LEAD

POLICY RECOMMENDATIONS

POLIS
CITIES AND REGIONS FOR TRANSPORT INNOVATION

LEAD

CIVITAS
Sustainable and smart mobility for all

THE CIVITAS INITIATIVE
IS CO-FUNDED BY
THE EUROPEAN UNION

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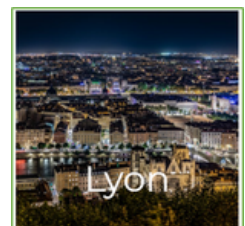## Digital Twins for last-mile low-emission logistics

LEAD created Digital Twins (DTs) of urban logistics networks in six cities to support experimentation and decision-making with on-demand logistics operations in a public-private urban setting.
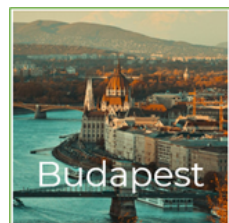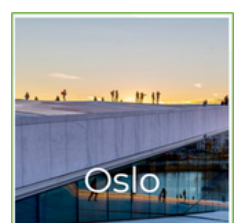
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Innovative solutions for city logistics were represented by a set of value case scenarios addressing the requirements of the on-demand economy while aligning competing interests and creating value for all different stakeholders. Each value case combined several measures (so-called LEAD strategies), such as:

Innovative business models

Agile freight storage and distribution

Low-emission delivery vehicles

Smart data-driven logistics solutions

Executive Summary

Urban freight is crucial for the well-functioning of cities. However, due to phenomena, such as rising consumer demand and online shopping, urban logistics has grown significantly in recent years. Decision-making and operational planning in urban logistics have gotten trickier as a result. Cities must create technology and processes that can assist in addressing and better managing urban logistics as a result of these challenges.
In come Digital Twins (DTs)!

With untapped potential, DTs can give users a greater understanding and sense of control over their assets. Through real-time decision support modelling and impact prediction, DTs offer public administrations a smart and affordable way to improve not just urban logistics but overall last-mile sustainability.

LEAD has created an open-source platform and experimented in six Living Lab's (LLs) activities, as the project endeavoured to explore the potential of Digital Twin for data-driven decision-making on urban freight. A set of policy recommendations to accelerate the acceptance and implementation of DTs is provided, based on the findings and key lessons from the pilot activities conducted in six European cities.

This brief is addressed to EC Services and EU policy-makers, transport and logistics experts working in cities, regions and local authorities, network organisations representing local authorities, transport operators and IT managers.

Digital Twins:
The next big thing for predictive urban logistics?

Every day, cities are faced with making important decisions when it comes to mobility. How can traffic jams and rush hours be reduced? Where should new cycle paths be added? How can public transport be improved?

A Digital Twin allows urban planners to answer such questions in a virtual model and test alternative scenarios for potential interventions. This helps keeping an overview and enables them to make the right decisions while making use of the costs and risks of failure in the real world.

Urban freight planning using DTs, however, is still a relatively new field of study. The complexity of DT is increased by the fact that urban freight planning involves longer feedback loops that rely on the cooperation of several independent agents. To develop a variety of logistics solutions for shared, connected, and low-emission logistics operations, the project developed the LEAD Platform - a sophisticated tool designed to assist in the optimisation of last-mile logistics operations. It provides an environment for simulating complex logistics scenarios, simplifying the evaluation process of several strategies, interventions, and policy decisions to promote sustainable last-mile deliveries.

What are its key features and benefits?

1 Impact Assessment: the LEAD Platform allows users to simulate complex logistics scenarios, making it possible to assess the impact of different interventions on operations (e.g. changes in fleet vehicles, last-mile network configurations, or delivery methods affect efficiency).

2 City Logistics Strategies: city authorities can use the platform to evaluate alternative logistics strategies tailored to their urban environments. This includes optimising routes, delivery hubs, and vehicle types to reduce congestion and the environmental impact.

3 Data-Driven Decision-Making: the platform empowers decision-makers with well-informed insights. Users can explore "what-if" scenarios, such as changes in demand, handling times, or network configurations, to make informed choices that improve logistics efficiency

Digital Twins are virtual replicas of physical objects, systems or processes that organisations can use for a variety of purposes, such as production line control, object malfunctions or performance monitoring.

They Integrate data sources, models, and software tools, that enable a comprehensive evaluation of logistics operations considering contextual indicators such as emissions, congestion, and noise, as well as operations performance indicators, labour and costs impact.

Recommendations to local authorities

Digital Twins are an emerging field whose full potential has yet to be explored. However, it now seems to be one of the most appropriate tools for local authorities to collect information about their territory to assist in their daily management and decision-making process.

As LEAD demonstrated, DTs represent an opportunity for them to become more agile and resilient. DTs can be instrumental in developing SULPs by providing city authorities with a comprehensive understanding of the existing logistics ecosystem and enabling them to make data-driven decisions. Here's how:

Do not wait to embrace digitalisation!

The deployment of DTs at the local and regional level will only be possible by promoting a culture of innovation, encouraging creative thinking, experimentation, and a growth mindset to digitisation, data management and technology.
The more mature a local authority is in managing IT projects, and the more experienced its human resources are, the more likely it is to be able to respond to the needs of its citizens.

Interdisciplinary experts should collaborate to increase innovation.

As the LEAD LLs have demonstrated, urban planners, commercial technology and logistics firms, research centres and universities, and other actors might be encouraged to engage in the cooperative development and sharing of DTs technologies and assist city managers in increasing the efficiency and effectiveness of their procedures.

A holistic approach and a long-term vision should be privileged.

The development of DTs needs to be demand-driven, data-driven, and people-driven. Cities' governments should examine the need for tracking urban operational indicators and create cross-sectoral, cross-industry scenarios that take advantage of DT technology. Defining needs and setting the strategic objectives for your DT objectives as an essential prerequisite. Create policies for the ongoing maintenance, updates, and sustainability of DT implementation, including regular data validation, technology upgrades, and budget allocation for continued development.

Data quality is key.

Good models depend on good data. DTs applications rely on data from external parties, hundreds or thousands of distant sensors functioning in challenging field settings and communicating over unreliable networks, it may be a challenging endeavour. Cities and companies need to implement procedures, at the very least, to handle gaps and irregularities in managing data streams as well as to recognise and isolate erroneous data. The challenge is organising the data and using it in the decision-making process**.**

But also, be realistic with available data.

Building a successful model representing historical and current knowledge for future scenario-planning requires the ability to synchronise and integrate existing data, provided in different forms, with varying degrees of granularity, stored in different locations or even unavailable. This is normally the case of logistics-related data, which is often owned by the private sector and cannot be shared to third parties for commercial purposes. Establish clear policies and regulations regarding the collection, storage, and use of data within the DT environment.

Tackle data sharing issue at the early stage.

Getting information from the private sector and operators is frequently a hurdle. To understand the issue and gather pertinent data, anonymising aggregated data should be given priority. Create structures and agreements for cooperation between local government agencies, business partners, academic institutions, and community organisations. To ensure that DT activities are as effective as possible, roles, duties, and data exchange processes should be clearly laid out.

Embrace Open Data Standards and Interoperability.

Implement and enforce open data standards to ensure that DTs can easily integrate with various data sources and systems. This fosters collaboration among stakeholders and enables the seamless exchange of information. Prioritise data security measures to protect sensitive information and ensure compliance with privacy laws.

Public-Private cooperation is key.

A wide spectrum of public and commercial sector players is looking for a better mutual knowledge of difficulties because of urban freight partnerships. In certain instances, including within the LEAD project, this cooperation has resulted in new solutions. Several answers can be found through the exchange of information and concepts, as well as a deeper understanding of the requirements of the public and private sectors in the urban freight system.

Invest in training and development.

Finding people with the right knowledge and expertise to implement and manage DT technology is increasingly difficult. Local authorities wishing to develop DTs would greatly benefit from including trained modellers in their teams, accessing pools of talent within education institutions or by joining forces with reputable tech companies that can help fill the skills gap.

Ensure full alignment with regional, national and EU targets.

Urban planning scenarios are simulated before any long-term decisions are made. In the simulations real-world traffic and logistics data can be used along with the documented opinions of residents. Simulations and "what-if scenarios" should be coherent with the policy objectives set by local authorities, as well as with the national and EU targets from legislation to reduce traffic, congestion, and pollution

Involve stakeholders in the decision-making process.

Urban planning scenarios can be simulated before any implementation is carried out or before long-term decisions are made. Urban planning decisions can be presented more visually and therefore stakeholders' concerns will decrease due to more transparent processes and the availability of information.

Co-creation with key external stakeholders.

Co-creation and the involvement of different partners in the setup of a logistic hub or a new logistic service is important, as more prominent business models and public-private partnerships are consolidated. This is expected to prepare the ground towards the physical internet paradigm, with the aim to digitalise the whole end-to-end freight journey.

Establish Living Labs "Communities of Practice".

A community of practice is a setting for peer-to-peer learning that includes, among others, governmental entities, shippers, transportation associations, neighbourhood associations, riders, and business associations. This open membership provides access to a variety of experts to assist with technical difficulties, foster continual progress, and enable more significant contributions to the objectives of the LLs. As a result, cooperation between various domains is ensured through a better understanding of the anticipated effects of implementing modifications in particular scenarios.

Raise Awareness and Use DTs to Engage Citizens in Urban Planning.

Engaging citizens in the design of DTs or logistics solutions is crucial for ensuring that the technology aligns with the needs, preferences, and priorities of the community. Maintain open and transparent communication about the developments, share progress reports, and address any concerns or questions raised by citizens.

Prioritise measures according to the cities SULPs / SUMPs.

DTs can play a crucial role in assisting cities in urban logistics planning, providing a powerful tool to analyse, optimise and manage city logistics operations.

Prioritise developing DTs that cover the measures needed to implement in the future and develop specific use cases for testing and impact assessment. Implement KPIs and evaluation metrics to assess the impact outcomes. Regularly review and analyse data to make necessary adjustments and improvements. This approach should be tailored to the specific context, needs, and priorities of each city.

Additionally, ongoing consultation with experts, stakeholders, and the public is crucial for refining and adapting policies as technology and urban planning practices evolve.

Recommendations to the EU services

Build up from the outcomes of LEAD, its ongoing follow-up projects URBANE & DISCO and continue to test and include new use cases into the LEAD Platform and Model library.

The LEAD Platform has been based on the use cases derived from the six LEAD Living Labs, but it can be fed with more applications. LEAD started with very specific use cases with the idea that there is open access for external users to use it and to input their own models and data to run their own simulations for the different what-if scenarios that they would develop.

Make use of the open datasets and open-source software API developed by LEAD

LEAD made available seven open datasets and one open-source software Application Programming Interfaces (API). They are focused on last-mile logistics networks and the examination of "what-if scenarios" regarding the several last-mile configurations in scope. Industry practitioners with strong ICT and R&D departments are encouraged to extract the most utility out of this set of tools. for the analysis of last-mile logistics networks.

Recommendations to the EU services
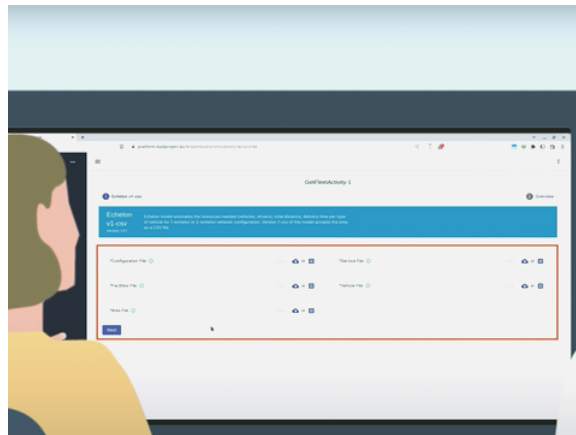
The LEAD Platform

- Allocation of funding via dedicated follow-up calls within some of the most relevant Research Programmes promoted by the EU. Importance to associate with Climate Neutral Cities Missions, and other key policies, which receive associated funding from the EC.
- Promote further research on the interfaces of freight/persons, intra-/inter-urban, last-mile/ long-distance transport and spatial-economic analysis of cities. Research on DTs applied to logistics is still very new and still developing. The applications of DT frameworks are mainly in the context of product management, shop floor or production management.
- Liaison with Living-in.EU, the movement for the European way of Digital Transformation of cities and communities will support the EDIC in the actual deployment of DTs and virtual worlds through 'the Citiverse' projects at the local level.
- Facilitate the development of standards and protocols and Data Spaces connectors that ensure interoperability between different stakeholders in the last-mile logistics ecosystem, including logistics companies, municipalities, and technology providers.
- Create clear and supportive regulations for the use of micromobility solutions (e.g., cargo bikes, electric scooters) and innovative delivery methods like drones and autonomous vehicles.
- Foster collaboration between public authorities and private sector stakeholders to jointly develop and implement last-mile logistics solutions that benefit both the public and private sectors.
- Establish mechanisms to monitor the effectiveness of last-mile logistics initiatives, collecting data on key performance indicators and using it to inform future policy decisions.

These measures, when implemented in conjunction with local authorities and stakeholders, can help cities effectively tackle last-mile logistics challenges and create more sustainable and efficient urban logistics systems.
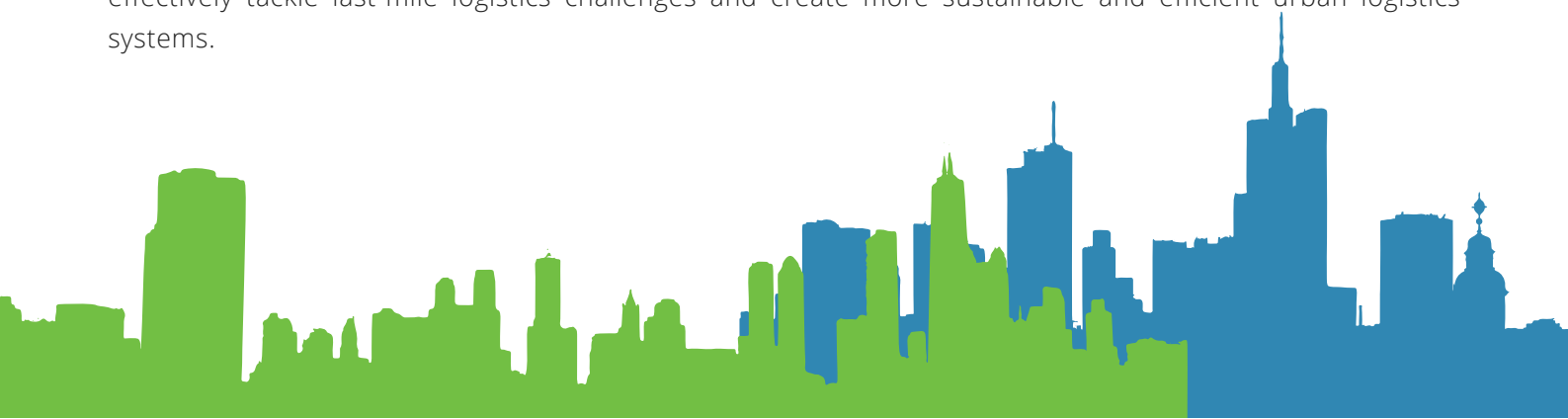
Conclusion

The use of DTs in urban logistics planning is an emerging field with significant potential for revolutionising the way cities approach freight management. DTs can support experimentation in the planning and development of urban logistics policies and the co-design of innovative solutions by local logistics communities.

However, despite several social, economic and environmental benefits, some challenges are making the diffusion and implementation of DTs complicated. DT creation and implementation are more expensive than basic control and monitoring methods. In addition, trained professionals are required to create, implement, and maintain a digital twin due to its technical complexity.

In the future, DTs should be able to share data with other cities or administrations thanks to studies that are being done to create standards and protocols. Future work and projects should focus on addressing scalability issues, such as lowering computing demands with simplified models and the integration of the LEAD platform with new and more sophisticated modules and libraries.

About the Publication

This Policy Recommendation brochure is a summary of the suggestions brought forward in the project deliverable titled:

D4.6 LEAD Roadmap and Policy Recommendations.

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