

Urban Logistics Innovation Day

26 September 2023, Brussels

Plenary Session:
Digital Twins for
low-emission
last-mile
logistics: the
LEAD story



#LEADFinalConference
#UrbanLogisticsInnovationDay

 www.leadproject.eu

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Living Labs as innovation accelerators for logistics

Carolina Ciprés

Director of Research, Zaragoza Logistics Center



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 861598



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LEAD Strategies



1

Innovative business models

with a view to optimising the performance of last mile logistics (based on volatility of demand, delivery life cycles and costs) in response to the challenges posed by the on demand economy



2

Agile freight storage and distribution

Agile schemes for urban freight storage and last mile distribution, including crowdsourced shipping, capacity sharing, multi-echelon and Physical Internet inspired approaches



3

Low emission delivery vehicles

including Electric Delivery Vehicles (EDVs), hybrid and automated vehicles for freight delivery like cargo-bikes, delivery robots and droids -walkers will also be considered



4

Smart data-driven logistics solutions

for shared, connected and low-emission logistics operations, empowered by an adaptive modelling approach and Digital Twin models, applied in real-life environments

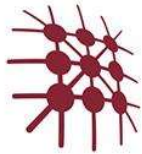


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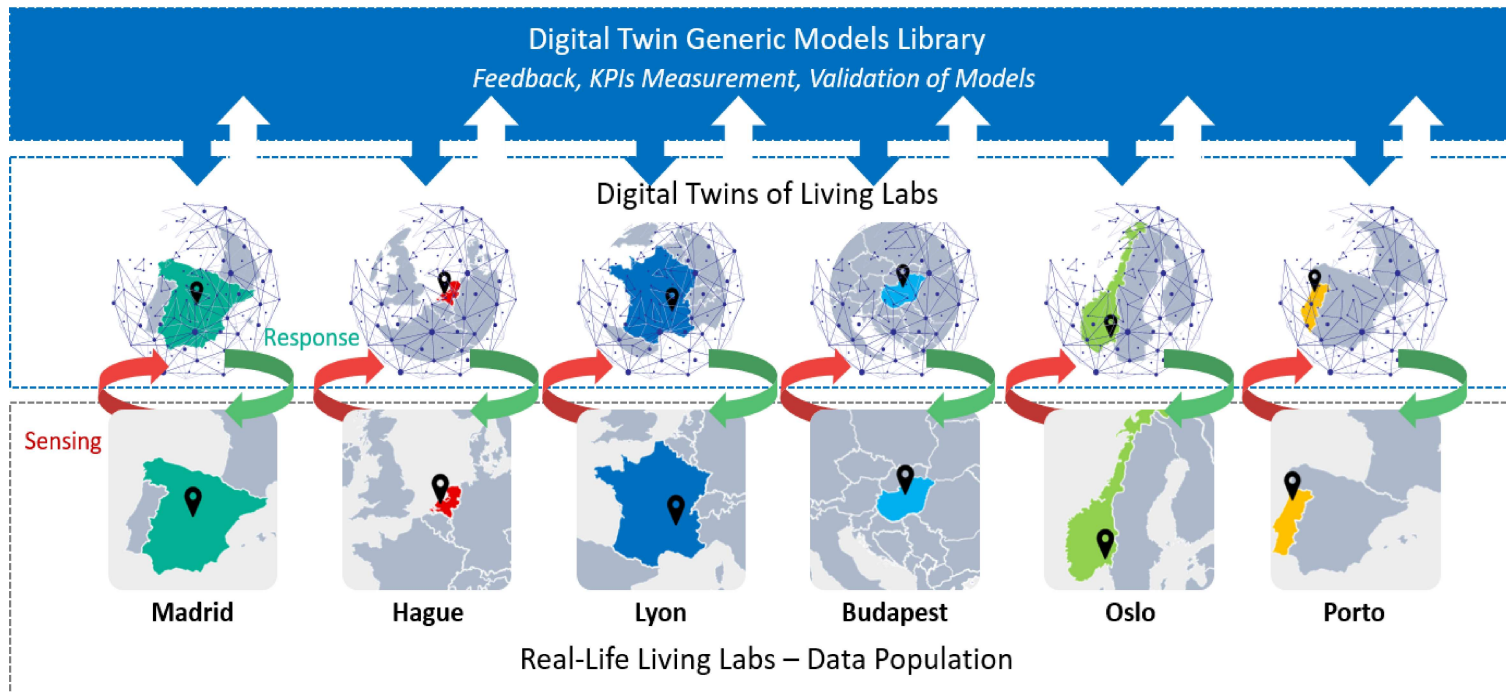
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MIT GLOBAL
SCALE NETWORK

Validation in Living Labs



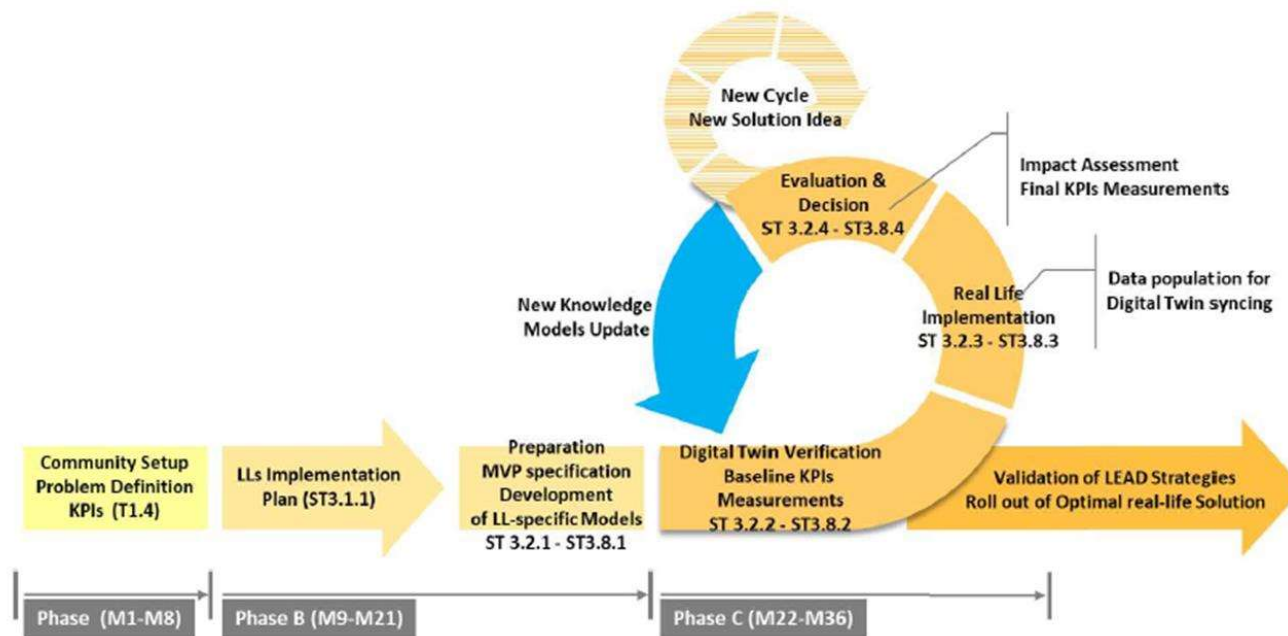
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Living Labs phases



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Phase A: Community Setup

First KPIs, stakeholders & Knowledge base
Workshop Design & Organisation

Workshop Implementation
& results analysis

Phase A



Local Workshop

Value case methodology
(Multi stakeholders, Multivalue)

- a) Scenarios definition
- b) KPIs definition

Objective

Communities of practice setup

Innovation Agenda

Value case scenarios

Validation KPIs

LEAD



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Phase B: Living Labs implementation



Living Lab
 Transforming a Parking Lot to an Urban Consolidation Centre



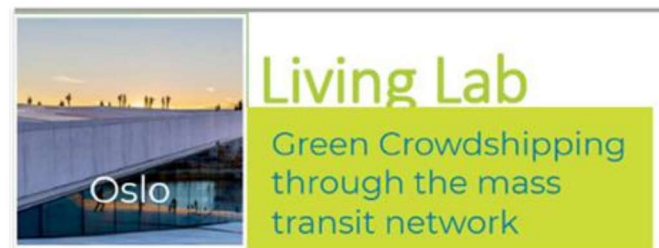
Living Lab
 Integrated last-mile logistics with demand-supply matching platforms



Living Lab
 Validation of last mile distribution models




Living Lab
 Spatial Planning of Inner-City Loading Areas



Living Lab
 Green Crowdshipping through the mass transit network

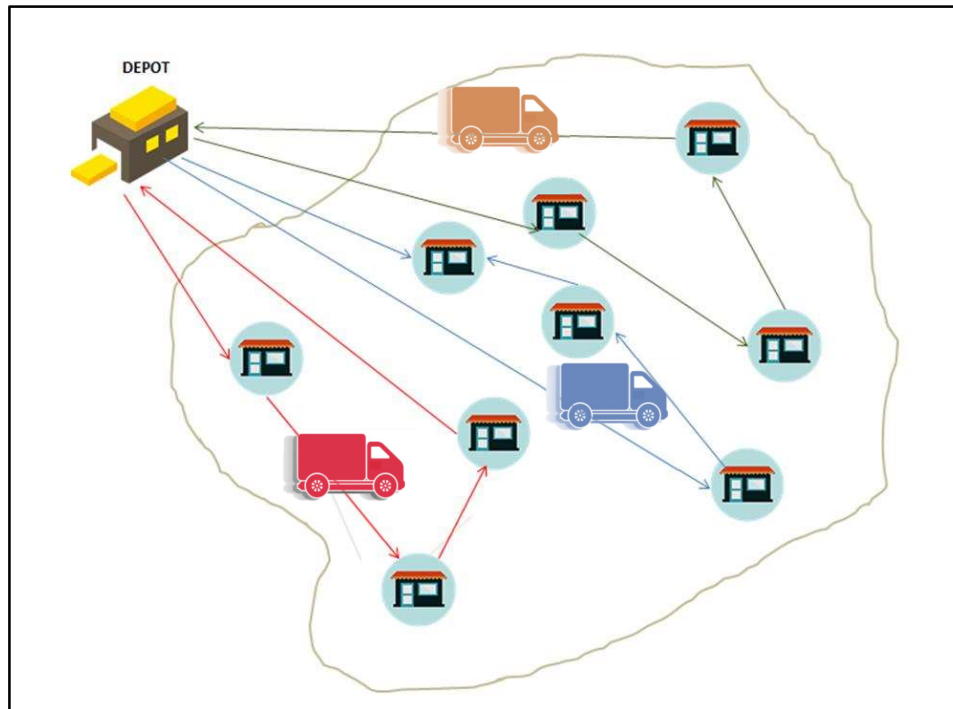


Living Lab
 Turning Retail stores to electric vehicles charging stations

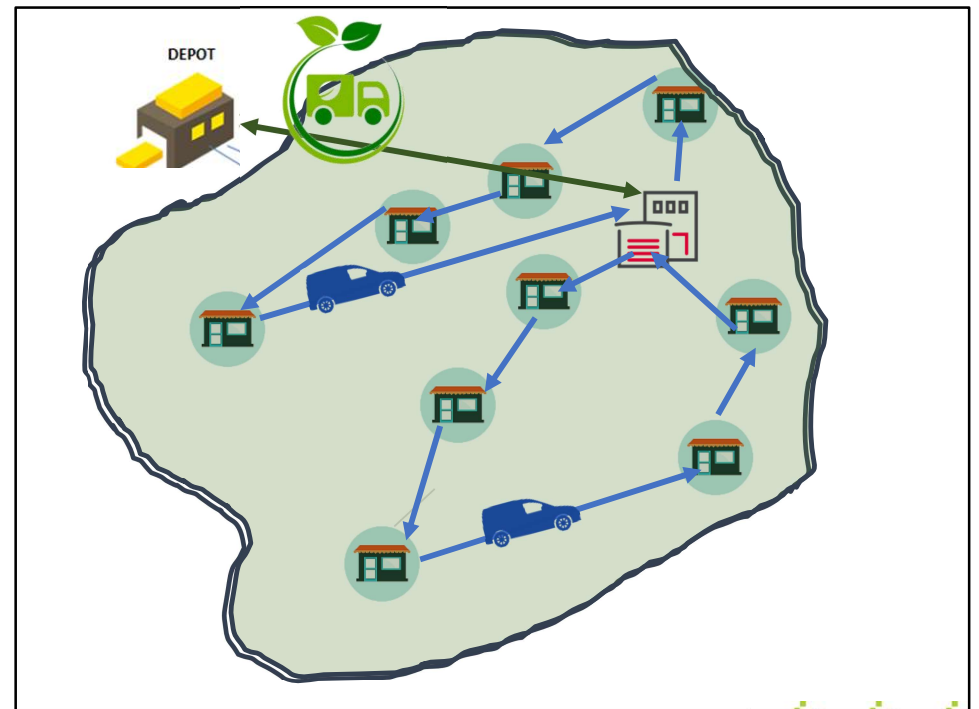
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LEAD Innovations: Agile storage + Low Emissions Vehicles

CONVENTIONAL DISTRIBUTION SCHEME B2B



INNOVATIVE DISTRIBUTION SCHEME B2B



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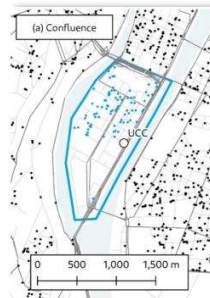
LEAD Innovations: Agile storage + Low Emissions Vehicles

Madrid



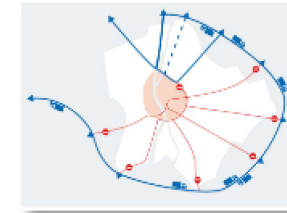
- 1 UC
- B2C
- Parcels
- PPP
- 2-echelon

Lyon



- 2 separate UCs
- B2C - B2B
- Parcels – Used cartridges/paper
- PPP – Horizontal Collaboration
- 2-echelon

Budapest

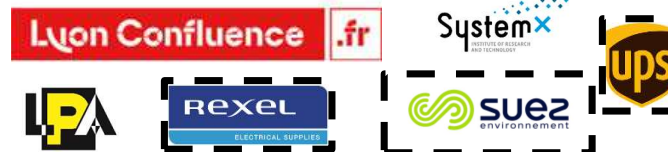


- 4 UCs (combined settings)
- B2B (grocery)
- 2-echelon
- Mobile vs fixed + (LEVs)
- 24h vs (7.00 - 12.00)am

- UCC: Underground Parking Plaza Mayor (EMT)
- UC1: Crossdocking facility using hybrid Vans + e-3 Wheelers (CityLogin)
- Route optimization engine
- Digital twin (5 scenarios combining different types of vehicles)

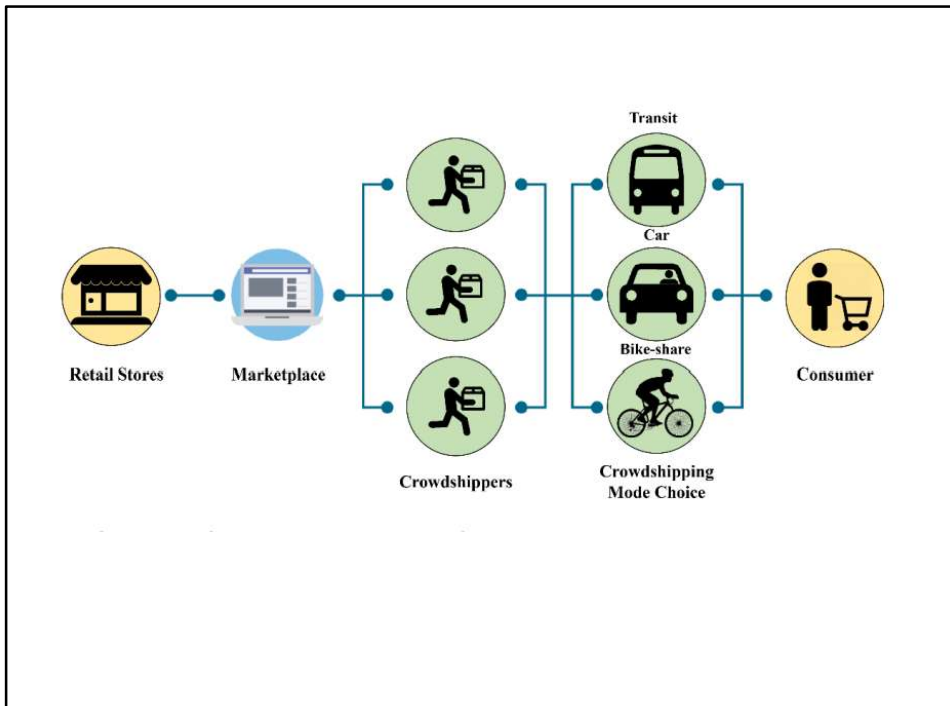
- UCC: Underground Parking Lyon Confluence (LPA)
- UC1: Crossdocking facility (UPS)
- UC2: lockers for storing used materials and reduce daily trips (Rexel and Suez)
- Digital Twin (simulation of different locations for the UCC and vehicles)

- UCC: Virtual location in the Grand Boulevard
- UC1&UC2: Fixed facility (BILK)
 - UC1:24h, LNG trucks + e-Vans
 - UC2:7-12am, e-16tons + e-Vans
- UC3&UC4: UCC in BILK + mobile depot
 - UC3:24h, LNG trucks + e-Vans
 - UC4: 7-12am, e-16tons + e-Vans
- Digital Twin (4 use cases simulation)



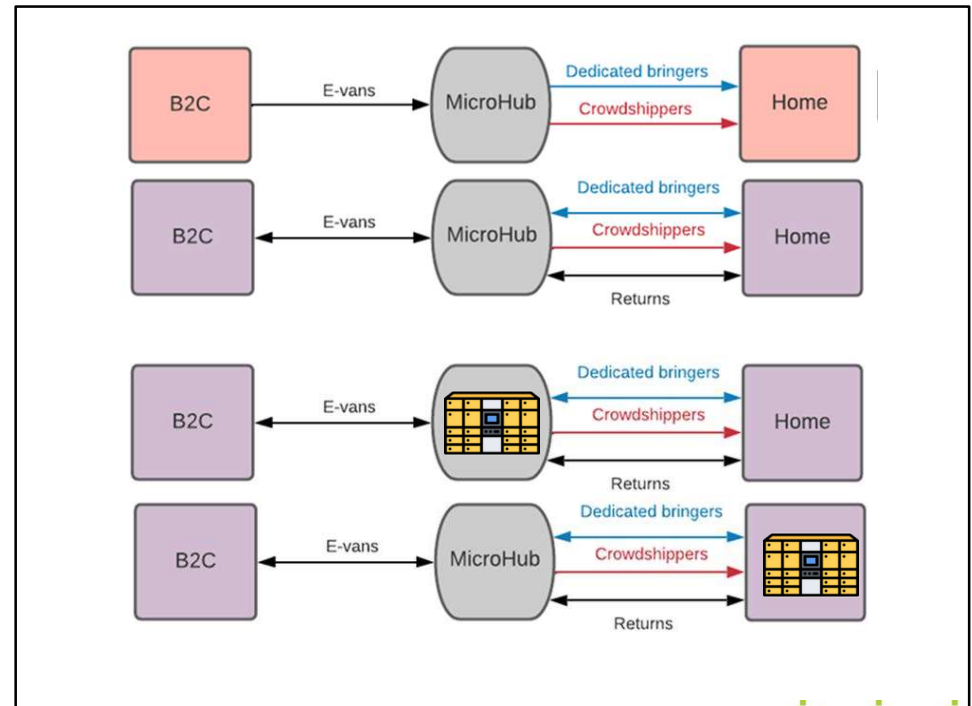
LEAD Innovations: Crowdshipping + Agile storage + LEVs

CROWDSHIPPING



Source: (Agnivesh,P.)

CROWDSHIPPING + AGILE STORAGE + LEVs



LEAD Innovations: Crowdshipping + Agile storage + LEVs

The Hague



- 3 evolutionary UCs
- Parcels
- Horizontal
- Crowdshipping + (lockers)

Oslo



- 4 evolutionary UCs
- B2C
- Furniture
- PPP – Horizontal Collaboration
- EVs – Crowdshipping – microhub - returns

- Hyperconnected logistics
- UC1: potential of crowdshipping (NIMBER)
- UC2: lockers (MyPup in TU-Delft)
- UC3: integrated services (crowdshipping – lockers as transshipment centers)
- Digital twin (scenarios simulation)

- UC1: Direct home deliveries (e-Vans)
- UC2: Microhub (e-vans + bringers)
- UC3: Microhub (e-vans + [bringers and crowdshippers])
- UC4: Microhub (e-vans + [bringers and crowdshippers and returns])
- Digital Twin (scenarios simulation)

LEAD Innovations: Retail electric deliveries

Porto



- 2 virtual Ucs + 1 real UC
- B2C
- FMCG
- 100% electric deliveries
- Physical Internet

- UC1: electric charging station networks (virtual)
- UC2: electric food deliveries (virtual) – new BM
- UC3: re-scheduling (real and virtual) – new BM
 - Electric modest or problematic same day deliveries with motorbikes
- Digital Twin (scenarios simulation)



inlecom

SONAE

ZLC

 LEAD



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Phase C: Validation

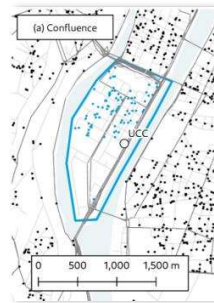
Madrid



The Hague



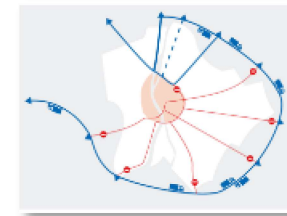
Lyon



Porto



Budapest



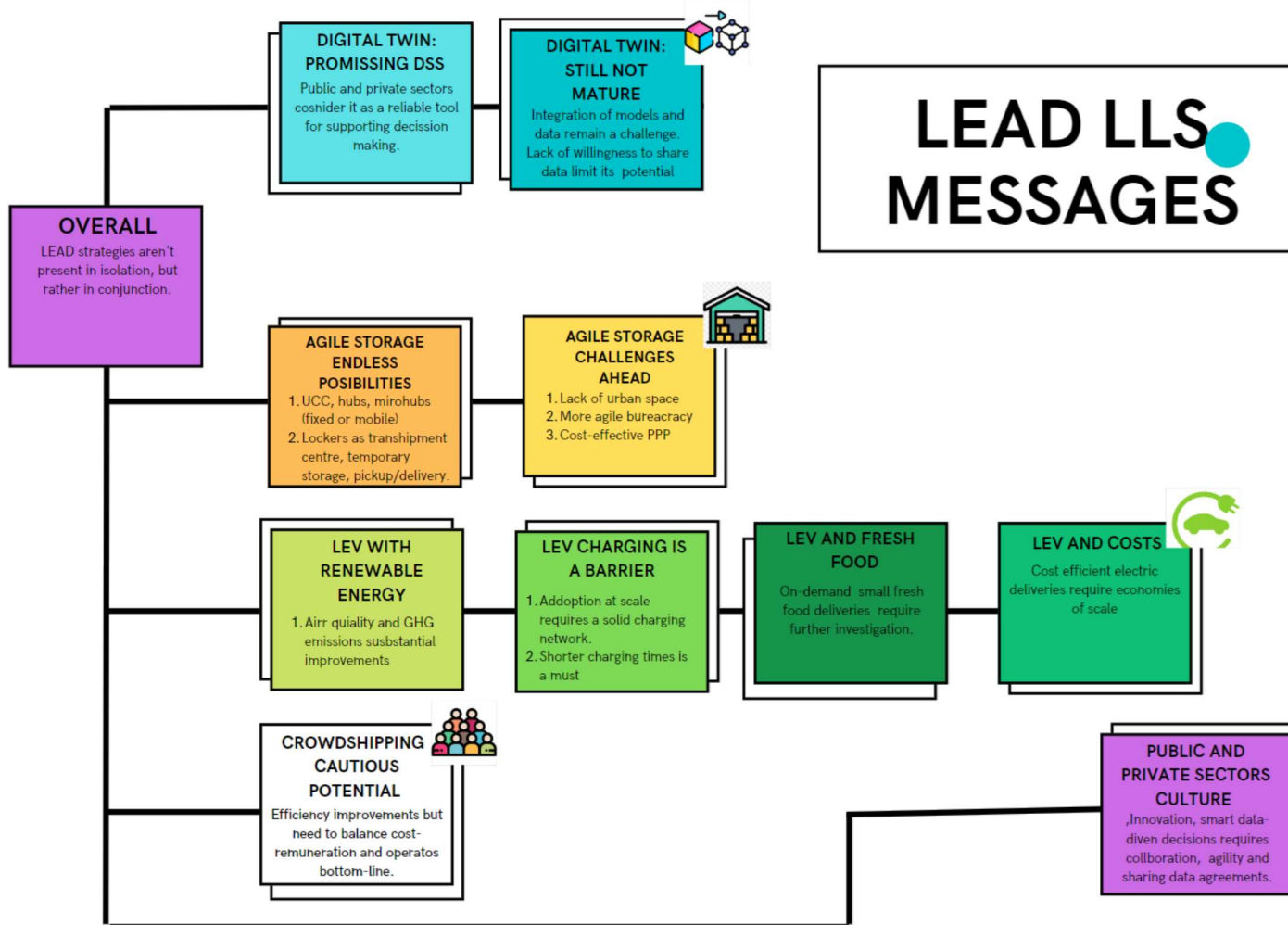
Oslo



Operational efficiencies (number of kilometres, vehicles, energy consumed, energy price)
 Social awareness
 Opportunities for innovation and collaboration

KPIs	Environmental and economic improvements	Environmental and economic improvements	Environmental – economic not possible to determine	Environmental	Environmental and economic improvements	Environmental and economic improvements
Validation	High satisfaction	Strong acceptance and lockers as transshipment centres	Strong acceptance despite the challenges	High satisfaction	High satisfaction and acceptance from logistics industry	Strong acceptance but with refinements

Phase C: Validation





Thanks!

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The LEAD Digital Twinning Platform

Urban Logistics Innovation Day, 26 September 2023

Ioanna Fergadiotou, INLECOM

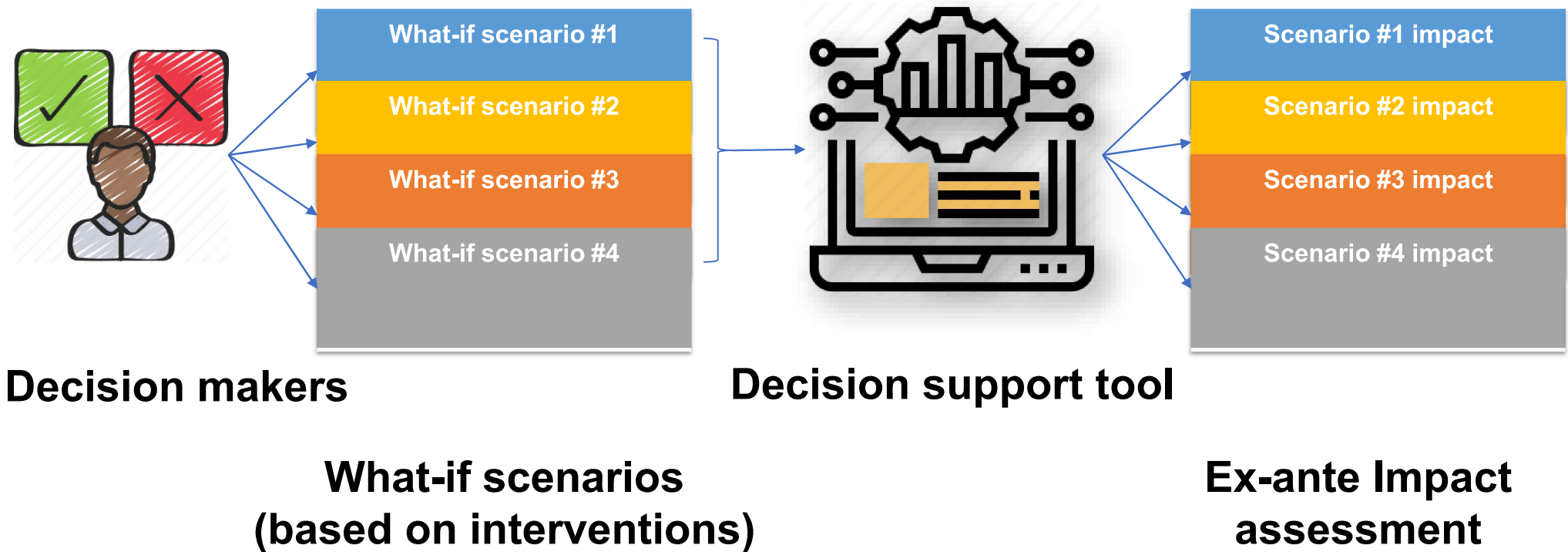


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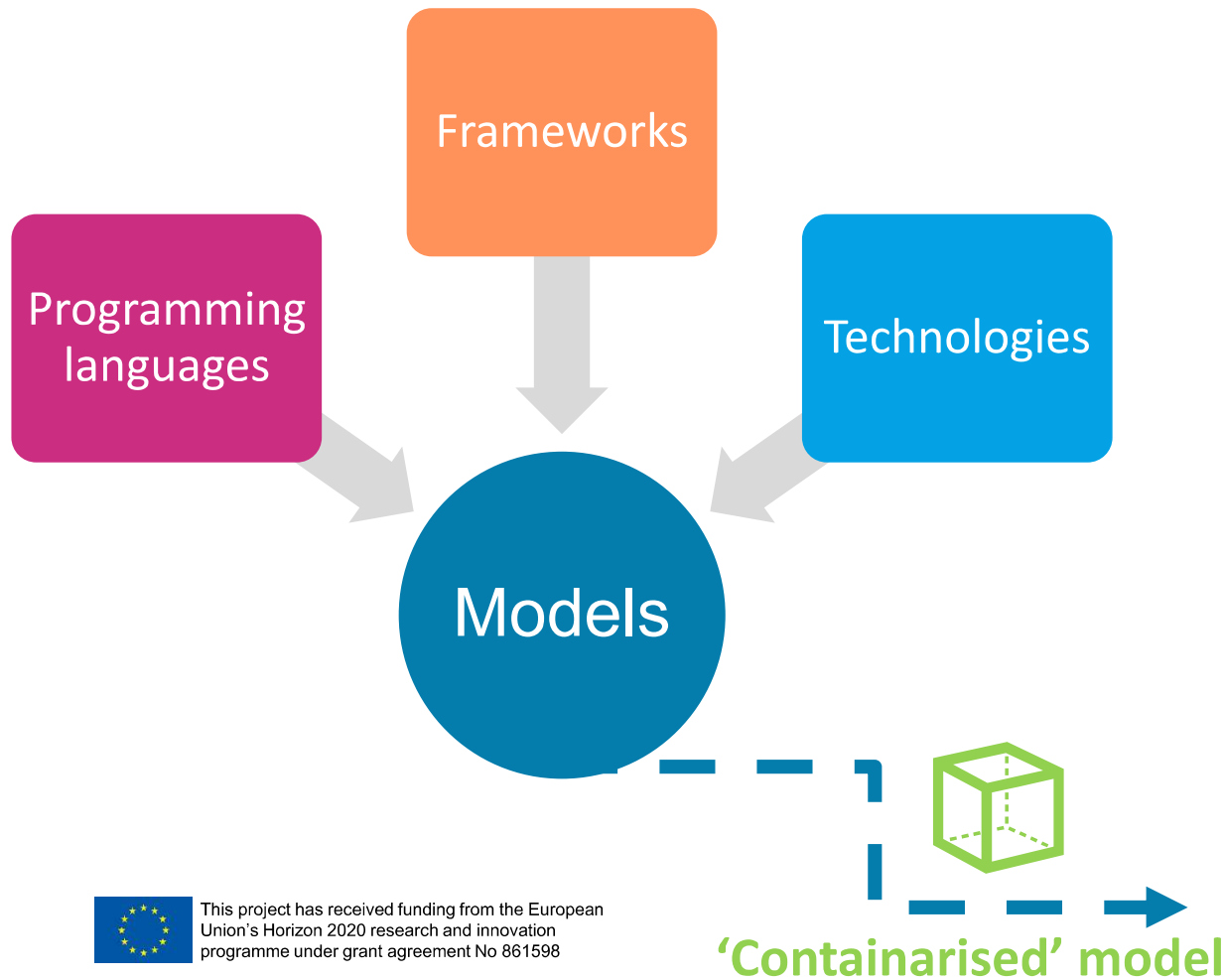
Impact assessment tool



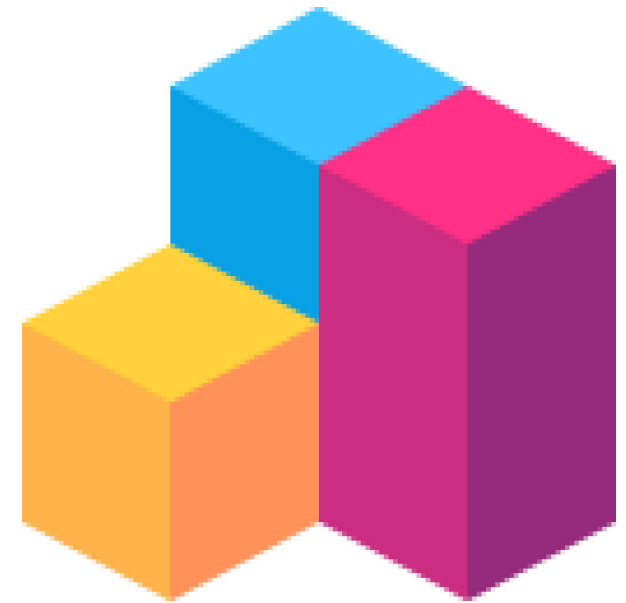
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Digital twin models



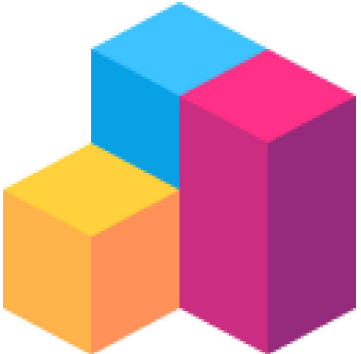
LEAD Model Library



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The LEAD Platform

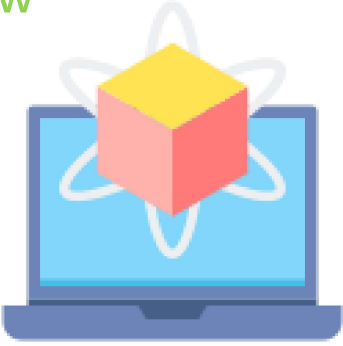


Model Library



Data Assets

Scenario: Model Workflow



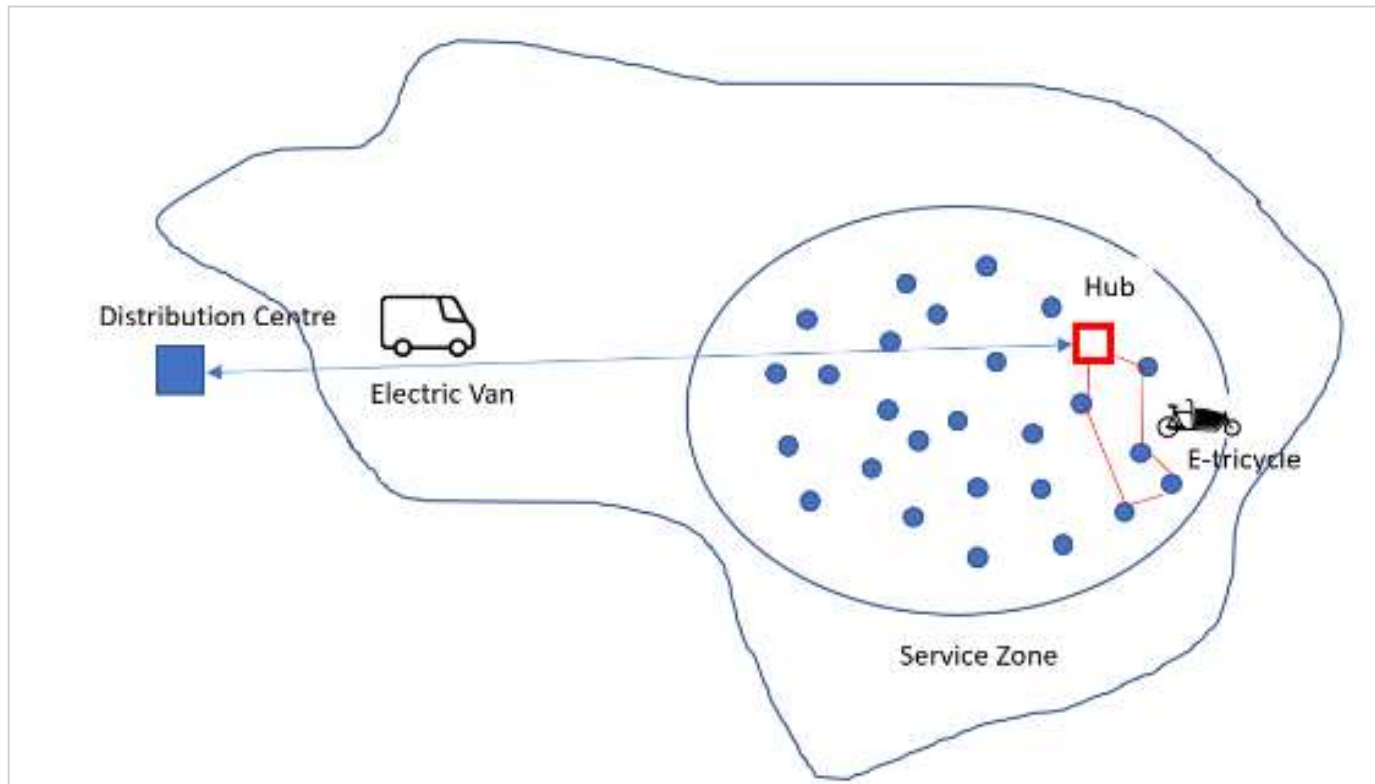
Simulations



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Example – Distribution in a service zone



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Models (I/O)

	2-Echelon	COPERT
Inputs	<ul style="list-style-type: none">• Facilities locations,• Fleet characteristics,• demand,• Zones and map data,• Handling times,• Required stop times at facilities	<ul style="list-style-type: none">• Temperature,• Humidity,• Traffic estimates,• vehicles types used,• Activity per vehicle type,• Number of vehicles
Outputs	<ul style="list-style-type: none">• Number of vehicles required,• Distance and Travel time required to cover demand in the as-is and to-be scenarios	<ul style="list-style-type: none">• Total energy consumption and• Estimated air pollution metrics (CO2, PM2.5, NO2, VOC).



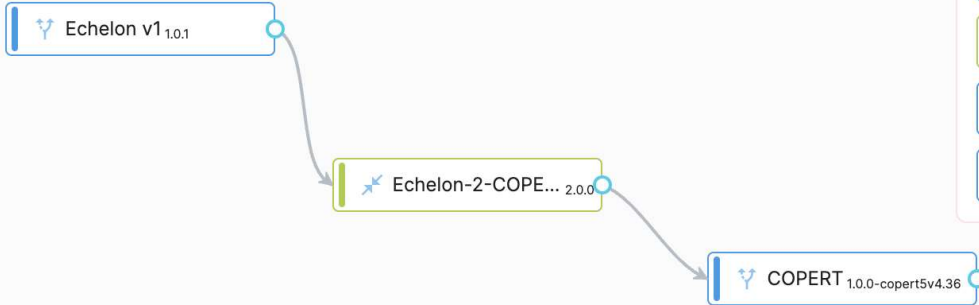
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Scenario Builder

Scenario Builder Scenario Name
Echelon-2-COPERT

Search Model By Name



Echelon v1 v1.0.1	Echelon v2 v2.0.0	COPE... v1.0.0-copert5v4.36
Echelon-2-COP... v2.0.0	Parcel Generation v1.0.1	Parcel Market v1.0.0
Parcel Tour For... v1.0.0	Parcel Generati... v1.0.0	Parcel Market t... v1.0.0
EVCO2 v1.0.0	EDM v0.0.1	DCM v0.0.1

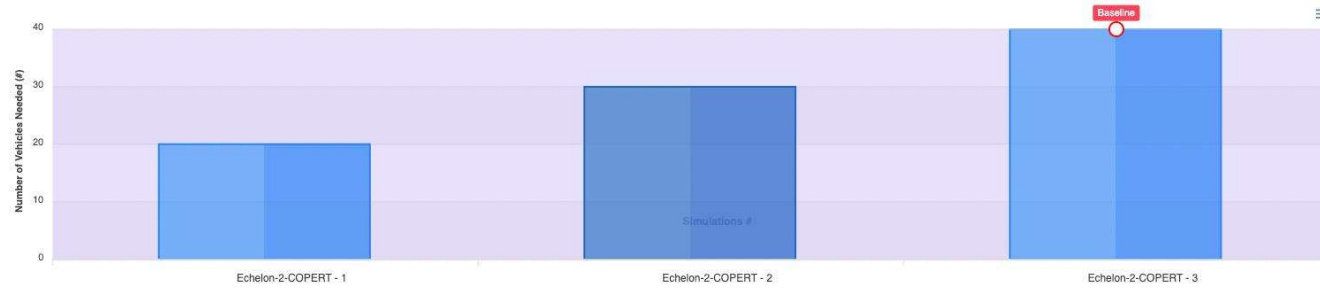


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Simulation Results

Number of Vehicles Needed #



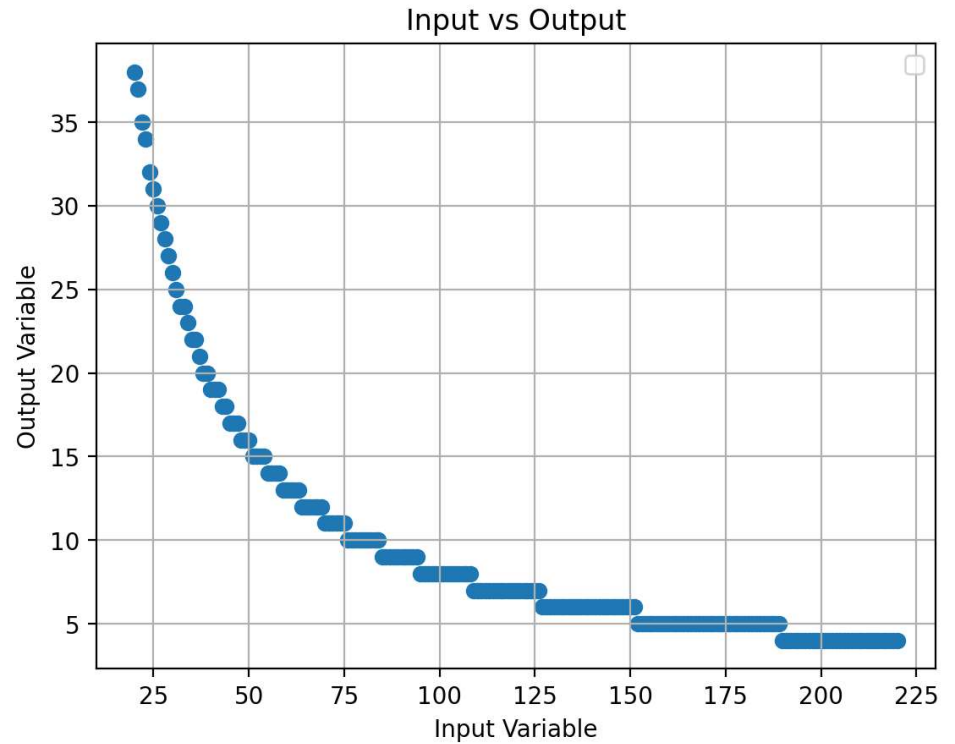
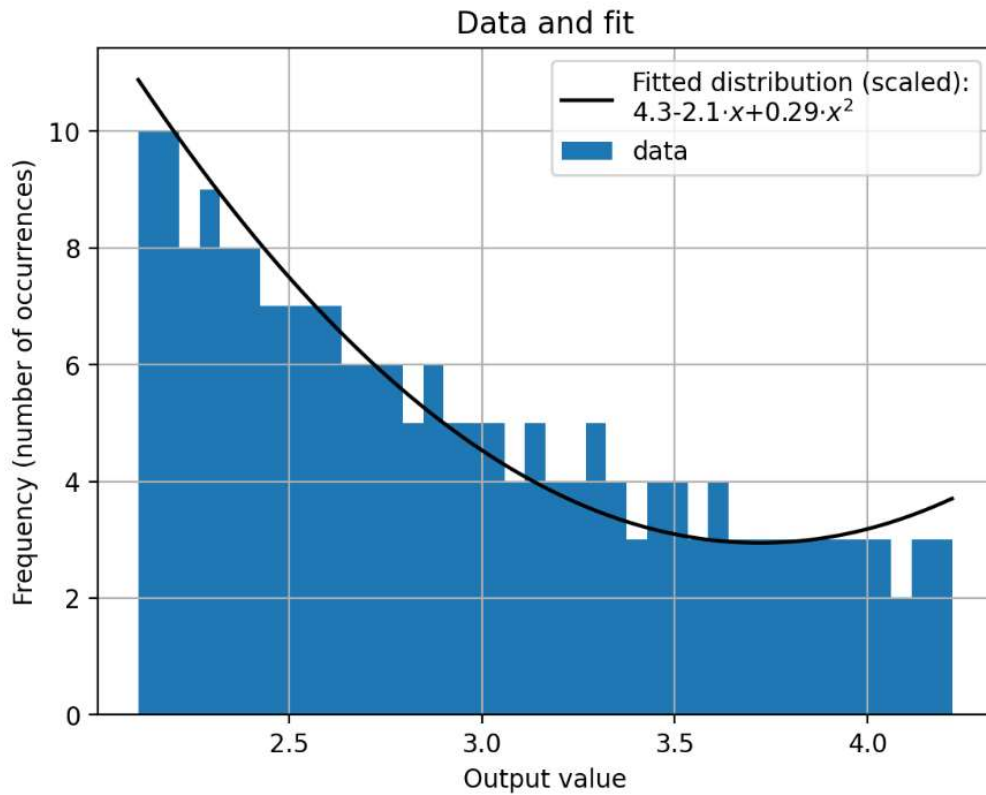
Total Delivery Distance (km)



Carbon Dioxide (CO2) Total (ppm)



DSS Cognitive Engine



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Key Advantages

Open Platform standardizing the execution of complex model workflows

Integrates models that have been developed in 3rd party tools

Scalability

Flexibility and resources sharing



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Contact us!

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SCLEP

Sustainable City Logistics Evaluation Platform

A Key Exploitable Result by the Madrid Living Lab

in the  Project

Urban Logistics Innovation Day
Brussels, September 26th, 2023



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Madrid Living Lab Objective

Demonstrate the **better efficiencies** in using a UCC connected to the TEN-T, to deliver to the city center



Partners



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Business-as-Usual (BaU) scenario

- One-echelon routing
- Direct delivery from a periurban DC located at 25 km from city center



Engine type	Payload	Max n° parcels
Euro6CI	878 kg	161



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Urban Consolidation Center (UCC) scenario

- Two-echelon routing
- Consolidated delivery to the UCC from a periurban DC located at 25 km from city center
- Final delivery with E-scooters



Engine type	Payload	Max n° parcels
Electric	250 kg	34



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Parcel and Journey Standards



Avg weight	Avg volume	Avg density
1 kg	0,036 m ³	22 kg/m ³



Workday start	Workday end	Break
09:00	17:30	30 min



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Service Time per Delivery Standards



Nº of deliveries	Average Service time (min)
< 300	7
> 300	6



Nº of deliveries	Average Service time (min)
< 300	5
> 300	4

In high-density delivery areas, service time comprises 65% to 80% of the driver's journey



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SCLEP output

Simultaneous evaluation of multiple urban delivery scenarios & vehicle types

- Taking current scenario & vehicle type as baseline
- Enabling cost-efficient, risk-free decision making



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May 2023 (7.125 deliveries)

Urban Consolidation Centre vs. Business-as-Usual

Scenario	Vehicle types	Total journey (hours)	Driving time (hours)	Serve time (hours)	Km driven	Nº of vehicles	Energy per delivery (kWh)	CO ₂ per delivery (grams)	PM _{2.5} per delivery (grams)	NO ₂ per delivery (grams)
BaU	Diesel van	1.151	293	792	10.980	148	1.39	372.86	0.04	0.46
	E-van	-	-	-	-	-	-96%	-100%	-100%	-100%
UCC	Hybrid van + E-scooter	-23%	-8 %	-28%	-22%	14%	-81%	-84%	-75%	-100%
	E-van + E-scooter	-23%	-8%	-28%	-22%	14%	-95%	-100%	-100%	-100%
	Big E-van + E-scooter	-25%	-14%	-28%	-33%	1%	-95%	-100%	-100%	-100%



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IPR background

➤ Last Mile Digital Platform, by Last Mile Team

- Route Modelling, Optimization & Scheduling. Input to UPM's Noise model

➤ COPERT, by EMISIA

- A European emission inventory model
- Internal Combustion vehicles emissions and energy consumption calculation

➤ REData Open API, by the Spanish Electrical Network Operator

- Retrieval of daily electrical energy production by generation technology
- Electric vehicles CO₂-equivalent emissions calculation



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IPR foreground

- Specifications and Workflow designs
- Discrete software components
- Infrastructure-as-Code
- Demonstrator – operated from the command line



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Current status

TRL-6

Working days	Services	km driven
460	96,000	138,000

Published in Horizon Results Platform

<https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-results-platform/62650>

Beneficiary of Horizon Results Booster services



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Seeking

City or Corporate investors

To accelerate SCLEP towards a profitable
commercial reality impacting the EU and beyond



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Want to know more?

Contact Us

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