Author(s): Angel Batalla

Author’(s’) affiliation (Partner short name): LMT

Route Optimisation

Last Mile Team

Configuration Documentation

for a LEAD Living Lab

Revision History

|  |  |  |
| --- | --- | --- |
| Version No. | Date | Details |
| 1.0 | 13/02/22 | First draft |
| 2.0 | 28/04/22 | Expanded output tables |
| 3.0 | 30/10/22 | Updated with refactored input, output and operational tables |
|  |  |  |
|  |  |  |

Contents

[1 Introduction 4](#_Toc102212521)

[1.1 Scope and objectives 4](#_Toc102212522)

[2 Requirements. 5](#_Toc102212523)

[2.1 Software requirements 5](#_Toc102212524)

[2.2 Input/Outputs 5](#_Toc102212525)

[2.2.1 Inputs 5](#_Toc102212526)

[2.2.2 Outputs 14](#_Toc102212527)

[3 Model Description 21](#_Toc102212528)

[4 Instructions to run the model 22](#_Toc102212529)

List of tables

[Table 1 - Step04\_CityHub - Configuration Inputs 6](#_Toc102212336)

[Table 2 - Step05\_ServiceTypeCustomer – Configuration Inputs 7](#_Toc102212337)

[Table 3 - Step06\_ZipCodeCityHub – Configuration Inputs 8](#_Toc102212338)

[Table 4 - Step10\_User – Configuration Inputs 8](#_Toc102212339)

[Table 5 - Step11\_ServiceTime – Configuration Inputs 9](#_Toc102212340)

[Table 6 - Step14\_PlatformCityHub – Configuration Inputs 9](#_Toc102212341)

[Table 7 - Step17\_Driver – Configuration Inputs 10](#_Toc102212342)

[Table 8 - Step18\_Vehicle – Configuration Inputs 11](#_Toc102212343)

[Table 9 - Service – Operational Inputs 13](#_Toc102212344)

[Table 10 - ResponsePendingService – Operational Outputs 15](#_Toc102212345)

[Table 11 - ResponsePlan - Operational Outputs 16](#_Toc102212346)

[Table 12 - Response Service - Operational Outputs 17](#_Toc102212347)

[Table 13 - ResponseServicePath - Operational Outputs 19](#_Toc102212348)

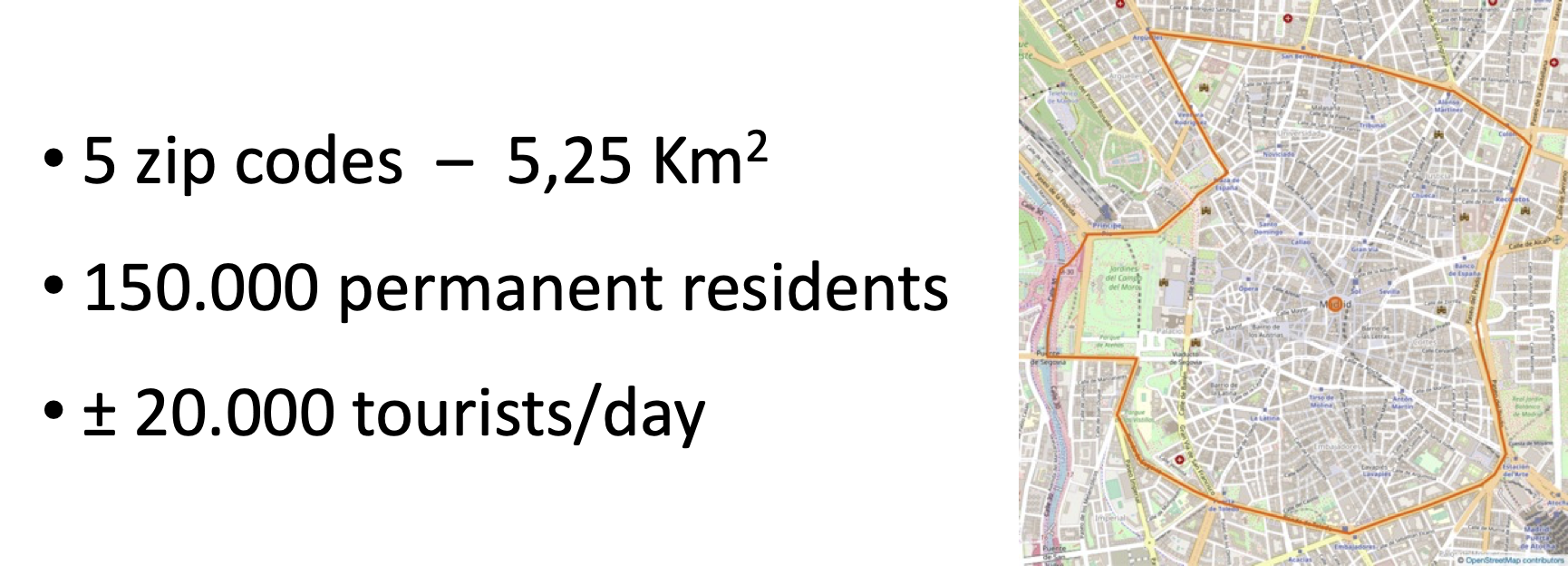
[Table 14 - ResponseVehiclePlan - Operational Outputs 20](#_Toc102212349)

# Introduction

## Scope and objectives

Madrid Living Lab ambition is to demonstrate the better economic and environmental efficiencies in using an Urban Consolidation Centre (UCC) connected to the Trans-European Transport Network (TEN-T), to deliver goods to the city centre.

The UCC is located in an underground parking in the center of ‘Madrid Distrito Centro’ Special Protection Low Emission Zone represented in the map below. The area main characteristics are:



Madrid Living Lab addresses real freight movement problems deriving from potential traffic restrictions to be enforced, by simulating and demonstrating the use of the urban consolidation centre to deliver/pick up freight, using two and three-wheel electric cargo scooters and vans.

To achieve this, it uses a Digital Twin that integrates and orchestrates different specialized simulation models, whose relationships and workflow can be seen in figure 1.1.

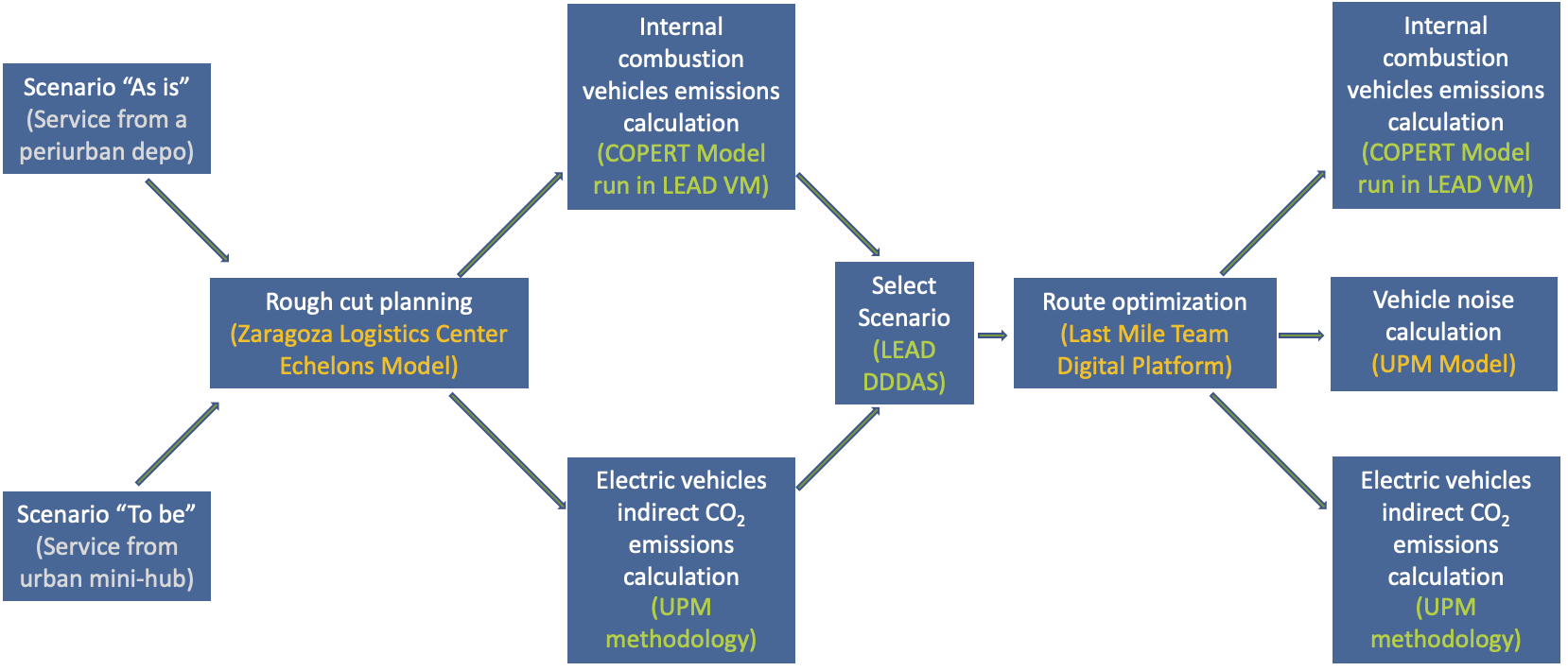


Figure 1.1 Madrid Living Lab Digital Twin models and workflow

The Route Optimisation model conducts the routing modelling and provides the outputs needed to assess the improvement of environmental indicators and the impact of alternative strategies for the clients in terms of cost and reliability, supporting the decision-making process.

# Requirements.

## Software requirements

The LMT Route Optimisation model is developed in C#, an object-oriented programming language created by Microsoft that runs on the .NET Framework. Is dependent on Windows operating system, Microsoft SQL, LMT Active Directory and Azure Active Directory.

Is executed on a Windows Azure Cloud environment, in the following Windows Server Virtual Machines: 2 Domain Controllers, 2 Web Servers, 1 Windows Services Server, 1 Build Server, 1 Jump Server. The database is Microsoft SQL, running in a Microsoft SQL Server.

## Input/Outputs

### Inputs

The Route Optimisation model is a proprietary model of LMT. It is an integral part of the Last Mile Digital Platform, a commercial asset used in LEAD as the underlying technology of Madrid Living Lab.

Receives as operational input only the Services file from the scenario selected by the user in the DDDAS.

Being an enterprise-certified commercial asset configuration is a critical process. It has to follow a specific order to populate the tables, establish relationships, create users, assign permissions, profiles, roles etc. to guarantee the expected levels of data integrity and operational security.

The configuration of the model is customer-specific. Currently there are twenty tables with over two hundred fields to configure a systemic Digital Twin, the aggregation of all individual Digital Twins of each and every one of customer owned, leased or managed physical assets used to perform its operations in the real world.

In real-life operations all individual physical assets configuration parameters are dynamically updated between optimization runs. The Route Optimization model uploads the snapshot of all individual physical asset’s configuration parameters at the time of execution, to ensure the best possible optimization to the specific services demand, balancing costs, environmental sustainability and driver working conditions and well-being.

Most of the configuration inputs for Madrid Living Lab scenarios is carried out by LMT, leaving the business partners to provide the minimal inputs specific to them as type of vehicles, working hours, etc.

LMT has completely redesigned for LEAD Madrid Living Lab a simplified, eight tables partial input configuration data model respecting the underlying database structure integrity, reducing the need of inputs to the minimum possible extent, following the once-only principle, to reduce administrative burden and enable fast scenario setting for Madrid Living Lab partners.

For the operational inputs the Living Lab technical partners (ZLC, LMT, UPM) and the business partners (CLOGIN, EMT) have co-created an anonymous-by-design single-table data collection model to capture the strictly minimum information of the physical activities necessary to feed the Route Optimization model.

The configuration inputs are described in Tables 1 to 8, the operational inputs in Table 9

Table 1 - Step04\_CityHub - Configuration Inputs

|  |  |
| --- | --- |
| Inputs | Description |
| CustomerLevelTwoId | Leave **BLANK** |
| CustomerLevelThreeId | Leave **BLANK** |
| Code | Assigned by LMT |
| Name | Assigned by LMT |
| Address | CityHub address |
| Number | CityHub address |
| City | CityHub city |
| ZipCodeId | CityHub zip code |
| Region | Assigned by LMT |
| Country | Assigned by LMT |
| Coordinates | Coordinates of the CityHub location, expressed as latitude and longitude separated by comma (,). Longitude preceded by a minus sign (-) if west, or without sign if east. Decimal separator is a dot (.) Coordinate system EPSG:4326 (WGS84). |
| LandLine | Assigned by LMT |
| Mobile | Leave **BLANK** |
| Email | Assigned by LMT |
| OpeningTime1 | Assigned by LMT, to ensure City Hub opening times are always within drivers working shifts |
| ClosingTime1 | Assigned by LMT, to ensure City Hub opening times are always within drivers working shifts |
| OpeningTime2 | Leave **BLANK** |
| ClosingTime2 | Leave **BLANK** |

Table 2 - Step05\_ServiceTypeCustomer – Configuration Inputs

|  |  |
| --- | --- |
| Inputs | Description |
| Name | Assigned by LMT |
| ShortName | Assigned by LMT |
| ServiceTypeId | Assigned by LMT |
| VehicleTypeId | Assigned by LMT. If possible, we will use the vehicle-equivalent designation in COPERT DB, to enable vehicle emissions and energy consumption calculation. |
| WindowStart1 | ServiceType time window start in hh:mm format |
| WindowEnd1 | ServiceType time window end in hh:mm format |
| WindowStart2 | Leave **BLANK** |
| WindowEnd2 | Leave **BLANK** |
| Price | Leave **BLANK** |
| Requirement | Assigned by LMT |
| Capability | Assigned by LMT |
| Priority | Assigned by LMT |
| Slot Duration | Assigned by LMT |
| AvailableForHolidays | Assigned by LMT |
| Activity | Assigned by LMT |

Table 3 - Step06\_ZipCodeCityHub – Configuration Inputs

|  |  |
| --- | --- |
| Inputs | Description |
| ZipCodeId | All zip codes served by the CityHub |
| CityHubId | Assigned by LMT |
| ServiceTypeCustomerId | Assigned by LMT |
| CountryId | Assigned by LMT |

Table 4 - Step10\_User – Configuration Inputs

|  |  |
| --- | --- |
| Inputs | Description |
| Name | Assigned by LMT |
| Surname | Leave **BLANK** |
| Email | Leave **BLANK** |
| UserName | UNIQUE – assigned by LMT |
| Password | Assigned by LMT |
| Mobile | Leave **BLANK** |
| LandLine | Leave **BLANK** |
| CustomerLevelTwoId | Leave **BLANK** |
| CustomerLevelThreeId | Leave **BLANK** |
| CityHubId | Assigned by LMT |
| PudoId | Leave **BLANK** |
| Type | Leave **BLANK** |

Table 5 - Step11\_ServiceTime – Configuration Inputs

|  |  |
| --- | --- |
| Inputs | Description |
| ServiceTypeCustomerId | Assigned by LMT |
| ZipCodeId | Assigned by LMT |
| Time | Average time for the ServiceType in hh:mm format |
| Province | Assigned by LMT |

Table 6 - Step14\_PlatformCityHub – Configuration Inputs

|  |  |
| --- | --- |
| Inputs | Description |
| Platform | Assigned by LMT |
| ZipCodeCityHubId | Assigned by LMT |
| CityHubId | Assigned by LMT |
| Country | Assigned by LMT |

Table 7 - Step17\_Driver – Configuration Inputs

|  |  |
| --- | --- |
| Inputs | Description |
| CityHubId | Assigned by LMT |
| Name | Assigned by LMT |
| Dni | Assigned by LMT |
| Email | Assigned by LMT |
| Mobile | Assigned by LMT |
| Imei | Assigned by LMT |
| StartHour | Working day start time in hh:mm format |
| EndHour | Working day end time in hh:mm format |
| Address | Assigned by LMT |
| Number | Assigned by LMT |
| City | Assigned by LMT |
| ZipCode | Assigned by LMT |
| Region | Assigned by LMT |
| Country | Assigned by LMT |
| Coordinates | Coordinates of the location where the driver working day starts, expressed as latitude and longitude separated by comma (,). Longitude preceded by a minus sign (-) if west, or without sign if east. Decimal separator is a dot (.) Coordinate system EPSG:4326 (WGS84).  By default LMT assigns to every driver the coordinates of the CityHub |
| ActiveforPlanification | Assigned by LMT |
| ControlWorkday | Assigned by LMT |
| AverageWorkday | Assigned by LMT |
| UserId | Assigned by LMT |

Table 8 - Step18\_Vehicle – Configuration Inputs

|  |  |
| --- | --- |
| Inputs | Description |
| NumberPlate | Assigned by LMT |
| VehicleTypeId | Assigned by LMT. If possible we will use the vehicle-equivalent designation in COPERT DB, to enable vehicle emissions and energy consumption calculation. |
| CityHubId | Assigned by LMT |
| EnvironmentalHallmark | Assigned by LMT |
| Capability | Assigned by LMT |
| ReturnDepartureLocation | Assigned by LMT |
| ArrivalCityHubId | Leave **BLANK** |
| ArrivalDriverId | Leave **BLANK** |
|  | Leave **BLANK** |
| Capacity | Vehicle capacity in parcels, baskets, crates etc. |
| InitialUnits | Assigned by LMT |
| CapacityKg | Vehicle capacity in Kg. |
| InitialKg | Assigned by LMT |
| CapacityM3 | Vehicle capacity in volume |
| InitialM3 | Assigned by LMT |
| FixedCost | Daily cost |
| KilometerCost | Leave **BLANK** |
| HourCost | Leave **BLANK** |
| OvertimeCost | Leave **BLANK** |
| OvertimeUnits | Leave **BLANK** |
| LimitOvertimeBefore | Leave **BLANK** |
| LimitOvertimeAfter | Leave **BLANK** |
| MaxKilometersDay | Assigned by LMT |
| MaxContDrivingTime | Leave **BLANK** |
| Priority | Assigned by LMT |
| Template | Assigned by LMT |
| StartTime | Assigned by LMT |
| EndTime | Assigned by LMT |
| WorkBreakStart | Work break window start time in hh:mm format |
| WorkBreakEnd | Work break window end time in hh:mm format |
| WorkBreakDuration | Work break duration, in hh:mm format |
| Notes | Leave **BLANK** |
| ActiveForPlanification | Assigned by LMT |
| DriverId | Assigned by LMT |

Table 9 - Service – Operational Inputs

|  |  |
| --- | --- |
| Inputs | Description |
| WayBillCustomer | UNIQUE identifier for a service |
| RetailerCustomerId | Assigned by LMT. The same value for all services of all shippers/retailers |
| WayBillOriginator | Leave **BLANK** |
| RecipientName | Leave **BLANK** **or include a consecutive anonimous designator meaningful for you**, as "Delivery Point X" or "Customer X" |
| RecipientAddress | Insert actual address(only street name and house number) **if allowed by Data Protection**. If not, fill it with any character or string. |
| RecipientCity | City name |
| RecipientZipCode | Has to be one of the zip codes served by the City Hub |
| RecipientCountry | Receiver country code in ISO format 3166-1-alpha-2 |
| RecipientMobile | Leave **BLANK** |
| RecipientLandLine | Leave **BLANK** |
| RecipientEmail | Leave **BLANK** |
| ServiceType | Name of the service/s configured by LMT |
| Coordinates | Coordinates of the location to drop off or pick up parcels, expressed as latitude and longitude separated by comma (,). Longitude preceded by a minus sign (-) if west, or without sign if east. Decimal separator is a dot (.) Coordinate system EPSG:4326 (WGS84). |
| AmountCashOnDelivery | Leave **BLANK** |
| AmountShippingCharge | Leave **BLANK** |
| Notes | Leave **BLANK** |
| InjectionZipCode | Assigned by LMT. Has to be one of the zip codes served by the City Hub. |
| ServiceTime | Leave **BLANK, except for a justified cause.**  If left **BLANK** the optimization engine will take for all services the ServiceType ServiceTime default of all the zip codes served by the CityHub, **OR** the one of the ServiceType ServiceTime of the specific zip code if these were individually configured.  **If NOT BLANK** the optimization engine will take the ServiceTime specified for the individual service, overriding the above. |
| LoadUnits | Units to Pick up (collect) at location. **If none, ensure UnloadUnits is > 0** |
| UnloadUnits | Units to Drop off (deliver) to location. **If none, ensure LoadUnits is > 0** |

### Outputs

Main model outputs are:

* Number and average distance driven per internal combustion engine vehicle type. This is the input to COPERT, the EU standard vehicle emissions and energy consumption calculator.
* Number and average distance driven per electric vehicle type. This is the input to EVCO2, a methodology adapted by UPM from Red Electrica Española, the Spanish power grid operator, to calculate the CO2 equivalent emissions of the energy consumed by the electric vehicles operation.
* Step-by-step routes geospatial data per vehicle. Input to the noise calculation module.

The main Route Optimization model outputs for LEAD Living Lab are:

* Step-by-step routes per vehicle. Available to the logistics partner (CLOGIN), for them to use as the input to estimate some of the operational and economic KPIs.
* lmt\_LEAD\_input\_to\_COPERT.json. This is a file with the number of internal combustion engine vehicles per COPERT vehicle type and the average distance driven per vehicle type. These data elements are inserted in a specific COPERT-proprietary Microsoft Excel file that is sent to LEAD COPERT server in Amazon Web Services using and ad-hoc Python Jupyter notebook. The server calculates vehicle emissions and energy consumption, that are downloaded in LMT environment and sent to LEAD platform.
* lmt\_LEAD\_input\_to\_EVCO2.json. This is a file with the number of electric vehicles per type and the average distance driven. These data elements are inserted in specific working files that, using and ad-hoc Python Jupyter notebook, calculates in LMT environment the CO2 equivalent emissions of the energy consumed by the electric vehicles operation, and sends the results to LEAD platform.
* lmt\_LEAD\_input\_to\_noise.json. This is a step-by-step routes GeoSpatial data set per vehicle, to be consumed by UPM as the input to their noise calculation module.

**CAUTION**: when there is more than one service in the exact same location, the GeoSpatial information of the route leg from the preceding location is only captured in the first service, having the other/s the value “LINESTRING EMPTY”. This dataset excludes the “LINESTRING EMPTY” data elements of the second, third, etc. services, to avoid the need of post-processing the data set to upload it in a GIS.

LMT Route Optimization operational outputs that could potentially be publicly shared are described in Tables 10 to 14.

Table 10 - ResponsePendingService – Operational Outputs

This table is blank most of the time. It captures the details of services that the optimization engine left unserved because they violate any of the set time, journey, cost or other constraints.

|  |  |
| --- | --- |
| Output | Description |
| Id | UNIQUE, created when the record is inserted in the DB |
| ResponsePlanId | UNIQUE, created when the ResponsePlan record is inserted in the DB |
| ServiceId | UNIQUE, created when services are inserted in the DB, before creating the Request to the optimization engine. |
| Name | Always BLANK, to abide to GDPR requirements |
| Duration | Time in minutes assigned to perform the service |
| LocationCoordinates | Coordinates of the location to drop off or pick up parcels, expressed as latitude and longitude separated by comma (,).  Longitude preceded by a minus sign (-) if west, or without sign if east.  Decimal separator is a dot (.) Coordinate system EPSG:4326 (WGS84). |
| Priority | Always set to 1. The optimization engine will treat all services equally, will try to serve them all. |
| WindowStart | ServiceType time window start |
| WindowEnd | ServiceType time window end |
| Requirement | Hard constraint associated to the ServiceType or location that must be met (need a specific vehicle type, a driver with certain skills, can only be accessed at certain time windows, etc. |
| UnloadUnits | Units to Drop off (deliver) to location (parcels, crates, pallets) |
| LoadUnits | Units to Pick up (collect) from location (parcels, crates, pallets) |
| LoadKg | Weight to Drop off (deliver) to location |
| UnloadKg | Weight to Pick up (collect) from to location |
| LoadM3 | Volume to Drop off (deliver) to location |
| UnloadM3 | Volume to Pick up (collect) from location |
| Comments | Field to communicate special instructios or other details of the service to the driver. Not used, always blank. |
| RegisterDate | The date corresponds with the services date. Discard the time, LEAD optimizations are asynchronous and the stated time is irrelevant |
| DeletionDate | Always null |

Table 11 - ResponsePlan - Operational Outputs

This table provides a summary of the main parameters and outputs of the Response to an optimization Request.

|  |  |
| --- | --- |
| Output | Description |
| Id | UNIQUE, created when the record is inserted in the DB |
| RequestId | UNIQUE, created in the DB before sending the Request to the optimization engine |
| JobId | UNIQUE, created in the optimization engine when receives a valid Request. Value is inserted in the DB for reference |
| CityHubId | UNIQUE |
| ExecutionTime | Total elapsed time from uploading the services file to the FTP folder to the insertion of all the data contained in the Response |
| Iterations | Number of iterations allowed to the optimization engine |
| NumberOfServices | Total number of services sent to the optimization engine |
| ServicesNotProvided | Services that the optimization engine left unserved because they violate any of the set time, journey, cost or other constraints |
| NumberofVehicles | Number of vehicles available at the CityHub |
| VehiclesInUse | Number of vehicles used for the specific optimization |
| TotalDrivingTime |  |
| TotalServiceTime |  |
| TotalBreakTime |  |
| TotalNotWorkTime | Provides an indication of the vehicle/delivery capacity available at the CityHub versus the vehicle/delivery capacity utilized. Disregard this field. It is not used in LEAD. |
| TotalOvertimeWork | Always 0 in LEAD. Overtime is not allowed |
| AverageWorkingTime | Of the vehicles used for the specific optimization |
| AverageWorkVehicle | Provides an indication of the average vehicle/delivery capacity utilized versus the available. Disregard this field. It is not used in LEAD. |
| OnTimeServices |  |
| TotalKm |  |
| TotalCosts |  |
| TollCosts | Always 0 in LEAD |
| ServicesOutOfWindow | LEAD services time window is from 09:00 to 17:30. Always 0 because overtime is a not allowed, hard constraint. |
| TimeOutOfWindow | Same as above |
| RegisterDate | The date corresponds with the services date. Discard the time, LEAD optimizations are asynchronous and the stated time is irrelevant |
| DeletionDate | Always null |
| IsOverLimitHours | Value 1 if the optimization does not violate regular working hours. In LEAD always zero because overtime is a not allowed, hard constraint. |

Table 12 - Response Service - Operational Outputs

This table provides data associated to each individual service of an optimization Request.

|  |  |
| --- | --- |
| Output | Description |
| Id | UNIQUE, created when the record is inserted in the DB |
| ResponseVehiclePlanId | UNIQUE, created when each ResponseVehiclePlan record is inserted in the DB |
| Start | Service start time |
| End | Service end time |
| ServiceId | UNIQUE, created when services are inserted in the DB, before creating the Request to the optimization engine. |
| Name | Always BLANK, to abide to GDPR requirements |
| Duration | Time in minutes assigned to perform the service |
| LocationCoordinates | Coordinates of the location to drop off or pick up parcels, expressed as latitude and longitude separated by comma (,).  Longitude preceded by a minus sign (-) if west, or without sign if east.  Decimal separator is a dot (.) Coordinate system EPSG:4326 (WGS84). |
| Priority | Always set to 1. The optimization engine will treat all services equally, will try to serve them all. |
| WindowStart | ServiceType time window start |
| WindowEnd | ServiceType time window end |
| Requirement | Hard constraint associated to the ServiceType or location that must be met (need a specific vehicle type, a driver with certain skills, can only be accessed at certain time windows, etc. |
| UnloadUnits | Units to Drop off (deliver) to location |
| LoadUnits | Units to Pick up (collect) from location |
| LoadKg | Weight to Pick up (collect) from location |
| UnloadKg | Weight to Drop off (deliver) to location |
| LoadM3 | Volume to Pick up (collect) from location |
| UnloadM3 | Volume to Drop off (deliver) to location |
| Comments | Field to communicate special instructions or other details of the service to the driver. Not used, always blank. |
| RegisterDate | The date corresponds with the services date. Discard the time, LEAD optimizations are asynchronous and the stated time is irrelevant |
| TravelDistance | Driven distance from the former location |
| TravelTime | Driving time from the former location |
| DepartureDate | Date and time when the vehicle start driving to the next location |

Table 13 - ResponseServicePath - Operational Outputs

This table provides GeoSpatial data of all legs of a specific route of a specific vehicle of a specific optimization Request.

|  |  |
| --- | --- |
| Output | Description |
| Id | UNIQUE, created when the record is inserted in the DB |
| Time | Driving time from the former location |
| Distance | Distance driven from the former location |
| Geometry | **CAUTION**: LMT backend underlying DB is Microsoft SQL. All records in this json file have a LINESTRING instance as a Geometry variable.  When there is more than one service in the exact same location, the GeoSpatial information of the route leg from the preceding location is only captured in the first service, having the other/s the value “LINESTRING EMPTY”  If you plan to load this data into a GIS consider use the geojson version to avoid having to process this json file, if fits your purpose. |
| Order | Is the sequence of the service stop in the route |
| ResponseVehiclePlanId | UNIQUE, created when each ResponseVehiclePlan record is inserted in the DB |
| RegisterDate | The date corresponds with the services date. Discard the time, LEAD optimizations are asynchronous and the stated time is irrelevant |
| DeletionDate | Always null |

Table 14 - ResponseVehiclePlan - Operational Outputs

This table provides the summary per vehicle of the routes of an optimization Request.

|  |  |
| --- | --- |
| Output | Description |
| Id | UNIQUE, created when the record is inserted in the DB |
| ResponsePlanId | UNIQUE, created when the ResponsePlan record is inserted in the DB |
| TotalDrivingTime |  |
| TotalServiceTime |  |
| TotalBreakTime |  |
| TotalOvertimeWork |  |
| TotalKm |  |
| TotalCosts |  |
| TollCosts |  |
| ServicesOutOfWindow | LEAD services time window is from 09:00 to 17:30. Always 0 because overtime is a not allowed, hard constraint. |
| TotalServices | Number of services by the vehicle |
| VehicleId | UNIQUE, assigned by LMT during configuration |
| Name | UNIQUE, assigned by LMT during configuration |
| StartTimeWorkday |  |
| EndTimeWorkday |  |
| CostKm | Not used in LEAD. Always 0 |
| CostHour | Not used in LEAD. Always 0 |
| LocationCoordinates | Coordinates of the location to drop off or pick up parcels, expressed as latitude and longitude separated by comma (,).  Longitude preceded by a minus sign (-) if west, or without sign if east.  Decimal separator is a dot (.) Coordinate system EPSG:4326 (WGS84). |
| WorkBreakStart | Work break window start time in hh:mm format |
| WorkBreakEnd | Work break window end time in hh:mm format |
| WorkBreakDuration | Work break duration, in hh:mm format |
| Barcode | UNIQUE for each vehicle. Not used in LEAD |
| RegisterDate | The date corresponds with the services date. Discard the time, LEAD optimizations are asynchronous and the stated time is irrelevant |
| DepartureDate | Date and time when the vehicle start the journey |
| ArrivalDate | Date and time when the vehicle end the journey |
| TravelDistance | Driven distance from the last route stop to the CityHub |
| TravelTime | Driving time from the last route stop to the CityHub |
| InitialBattery | Not used in LEAD. It does not appear in the file. |
| FinalBattery | Not used in LEAD. It does not appear in the file. |
| InitialKilometers | Not used in LEAD. It does not appear in the file. |
| FinalKilometers | Not used in LEAD. It does not appear in the file. |

# Model Description

At the core of the LMT Route Optimisation model are different road transport specific Artificial Intelligence algorithms plus a comprehensive, in-house developed, IP registered, technology stack.

The core enables to optimize urban logistics networks in cities, urban and peri-urban areas considering the road/streets existing network plus all available resource: people, their working hours, customer delivery windows, municipal, regional, national and European rules and legislation in diverse road-transport related regulated fields as vehicle types, low emission zones, other geo-fenced vehicle, time or otherwise restricted areas, specific transport regulations etc. to ensure the best possible optimization to any specific need not only from an economic point of view but also from an environmental sustainability and driver working conditions and well-being points of view.

# Instructions to run the model

The Route Optimization model environment, libraries, system dependencies etc. are kept up to date by LMT. Can’t be executed through the command line by the user, is only run by LMT.