

## Massive Open Online Course: Unlocking the potential of Digital Twins for sustainable on-demand urban logistics

### Overview



[LEAD](#) is launching its new Massive Open Online Course, open to all those interested, with the goal to “Unlocking the potential of Digital Twins for sustainable on-demand urban logistics”.

It builds upon the results of the project’s Living Labs to deliver a Digital Twinning Capacity Building Programme, with a first-of-its-kind focus on urban logistics, to improve the capabilities and skills of personnel of authorities and researchers on open-source tools and modelling for Digital Twins. The course will also provide a general introduction to urban freight, with a focus on on-demand and last-mile logistics. **You can consult the programme for Units 1 and 2 below.**

Sign up [here to join the kick-off webinar](#) on **23 February, 11:00 – 12:00 CET** to learn more about what to expect from the e-course and each unit.

#### **Content and workload:**

This course consists of video lectures with accompanying slide sets, as well as complimentary optional reading material, and assignments. The video lectures will be complemented with live Exchange Sessions, where you will get the chance to exchange with lectures and dig deeper in the topics presented. Make sure to stick to the deadlines for each assignment, as the in-time submission is a prerequisite for certification. You can plan approximately 2 hours per week to complete each Unit (incl. lectures and assignments).

#### **Timeline:**

- February to April: Part 1: Units 1 and 2
- May to July 2023: Part 2: Units 3 to 5.

#### **Objectives:**

- Using the results of the LEAD the Living Labs to deliver a Digital Twinning Capacity Building Programme,
- Provide a general introduction to urban freight, with a focus on on-demand and last-mile logistics,



- Establish a mechanism to facilitate knowledge sharing & enabling the exchange between experts,
- Deliver a dynamic course in a flexible and modular format,
- Improve the capabilities and skills of personnel of authorities and researchers on open-source tools and modelling for Digital Twins.

**Target audiences:** Local and regional authorities, Policy-makers, University students, Industrial/business/research sector.

**Platform:** The course will be hosted on the [Mobility Academy](#). Instructions to register [are available here](#).

**Interaction and organisation:**

- Visit the discussion forum regularly to get in touch with other students: [Discussion Forum \(mobility-academy.eu\)](#)
- Make sure to subscribe to the news and events section to keep up with the next webinars and tasks: [Announcements \(mobility-academy.eu\)](#)

**Technical issues?**

You can always reach us at:

- Claudia Ribeiro: [cribeiro@polisnetwork.eu](mailto:cribeiro@polisnetwork.eu)
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**Learning Programme:**

**Unit 1: Introducing Urban Freight & on-demand last-mile logistics (POLIS)**

**Scope:** This unit aims to provide a brief general introduction to urban freight, focusing on on-demand and last-mile logistics, namely current trends, challenges, influencing factors, and decarbonisation of operations. The content shared departs from the activities developed by project partners, from LEAD outputs, and external contributions from cities, local authorities, industry players and other EU-Funded projects.

**Kick-off webinar:** Live event to explain course objectives, *modus operandi*, content, etc.

The **first module** will provide a quick overview of the [POLIS/ALICE guide for advancing together towards zero-emission urban logistics by 2030](#). It will be complemented by the testimony of the leading city of Rotterdam on the challenges and ambitions to reach zero-emission logistics. A lecture will be provided on the main concepts and components of urban freight, describing what last-mile logistics consists of, and different possibilities to organise last-mile deliveries. A final lecture will focus on the main factors and challenges influencing last-mile on-demand logistics as uncovered in the LEAD project.

The **second module** will focus on push and pull policies enabling the transition to zero-emission urban logistics, particularly the last-mile, such as Zero-Emission Zones. The lecture will focus on the context, opportunities, challenges, and requirements, taking hints from the [‘How-To Guidance to support cities and countries considering freight and service deliveries in their decarbonization strategies](#), drafted by POLIS, Transport Decarbonisation Alliance and C40.

The **third module** will shed light on different last-mile distribution schemes, from micro-hubs, to transport to mobile depots with the assistance of e-vehicles, dual flow hubs and cargo hitching. The lecturers will represent the whole chain of knowledge, with city stakeholders, industry players, and fellow H2020 projects providing their insights on the topic.

**Runtime:** 27th of February to 10th of March

1. Introducing Urban Freight & on-demand last-mile logistics (POLIS)	Module 1.1 <i>Trends, challenges and factors influencing city logistics</i>	<b>Towards zero-emission urban logistics by 2030: a guide for action</b>	Yanying Li ALICE
		<b>Boots on the ground: cities striving for zero-emission logistics</b>	Jos Streng, City of Rotterdam Rotterdam
		<b>ABCS of urban freight, e-commerce, and on-demand logistics</b>	Edoardo Marcucci and Valerio Gatta, Molde University College
		<b>Main factors and challenges influencing last-mile on-demand logistics</b>	Edoardo Marcucci and Valerio Gatta, Mold University College
	Module 1.2 <i>Electrifying the last-mile</i>	<b>Zero-Emission zones for Freight (ZEF)</b>	Claudia Ribeiro, POLIS
	Module 1.3: <i>Last-mile distribution schemes</i>	<b>Last-mile configuration: from 1-echelon to 2-echelon distribution networks</b>	Beatriz Royo, Zaragoza Logistics Centre
		<b>Microhubs as fixed or mobile depots as a combination with e-vehicles: the experience of the city of Mechelen</b>	Roos Lowette, city of Mechelen
	<b>Dual flow hubs &amp; CargoHitching: ULaaDS</b>	Domien Stubbe, VIL	

## Unit 2: Living Labs as innovation accelerators for mobility and logistics (ZLC)

**Scope:** This unit aims to explain how real-life experiments are implementing the theoretical content of module 1. To this end, the course counts on the participation of LEAD Living Labs and other existing demonstrators will be the basis for the modules.

The **first module** will introduce the concepts of a community of practice, Living Labs, and the LEAD project. The last part of the module will explain the evaluation framework the LEAD project defined for assessing the sustainability impacts of the demonstrators.

The **second module** will explain the physical implementation of an Urban Consolidation Centre in the inner city in the [LEAD Living Lab Madrid](#). The Living Lab Madrid members will describe:

- a) The objectives of the Living Lab, the members of the CoP and their roles.
- b) The real-life implementation: BAU vs new business model. It will focus on the technical implementation of the Proof of Concept, the challenges and drivers experienced during the testing period. Finally, the pilot will explain the outcomes (benefits and drawbacks).

- c) The Living Lab Madrid digital twin: this video will explain the digital twin pipeline representing the real-life experiments (inputs, outputs (KPIs, operational information [routes]), sequence of models). The Living Lab Madrid will explain how the digital twin helps policymakers and business decision-makers in their daily and strategic decisions.

The **third module** focuses on crowdshipping and hyperconnectivity concepts in the [LEAD Living Lab The Hague](#). The Living Lab The Hague members will describe:

- a) The objectives of the Living Lab, the members of the CoP and their roles.
- b) The real-life implementation: BAU vs new business model. It will focus on the technical implementation of the Proof of Concept, and the challenges and drivers experienced during the testing period. Finally, the pilot will explain the outcomes (benefits and drawbacks).
- c) The Living Lab The Hague digital twin: this video will explain the digital twin pipeline representing the real-life experiments (inputs, outputs (KPIs, operational information [routes]), sequence of models). The Living The Hague will explain how the digital twin helps policymakers and business decision-makers in their daily and strategic decisions.

Exchange session with contributions from other projects: an on-streaming webinar by April with open questions from the audience. People subscribed to the course can attend the webinar, but it will also be open to a wider audience as a stand-alone webinar (*hands on training workshop and lab*). It will be made available on the website as complementary work for Unit 2.

**Runtime:** 13<sup>th</sup> of March to 31<sup>st</sup> of March

2.Living Labs as innovation accelerators for mobility and logistics (ZLC)	<i>Module 2.1: Future city logistics: the role of CoPs, the Living Labs &amp; sustainable evaluation frameworks</i>	<b>Introduction to the Living Labs Concept</b>	Carolina Cipres, ZLC	
		<b>Communities of Practice: role in the future of logistics</b>	Carolina Cipres, ZLC	
		<b>LEAD LLs sustainable evaluation framework: description of the list of KPIs the LLs are using</b>	Jose Manuel Vassalo, UPM	
	<i>Module 2.2: UCC centers in the inner city</i>	<b>LEAD Living Lab Madrid: Explain the physical implementation of an Urban Consolidation Centre in the inner city in the LEAD Living Lab Madrid</b>	<ul style="list-style-type: none"> <li>• <a href="#">LEAD LL Madrid introduction</a></li> </ul>	Sergio Balaguer Fernandez, EMT Madrid
			<ul style="list-style-type: none"> <li>• <a href="#">LEAD LL Madrid physical implementation</a></li> </ul>	Alfonso Molina, CityLogin
			<ul style="list-style-type: none"> <li>• <a href="#">LEAD LL Madrid Digital Twin</a></li> </ul>	Angel Batalla, LastMile Team
			<ul style="list-style-type: none"> <li>• <a href="#">LEAD LL Madrid Conclusions</a></li> </ul>	Sergio Balaguer Fernandez, EMT Madrid
	<i>Module 2.3: Crowdshipping and hyper connectivity</i>	<ul style="list-style-type: none"> <li>• <b>LEAD Living Lab The Hague: Explain the crowdshipping and hyperconnectivity concepts in the LEAD Living Lab The Hague</b></li> <li>• <a href="#">LEAD LL The Hague introduction:</a></li> </ul>	Thomas Robbers, Next2Company	

	<ul style="list-style-type: none"> <li>• <u><a href="#">LEAD LL The Hague physical implementation</a></u></li> </ul>	Thomas Robbers, Next2Company
	<ul style="list-style-type: none"> <li>• <u><a href="#">LEAD LL The Hague Digital Twin</a></u></li> </ul>	Rodrigo Tapia, TU Delft
	<ul style="list-style-type: none"> <li>• <u><a href="#">LEAD LL The Hague: Conclusions</a></u></li> </ul>	Thomas Robbers, Next2Company

### Unit 3: Modelling, simulation and data for urban freight planning (TUDelft)

**Scope:** This unit aims to explain how real-life experiments are implementing the theoretical content of Units 1 and 2. To this end, the course counts with the participation of LEAD Living Labs and other existing demonstrators as the basis for the modules.

This unit aims to present different urban freight models and their adaptation to the Digital Twin. It will give some theoretical knowledge of the models and present the digital twins from a modelling perspective (i.e., looking at what phenomena to be represented and looking for the tools and assumptions of them).

**An introductory video** explain the organisation and contents of the Unit 3 modules.

The **first module** will provide the basics regarding urban freight models. It will start characterising the main types of models present in the model library and give a general approach to their requirements. Moreover, it will give more detail to the different types of models in the LEAD model library.

The **second module** will provide basics regarding the digital twin. It will start with defining a digital twin and how it differs from other approaches for decision support. Moreover, it will describe the model library in more detail and give an overview of the data requirements for the digital twin.

The **third module** will give the notion on how the LEAD platform constructs the scenarios by mapping the KPIs and needs that the user (living labs) have and how it reflects on model selection. It will also illustrate the digital twins of other living labs that have not been described yet.

**A conclusion video** gives an overview of what has been given in the unit.

**Runtime:** 3rd to 21st of April

<b>3. Modelling, simulation and data for urban freight planning</b>	<i>Module 3.0</i>	<b>Introduction of Unit</b>	Rodrigo Tapia, TUDelft
	<i>Module 3.1</i>	<b>Model types and roles</b>	Rodrigo Tapia, TUDelft
	<i>Urban freight models</i>	<b>Demand and ABM models</b>	Ali Nadi, TUDelft
		<b>Optimisation, network models and impact assessment</b>	
	<i>Module 3.2</i>	<b>What is a Digital Twin? Application to logistics and planning</b>	Sebastian Hörl, IRT SystemX
	<i>Digital Twins 101</i>	<b>Digital twins: challenges and opportunities</b>	Carla Nascimento, Molde University Colleague
		<b>Model library</b>	Rodrigo Tapia, TUDelft
		<b>Data requirements</b>	INLECOM



	<i>Module 3.3</i> <i>Define scenarios with modelling and simulations</i>	Introduction to scenario planning deployment  Digital Twin for Lyon  How can cities use the DT results for informed decision making	Rodrigo Tapia, TUDelft  Sebastian Hörl, IRT SystemX  Beatriz Royo, ZLC
	<i>Module 3.4</i>	<b>Unit Summary</b>	Rodrigo Tapia, TU Delft

#### Unit 4: Digital Twin Technologies (ISX)

**Scope:** The scope of the unit is to introduce digital twin architectures, which might vary between use cases and application domains. To that end, the unit starts with an overview of existing or ongoing efforts on constructing digital twins for applications related to transport, mobility and smart cities with a focus on the relevant inputs, outputs and processing architectures. After, a conceptual digital twin architecture that has been developed in the LEAD project is presented, followed by a general way on the concrete implementation of those components in the LEAD platform.

**An introductory video** explains the structure of the unit, pointing out the line of thought from various possible digital twin architectures for different use domains, over the need for a conceptual understanding of the needs and processes in the specific context of urban logistics, to the concrete implementation in the LEAD platform.

The **first module** introduces three digital twinning approaches in the scope of transport, mobility, and smart cities with different points of focus and application domains.

The **second module** introduces a conceptual architecture for digital twins on urban logistics that has been developed in the LEAD project. It introduces the need for such digital twins based on the state of the art, describes the business process that includes the interaction of sensors, actors, and users with the system, and describes, on an abstract level, the necessary components to set up the solution.

The **third module** focuses on the specific developments of the LEAD platform by presenting the general technical architecture that has been chosen and providing a deeper look into the crucial decision-making and data-processing pipelines that are at work behind the platform user interface.

**A conclusion video** gives a recap of the individual modules and provides the most prominent take-home messages.

**Runtime:** 24th of April to 12th of May

<b>4. Digital Twin Technologies</b>	<i>Module 4.0: Introduction</i>	<b>Introduction of the unit</b>	Sebastian Hörl, IRT SystemX
	<i>Module 4.1: Digital Twin Approaches</i>	<b>Transcality: Automated generation of simulations for traffic operations</b>  <b>A Digital Twin approach for Sustainable Territories Planning: A case study on district heating</b>	Lukas Ambühl, Transcality  Abdelhadi Belfadel, IRT SystemX

<p><i>Module 4.2: Towards a conceptual digital twin for Urban Logistics</i></p>	<p><b>Need for a conceptual digital twin / state-of-the art Business process Technical components</b></p>	<p>Sebastian Hörl, IRT SystemX</p>
<p><i>Module 4.3: The LEAD Platform</i></p>	<p><b>LEAD Digital Twinning Platform Components: Decision Support Systems, APIs</b></p>	<p>INLECOM</p>
<p><i>Module 4.4: Conclusion</i></p>	<p><b>Summary of the unit</b></p>	<p>Sebastian Hörl, IRT SystemX</p>

#### Unit 5: Decision-making with Digital Twins (INLECOM)

**Scope:** This unit aims to explain how Digital Twins in the context of urban logistics can support decision making and serve as an impact assessment tool for:

- Modelling and simulating complex operation scenarios towards optimizing efficiency of last mile logistics operations,
- Evaluating alternative city logistics strategies by changing parameters such as parcel volumes, delivery time windows or types of fleets, and,
- Measuring the impact of interventions in terms of efficiency and carbon emissions.

To this end, the course enhances understanding of the Digital Twins concept, by presenting the digital twinning LEAD platform developed in the project. It also presents examples of models and simulations drawn from the Living Labs. Last learners that wish to experiment on their own with the tools will have the opportunity to enroll as users to the platform and run their own tests.

**Introductory video** (Unit 1): The LEAD Platform – Quick Walkthrough.

**Videos 2 to 7** will present different features of the platform, namely User Registration, Models integration, Scenario Building, the use of Data Assets, Simulations Execution and Data sharing with collaborators.

**Videos 8 and 9** will provide practical example of the use of the platform, associated with specific scenarios and reference data. These units present the full workflow of a user in the LEAD Platform Environment.

**The conclusion video** summarises the key takeaways for exploiting the power of data for greener logistics operations. Gives an overview of the basic concepts discussed in Units 1-9.

**Runtime:** 15th to 31st of May

<p><b>5. Decision-making with Digital Twins</b></p>	<p><i>Video 1</i></p>	<ul style="list-style-type: none"> <li>• The LEAD Platform</li> </ul> <p>Quick walkthrough</p>	<p><b>INLECOM</b></p>
	<p><i>Video 2</i></p>	<ul style="list-style-type: none"> <li>• User Registration to the platform</li> </ul> <p>Account setup and gaining access to the platform.</p>	<p><b>INLECOM</b></p>



	<i>Video 3</i>	<ul style="list-style-type: none"> <li>Model Integration</li> </ul> <p>Explaining the process of embedding a model in the LEAD platform.</p>	<b>INLECOM</b>
	<i>Video 4</i>	<ul style="list-style-type: none"> <li>Scenario Builder</li> </ul> <p>Explaining the process of combining models together to automate their sequential execution.</p>	<b>INLECOM</b>
	<i>Video 5</i>	<ul style="list-style-type: none"> <li>Data Assets</li> </ul> <p>Presenting the capability to store and use data sets in the digital twinning processes.</p>	<b>INLECOM</b>
	<i>Video 6</i>	<ul style="list-style-type: none"> <li>Simulations</li> </ul> <p>Presenting the simulations engine that executes a series of models in a built scenario.</p>	<b>INLECOM</b>
	<i>Video 7</i>	<ul style="list-style-type: none"> <li>Sharing</li> </ul> <p>Explaining sharing capabilities of models and data assets across platform users.</p>	<b>INLECOM</b>
	<i>Video 8</i>	<ul style="list-style-type: none"> <li>Example 1</li> </ul> <p>End to end scenario from LEAD Living Labs.</p>	<b>INLECOM</b>
	<i>Video 9</i>	<ul style="list-style-type: none"> <li>Example 2</li> </ul> <p>End to end scenario from LEAD Living Labs.</p>	<b>INLECOM</b>
	<i>Video 10</i>	<ul style="list-style-type: none"> <li>Key Take Aways</li> </ul> <p>Summarising the key concepts from Units 1 to 9.</p>	<b>INLECOM</b>