

3.1 "Rebeka" planning mode

The Contracting Authority also requires features to test the parameters of the equipment, terrain, and crew within the "Planning" module. A feature is required to enable the waste collection plan test mode, in which a test waste collection can be generated tailored to all parameters and assigned to a specific crew to execute in order to evaluate the feasibility of the performance. Assignment to the crew by setting the availability in the tablet. The crew runs the plan on the tablet and drives the proposed route, gathering information regarding the route's vehicle passability. The system generates a report on which the vehicle crew can provide comments about the test drive's execution. The information gathered in the records is subsequently applied to the particular entities by the planning department (roads, streets, stands, containers, collection points, etc.).

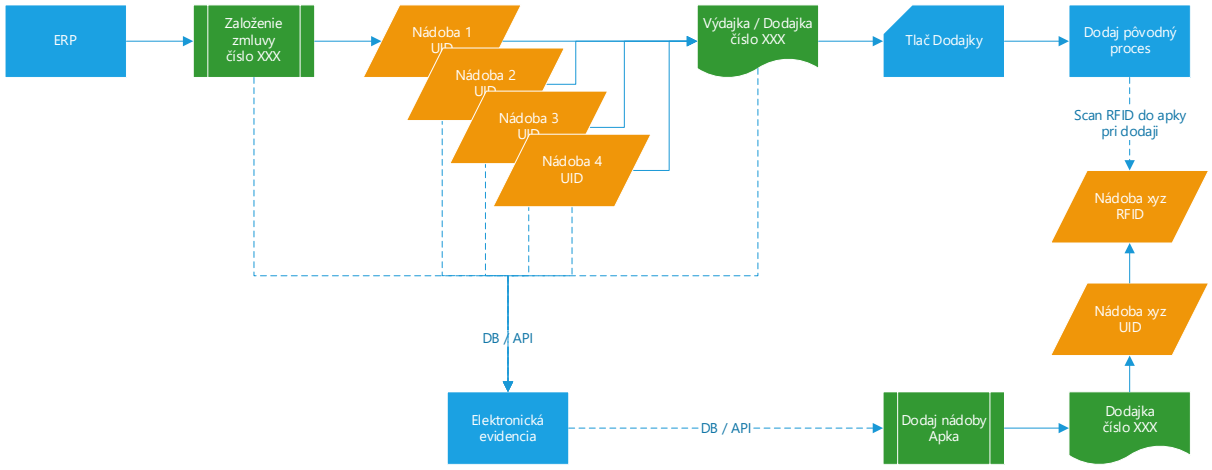
The goal is to collect data from which the waste collection parameters will be confirmed or adjusted before they are incorporated in the "live" waste collection plan.

3.2 Planning mode Delivery/Collection/Replacement of the containers

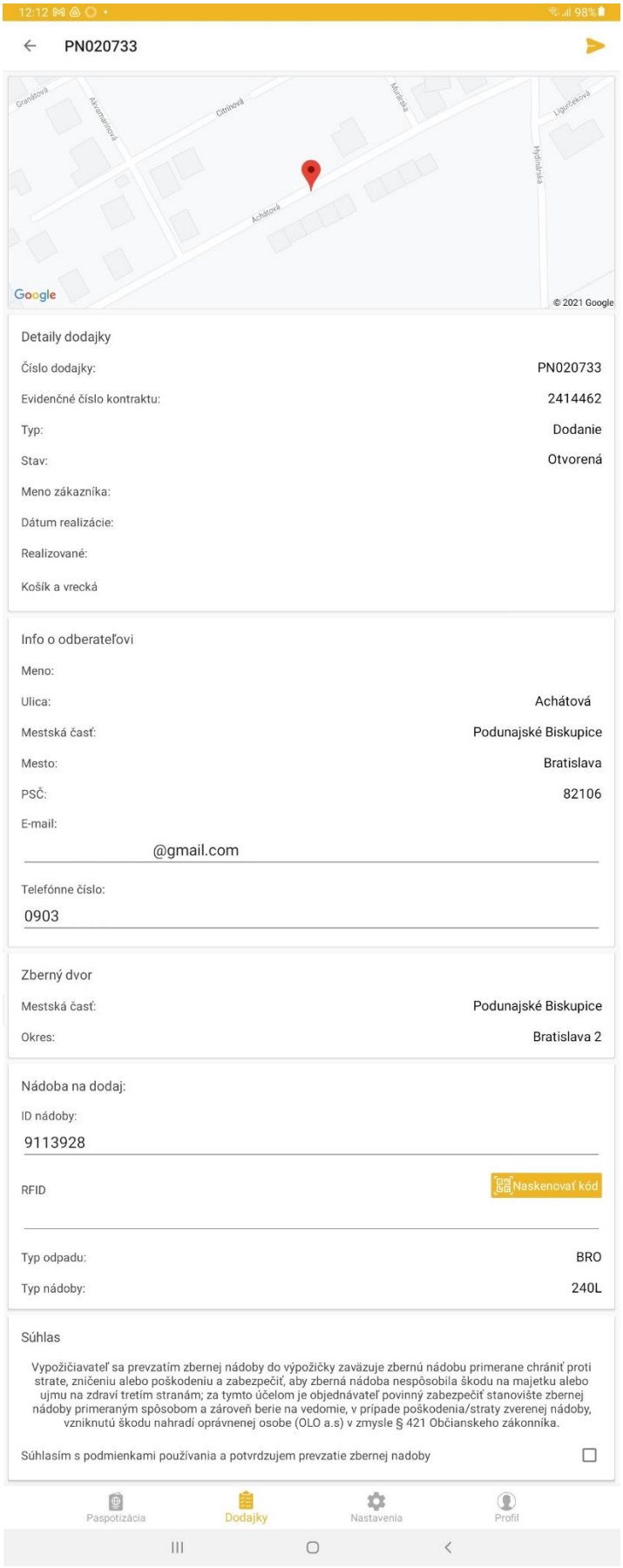
A distinct scheduling mode as a feature in the planning module allows to schedule the performance of the crews that provide this activity based on the states defined on the containers (For delivery, For replacement, For collection). Integration with the Documentation app and the 3.16 Container Storage System Module. Integration with Noris and Softip that provide requests for additional containers and their removal or replacement.

Preparation of the delivery route, based on the set schedule, information to the customer about the delivery time, information to the Container Storage System Module for container preparation and label printing. Generating a consignment note that specifies the exact order of loading and unloading (First In, Last Out).

Example of Softip delivery note process



Example of delivery note in the application



3.3 OLO Taxi planning mode

Separate feature in the planning module that allows planning of OLO Taxi department staff capacities. OLO Taxi is a service that collects oversized waste, most commonly furniture, that can be ordered by a resident of the capital city, and for a fee, a flatbed truck is delivered to him, and the crew of the vehicle will ensure the loading of the waste on the bucket and the removal of the waste to the Waste-to-energy facility. As part of the feature, we require staff capacity planning as well as vehicle capacity planning for OLO Taxi. The feature requires integration with a future CRM solution that will include a client zone where the customer will be able to buy, pay for, and schedule the service.

3.4 Large Capacity Container planning mode

A separate feature in the planning module allows for the planning, monitoring, and assessment of the usage of available Large Capacity Containers (number of containers in the warehouse and number of containers at the customer), as well as allocated vehicles - hydraulic hooklift hoists. Long-term internal container usage (for the Contracting Authority's needs)/external container use (for the Contracting Authority's contractual clients) and ad hoc external planning (according to ad hoc customer orders).
The plan must allow for dynamic data inputs from CRM/Softip, Contracts and Orders.
Integration to the future CRM system, within which the customer will be able to order and pay for the service and choose the date of service execution, will be required during the period of the contract, which will be the outcome of this tender.
Integration of contracts and orders into the Softip database, from which information for capacity and activity planning will be derived.

We also require Asset Management feature to track the deployment of Large Capacity Containers on map layers and track available Large Capacity Container for resale back to the Sales department. Automatically recorded container placement time and location on GPS coordinates by the monitoring unit, when the container is delivered or loaded.

3.5 "Freestyle" planning mode

Separate feature in the planning module that enables the planning of additional types of tasks on already existing documents and data. Planning the distribution of new commodities, for example, requires viewing the current distribution of containers, stands, and address points on a map layer in selected areas, as well as the option to place distribution points on the map with the assignment and calculation of related objects in a given area, followed by the display of summary counts.

4.0 Integration Interfaces

The platform will be integrated with the existing and forthcoming OLO and municipal systems listed below. The integrations will take place gradually, with a separate analysis prepared for each integrated Software, which will include a list of parameters to be transferred, transfer circumstances, editing mode and responsibilities for specific parameters, and change logging.
For integrations, a feature or tool is necessary to allow OLO staff to analyse and change data before it is recorded in the main database; this control ensures that the recorded data is of higher quality.
A tool is required to examine the data before it is transmitted for integrations from OLO "outwards".

4.1 Noris

A Municipality-managed system used to process records for the collection of local taxes and fees at the OMDPaL. (Department of Local Taxes, Fees and Licenses). The primary source of data for the execution of OLO activities. The data from the Noris application must be synchronised to the central database using the integration API or, temporary, via Web Scraping. The mode of integration, synchronisation, and data editing will be defined as a part of the integration. The integration must include a changelog that can be used to uniquely identify data changes, allowing an employee to make the relevant action or initiate the corresponding automated procedure.

4.2 Softip

Economic, accounting and ERP software.

4.3 Protank

Software for the performance of waste collection activities.

4.4 Passport App/Delivery Collection Replacement

Application for the registration of field collection containers.

4.5 Stand takeover and quality control app

Application for taking over new stands, registering stands, and evaluating waste collection performance in the field.

4.6 eSTAS

Integration of several of the aforementioned systems in order to logically combine data in order to provide a daily vehicle performance report.

4.7 Ron

OLO staff attendance system.

4.8 MS Sharepoint

Intranet as well as a variety of administrative and support apps. Crew time and personnel scheduling by Masters.

4.9 Venzeo

An application used to record reports of noncompliance and issues with collecting performance by field crews.

4.10 CRM

Central service software for digital business process and service request processing (internal and external).

4.11 Fleet maintenance system

Vehicle maintenance planning and recording system.

4.12 Hemak Automated vehicle weighing system

Automated Vehicle Weighing System at Waste-to-energy facility.

4.13 MS Power BI

Data transmission for statistical processing.

Preliminary report generation during initial integration. Report examples are shown in the table below. As part of the implementation analysis, the quantity and scope of reports will be determined. The provider may anticipate the requirement to generate reports on all types of processed data, with various summaries and filters.

If reports that are not based on the implementation analysis must be prepared during the term of the contract, the generation of such reports will be governed by the change management terms and conditions provided in the SLA and Support document.

Report Table Examples

Waste collection – Overview	**Notifications**
• Waste collection *(District/ID/Day)* • Operation *(Master)* • Waste collection date *(Planned date)* • Shift *(Morning/Afternoon/Day/Night)* • Vehicle *(Registration number + ID)* • Driver *(Name/Surname/Employee ID number)* • Assistant 1 *(Name/Surname/Employee ID number)* • Assistant 2 *(Name/Surname/Employee ID number)* • Assistant x *(Name/Surname/Employee ID number)* • Supporting vehicle *(Yes/No)* • Departure time • Return time • Waste collection route duration *(Hours/Minutes)* • Container service rate (Planned/Actual) • Street service rate • Concluded waste collection *(Yes/No/Name of the concluding employee)* • Distance driven (km) • Service per km • Number of loads • Waste weight per load *(t)*	• idle RPM at 0km/h for more than 5 minutes (adjustable); • hydraulics activation outside of the planned collection point; • 3% deviation from the planned route (adjustable); • exceeding the maximum speed limit on the road or in a polygon; • driving in the opposite direction • excessive acceleration, braking, crash or accident; • notification of vehicle owner in the event of certain occurrences (e.g. unauthorised driving); • theft or towing indication; • setting up fuel tampering notifications for trucks through email or SMS (sudden leakage of diesel in the tank); • notification when driving in reverse with assistant on footboard; • entering or exiting the polygon

• Fuel used	
Driving style / Vehicle activity • Vehicle *(Registration number + ID)* • Driver *(Name/Surname/Employee ID number)* • Beginning of the reference period • End of the reference period • RPM graph • Speed graph • Fuel consumption graph • Acceleration graph • Braking graph • Distance driven (km) • Route view on map	**Vehicle report** • Vehicle *(Registration number + ID)* • Monitoring unit (ID) • Unit status • SIM (mobile phone number) • Data connection status • Vehicle type • Date and time of the last activity • Error message code
Fuel consumption • Vehicle *(Registration number + ID)* • Driver *(Name/Surname/Employee ID number)* • Vehicle type • Centre • Distance driven (km) • Refuelling (litres) • Consumption (litres) • Consumption (litres/km) • Consumption (litres/100k RPM) • Consumption standard per 100km • Consumption per 100km by refuelling • Deviation • Operating time *(hh:mm)* • Movement time *(hh:mm)* • Idling *(hh:mm)*	**Waste collection - Container details** • Waste collection *(District/ID/Day)* • Stand *(ID + Address)* • Waste collection date *(Planned date)* • Vehicle *(Registration number + ID)* • Customer • Municipality • Street • House number • Container count *(1)* • Waste type • Volume • Service type *(GPS/RFID Scan)* • Service time *(Date/Time)* • RFID • Container number • Unservices container flag

4.14 "Waze"

Utilize market-available platforms to gather traffic-related information.

4.15 Dashboards

Dashboards that display information and statistics.

4.16 Handheld Chainway RFID UHF 2D Sled - Android APP BT Integration

RFID, BAR and QR code scanner independently connectable to mobile device via Bluetooth.

4.17 XStation

Personalized recording software for vehicle fueling.

4.18 ArcGIS

A GIS platform for displaying data on maps in layers and contexts.

4.19 Samsung Galaxy Tab Androind 10” Tablet

Tablets in vehicles with apps installed.

10.0 Contract conditions

The Contractor shall devote the following numbers of full-time employees/functions to the entire project.

- Project Manager
- Platform Architect
- Data Analyst
- UI UX Developer
- Developer

Annex No. 1 VEHICLE AND TECHNOLOGIES LIST

No.	Type	Estimated number at start of implementation	Maximum number	Probe
1.	Waste collection equipment	105	180	0
2.	Small equipment (loader, crusher, diesel aggregate...)	5	5	5
3.	Passenger vehicles	15	20	0