Ref. Ares(2021)2012848 - 22/03/2021

Innovative Business Models, Governance and Public-Private Partnerships

Knowledge for innovative actions, measures and business models in the LEAD Living Labs

Deliverable number: D1.3
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Deliverable No.		**D1.3**	
Workpackage No.	**WP1**	Workpackage Title	**Adaptive City Logistics Framework and LEAD Value Cases**
Task No.	**T1.3**	Task Title	**Innovative Business Models, Governance and PPPs**
Date of preparation of this version:		**26/02/2021**	
Authors:			
Status (F: final; D: Draft; RD: revised draft):		**F**	
File Name:		**LEAD_D1.3_draft.docx**	
Version:		**3.0**	
Task start date and duration		**1/06/2020 – 28/02/2021**	

This document is issued within the frame and for the purpose of the LEAD project. This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 861598.

Revision History

Version No.	Dates	Details
1.0	18/01/2021	1st draft version
2.0	5/02/2021	2nd draft version, including contributions of: ZLC, Panasonic, Number, Waberers, Last mile, Lyon Confluence, LPA, DHL, Next2Company, City of Oslo, EMT Madrid, SONAE, TU Delft, BKK Budapest.
3.0	26/02/2021	Revised draft including reviews of Laura Garrido Maza and José Manuel Vassallo (UPM), and Bas Groothedde (Argusi)
4.0	19/03/2021	Final version

Reviewers List

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Bas Groothedde	Argusi		
José Manuel Vassallo	UPM		

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List of acronyms

AV: autonomous vehicle

B2B: business to business

B2C: business to consumer

BM: business model

BMC: business models canvas

CAV: connected and automated vehicle

EC: European Commission

EDV: electric delivery vehicle

EU: European Union

EV: electric vehicle

FAC: Freight Advisory Committee

FCEV: fuel cell electric vehicle

GDPR: General Data Protection Regulation

ICT: Information and Communication Technology

LA: Local Authority

LEZ: Low emission zone

LL: Living Lab

LUA: loading and unloading area

MSP: multi-stakeholder platform

ODE: On-Demand Economy

PI: Physical Internet

PPP: public-private partnership

SH: stakeholder

TAC: Technical Advisory Committee

TCO: total cost of ownership

SUMP: Sustainable Urban Mobility Plan

UCC: urban consolidation centre

UFD: urban freight distribution

UFT: urban freight transport

V2E: vehicle-to-ecosystem

V2I: vehicle-to-infrastructure

V2S: vehicle-to-surroundings

V2V: vehicle-to-vehicle

ZEZ: Zero Emission zone

Executive summary

This deliverable aims to analyse how the various solutions for on-demand urban logistics can be deployed in different ways within a real-life environment, considering the most relevant issues related to stakeholder (SH) collaboration, governance, and business models (BMs).

The work is directly linked to D1.1 City Logistics landscape in the era of the on-demand economy (ODE), which collected and reviewed innovative and integrated solutions to reduce the negative impacts of logistics on the urban transport system in European cities. In particular, the work considers the solutions identified in D1.1 and reviews them with respect to emerging and existing BMs, governance models and SH cooperation, regulation, privacy and ethics requirements. Furthermore, it delves on the enablers and barriers that determine their implementation.

These theoretical findings are connected to the LEAD Living Labs (LLs) and their corresponding Value Cases, to provide them with functional elements for the development of the local strategies and the application in the various local contexts. For each Value Case, the correspondence with the innovations and solutions identified in the review is established. Moreover, a matrix synthesises the knowledge derived from the analysis of existing and emerging BMs, governance and ethical, privacy and regulatory requirements pertaining to each of them.

Finally, the deliverable provides a mapping of information exchange requirements between heterogeneous SHs within each LL, to take stock of the status quo and immediately identify areas where information sharing proceeds smoothly, and where, in contrast, work needs to be done to anticipate any critical issues.

The information and knowledge gathered will be relevant for developing and implementing innovative actions, measures and BMs in the LEAD LLs. Together with D1.1, D1.3 and D1.4, it represents the basis for the definition of the LEAD reference strategies and prominent value case scenarios to be explored through simulation in the Digital Twins and real-life urban setting experiments (LLs).

Tasks developed in the deliverable	Devoted section
T1.3 Innovative Business Models, Governance and PPPs This task will define, discuss, evaluate, prioritize and align competing interests of the private and public sectors. The information and knowledge gathered will be relevant for developing and implementing innovative actions, measures and business models in the LEAD LLs. This allows for promoting innovative business models (e.g. operational models of shared and connected last mile logistics) capable of supporting a zero-emissions urban freight distribution, where stakeholder coordination/governance and, more in general, PPPs are fundamental to produce efficient, cost-effective and sustainable city logistics solutions.	
ST1.3.1 Regulatory, Ethics and Privacy requirements. This subtask will explore regulatory (2.3) , ethics (2.5) and privacy (2.4) requirements that recent technological developments impose.	2.3, 2.4, 2.5
ST1.3.2 Operational Models of shared and connected last mile logistics, Incentives – Barriers-Enablers, Consensus Building, Stakeholders Coordination- Governance. This subtask, adopting a top-down approach, will review the most relevant issues related to stakeholder collaboration (2.2), governance (2.2) and business models (2.1). In more detail, it will investigate existing and emergent business models (2.1), while also illustrating incentives and barriers/enablers (2.6) linked to stakeholder cooperation (2.2) , interactions (2.2.3) and consensus building (2.2.2) .	2.1, 2.2, 2.6
ST1.3.3 Actors map and information exchange requirements. This subtask, adopting a 'bottom up' approach for gathering data, will map, for each LL, the heterogeneous actors and their information exchange requirements.	3, 4

1 Introduction

1.1 The LEAD project

LEAD will create Digital Twins of urban logistics networks in six cities, to support experimentation and decision making with on-demand logistics operations in a public-private urban setting. Innovative solutions for city logistics will be represented by a set of value case scenarios that address the requirements of the ODE while aligning competing interests and creating value for all different SHs. Each value case will combine several measures (LEAD strategies): a) innovative BMs, b) agile urban freight storage and last-mile distribution schemes, c) low-emissions, automated, electric, or hybrid delivery vehicles, and d) smart logistics solutions.

Cost, environmental, and operational efficiencies for value cases will be measured in 6 LLs. Evidence-proven value cases and associated logistics solutions will be delivered in the form of exploitable Digital Twins, incorporating the models that support adaptation to different contexts and that provide incentives for public-private partnerships (PPPs).

The LEAD consortium comprises 22 partners, all of whom are involved in the LLs, supported by 5 international partners for knowledge transfer. This structure incentivizes the co-creation of solutions by city authorities, logistics industry leaders, start-ups, and research experts in freight modelling, complex simulation and logistics optimisation.

1.2 Purpose of this deliverable and document structure

This deliverable aims to analyse how the various solutions for on-demand urban logistics can be deployed in different ways within a real-life environment.

In particular, the work considers the solutions identified in D1.1, and reviews them with regard to emerging and existing BMs, governance models and SH cooperation, regulation, privacy and ethics requirements. Furthermore, it delves on the enablers and barriers that determine their implementation (Section 2).

The information and knowledge gathered will be relevant for developing and implementing innovative actions, measures and BMs in the LEAD LLs. In this regard, LL owners are requested to identify (in Section 3) the characteristics of their Value Cases, on the basis of categories and knowledge systematized through the review.

Finally, Section 4, adopting a 'bottom-up' approach, maps, for each LL, the heterogeneous actors participating in the value cases and the local Community of Practice. It defines their information exchange requirements, i.e. what participants potentially require and/or are willing to share in terms of data to inform urban logistics planning. Specifically, a matrix clarifies whether there is uniformity between data/information supply and demand as available/demanded by the various SHs, and in which direction the Community of Practice can work to facilitate the match between the two.

The information and knowledge gathered will be relevant for developing and implementing innovative actions, measures and BMs in the LEAD LLs, so to anticipate risks and exploit the opportunities associated with their specific cases, as well as for LEAD partners, so to generalise this knowledge when defining LEAD Strategies (D1.5). These will promote innovative BMs (e.g. operational models of shared and connected last-mile logistics) capable of supporting a zero-emissions urban freight distribution. In this regard, SH coordination, new governance models and PPPs are fundamental to produce efficient, cost-effective and sustainable city logistics solutions.

2 Review of stakeholder collaboration, governance and business models for on-demand logistics solutions

Deliverable 1.1 collected and reviewed innovative and integrated solutions to reduce the negative impacts of logistics on the urban transport system in European cities. The innovations previously and currently tested can be allocated into four separate categories: 1) delivery locations, modes and time, 2) loading and unloading area (LUAs) management 3) consolidation and 4) new technologies. These are different but complementary and must be investigated and validated through an integrated approach to define policies for rationalization, efficiency and cleaning of on-demand logistics. **Table 1** summarises them.

Table 1 - Innovations and solutions for agile storage and last-mile distribution schemes

Delivery locations, modes and times	Loading and unloading area management	Consolidation	New technologies
Innovations and solutions to improve the delivery process, i.e. where the goods are delivered, how and at what time.	*Innovations and solutions to improve the management of scarce urban space, in a flexible and integrated way, and of the contested curbside.*	*Innovations and solutions to better consolidate and improve the management of flows. It includes both delivery and demand consolidation.*	*Technological innovations and solutions that can make the freight distribution process more efficient through automation and data analysis.*
Delivery locations: parcel lockers, pickup points, door-to-car		Urban Consolidation Centres	Automated and Autonomous delivery systems
Delivery mode: click and collect, crowdshipping, Instant delivery		Micro-depot	Cloud Computing, Artificial Intelligence and Data Collection through the Internet of Things
Delivery times: night deliveries		Mobile Depot and small electric vehicles	

Starting from this work, this deliverable takes a further step of analysis. Starting from the innovations and solutions identified in D1.1, this section discusses existing and emerging BMs, SH cooperation and governance models, while also illustrating regulatory, ethics and privacy requirements that recent technological developments impose. Finally, it outlines both enablers and barriers that arise when new business and governance models are introduced in the field of urban logistics.

2.1 Business models

Since there is no consensus on the definition of BMs among researchers (George & Bock, 2011), it is worth anticipating the perspective adopted in this deliverable, in terms of definition, components and archetypes.

Basically, BM represents a useful framework (Baden-Fuller & Morgan, 2010) of 3-levels analysis (economic, operational, and strategic) explaining how a firm — i.e. an interrelated set of decision variables — makes a profit (Stewart & Zhao, 2000), creates value for the SHs (Amit & Zott, 2001; Lecoq *et al.,* 2006; Casadesus-Masanell & Ricart, 2010; Zott *et al.,* 2011), achieves competitive advantage and sustainability (Morris *et al.,* 2005; Achtenhagen *et al.,* 2013).

Moreover, advances in Information and Communication Technology (ICT), on the one hand, and social and environmental expected business commitment, on the other hand, enhanced recent BM innovations, resulting in “disruptive” or “emerging” BM (Al-Debei & Avison 2010; Yang *et al.,* 2017; Schiavi & Behr, 2018; Guan, 2020; Baden-Fuller & Haefliger, 2013)

This is especially true when dealing with e-commerce (Shafer *et al*., 2005; Casadesus-Masanell & Ricart, 2010) and ODE in the transport sector (e.g. delivery Business to Business (B2B), Business to Business (B2C), Consumer to Consumer C2C, Consumer to Business C2B), with the latter allowed by ICT, but at the same time is potentially increasing external costs.

Nonetheless, most of the innovative BMs are forged by start-ups, due not only to their stronger motivation to capture new value, but also because there is little codified and shared knowledge/understanding of the existing BM elements (Christensen & Johnson, 2009; Osterwalder *et al.,* 2005). Since, innovation in a BM can not be limited to an improved process (DaSilva & Trkman, 2014; Foss & Saebi, 2017), a more operational definition could be helpful (Chesbrough & Rosenbloom, 2002), together with the punctual description of its elements (Wirtz *et al.,* 2016; Fielt, 2013) and archetypes (Lambert, 2015).

Indeed, urban logistics now faces new challenges, such as: the increasing demand for frequent and just-in-time deliveries in urban areas, recently due to the social restrictions aimed at facing the Covid-19 pandemic; the increasing competition for the use of limited urban infrastructure; the increasing complexity of its multidisciplinary nature (Macario *et al.,* 2008; Anand *et al.,* 2012; Marcucci *et al.,* 2019). Within this context, it is worth identifying the critical aspects for urban freight distribution (UFD) BMs aimed at the rationalisation of the distribution process, i.e. the reduction of goods flow yet keeping the adequate level of distribution to satisfy consumer’s needs (*ibidem*). To this aim, the following Sub-sections 2.1.1 and 2.1.2 present taxonomies and components of BMs, with a focus on ODE in UFD.

2.1.1 Classification Criteria

It is possible to group UFD BMs according to many different criteria.

UFD modelling techniques have been clustered in three “economic-based” groups: gravitational models, input-output, spatial equilibrium of the prices (Russo & Comi, 2004).

Moving specifically to urban freight, Operational BMs, dealing with flow management, are distinguished from Systemic BMs, focused on the UFD impact on flows (Ambrosini *et al.,* 2004).

Traditional BMs are compared to innovative (i.e. internet based) ones; moreover, hybrid BMs present a combination of both (Baden-Fuller & Haefliger, 2013). Four categories, depending upon the centralization level, have been identified by Carbone *et al.,* (2015), while other classifications are dealing with specific UFD measures; like, for example, crowdshipping (Rougès & Montreuil, 2014) or instant deliveries (Dablanc et al., 2017). According to their object, models can be grouped in disaggregated, with the focus on individual actions of each agent, or aggregated, if the focus is rather on a specific group of agents. The first can be further classified into behavioural, taking into consideration only one dimension at a time, and inventory, otherwise. The second group can be also furtherly grouped according to the unit of analysis: products, i.e. the flows of goods, or vehicles' trips, when the focus are routes and vehicles needed to fulfil the demand on each route. Combined models are also considered (Macario *et al*., 2008).

In the last two decades, under the umbrella of City Logistics (Taniguchi *et al.,* 2003; 2020), several existing models have been adapted to UFD (e.g. vehicle routing and scheduling, dynamic flow simulation, logistics terminal location models, simulation, multi-agent systems, and network models), taking into account their viability and replicability.

More recently, the focus has moved to agents' rationality and behavioural approach and to the dynamic nature of the logistic systems, while the evolution of simulation models allowed to develop tools to support the decision process in the logistic activity (Hensher & Puckett, 2005; Anand *et al.,* 2012), especially concerning new technologies, such as ITS (Intelligent Transport Systems), ICT (Taniguchi *et al.*, 2020). Methodological improvements are provided for generic logistics market analysis (e.g. Van Duin *et al.*, 2007), for assessing public policy acceptance level in urban freight transport (UFT) *via* multi-agent based models (Le Pira *et al.,* 2017), or for enhancing successful UFT measures by means of Multi-Actor Multi-Criteria Analysis (MAMCA) (Kin *et al.,* 2017).

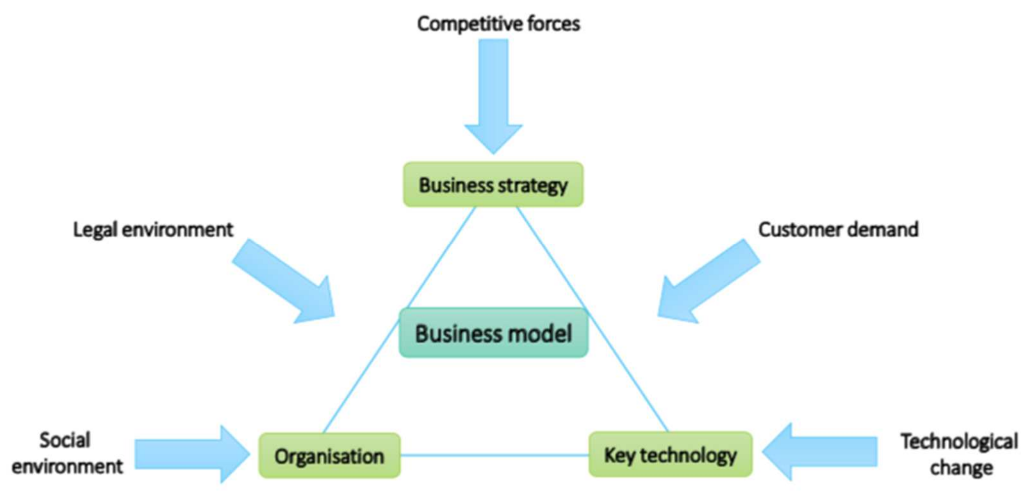
Finally, a BM can be considered as a sum of components (e.g. in the BMCanvas – NOVELOG, 2018) or real operating models (i.e. the organization's core logic for creating value) explaining how the company competes for customers and resources, and highlighting the drivers for being successful to attract customers, employees, investors, and to work profitably, or change models that describe how an organization adapts over time in order to remain profitable. To sum up, while operating BMs create core assets, capabilities, relationships, and knowledge, change BMs extend and leverage them (Macario *et al.,* 2008).

2.1.2 Content, definition and components

BM should mostly describe the value that a company offers to customers and partners (Ostenwalder *et al.,* 2005; Magretta, 2002). Transport planners, willing to introduce UFT measures/solutions and considering the financial impact on private businesses, should contemplate BM as an element of due diligence (Lindholm & Ballantyne, 2015).

E-commerce, thanks to huge changes, has clearly heightened the competitive pressure and the customer role, highlighting a (temporary) lack of legal intervention (**Figure 1**). Technology is developing faster than regulation (Maselli *et al.,* 2016).

Figure 1 - Business Model framework



Source: NOVELOG (2018) adaptation of Ostenwalder et al. (2005).

In more detail, a BM can be a sum of components, such as, in the well-known BM Canvas (BMC) visualization by Ostenwalder & Pigneur (2010) – see figure debajo de (

Figure 2).

Actually, BMC is useful for analysing which part of the business will be affected by innovation and for sharing information easily among different SHs. It enables to construct a sustainable UFT BM in a cooperative way by agreeing in advance on the trade-offs among partners and to account for all the SHs views and to achieve consensus on how the sustainable UFT solution can be implemented.

Figure 2 - Business Model Canvas

<table>
<tr><th>Key partners</th><th>Key activities</th><th>Value proposition</th><th>Customer relationships</th><th>Customer segments</th></tr>
<tr><td rowspan="3">Who are the firm's partners?</td><td>What are the key activities, such that the firm operates successfully?</td><td>What value does the firm deliver to the customer?</td><td>What type of relationship is established between the firm and the customer?</td><td rowspan="3">For whom is the firm creating value?</td></tr>
<tr><th>Key resources</th><th>Internalization of externalities</th><th>Channels</th></tr>
<tr><td>What does the firm need to create value?</td><td rowspan="3">How are externalities from firm's business activities internalized?</td><td>How does the firm reach the customer?</td></tr>
<tr><th colspan="2">Cost structure</th><th colspan="2">Revenue streams</th></tr>
<tr><td colspan="2">What are the costs associated to the business model?
novelog</td><td colspan="2">For what value are the customers paying and how are they charged?</td></tr>
</table>

Source: (NOVELOG; 2018)

The figure above (

Figure 2) can help analysing BMs according to 3 different perspectives and impact: customers (right part), financial/business (left part for value and ground elements for profit) and society (central column). This is also partially in accordance with the literature grouping BMs by gains when dealing with specific UFD measures; like, for example, crowdshipping (Rougès & Montreuil, 2014) or instant delivery (Dablanc *et al.*, 2017).

The main SHs of the pilots and case studies conducted within the NOVELOG project have used the BMC to design and strategize on the implementation of their selected UFT solutions with the help of experienced NOVELOG partner consultants. As an example, the case of Barcelona is reported in Figure 3. The action involved identifying potential public land matching to a micro-platform design template and then obtaining municipal permission to cede such spaces to operators committing to make last mile deliveries by electric cargo-bike.

Figure 3 - Business Model Canvas for Barcelona's micro-distribution centre

Key partners	Key activities	Value proposition	Customer relationships	Customer segments
• Carriers and transportation companies - e.g. DHL, SEUR, TNT (as owners of original transport orders) • City council/ Department of mobility (provides space for facility). Municipality works to allocate public space for the purpose of micro-distribution. • Last Mile operator (LMO) (takes over last mile operations from LSPs, using electric cargo-bikes.	(1) Reception of goods (2) Operation of the MDC (3) Delivery to the final destination using sustainable modes (4) Maintenance of facilities and repair of vehicles (5) For Vanapedal MDC is pickup point for DHL parcels (6) Continuous innovation of service to attract new clients or make the business more efficient. (7) Information gathering by authorities	• Customers : increased time frame to perform deliveries and extended delivery coverage. (availability, convenience) • LMOs: Additional services of maintenance and repair of cargobikes, stocking goods, pick-up point for ecommerce. • Conventional LSPs: cost savings because trips outsourced to LMOs; in one of the cases access to city centre is provided via LMOs • City council: Collect data on LSP services	• Municipality cedes public space to LMOs • Direct B2B with LSPs for coordination and integration of services • B2C with the final recipients of the packages. Direct face-to-face delivery, but indirect booking via LSP partners	• E-commerce/express parcel recipients • LSPs for partnering
	Key resources	**Internalization of externalities**	**Channels**	
	• Physical assets (property for MDC: transshipment, office • Electric bikes and tricycles • Human resources (delivery & operations staff and transportation manager) • ICT to follow deliveries and track parcels. • Office equipment • Charging equipment for electric cargobikes(& energy)	2 positive externalities have been calculated (over 5 month period): • CO2 emissions reduction from 9.8 to 0.6 tonnes • Clean and silent vehicles distance travelled 35,827 km Other potential: • Reduction of vehicles in city centre/pedestrianized areas	• Website • City council to promote • LSPs to offer option for green delivery	
Cost structure			**Revenue streams**	
• Cost for running website (to customer), tracking of cargo-bike fleet... • Integration with partners via sales force and web-sales • Investment and operating cost for MDC (no space rental because provided by city council), charging equipment • Cost of cargobike deliveries – vehicles, labour, maintenance, energy cost (electric) • City council: meetings and information reports			• Primarily, carriers are charged for usage of facility, revenue is shared from delivery charges to customers • In addition, secondary revenues from other activities like bike maintenance for other companies, pick-up point for e-commerce deliveries, etc.	

Source: (NOVELOG; 2018)

Without the claim to produce a comprehensive classification system, in the following sections, each group is presented when dealing with the new trends of UFT (i.e. with regard to emerging BMs' category). A 4th category has been added in order to include fixed capital effect.

2.1.3 Customers (gains for – inputs from)

Within the contest of ODE, UFD is evolving quite rapidly, adapting to constant changes in the requirements of consumers and clients, who are more and more likely to buy online and have their goods swiftly delivered at home or ready to be picked up at a specific place. At the same time, customers are now more concerned about the environment, that may be affected by the increased number of deliveries. This is especially true when they consider placing many orders at different e-shops, taking into account that they might generate many different shipments. Within this context an interesting solution could be to provide customers with alternative shipping modes for each individual order (e.g. eco footprint, cost and ETA[1]) for fast, or green or for “light” consolidated or “larger” consolidation.

Apart from the availability of a new channel for purchases and consequently purchases themselves, which is inclusive and time-saving, consumers can take advantage of e-commerce in terms of power to influence sales and items sold throughout reviews. They are likely to be interested in having full visibility on the (end to end) distribution process, thus personalisation and customer-centricity are dominant design principles for developing new logistics services. The supply chain of tomorrow will be leaner, faster and most importantly, self-orchestrated. This unprecedented pace of change will be driven by a few radical technologies that will be cautiously adopted by industry participants over the next 15 years.

On the other hand, e-commerce tends to fragment orders and multiply the number of deliveries, which makes it difficult to plan times and routes delivery.

In addition to the dominant logistics perspective — B2B and B2C — economics and transactions should be enriched by considering the future potential increase of (local) C2C transactions and volumes.

Ultimately, the UFD is now customer-driven, since the demand is increasingly connected and informed, expecting fast (or, which is more important, sharp, i.e. received at the expected time) and cheap[2] service. The consequent huge impact on the delivery process, which is no longer driven by the supplier, forces operators and retailers, as well as e-commerce enterprises, to move from a push-driven supply to a pull-driven approach (i.e., demand-driven logistics), which has quickly been reshaping the supply chain. Retailers and last-mile operators should take it into account. The coherence of urban logistics services with certification schemes, given a real and transparent communication campaign about the efforts for being simultaneously efficient, demand-responsive and sustainable, could be an interesting strategy in urban logistics.

Another useful effort has been made for improving the transparency of the process, namely letting customers participate directly to the tracking service and providing them with real-time information.

2.1.4 Efficiency and Business

Due to this trade-off between demand satisfaction and environmental protection, mostly managed within a Corporate Social Responsibility approach, the supply chain agents (shippers or receivers) started to be more involved in the final delivery, the last and most expensive leg of the supply chain, often outsourced to specialised companies (both integrators or logistics operators) for improving its efficiency.

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[1] Environmental transport association – a carbon-neutral provider of vehicle breakdown, bicycle and travel insurance for the environmentally concerned consumer (www.eta.co.uk).

[2] A further more technical analysis should consider the role of the firms regarding the “price” of delivery. Indeed, some firms sell for “free delivery”, as a consequence it is now difficult for customers to accept to pay for the delivery. Free delivery does not mean delivery offered (which implies the cost/price of the delivery is offered).

In particular, in order to reduce freight trips, there is a growing interest on BMs for consolidation schemes and increasing the load factor, searching an optimal utilisation of both vehicles (full load, sharing or used also for reverse logistics) and infrastructures.

For example, concerning the implementation of small urban consolidation centres, the joint problem of operating these facilities and providing services to customers must be addressed in an innovative BM approach. Real data could play a key role in the Satellite Depots management for consolidating goods from different providers, stockholding and other value-added logistics services (Perboli *et al.,* 2021).

At the same time, urban land space is also required to be better used, due to its scarcity and the consequent high cost. Horizontal Cooperation among operators also needs to be reconsidered.

New opportunities are also provided by the outburst of e-commerce, suggesting the adoption of other UFD already existing logistics models, such as night delivery or more generic out-of-office hour delivery strategies. This is especially true for small business, retail and specific logistics chains such as the Hotel/Restaurant/Café sector. Even in this case, consolidation may be a good solution, provided that information and communication technologies (ICTs) enabled (real-time) data sharing possibly across the different supply chains following an Internet of Things approach.

For addressing the specific trade-off between sustainable and efficient delivery pick-up point stations (and more broadly speaking by decoupling delivery and reception), an interesting solution could be represented by flexible pick-up point networks, e.g. public transport hubs or parking, whose gains would be in terms of saved costs and sustainability (ALICE, 2014).

Furthermore, whenever retailers transform their brick shops into showrooms, getting free of the warehouse function, they will also reduce freight flows needed to replenish the shelves. This is also to be taken into account as a possible outcome of the digital market transformation.

2.1.5 Value creation and Society

Innovative BMs are mostly associated to smart urban logistics both tackling sustainability (for the society) and growth (for businesses), and guaranteeing well-being (for citizens, workers and customers) (ALICE, 2014). This means creating value not only for customers and business but also for the entire/whole community. According to the four groups of solutions previously described in **Table 1**, existing or innovative/emerging BMs can be thus suitable, depending on the different initiatives.

This social value should be well communicated and integrated into a new UFD paradigm, which could not only help understanding but also changing behaviour.

According to this, the public value dimension must be added to the commercial and business perspective, especially in terms of carbon neutrality, fair labour and subcontractors arrangements, gig economy (see Section 2.3), etc. and their impact on new logistic service models.

Within this context, it could be worth also considering Social and Solidarity ODE and “last yard” initiatives, that sharply grew since the Covid-19 pandemic first wave. Most of them were endorsed by municipalities to support local businesses, all use sustainable vehicles, or even deliver on foot.

In particular, these initiatives could be grouped with crowdshipping and full-blown gig economy[3].

2.1.6 Technology and Infrastructures

Setting up UFD more or less flexible infrastructures such as, for example, LUAs, Urban Consolidation Centres (UCCs), pick-up points, warehouses, etc.) is a crucial task, dealing with purely land use planning aspects (e.g. logistic facilities in urban areas), such as brownfield vs greenfield projects or vertical vs horizontal expansion (ALICE, 2014).

Financial aspects are worth investigating, especially when affecting public and private SHs.

At the same time, managing UFD infrastructures, as well as the introduction of new technologies, involves regulatory activities (e.g. a preferential use of the infrastructure by clean vehicles or a better control on LUAs or private infrastructure installation in public space).

As it will be further investigated in the next Section (2.3), the regulatory framework is expected to fast develop for setting up UFT strategies. Due to the complex nature of UFT described in Section 2.2, the dynamic private sector requests may not be immediately met by the public sector, whose reactions could take longer.

This is especially true when dealing with new technologies (e.g.big real-time data provider), which raises privacy issues, and/or where a strong public intervention is needed. Think about a dedicated public space allocation, such as install parcel-lockers or re-charging infrastructure for electric vehicles (EVs), as well as allocating platforms lines for cargo-bikes or controlling LUAs, or managing “instant deliveries” (within two hours from the order) or crowdshipping.

Finally, it must be noticed that in many cases, such as, for example, instant delivery or crowdshipping (Dablanc *et al.,* 2017; Rougès & Montreuil, 2014), powerful collaborative platforms providing real-time updates of supply and demand represent the core of UFD innovative BMs (Dablanc *et al.,* 2017; Rougès & Montreuil, 2014). This can also be illustrated by examples of on-demand warehousing and fulfilment (DHL Logistics Radar, 2020)[4]. Indeed, platforms like FLEXE and STORD have enabled enterprises to add more flexibility to their storage by renting pallet positions in warehouses. Additionally, companies like Darkstore and Deliverr offer third-party fulfilment services through a network of warehouses (from urban micro-distribution centres to traditional centralised warehouses) with shared inventory.

2.1.7 Conclusions

To sum it up, apart from the different available definitions, a BM in UFD encompasses elements to produce (i.e. partners, activities and resources), to deliver (i.e. channels and relationships); to generate profit for the logistics service providers (Macharis *et al.,* 2014).

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[3] These initiatives are differentiated from “riders” Platforms, that are not entrepreneurs but economic powerhouses whose operating model, labour, tax, regulation are quite differently appreciated and considered in EU member states.

[4] For more examples, a good reference is the Maturity matrix of SupplyChainManagement Magazine.

Since BMs are considered crucial to the success of city logistics initiatives, especially when dealing with new technology (Björklund *et al.,* 2017), their absence represents a major barrier to the implementation of such initiatives (Malhene *et al.*, 2012; Quak *et al.*, 2014).

Indeed, this is only half of the story. The private sector and citizens are still aware that sustainable logistics is a common and shared responsibility (Anand *et al.,* 2012; Marcucci *et al.,* 2019; Macario *et al*., 2008). Because of the complexity of issues involved in sustainable UFD objectives, engaging private sector and citizens in the decision-making process and thereby developing accountable partnerships among all SHs have become important in the policy-making process.

Since logistics system agents are not naturally inclined to participate in public policy making (Holguìn – Veras *et al.,* 2015) neither to take into account their (negative) impact on the city sustainability, it is worthwhile investigating how the multi-faceted cooperation among public and private sector can help in building a new "collective" awareness (next Section 2.2).

It is widely acknowledged that many (also innovative) BMs have failed because some SHs were not involved in the decision-making process (Macharis & Melo, 2011).

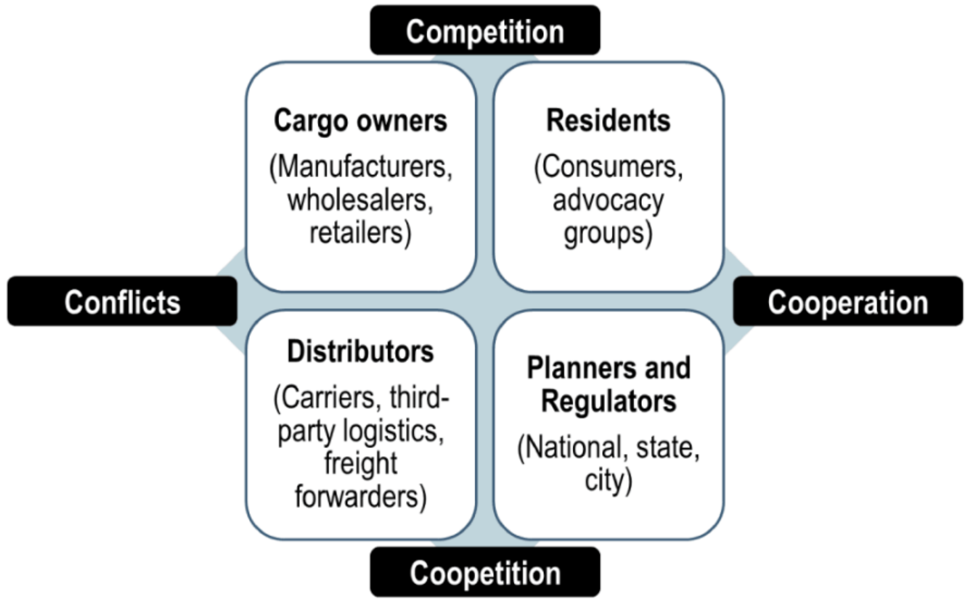
This is especially true when trying to preconise the potential impact of the European Commission's proposal to cut greenhouse gas emissions by at least 55% by 2030 (endorsed by all member state leaders in December 2020) will have on BMs. Indeed, it will probably accelerate the creation of Low Emission Zones (LEZs) in European Union cities over 50.000 inhabitants, influence every SH's consideration to urban logistics and last-mile environmental footprint, and cascade to vehicle manufacturers, transport operators, citizens and certification schemes.

2.2 Governance and stakeholders cooperation

The freight transport at the urban scale (UFT) includes a wide range of SHs: from Trade & Industry i.e. the professional SHs (shippers, logistics operators, carriers, wholesalers and distribution companies, recipients/receivers), to citizens (society), whose objectives can often be in possible trade-offs (MDS Trans, 2012; Anand *et al.,* 2012) and, obviously, public Policy Makers, i.e. local, regional and national governments, or LAs (Macharis *et al.,* 2014) and regulation/infrastructure authorities (Anand *et al.,* 2012).

The next **Figure 4** illustrates the different relations among SHs.

Figure 4 - Relationships between stakeholders



SOURCE: adapted from Taylor (2005)

Specifically, different users may actually be in competition for the same infrastructures (e.g. residents and city users on the one hand, and couriers on the other, for public land – roads, parking areas and loading areas). More broadly speaking, with regard to policies relating to freight transport, the heterogeneity of preferences of the SHs is even more relevant and significant for the decisions making process (Marcucci *et al.,* 2012).

Actually, the urban freight distribution system is mainly based on both horizontal competition among couriers and vertical cooperation between logistics and transport operators, traders and citizens (Marcucci *et al.,* 2013), whose utility functions are very different. Therefore, they are expected to be differently affected by intervention measures. Consider, for example, a measure regulating freight access to a Limited Traffic Zone (henceforth LTZ), which is probably desired by citizens, but not by merchants and transport operators. The same can be said for night-delivery, which could easily be preferred by couriers than by residents.

This is especially true when dealing with the recent spread of e-commerce, even enhanced by the covid-19 pandemic outbreak in 2020, and the consequent huge increase of B2C urban deliveries. Moreover, ODE aspires to fulfil consumer demand via the immediate supply of goods and services, which furtherly multiplies deliveries.

As a consequence, nowadays, UFT includes multiple agents as SHs and, ultimately, potential decision makers: shippers and receivers, primarily concerned with their businesses profitability, local authorities (LAs), appointed to and citizens, more and more involved as ODE increases.

2.2.1 Stakeholders outreach and (agency) coordination

Due to the public/collective interest in these targets, LAs may successfully lead a higher level of local UFT SH involvement and cooperation (Lindholm & Browne 2013) materialised into cooperative schemes, incentives and PPPs (Lozzi, 2018). Within this context, also following Section 2.2.5, scholars and technicians should support and coordinate the process, even from the impact area of a solution identification and the consequent SHs recognition.

In fact, through the clear identification of all the SHs and their needs, it is possible to explore the acceptability of the proposal by the community reducing times and costs of the decision-making process about a measure and the potential conflicts during its implementation.

From an operational point of view, it is important that the LA sets up strong coordination (management and organisation) of the partnership, not underestimating the needed resources in terms of staff and time it takes to organise and keep it alive (Lindholm & Browne, 2013).

2.2.2 Participation and consensus building

Participation produces a sense of decision ownership, creating a sense of responsibility among politicians, technicians and planners, citizens and operators (Lindenau *et al.,* 2014).

Participation is hopefully expected, throughout a preliminary advisory phase, when drafting urban mobility plans (Lindholm, 2010; Marcucci *et al*., 2015) and policies (Fossheim & Andersen, 2016).

LAs are aware of the importance of SHs involvement in the decision-making process especially when dealing with multi-agents and multi-purposes freight decisions, since an *ex-ante* involvement can significantly reduce times and costs of any agreement and thus increase its chance of success.

Actually, the participation of every SH enriches the decision-making process (Formez, 2006) being an opportunity for dissemination, comparison, learning and rational support to decision-makers (Quick et al., 2015).

Furthermore, conflicts are likely to be minimised and consensus built around the decision to be taken, at the same time increasing the reliability of the decision maker (Marcucci *et al.,* 2019).

As an example, in a satellite-based consolidation approach, the presence of regulatory measures to limit the times for freight activity to take place, in order to achieve a sustainable urban logistics, reduce the possibility for a system optimization; which can be solved by coordinating the involved multiple SHs (LA, couriers, the satellite manager) (Perboli *et al.,* 2021).

Similarly, a lack of interaction among SHs ends up by misperceiving the aims of a policy or the needs of an operator, like in the case of the digital platform needed for managing LUAs within the centre of a city (Pronello *et al.,* 2017).

2.2.3 Plan or Project Lifelong Collaboration

A stronger agreement among SHs is based on Project Lifelong Collaboration, i.e. the cooperation lasting during all the phases of the planning, implementation and controlling of projects and plans (Kiba-Janiak, 2017), as a good cooperation framework takes time to take off and enable the development of a common vision (Lozzi, 2018).

This is especially true for complex and/or innovative initiatives, that can more often confront changes and unexpected events. The first (i.e. complex initiatives), such as in the case of consolidation solutions, must rely on a strong and lasting common interest, while the second (e.g. door-to-car, drones), in the lack of pertinent regulation, are the focus of still ongoing decisions.

In line with the EU prescriptions, LAs should pursue a continuous SH engagement (see Section 2.2.5) also through the creation of a full-time team focusing on UFD related issues (Lindholm, 2010).

2.2.4 Replicability and living labs

Despite the specific characteristics of any local reality (objectives, resources, constraints, opportunities), it is necessary to develop a generic decision-making framework to facilitate meaningful interaction between various SHs (Ballantyne *et al*., 2013).

Nonetheless, there is no one-size-fits-all solution, therefore each partnership must take into account these specific characteristics (Lindholm & Browne, 2014), which can be modified and improved as demanded by circumstances.

SH cooperation is also crucial when trying to transfer or replicate the development process to other cities, especially when LA initiated it. The same can be said for knowledge sharing and information exchange, which ultimately allow adapting the governance structure to local conditions for a successful UFD improvement.

Some replicable solutions for enhancing SHs cooperation have been recently provided by EU-funded Horizon2020 (H2020) projects.

In line with the Living Lab(oratory) (from now on LL) approach promoting a new method for collaborative planning (Quak et al., 2015), H2020 – CITYLAB co-created, tested and implemented sustainable city logistics solutions in European cities inside LLs. This helped in developing and sharing knowledge, in the up-scale and roll-out of strategies, measures and tools for emission-free city logistics in urban centres, by delivering best practices guidance on innovative approaches and how to replicate and/or transfer them (CITYLAB, 2018).

2.2.5 Stakeholder engagement and public–private partnership

An effective SH engagement requires creating mechanisms to discuss freight issues among LA, private sector (operators and customers) and communities (receivers) (Wilbur Smith Associates and S.R. Kale Consulting, 2009). The aim is twofold: to identify potential solutions and the role of the various SHs, and to secure commitments to a strategy of improvements (Holguín-Veras *et al.,* 2015).

According to Holguín-Veras *et al.* (2013), in order to have a solid foundation for private-sector engagement, many initiatives can be initiated, such as having a "freight-person" in place at key agencies (which will likely significantly improve communications between the public and private sectors), or setting up specific Committees. For example, a Freight Advisory Committee (FAC), where to discuss freight issues and develop the trust between public and private thus facilitating the implementation of novel solutions, whose staff should educate elected and appointed officials about the importance of freight to their metropolitan areas, and how to enhance system performance. Technical Advisory Committee, instead, is a forum where to discuss freight policy in complex metropolitan areas that need more coherent public sector coordination. Another solution may be to foster an industry-led best practices dissemination program for sensitizing and teaching private-sector companies how to internalise (and thus mitigate) the negative impact produced.

2.2.6 Freight quality partnership

More specifically, a PPP could result in a freight quality partnership (FQP), i.e. a formal working environment between LAs and UFT SHs for the implementation of practices that ameliorate the negative impacts of freight activity (Department for Transport, 2010a). In the UK, this concept aimed to engage with committed SH in a continuous and structured framework for identifying problems for each interest group, and best practice measures and principles for achieving a sustainable UFD. Specific SHs are expected to be included (Allen *et al.,* 2010), their preferences and behaviour carefully mapped and taken into account (Gatta & Marcucci, 2016; Holguín-Veras *et al.,* 2015), in order for decision-makers to develop a comprehensive and informed overview and take the right decisions accordingly (Gatta & Marcucci, 2014).

A freight quality partnership is an easily transferable good practice (2.2.4) from one city to another (Lindholm, 2014). It has to be intended on a long-term perspective (2.2.3), involving a good and exhaustive mix of SHs (2.2.1), politically endorsed (2.2.5) (Lindholm & Browne, 2013) and with an effective communication strategy (2.2.7).

A key challenge is also to bring all different logistic operators into a collaborative format, clarifying roles and responsibilities – especially when dealing with financial issues - ownership of processes, goods and data to coordinate a smooth delivery to the customer.

2.2.7 Lack of data and shared knowledge

In this context, sharing and transfer knowledge between partners is highlighted as one of the most important effects of any kind of partnership, allowing to identify and investigate the main barriers and drivers/incentives/enablers.

In particular, the public sector must fully understand the other SHs perspective about the discussed issue, otherwise, policy decisions about e.g. zoning, parking regulations, time or vehicle restrictions can result in unintended problems (Jones *et al.,* 2009). Limited knowledge and awareness of the sector prevent an adequate setting of measures for their effective, sustainable and integrated management (Lindholm, 2010).

Moreover, adequate tools to deploy effective measures regarding urban logistic problems turns out in a rather narrow scope, being commonly limited to traffic restrictions (e.g. access times or vehicles' dimensions).

On the other hand, scientific knowledge, normally out of reach to many professionals, may be diffused, otherwise, no accepted body of knowledge can help Policy Makers decide how best to tackle freight issues.

Moreover, data exchange is also crucial for individual and collective evaluation, at every stage (*ex-ante, in itinere, ex-post*) of the assessment process (Marcucci *et al.,* 2019). In particular, the *ex-ante* evaluation should become a co-participated process aimed at discovering in advance the effects of the decision to be taken.

Communication, dissemination of outcomes, knowledge sharing, and information exchange are thus essential characteristics of a well-functioning and established cooperation among LAs and SHs. Moreover, they can ensure the transferability of knowledge between partners and non-partners SHs.

According to this, the EU funded and funds many research programmes, aiming at improving and sharing knowledge on urban logistics.

Among these, H2020- NOVELOG supports the development of multi-SH platforms at the local level, to facilitate and guide local cooperation for UFT decision making. Albeit not compulsory or rigidly structured, a multi-SH platforms is important to discuss generic measures and evaluate their potential from the perspective of the private sector. They require more binding forms of cooperation if a target-oriented PPP must be set up to address a specific issue or test new BMs (Allen & Browne, 2016). Above all, they support the exchange of knowledge and best practices and the implementation of the most effective UFT measures, given the local context.

Additionally, Horizon 2020 SPROUT project originated from the fact that previously tested and implemented policy responses employing access restrictions, congestion charging or infrastructure provision proved to be inadequate to address recent changes in urban logistics. Indeed, SPROUT proposes data-driven policies both for delivery management and city logistics. These data-driven policies range from dynamic pricing, restricting delivery to off-peak hours, provision of inner-city loading zones, micro consolidation centres, urban freight corridors or crowd-shipping systems.

Finally, it is worth mentioning that without reasonable knowledge and value-sharing among SHs, in terms of cross-sector collaboration and the setup of roles and responsibilities, it is difficult to recognise big data’s potential value, along with cloud computing and the Internet of Things (IoT) (Jung & Kim, 2015). On the other hand, it is not easy to predict the consequences of these BM changes, that is why it is so important that city plans and policies take into account these innovations also adapting process and regulation (Dablanc, 2017).

2.3 Regulation

This section highlights regulatory aspects that recent developments on technological and logistics solutions impose.

Ambitious targets and policies underline the crucial role of regulations in the transport sector. For instance, the European Commission (EC) commits to reduce transport emission by 90% no later than 2050, to have at least 1 million of publicly accessible recharging and refuelling electric points by 2025, planning to invest more than EUR 130 billion per year in vehicles and low carbon fuel infrastructures (European Commission, 2020c; European Commission, 2020a)[5]. Furthermore, the fulfilment of

[5] *The additional investments for 2021-2030 in vehicles (including rolling stock, vessels, and aircraft) and renewable and low carbon fuels infrastructure deployment are estimated at EUR 130 billion per year, compared to the previous decade. The ‘green and digital transformation investment gap’ for infrastructure would add an additional EUR 100 billion per year* (European Commission, 2020c).

Sustainable Urban Mobility Plans (SUMP)' targets (in term of emission, congestion, safety, quality of life) highlights the crucial function of the rules characterising the urban environment. In addition to huge infrastructural investment, a proper management of LEZ and land use (multimodal mobility hubs, parking, car lanes, park and ride facilities, warehouses) could determine the success of such SUMPs. From a business approach, instead, legislations determine the possibility to create or make a BM profitable.

Next Sub-section (2.3.1) will analyse the rules related to authorisation and test, infrastructures, competition, safety, cybersecurity, liability and ethics.

2.3.1 Authorisation and test

In the UFT context, in particular, regulations are crucial as they determine if a technology can be properly tested and launched on the market. In fact, a set of rules can forbid the use of new technology or apply restrictions that can make difficult trials and/or investment unprofitable.

In UFT, the main examples involve drones, connected and automated vehicles (CAVs) and also Fuel Cell Electric Vehicles (FCEV).

However, authorisation can be an issue for every, even already spread, technology or BM. For instance, any kind of transportation mode, system or data handling (see Section 2.4), or use of parking lots has to be authorised by governmental regulations.

Until now, when it comes to drone delivery or Automated Car/droids delivery, a mass scale production does not exist but only a few pilot projects (for instance drones postal and good delivery programmes are underway in 26 countries around the world (Unmanned Space, 2019).

Until now, testing drones, droids and CAVs is quite limited by regulations.

When it comes to drones, UE is fixing this gap. EU Regulations 2019/947 and 2019/945 on *Easy Access Rules for Unmanned Aircraft Systems* set the framework for the safe operation of drones in European skies creating a shared space for drones. Nowadays (from 31/10/2020) urban drones' delivery Beyond Visual Line of Sight can start after an operational authorisation given by National Aviation Authority based on a safety risk assessment. However, in the EU, several years will be needed to create a U-Space, a set of highly digitalised services and functions designed to secure the safe access of a large number of drones in the airspace of up to 150 metres[6]. The U-space regulatory framework, supported by clear and simple rules, should permit safe aircraft operations in all areas and for all types of unmanned operations (EASA, 2020).

The US are a step forward: in 2020, Federal Aviation Authority authorised flight over populated areas and at night (Ryan Duffy, 2021).

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[6] *The U-space is an EU-initiated platform for the safe integration of civil drones in the airspace. It is a set of highly digitalised services and functions designed to secure the safe access of a large number of drones in the airspace of up to 150 metres. It aims to create an interface between manned and unmanned air traffic (Tania, 2019).*

As it is for CAVs authorisations and restrictions, the situation is very different according to government strategies.

In Europe, CAV testing is legally permitted thanks to the amendments to the 1968 Vienna Convention on Road Traffic took effect in 2016 legalising the use of automated driving technologies. However, the legislation still requires every vehicle to have a driver who should always be ready to take control of CAVs). The European Parliamentary Research Service (EPRS) states that this is incompatible with most highly or fully automated systems, which may not require a driver (Taeihagh & Lim, 2019). Furthermore, CAV is typically “confined to private streets” and “pre-defined routes” or “restricted to very low speeds”. This policy depends on the attitude to protect citizens from technological risks. For this reason, at both the EU and national level, European governments are still assessing the implications of CAVs before establishing permanent rules (Taeihagh & Lim, 2019). However, European states are developing different approaches: Germany is focusing on testing them in private locations that include shuttle services interacting with pedestrians and bicycles, French is establishing a legislative framework that will allow testing autonomous cars on public roads; more than 50 autonomous-vehicle test projects have taken place in France since 2014, including robotaxis, buses and private vehicles in 2019 (Autovista Group, 2019).

In the US, CAV testing is allowed on public roads without any mandatory standards to follow due to focus on the “race for innovation and progress”. In California, for instance, CAVs testing does not require a human safety driver inside the car (Taeihagh & Lim, 2019).

A similar market-oriented approach has been developed in the UK and Australia.

In Singapore there is a control-oriented strategy: the law allows that a motor vehicle does not need to have a human driver, instead robust plans for accident mitigation must be developed before road testing, and the default requirement for a human driver can be waived once the CAV demonstrates sufficient competency to the Land Transport Authority (LTA). After displaying higher competencies, CAVs can trial on increasingly complex roads (Taeihagh & Lim, 2019).

The approach is slightly different in Japan where there is a prevention-oriented strategy. Here rules require a human driver with a driver’s licence in the vehicle, police approval, clear labelling on CAV test vehicles and testers to always be prepared to apply brakes (Taeihagh & Lim, 2019).

As far as FCEVs concern, California is an example of best practice with the largest fleet in the world. In Europe, SHs report missing or inadequate permitting procedures as one of the main regulatory hurdles[7].

2.3.2 Infrastructure

Infrastructure’s laws are another core regulatory feature for the rise of the new technologies as indicated by the commitment in the EC’s proposal to boost the uptake of green vehicles, automation and related infrastructure (European Commission, 2020c).

[7] Regulation | H2Valleys

The issue affects not only technology of future applications such as automated delivery vehicles and droids that require an amendment of Road Traffic Code and the creation of new infrastructural elements but also existing technologies in UFT such as parcel lockers, cargo-bikes, EVs, FCEVs and UCCs. Lack of standardisation rules for constructing parcel lockers impacts their diffusion (AGCOM, 2020). Delays in the creation of bike lanes or inefficient design and lack of suitable space available for hub impact on cargo-bike and UCC, while shortage of proper charging stations affects EVs and FCEVs. EVs, in particular, in terms of rules require (Transport Decarbonisation Alliance (TDA) et al., 2020):

1. definition of regional and national targets in term of vehicles sales targets and/or emission targets
2. creation or support of multi-SH partnerships that work on charging infrastructure and grid capacity assessment
3. deployment of an effective charging strategy in cities that takes in due account where and how often charging can/should take place, type of charge and vehicle's battery size
4. SHs to adapt regulations and issue permits (ibidem)

Overall, as far as alternative fuels infrastructures concern in Europe, EC reports the persistent fragmentation and pervasive lack of interoperable recharging/refuelling services across Europe for all modes (European Commission, 2020c).

Furthermore, rules to preserve space to urban logistics are crucial in urban planning.

The success of new and emerging technologies, in fact, depends also on a holistic approach of public authority to urban mobility through urban land-use codes, ordinances, and regulation including zoning. Conventional land-use and zoning regulations address density, lot size, dimensions, building size and setbacks, street geometrics, access points and driveways, parking standards, roadway and sidewalk design, layout, truck loading facilities, and use of the land (Plumeau et al., 2012). This is crucial because in urban areas, mobility and access for all vehicles, especially trucks, is constrained by the dense proximity of buildings and limited space for parking. In particular, regulation on truck routing, parking and loading zones, time of day delivery, truck size and weight, building code/design, infrastructure design, land use and zoning/enforcement polices affect congestion, air pollution, business competitiveness and figure out a possible conflict between several users (Plumeau et al., 2012). LEZs are an example of such regulations and are crucial for the functioning of green solutions and BMs.

Shenzen (China) represents a valid example of successful LEZ, with almost 80,000 EVs and 10 green logistics zones. The Municipality offers a large set of monetary and non-monetary incentives: local purchase subsidies, operation subsidies, charging utility rate discounts, subsidies on charging infrastructure provision, diesel vehicle scrappage subsidies, parking incentives, road access management, vehicle registration requirement and city-specific data platform (Transport Decarbonisation Alliance (TDA) et al., 2020).

When it comes to new technologies such as CAVs or droids further steps are needed: vehicle-to-infrastructure (V2I) systems, road maintenance, support facilities, staging areas and curb modifications will be key infrastructural elements to exploit properly such technologies (McKinsey &

Company, 2019). Furthermore, next to physical infrastructure will be crucial to invest in the digital equivalent of infrastructure[8].

2.3.3 Monopoly vs competition

Another significant impact of the regulatory framework on UFT new technologies and BM is the reshaping of the market's structure. A different set of rules or their absence can affect the number of players of a BM or even the nature itself of the BM.

Two examples in the UFT ecosystem can be parcel locker and instant-delivery.

In the first case, regulation could change drastically the number of players and the nature itself of the service.

On one hand, regulations could simply speed administrative procedures, lowering costs. On the other hand, they could foster interoperability and accessibility between networks or financing directly the edification of parcel lockers (e.g. Singapore) (AGCOM, 2020). The two last possibilities could foster the idea of parcel lockers as an essential facility part of a universal service.

As it is for instant-delivery[9], the possible implementation of laws that concern classification of workers (see Frenken et al. (2020) and Koutsimpogiorgos et al. (2020)), a minimum wage, a minimal form of social protection and health insurance, liability insurance for damage to third parties, regulation of privacy protection (also for tax regulation see Frenken et al. (2020)) could limit profit and the number of players as well as change the nature of the crowdsourced delivery (Dablanc et al., 2017). Further enforcement (see Koutsimpogiorgos et al. (2020)) (e.g case Uber Pop 2015) could heavily damage the rise of the sector. However, regardless of European legislation, Member states followed several approaches but either EU or national regulators have yet provided effective rules on the gig economy (Molina, 2020).

So far, we have seen the impact of regulation on new technologies looking at test, infrastructures and shape of markets. However, in order to increase their role in UFT, regulations need to address further issues such as safety, cybersecurity, liability, privacy by adopting a holistic perspective.

In fact, although in many cases is possible to test or even to create a start-up and launch a business (e.g. Starship industries deliver products using droids), the risk of heavy civil or even penal liability can make the profitability of the business too uncertain, as well as concerns of the public sector on safety (Lee & Hess, 2020), cybersecurity and privacy, a low public acceptance and negative events (accidents, terrorist attacks, criminal uses) could lead to new restrictions or delay in the entry into force of new suitable regulations.

The importance of each factor depends on trade-offs (e.g safety could be deemed more important than privacy) that Policy Makers might consider when developing a policy measure. According to Taeihagh & Lim (2019), Policy Maker cannot take any specific action to address risk, predict and regulate risk (for example through safety assessment and robust accident mitigation plans), tolerate

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[8] *Infrastructure Categorization – Inframix EU Project*

[9] On-demand delivery within two hours by either private individuals, independent contractors, or employees by connecting consignors, couriers and consignees via a digital platform (Dablanc et al., 2017)

the risk (for instance set a comprehensive list clarifying the liability of insurers and owners in the event of an accident and under a wide range of circumstances), adapt to the risk (include aspects of “forward-looking planning, joint responsibility”, and “co-deciding”) and, in the end, prevent risk through temporary restrictions or prohibitions.

2.3.4 Safety

A first problem that Policy Makers need to address is safety. New technologies and solutions can be dangerous for people (data will be considered in Sub-sections 2.3.5, 2.4, 2.5) and goods, and accidents can create pressure for halting field experiments. Safety concerns accidents, such as a drones’ crash, a CAV’s crash or disruption of public spaces (e.g London Gatwick 2018), hydrogen station explosion but also misuse such as drug smuggling or be weaponised in order to perform an attack (e.g assassination attempt on President of Venezuela in 2018). The dimension of safety is strictly related to cybersecurity, ethics and privacy that will be discussed in Sub-sections 2.3.5, 2.4, 2.5.

The approach to safety is quite different between countries and regions and even between technologies.

Overall, there is a light-control and even a toleration approach for CAVs and a more restricted regulatory framework on drones while for other technologies and solutions such as droids, parcel lockers or cargo-bike safety is not an issue.

When it comes to CAVs, California and Australia have one of the most advanced regulations that combine flexibility between advanced tests and safety. A good regulation on safety should include (Lee & Hess, 2020):

1. Separate license with additional provisions (in California) (ibidem)
2. Possibility to deactivate the system easily and at any time
3. A training program for safety driver and remote monitors (California)
4. A full safety management plan (in Australia)
5. Trials recorded in real time (in Australia)
6. Substantial fines or other penalties for non-compliance with safety rules (in Australia)
7. File disengagement reports (in California)
8. Black box for safety investigation (in California and Germany)

In Europe, measures are not the same because the level of automation 4 and 5 has not been reached: in Germany, for example, the safety strategy is quite different. In fact, the law requires a subsidiary safety driver capable of taking control of the CAV upon request.

As far as drones concern, in the US and Europe, in 2019-2020, authorities introduced Remote ID rules: drones have to register and in order to fly have to broadcast their location and identification (including the location of the drone operator). This is a sort of license plate that is controlled in real time by aviation authorities and can be accessed by a law enforcer. In this way, non-compliant drones and illegal uses can be detected.

Other regulations that could possibly be related to safety concern are: 1) ban to fly on populated areas; 2) spatial restrictions; 3) presence of a device to protect third parties, anticollision and against misleading signals; 4) specific authorisation for remote operators, and 5) specific flight authorisation information (the type and purpose of the operation, the altitudes and routes to be used on the approach and departure to and from the area where the operation will be carried out, and other necessary identifying details regarding the planned operation) (Levush, 2016).

A further safety measure for drones in the US is the possibility to use other means of transport to mitigate credible drones threats (Interagency Security Committee, 2020) and in China the requirement of an electric fence when flight cross a forbidden area (Levush, 2016).

2.3.5 Cybersecurity

Hacking's threat implies a high risk to safety, as new technologies can be used for malicious purposes or criminal activities. Hackers could target drones, CAVs, droids for stealing information, to inflict harm, to spy or to trade illegal goods. The risk is not low for drones as shown by OCIA (2018), that could be attacked by hacking their unencrypted communication through radio, WiFi or GPS. When it comes to CAVs, attacks on AVs depends on vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) weaknesses of communication channels. Provision of fake messages and spoofing of global navigation satellite systems (GNSS) can erode CAV's safety-critical functions (Taeihagh & Lim, 2019). Other attacks could exploit the use of sensor manipulation to confuse CAV's systems.

Furthermore, Cyber risk is a huge threat for the success of modern enterprises (cyberwatching.eu, 2019).

Overall, UFT developments (Digital Twins, ITS, PI) are moving towards an interconnection between several physical objects and, hence, increase vulnerability and possibility of hacking (Axelrod, 2017; cyberwatching.eu, 2019). In particular, Axelrod (2017) shows that this issue can increase as "V2V, V2S and V2I communications and systems, and V2E systems and communications are completely omitted from many documents that pretend to cover the general system environment" (ibidem). Furthermore, the avoidance from manufacturer to update vehicles' internal intelligence due to slow infrastructural improvements could provide hackers with greater opportunities to pursue their maleficent objectives (ibidem).

Despite these gaps, some States have undertaken several actions to mitigate cybersecurity risks mixing non-mandatory guidelines on cybersecurity best practices, research to explore the implications of new technologies on cybersecurity and new legislation to tackle cybersecurity risks.

The US enforced cybersecurity legislation involving CAVs in 2017 with SPY Car Act.

"According to this law, critical and noncritical software systems in every vehicle must be separated, and all vehicles will be evaluated using best practices. It introduces specifications to ensure the security of collected information in vehicle electronic systems while the data is on the vehicle, in transit from the vehicle to a different location or in any offboard storage. It also requires vehicles to be able to instantaneously detect, stop and report attempts to capture driving data or take control of the vehicle and requires the CAV to display the extent to which the CAV protects the privacy and cybersecurity of the consumers"(Taeihagh & Lim, 2019).

Furthermore, the US, in addition to voluntary guidelines for manufacturers and software companies, set up a new electronics systems safety research department to assess and monitor potential cyber vulnerabilities.

As far as Europe concern, there are several strategies to handle cybersecurity risks regardless of the technology. In 2016, “the EU enacted the first EU-wide legislation on cybersecurity and EU Agency for Network and Information Security released best practices guidelines for the cybersecurity of connected vehicles, including both conventional and CAVs, to increase awareness of and provide guidance on these issues” (Lim & Taeihagh, 2018).

Regulations undertaken for drones, instead, do not explicitly specify provisions to defend from cybersecurity issues, hence not providing a sufficient level of protection (Pyzynski, 2020).

Overall, lack of mutual recognition and harmonization of cybersecurity standards are the two most important gaps (cyberwatching.eu, 2019).

In particular, the weaknesses that regulations can contribute to fix are lack of (ibidem):

1. common language in cyber risk management processes
2. integration between Business-Critical Processes and Cyber Security process
3. integration between Cyber Security and Privacy Compliance
4. solid data on Cyber Incidents and Threats
5. impactful measurements and standards hinders comparisons

In order to fix the gaps, EC has adopted a proposal for a revised Directive on Security of Network and Information Systems. The proposal strengthens security requirements for companies, by imposing a risk management approach providing a minimum list of basic security elements that have to be applied. The proposal introduces more precise provisions on the process for accident reporting, content of the reports and timelines. Furthermore, the Commission proposes to address security of supply chains and supplier relationships by requiring individual companies to address cybersecurity risks in supply chains and supplier relationships (European Commission, 2020b).

On a global scale, there are several standards that can help assessing the implementation of solutions to prevent cyberthreats, such as the standards proposed by ISO 27001 and the National Institute of Standards and Technology, NIST 800-55.

2.3.6 Liability

Spread of the new technologies in UFT cannot overlook the liability for misuses (also due to lack of privacy) and accidents due to defective devices, lack of cybersecurity or other reasons. The decision to undertake a specific BM (e.g droids) must consider this risk and the cost of the insurance schemes, if exist.

The knowledge of how liability is attributed (manufacturer, supplier, software provider, remote operator, safety-driver, owner of the vehicle, insurer) and how it applies represent key issues. Answering to both questions is often difficult as legislation is not always present, updated or clear for technologies such as drones, CAVs or droids. In particular, it is necessary to provide legislation addressing new technologies in Traffic Law.

Common problems of responsibility could be the following:

1. Which kind of tort liability has to be applied for an accident? In the case of droids, it is important to understand whether standard tort liability, product liability or traffic law liability should apply in case of accidents. For this reason, it is very important to clarify the “liability status” of delivery robots in the receptive jurisdiction (Hoffmann & Prause, 2018).
2. “How liability will be apportioned between the CAV’s autonomous system and the human driver? Will the human bear part of the responsibility of a crash if there is a manual override function they failed to use?” (Taeihagh & Lim, 2019).
3. In which case insurer liability can be limited?
4. In which case are manufacturers protected by the law?

Nowadays, the situation is different according to technologies: as far as CAVs concern, majority of countries do not address liability risk and insurance scheme, including EU where does not exist comprehensive legislation on new technologies (cyberwatching.eu, 2019; Taeihagh & Lim, 2019). By contrasts, for drones Policy Makers apply a toleration-approach, not addressing liability but only an adequate insurance policy (Stöcker et al., 2017).

Overall, gaps involving this theme are the following:

1. Assignment of liability and the corresponding effect in insurance cost are currently unknown (Taeihagh & Lim, 2019).
2. Lack of liability in the case of cyber-attacks (cyberwatching.eu, 2019).
3. Apportioning of liability.

2.4 Privacy

Privacy is another pivotal issue that new technologies have to deal with. Drones, CAVs and droids can easily collect imagery, record conversations and intercept electronic communications storing and transmitting such data to other means of transport, connected infrastructure, and third-party organisations through external V2V and V2I communication networks.

There are no explicit motivations justifying information collection. Additionally, there is no specification about information accessibility issues and their storage duration. Regulation will soon have to address these issues (Taeihagh & Lim, 2019).

Tracking of vehicle’s movement (drones, droids, CAVs), use of personal data for different uses (profile users, predict user behaviour and other uses, see Section 2.5, spying through some technology (e.g using drones), spying a mean of transport (spying a CAV) are the main threats. Deanonymisation of data is a further menace (ibidem). The approach to privacy depends on the inner value given to it. Privacy is a value that a Policy Maker has to balance with security and freedom of the economic initiative.

In the US, for instance, Policy Makers are inclined towards security and a market-oriented approach (ibidem) and federal law on privacy does not exist.

For instance, the lately approved new regulations on drones raise concern on privacy and strong criticism in the US. In fact, an observer tracking a drone can infer sensitive information about specific users, including where they visit, spend time, and live and where customers receive packages from and when (Wing, 2020). Moreover, for CAVs, the extent of information sharing in different conditions is not specified by federal law (Lim & Taeihagh, 2018).

By contrasts, in Europe, privacy is one of the pivotal values. In 2018, the EU General Data Protection Regulation (GDPR) became effective. GDPR restricts the use of personal data to avoid any potential violation of privacy.

These rules, if extensively applied, might undermine the competitivity of European technologic sector as reduces data sharing (Kunze, 2016; Lim & Taeihagh, 2018).

In fact, picture, sound recordings and film catch by drones, CAVs and droids, could violate GDPR as well as companies could easily not comply with art. 25 of the Regulation which calls for the implementation of privacy by design or privacy by default (PbD) (Hoffmann & Prause, 2018)[10].

GDPR also raises the integration issue between privacy compliance and cybersecurity. There is also a gap between the legislation and its application with respect to the techniques needed to ensure and demonstrate compliance through certifications (cyberwatching.eu, 2019).

Furthermore, privacy can counterpose to safety when pictures, sound recordings and films, taken in order to provide evidence in case of eventual accidents, are mixed with audio information on human individuals moving in the direct vicinity of the robots (Hoffmann & Prause, 2018).

Globally, not considering Europe, the issue of privacy does not seem so crucial. For instance, only a few countries mention privacy in drones legislation (Stöcker et al., 2017).

Overall, legislation on privacy could affect not only new technologies, but also new BMs such as instant-delivery and crowdshipping. For instance, "a company for not having their records in order, not notifying the supervising authority and data subject about a breach or not conducting impact assessment" can be fined until 4% of annual global turnover (Hoffmann & Prause, 2018). Decisions on enforcing, regulating or deregulating privacy could have also an effect on revenues. For instance, relaxing privacy rules would allow governments to obtain personal data from companies and a better tax collection (Frenken et al., 2020).

2.5 Ethics

All the emerging technologies, due to the disrupting impact on society, should be built upon ethical guidelines grounded in fundamental ethical and legal principles, such as dignity, personal autonomy,

[10] Privacy by default means that data controllers have to implement appropriate and technical measures in order to ensure that, by default, only personal data necessary (and at the necessary amount, period of storage, and accessibility) for the respective specific purpose of processing are processed (Hoffmann & Prause, 2018).

justice, responsibility, solidarity, and beneficence. These concepts can be grouped in the issue of corporate social responsibility if we refer to companies.

Even if early research claims improvement in terms of reduction of externalities (mainly emissions and accidents) and employment rate growth, it will be vital to establish a coherent metrics in order to publicly demonstrate the societal benefit of such technologies or BMs (e.g safety, employment for CAVs).

Hence, regulation (soft and hard law) have to address the ethical obligation for researchers, Policy Makers and manufacturers and deployers to maintain a scientifically sound and critical approach in this respect (Horizon 2020 Commission Expert Group, 2020).

Instead, if some BMs showed negative effects (in terms of employment, equality), rulemaking has to figure out solutions following ethical principles.

For example, Policy Makers are looking for regulatory solutions to address the problem of low level of labour protection in the gig economy and inequalities' effect that it creates (inequality between companies of the sector and between sector of workers). Policy Makers have to balance these negative effects with positive effects, namely, lower prices, environmental benefits, convenience, flexibility, and opportunities for work and income (Frenken et al., 2020). Furthermore, Policy Makers have to consider also unintended effects of their regulations (e.g. closure of matching platform can foster anonymous peer to peer platform; create a third labour category could drop a person from employee status to a worse working condition (Frenken et al., 2020)).

In some cases (e.g. CAVs), regulations can move up negative effects of some aspects of new technologies related to inequality (e.g. harm exposure ratio for CAVs), discrimination (e.g provision of a services algorithm biased by ethnicity considerations), privacy (e.g. who should be granted rights over data that concerns various people simultaneously?), moral dilemmas (e.g. who save in a CAV's crash?) and culpability dilemmas.

For CAVs, new regulations should consider (Horizon 2020 Commission Expert Group, 2020):

1. Develop and deploy CAVs to reduce strong disparities in harm to exposure ratio (ibidem).
2. Explore acceptability of CAVs behaviour in dilemmas based on adherence to principles of risk distribution.
3. Identify contexts and appropriate actions in situations where CAVs may contravene traffic rules.
4. Engage with the public in an inclusive process on CAVs behaviour in dilemmas.
5. Develop ethical and legal guidelines that protect individuals' rights at the group level.
6. Establish independent bodies to analyse data, algorithmic and machine learning bias and deduce standards and good practice recommendations, enforced by regulation.
7. Develop industry standards around algorithmic inference addressing ethical data sharing, transparency and business practices and protecting informational privacy and informed consent.
8. Establish institutions that continuously monitor, evaluate, and steer CAVs manufacturers and deployers in relation to non-discrimination and inclusion.

9. Encourage and undertake further research on explainable AI, and fairness, accountability and transparency in algorithmic systems.
10. Ensure the development and deployment of methods for communication of information to all SHs, facilitating training, AI literacy, as well as wider public deliberation.
11. Create a system of education and accreditation for CAVs developers and promote ethics programmes in engineering curricula combined with citizen education on the obligations of different SHs, including users of CAVs.

Nowadays, legislation on new technology that fully considers ethic principles does not exist.

However, a few examples of soft law are presented (e.g. Germany) in form of voluntary recommendations or guidelines. Furthermore, some States are creating AI guidelines and committee to examine some ethical aspects. Japan, Korea, Singapore, UK and China, for example, are creating design and testing methods to mitigate bias and discrimination from AI (Lim & Taeihagh, 2019).

2.6 Enablers and barriers

This concluding section includes elements enabling or cramping innovative and integrated solutions aimed at minimising the negative impact of urban logistics.

2.6.1 Enablers

In this deliverable, the main solutions are grouped by four categories, namely:

1. Delivery locations, modes and time
2. LUAs management
3. Consolidation
4. New technologies

A different set of measures (regulatory, governance, technologic, natural), with a different weight, can contribute to fulfil the logistic solutions described above.

Solutions related to delivery locations, modes and time have already quite consolidated BMs in the majority of the cases. The extent and the set of incentives depend also on social acceptance, the maturity of the BM and the numbers of the actors involved.

For this reason, incentives are not really necessary for parcel lockers and pick-up points which do not require a high number of actors, are quite consolidated as a logistics solution and do not have social acceptance problems (Cagliano et al., 2020). These technologies rely on “natural” incentives such as the size of the market, density of the neighbourhood, presence of nodes and corridors (Morganti et al., 2014). These factors impact on the possibility to reach a critical mass in order to have profits (in the case of parcel lockers is crucial due to high fix costs (AGCOM, 2020)). Furthermore, parcel lockers need also that consumers are willing to use them, several agreements with e-commerce retailers (ibidem) and places accessible h24 (Zurel et al., 2018). In conclusion, the success of these logistic schemes depends on proper utilisation of element present in the existing and emerging BMs.

By contrasts, crowdshipping, defined according to the definition of Simoni et al. (2020), and night delivery are not consolidated solutions and could have social acceptance problems. For this reason, an incentive could be based on a bottom-up approach involving all SHs in every phase of the implementation of the BM instead of a “decide and defend” syndrome (Gatta et al., 2019). Such cooperative approach is based on participation, necessary to create a sense of ownership and consensus-building, and SH engagement that reaches its climax in formal and informal initiatives such as freight committee, Freight Person at key Agencies, freight quality partnerships. In this stance, knowledge sharing is the key enabling factor.

Associate the night delivery with an UCC could be another enabling factor (ibidem). Summarising, it is possible to say that cooperation is a key enabler of such solutions.

As far as LUAs concerns, the high number of actors involved and the problematic acceptability urge to regulatory and cooperative initiatives. Technology can act as an enabler too as highlighted by the project undertaken in Seattle to geo-reference public and private areas (Goodchild, 2018). For LUAs it is crucial to mix regulatory measures with cooperative initiatives so to raise the awareness of the participants. In Washington, for instance, a fee was applied on LUAs that initially drew hostility from hauliers, but once accepted, led to a 50% decrease in double-row parking as hauliers noticed the time and safety benefits of the unloading area. Such a policy, as suggested by the report of Lee (2020), could be even more effective if it was accompanied by an increase in off-the-road parking and a reduction in parking time at the kerbside. Overall, considering the issue from a broader perspective, policy could limit the use of cars as a means of transport for commuting, improving the overall availability of parking. Evangelinos *et al.* (2018) show the possibility of an increase in available parking spaces through the monetization of the company parking space, in particular through the reward equivalent to the monetary value of parking in case of voluntary renunciation of the parking space.

As far as consolidation concerns, due to the high number of players and the low social acceptance, only a set of different measures can support them.

The first helping element for all the solutions related to the consolidation, in this case, is the monetary incentive due to high starting costs (Akgün et al., 2020). Other key factors for the take-off of such solutions are regulatory, governance-based and cooperative.

According to the literature, successful regulatory measures for UCC can be the definition of a strict time window combined with weight access restrictions (Ralf & Friedrich, 2018), the requirement of a certain number of goods to be unloaded per delivery, the obligation to use the UCC and the requirement to separate out tenders for product and delivery costs (European Commission, 2016).

Cooperative measures are the last set of enabling factors for UCC. Overall, only a wise mix of proper BMs, cooperative approaches and suitable regulations can act as enablers for this solution.

EV-based solutions require a large set of incentives too (Taefi et al., 2016):

1. A subsidy to the purchase price of the freight EVs (ibidem)
2. Fiscal depreciation of 50% in the first year after purchase
3. A subsidy to the implementation of freight EVs by offering tax incentives

4. Non-monetary incentives (exclusive access to LEZ/LEZ, extended delivery windows, preferential lanes or parking or exclusive LUAs) (Transport Decarbonisation Alliance (TDA) et al., 2020)

However, EV-based solutions rely especially on governance and cooperative solutions. Good governance has to align policies across different levels of government, establishing a common approach or common principles for the zones in order to create predictability that helps companies make the business case for zero-emission solutions. "Cities, in particular, play a key role as facilitators and can convene multiple SHs to ensure a charging infrastructure network that works for all classes of freight vehicles" (ibidem). As far as FCEVs concern, California is an example of best practice. Local government intervenes through a large set of incentives and regulations (Trencher, 2020):

1. Regulation to mandate a minimum share of ZEVs sales
2. Government grants for station construction
3. Government and industry coordination of refuelling network
4. Market incentives to provide operating revenue
5. Government grants to support renewable hydrogen production and legally mandate minimum share (33%) of renewable hydrogen content
6. Co-ordination of industry and government activities via public–private platforms
7. Public vehicle demonstrations

Another group of emerging solutions involves new technologies such as drones, droids and CAVs. In this case, entrepreneurs have not yet evaluated the profitability of such businesses as the introduction of these technologies is relatively recent. Therefore, main incentives are governance-based: funding and cooperation with Policy Makers and other relevant SHs are the key ones. These could foster data-sharing and other sharing of best practises.

Other remarkable incentives could make it possible further advancement in the technology in terms not only of competitive advantage but also of safety and cybersecurity. Overall, being at the initial stage of their technological development, regulations and cooperation can be the most relevant enablers for these new solutions.

2.6.2 Barriers

Several barriers affect all the solutions described above. There seem to be more barriers than incentives, since the former comprehend also infrastructural and spatial factors and suffer legislative uncertainty and gaps.

Solutions related to delivery locations, modes and time suffer mainly spatial barriers and, to a lesser extent, regulatory and, in particular, administrative barriers. By contrasts, uncertainty of laws and social acceptance affects, respectively, instant delivery and night delivery.

Starting from delivery locations, the space, having an effect on drop density and thereby on returns, is a significant barrier for parcel lockers and home delivery as the low density of such solutions in the rural area proves (Morganti et al., 2014). Administrative barriers, instead, such as the lack of standardised rules for the edification in public spaces (AGCOM, 2020) can limit the rise of parcel lockers.

The nature of the previously mentioned potential legal barrier affects the future of the instant-delivery as we know it today: modification of employment status of "riders" and tax regimes could hit returns of gig economy's entrepreneurs and reshape the BM (Dablanc et al., 2017; Koutsimpogiorgos et al., 2020).

Overall, regulatory issues could be the main barriers to these two solutions.

As regard night deliveries, the main hardship is the lack of acceptance of the model by retailers, carriers and citizens (Gatta et al., 2019). Cooperation between SHs, therefore can act as an enabler as well as a barrier.

Similarly, LUAs solutions are not always implemented for the opposition of certain SHs (e.g. citizens), in particular, parking pricing and the creation of new LUAs. Furthermore, bad management of urban planning, namely, urban land-use codes, ordinances, and regulation, including zoning, can reduce the space for urban logistics, making new solutions not effective or very difficult to implement.

When it comes to consolidation solutions, there are mainly infrastructural and governance barriers.

For instance, UCC, in order to be a sound BM, need collaboration between SHs that have heterogeneous preferences (Akgün et al., 2020). Location of UCC is another barrier to such solution. Overall, although there is nowadays a better insight into UCC'S BMs, cooperation is still missing and represents a huge barrier.

As far as EVs are concerned, barriers can be infrastructural, technological but also due to cooperation issues. In the first place, similarly to UCC, space for logistics in good sites, especially city centres, is pivotal. In the second place, EVs still suffer technological problems such as lower payload, limited range, limited and expensive after-sales support and high purchase cost. Social acceptance, especially from carriers, can be a hindrance, only, if routes are not predefined. Last infrastructural barrier is the shortage of suitable electric charging stations. However, even supposing to overcome technological gaps, the lack of cooperation limits the share of data and the possibility to understand main drivers of the logistic system (Transport Decarbonisation Alliance (TDA) et al., 2020). In this way, it is very complicated to shape suitable policy for every SH and to overcome their heterogeneous preferences.

The last group of solutions suffer mainly regulatory, infrastructural and governance barriers, in addition to technological gaps.

Regulatory barriers depend on gaps, uncertainty of the law or simply restrictions that delay, stop or make not effective specific trials.

Three examples of the latter category are the huge set of requirements that are needed to make a drone delivery (currently there are only a few pilots all around the globe), the strict conditions to try CAVs in Europe, namely, CAVs are "confined to private streets" and "pre-defined routes" or "restricted to very low speed with a safety driver inside the vehicle (Taeihagh & Lim, 2019) and in the end strict restrictions to walk around the curbside for droids.

Governance barriers, instead, regards mainly the lack of global/regional approach, namely a deep share of vision, strategies, data between industry, research and Policy Makers that imply the lack of standardisation of the procedures on privacy, cybersecurity, safety and ethics (cyberwatching.eu, 2019).

Infrastructural barriers, instead, means for droids and CAVs, lack of V2I systems, road maintenance, support facilities, staging areas and curb modifications, while for droids lack of an U-space (see Section 2.3) that coordinates all unmanned flight and connect it properly with airspace.

Last barriers are linked to the hole or uncertainty of the law that imply a great risk for companies.

Global regulations do not address properly safety, cybersecurity, liability, privacy and ethics theme (see paragraphs above).

Risk of heavy fines for violating privacy testing CAVs or droids in Europe (Frenken et al., 2020), strong civil responsibility for violation of the Traffic Law for drones and droids (Hoffmann & Prause, 2018) could, for example, deter a company to start a new business.

Furthermore, the lack of enforcement of privacy laws (especially in the US), not addressing safety and cybersecurity risk, and the elusion of ethic-relevant matters could easily undermine public acceptance.

3 Categorisation of the LEAD Value Cases

A value case "aims to collaboratively define the full value of a transition, and to support meaningful futures for the system" (Van Scheppingen et al., 2012). In LEAD, city logistics solutions are represented by a set of value case scenarios addressing the requirements of the ODE, while aligning competing interests and creating value for all different SHs. Each value case will combine a number of measures – the so-called LEAD Strategies.

In this section, the findings of Section 2 are applied to the LEAD Value Cases, to provide them with functional elements for the development of the local policies and the application in the various local contexts. For each Value Case, the correspondence with the innovations and solutions identified in the review is established. Moreover, a matrix synthesises the knowledge derived from the analysis of existing and emerging BMs, governance and ethical, private and regulatory requirements pertaining to each of them.

The findings of Section 2 are useful for highlighting critical issues, aspects to be considered and tools available to LEAD LLs when they develop BMs and governance and participation schemes with local SHs for their respective Value Cases.

For example, it is important that the BMs of both existing and emerging solutions take into account not only economic but also social and environmental sustainability. Only this approach allows to internalise the actual costs, both for the business and for the community, and unveil possible distortions. As regards SH cooperation, the literature analysis highlighted the heterogeneity of preferences of the SHs as a key influencing factor of the decisions making process, as well as horizontal competition among couriers (opposed to and vertical cooperation between logistics and transport operators, traders and citizens). The LLs have created a Community of Practice and will have to take these risks into account while favouring a constant dialogue between different actors and competitors. An overview of the regulation, privacy and ethics requirements that have emerged in the implementation of other similar solutions will help LL owners to integrate these aspects into their Value Cases.

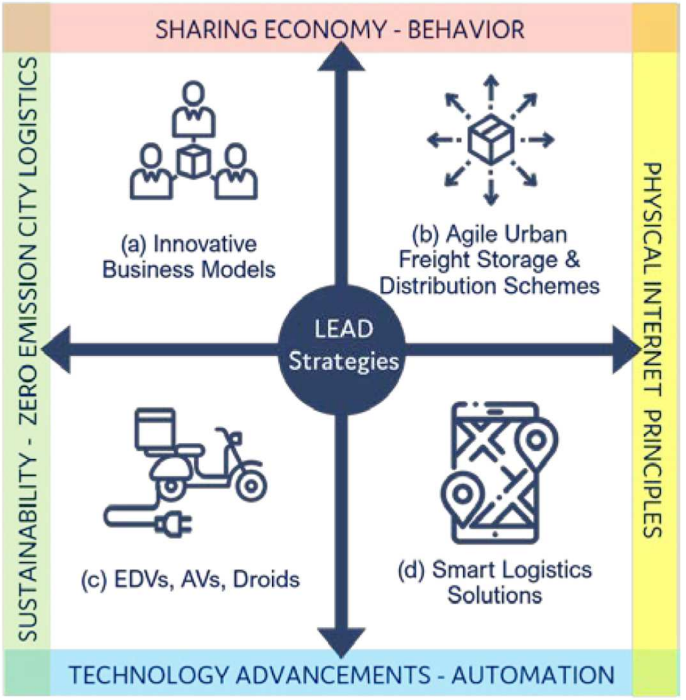
LLs owners were asked to refer to Section 2 to populate the fiches related to their Value Case (Section 3.2). This exercise is intended to immediately identify the key elements to be taken into account for the deployment of the Value Case, anticipate any risks, and share enablers and barriers between the different LLs in a schematic way, to facilitate peer to peer exchange within the project.

3.1 Description of LEAD value cases

This section provides a general description of LEAD value cases Each LL covers a different region with distinct logistic profile characteristics, and diverse business and urban planning challenges. The LEAD value case scenarios will incorporate opportunities for shared, connected and low-emission logistics operations by considering four innovation drivers: i) Sustainability - Zero Emission Logistics,

ii) Sharing Economy and behaviour, iii) Technology Advancements and iv) the emerging Physical Internet (PI) paradigm[11].

Figure 5 - LEAD Strategies and Innovation Drivers



[11] The PI aims at realising full interconnectivity (information, physical and financial flows) of several (private) freight transport and logistics services networks and make them ready to be seamlessly usable as one large logistics network. PI concepts applied to urban logistics will ultimately lead to an optimised specification for the location and capabilities of 'city PI eco-hubs' and the use of low emission, connected and automated delivery vehicles.

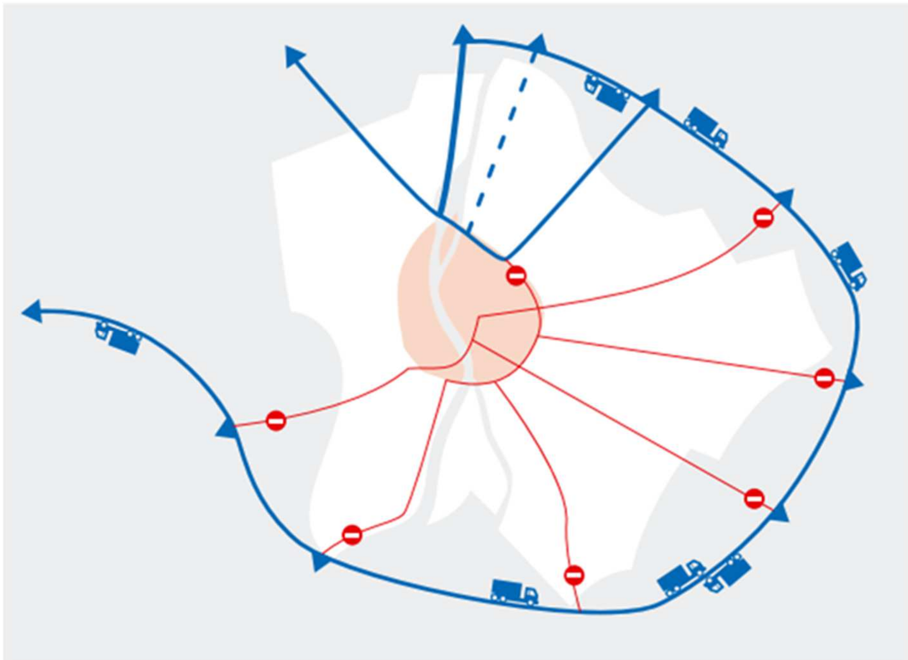
3.1.1 Budapest

Budapest will work on spatial planning of the inner-city loading areas to provide solutions and to quantify the different effects of e-mobility on transportation scenarios. In Budapest LL, the aim is to produce evidence to prove the necessity of UCCs in the city. In reference to the SUMP, this will support local decision makers with contextual investigations of scenarios and solutions. New Key Performance Indicators will support the quantitative assessment of local objectives. Once evaluated and selected, a set of solutions will be tested in operating environments, based on prototype solutions, innovative regulations and governance schemes. Among the options to be specified and qualified, there are a local distribution centre, distributed pick up services, concierge services, access control, delivery bay booking, global parking strategy.

The following elements will be explored:

- **Advantages of UCCs**, in terms of optimal distance from endpoint and impacts of UCCs on air quality and the environment.
- Digital Twin interaction with existing **macroscopic transport model** for the improved assessment of UFT.
- Assessment of **inner-city UFT demand and practice**, to be able to make suggestions for policy refinement in certain cases (e.g. for off-peak hour deliveries, development and assessment of loading area policy and regulation and also for establishment and usage, based on citizens user demands and needs).
- **Impact of freight vehicles** from UCCs **on the environment and traffic**.

Figure 6 - UFT Strategy Map

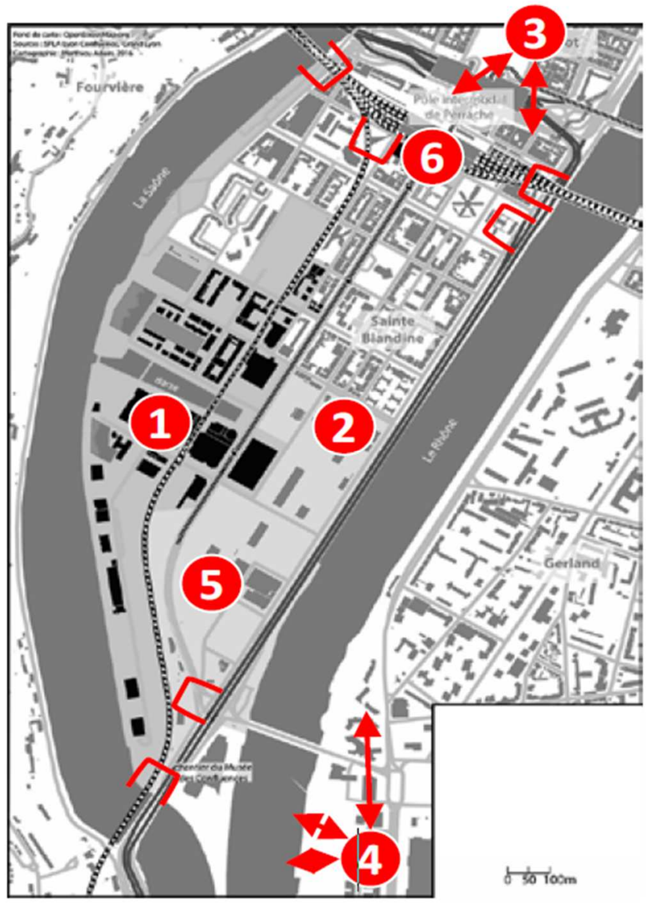


3.1.2 Lyon

In Lyon, the exploration of last-mile distribution models will be based on soft modes and/or autonomous vehicles. Framework conditions will be defined to deploy an urban logistic platform in an underground parking. Moreover, freight traffic flow qualification will support the detection of freight vehicles through video cameras. As for these cases, the following elements will be explored:

- Equip the urban planning team with a **decision support framework** to better evaluate the implementation of various logistic solutions.
- Implement a robust and **flexible logistic infrastructure** to support innovative solutions.
- **Leverage public policies** to cope with socio-environmental objectives.
- Promote **partnership governance**

Figure 7 - Lyon testing sites



3.1.3 Madrid

In Madrid, the project will transform part of a parking lot into an UCC. The LL will address real freight movement problems deriving from potential traffic restrictions to be enforced, by simulating and demonstrating the use of an UCC, along with other mini centres and lockers, to deliver/pick up freight, using electric cargo bikes and vans. The UCC will be located in the city centre, within 'Madrid Central' area (the LEZ), and also close to the M30 ring road, which belongs to the TEN-T. The following elements will be explored:

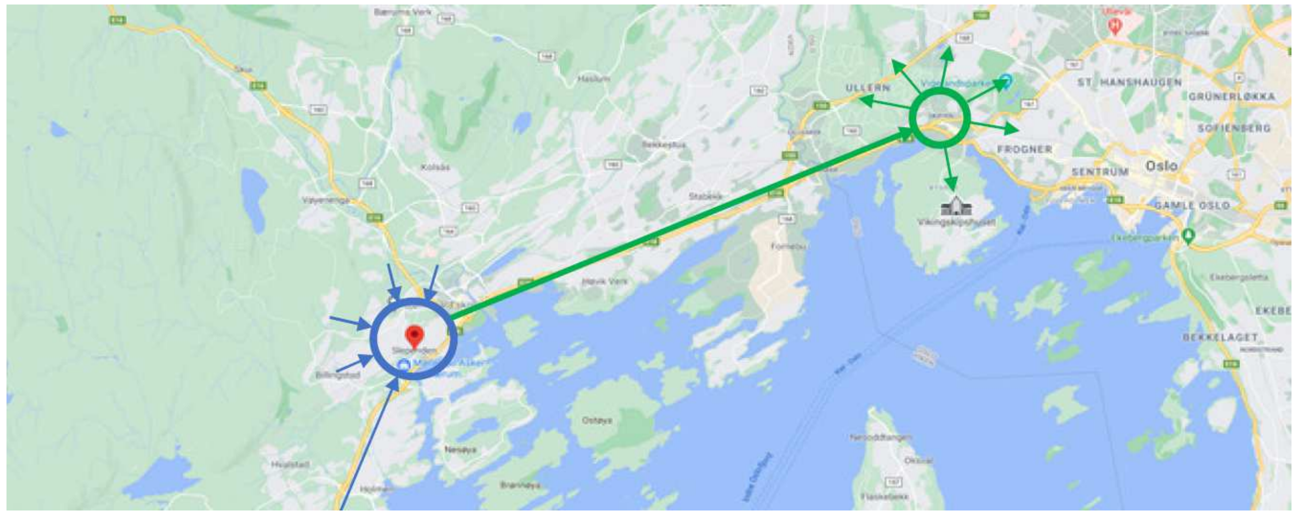
- Demonstrate the **better efficiencies** in using an UCC to deliver to and within the city centre.
- Assess flows and congestion **route optimization engine** in many to many and many to one scenarios, combining vehicles of different fleets.
- Improving environmental indicators.
- Explore **alternative (and sustainable) BMs.**
- **Public-private cooperation mechanisms** identifying new ideas for cooperation and evaluating the costs and benefits of implementation.
- The economic **efficiency and reliability** for courier companies, and henceforth for clients, of using the LEAD strategies compared to conventional freight delivery approaches.
- Explore potential **economic incentives.**
- **Data management.**

Figure 8 - Madrid Central LEZ and M30

3.1.4 Oslo

The Oslo case will explore various design on home deliveries of mostly larger items in urban areas, with a focus on non-dedicated trips made by the crowdshippers' own vehicles and if possible combined with crowdshipping through the mass transit network[12]. Crowdshipping comes in addition to efficient dedicated distribution with zero-emission vehicles. The value case concentrates on B2C and home-deliveries representing the most preferred option from a consumer's perspective. It considers, at least, two locations, namely Slependen west of Oslo CBD (Figure 7, left circle) as an origin and consolidation point, combined with a mobility hub at Skøyen close to the Oslo CBD for splitting and final distribution (Figure 7, right circle). The distance between these locations is 12 km. The flexible service envisaged involves a pre-determined sequence of operators, namely: commuters, Nimber community members and regular logistics operators (trade-offs between costs and reliability issues).

Figure 9 - Oslo testing sites



The following elements will be explored:

- **BM** financial viability and benefits from a **social/environmental** perspective.
- Senders'/bringers'/receivers' preferences for **alternative delivery service concepts**.
- The interplay between demand and relevant **supply design of crowdshipping services**.
- A possible role for parcel lockers to enhance **delivery/pick-up flexibility.** However, at the outset, the location of a mobility hub close to the customers combined with a dense network of bringers will be used for true on-demand delivery of mostly larger items.
- The economic, financial and environmental potential for a green **crowdshipping service**.
- The **integration of data modelling** (Discrete Choice Modeling and Agent-Based Modeling) with real-market data to support a Digital Twin approach.

[12] The original set-up was with crowdshipping of smaller items through the mass transit system, but the set-up had to be adjusted after an initial pilot study among SHs that revealed a strong competition and low rates for shipments of such parcels through ordinary parcel delivery services.

The Oslo LL will be designed around the mobility hub at Skøyen where the neighbourhood will be exposed to the activities and where most of the customers will live relatively nearby.

3.1.5 Porto

In Porto, SONAE will explore the possibility of turning retail stores into EV charging stations. The capillarity and convenience of retail stores networks (in Portugal, Sonae MC operates +700 stores), provides a possibility of using them as B2B and B2C electric charging docks. This creates an advantage in the expansion of such grids and sustains a business case that mixes energy distribution, retail, logistics and transportation, leveraging and integrating synergies from all markets. The following elements will be explored:

- The **optimisation of delivery routes for EDVs**, taking into consideration the potential grid of **EDV charging stations**.
- **EDV's take-up projections** if the grid enables mass adoption.
- The **development of new BMs** (e.g. dynamic pricing, incentives research, cost optimisation, demand forecast, emissions and supply planning).
- Leveraging Sonae's digital platform to **capture additional e-commerce growth, with new services to consumers**.
- **Last-Mile optimisation for e-commerce** deliveries based on PI principles.

Figure 10 - SONAE retail store

3.1.6 The Hague

The Hague will integrate last-mile logistics with demand-supply matching platforms: the mission is to connect shared freight movements around mobility hubs via a digital freight fulfilment platform. This will be applied in a Central Innovation District (CID). The following elements will be explored:

- The potential of **integrating crowdsourcing** in last-mile urban deliveries.
- **Evaluate the effectiveness of crowdshipping** to meet the growing expectations of customers for faster, more personalised, and cost-efficient delivery services.
- **BMs, challenges** and success factors for new players in the industry.
- New digital service platforms with algorithms that allow the **interconnection of crowdsourcing services.**

Figure 11 - The Hague CID

3.2 Categorisation of the LEAD value cases

The first step (D1.1) carried out an analysis of the factors (strategic, regulatory, business, technology) influencing complex city logistics systems in the era of ODE, backed by a consolidated survey of current needs, trends and challenges of last-mile logistics.

LEAD will define a set of innovative BMs with a view of optimising last-mile logistics in response to the challenges posed by ODE (e.g. the lack of space for logistics facilities).

Section 2 carried out a review of business and governance models, as well as regulatory, privacy and ethics requirements. In this section, LEAD LL owners identify, for each value case, how these are reflected in practice in their local contexts, and for each value case that will be developed.

In particular, for each Value Case a "fiche" has been created that reflects the elements identified in Section 2, and LL owners have been asked to fill it on the basis of the Value Cases as they have been conceived so far. The "Category" item refers to D1.1, which has collected, reviewed and categorised innovative and integrated solutions: LL owners have been asked to identify the category to which their Value Case(s) belongs. For the other items, they highlighted the most relevant aspects of their Value Cases, taking inspiration from the elements provided by the analysis of the literature in Section 2.

3.2.1 Budapest

Table 2 - Budapest LL

LEAD Value Case	Budapest
Category (from table 1)	UCCs (Cross-dock facility), Delivery times.
Existing or emerging business models	Development of new BMs for new solutions and measures, such as dynamic pricing, incentives research, cost optimization, demand forecast, emissions and supply planning.
Stakeholder cooperation, Governance model, PPP	Close cooperation and partnership between the Policy Makers, the logistic service providers, the energy providers, urban public road operator and shop owners.
Regulation requirements	Freight transport weight restrictions (access permit system), e-charging network usage regulation, usage of public space for loading and charging. Innovative and green delivery vehicles have to operate under a legal, regulatory framework, enabling low emission alternate technologies, incentivising particular shops deliveries timing options.
Ethics requirements	Working conditions of drivers/riders.
Privacy requirements	Data handling, with new services to consumers and retailers, should be GDPR compliant.
Enablers	The Budapest LL participants are all well involved and including all the relevant parties interested in the developing UFT logistics and environment. The pilot mixes objectives for Policy Makers, energy distribution, retail, logistics and transport, leveraging and integrating synergies.
Barriers	Positioning the minihubs. Financing of new systems. Load limitation of smaller e-vehicles. Charging time duration and infrastructure for e-vehicles (number of charging stations available at one location)

3.2.2 Lyon

Table 3 - Lyon LL

LEAD Value Case	Lyon
Category (from table 1)	Loading and unloading area management: micro-depot. Delivery modes: cargo bikes, small EVs, small autonomous vehicles.
Existing or emerging business models	Exploration of the framework for new BMs on new solutions and measures, such as dynamic pricing, regulation and incentives, cost optimization, demand forecast, emissions and supply planning.
Stakeholder cooperation, Governance model, PPP	Cooperation scheme between pilot SHs (SPL Confluence and LPA) and a last-mile logistic operator. Provision of access to the logistic hub.
Regulation requirements	Exploration of the needs for new regulation: extension of the LEZ, timely restricted accesses, booking of delivery areas. Authorisation to experiment with autonomous vehicles.
Ethics requirements	For the operators which do not own the fleet, it works with external logistics partners. Check the working conditions of drivers/riders.
Privacy requirements	Operators' digital platform to capture additional growth, with new services to consumers should be GDPR compliant.
Enablers	Provision of a logistic hub area (underground parking). Collaboration with local shops and economic SHs.
Barriers	Accesses to the underground parking (2.30 m max). Budget to support the experimentation phase. Cost factor for operators. Market share of existing operators. Autonomous vehicles experimental authorisations.

3.2.3 Madrid

Table 4 - Madrid LL

LEAD Value Case	Madrid
Category (from table 1)	UCCs
Existing or emerging business models	Development of BMs on new solutions and measures, such as agreements between public and private SHs, incentives such as increasing time delivery windows, cost optimization, demand forecast, emissions and supply planning.
Stakeholder cooperation, Governance model, PPP	PPPs for setting consolidation centres. Learnings about optimization of routes to be used for both private SHs and public administrations (for better planning).
Regulation requirements	No major changes are foreseen.
Ethics requirements	No specific requirements are foreseen.
Privacy requirements	Retailers and shippers are GDPR compliant concerning services to consumers.
Enablers	Density of clients in the area. Short distances within the area. Clear environmental benefits – alignment with city strategies. Reduced upfront cost for the deployment, as EMT is the owner of parking facilities that can potentially become consolidation centres.
Barriers	Rental costs (beyond project life limits). Lack of availability of publicly owned locations, and structural limitations of those available (entry gauge and manoeuvrings). Huge diversity of shippers/delivery companies.

3.2.4 Oslo

Table 5 - Oslo LL

LEAD Value Case	Oslo
Category (from table 1)	Delivery mode: Crowdshipping, dedicated trips, e-van and e-car-to-door (zero emission). Delivery locations: Mobility hubs, possibly parcel lockers, car-to-door on-demand morning until late evening. Consolidation: UCCs New technology: Apps for bringer network communication, Machine Learning can possibly be researched as data builds up.
Existing or emerging business models	Development of new BMs to exploit economics of scale, scope and density, e.g. by consolidating longer-haul deliveries outside of Zero Emission Zones (ZEZs) and bring it efficiently to the end customers with zero emission vehicles. Including return logistics in this scheme could be considered by using the mobility hub. Adding value-added services like assembly of items could be considered. Designing the home delivery services based on consumer preferences for flexibility and reliability. Use the flexibility and planning opportunities that are embedded in the use of a mobility hub to meet end-customer needs. Flexible and dense distribution models are sought for with a modest need for forecasting. The potential for crowdshipping will be investigated.
Stakeholder cooperation, Governance model, PPP	Partnership with private and public entities for setting up and running the mobility hub. Involve the citizens when setting up the home delivery services to exploit potentials for involving different groups and to stimulate local community cooperation (e.g. "Paadriv" initiative at Bjerke, Oslo, where NIMBER has been involved). Working with NIMBER members and regular logistics operators when detailing the operations in the 4 scenarios. Cooperating with other urban freight initiatives if involving parcel lockers as pick-up/delivery points. Cooperating with related H2020-project ULaaDs in developing the evaluation of the 4 scenarios.
Regulation requirements	Innovative and green delivery vehicles have to operate under a legal, regulatory framework to avoid accidents and traffic congestion (e.g. affecting protected bike and bus lanes). Deliveries have to comply with the urban ZEZs. Home deliveries have to comply with general regulations concerning e.g. night-time operations, noise, etc.
Ethics requirements	The operations have to comply with sound working conditions for the bringers.

Privacy requirements	The digital platforms used should be GDPR compliant.
Enablers	High density of end consumers in the vicinity of the Skøyen mobility hub. The City of Oslo participates as an enabler for securing contacts and facilitating/solving practical issues. The businesses involved as suppliers have a regular flow of items allowing for regular services in all Oslo LLs four scenarios. This flow allows for base case comparison and impact assessment and reliable research on consumer's preferences (the business cases in question are fairly well known to the public). Scenarios are part of actual testing of BMs and a pre-test with the main business as supplier (IKEA) has been successfully carried out.
Barriers	Positioning of the mobility-hub close to dense residential areas because of scarce land areas. Dealing with ZEZs if conventional vehicles have to be used in order to increase the use of crowdshipping.

3.2.5 Porto

Table 6 - Porto LL

LEAD Value Case	Porto
Category (from table 1)	Mobile depot, and small EVs Delivery locations: customers' homes | Modes: to the electric mobility, considering the electric charging stations' locations that will be deployed in owned warehouses as well as in some stores. Depending on this, the process and flow will be completely different (compared with the one that is currently performed, based on diesel). | Instant deliveries will be explored in the use-case nº2 about food delivery (a new BM). Loading and unloading area management: find the best way and strategy to perform EDV charging. Loading and unloading of goods/products will likely be similar to the current situation. Consolidation: Small EVs (vans and mopeds). New technologies: electric mobility (e.g. electric chargers, a new mindset, new processes, new partnerships, etc.). Data Collection: As a food retailer, all the data needed (e.g. orders, delivery addresses, goods, stocks etc.) are available. However, the three uses-cases about electric mobility will be tested through a new data collection paradigm: Digital Twins based on the electric mobility mindset.
Existing or emerging business models	Development of two new BMs on new solutions and measures, such as dynamic pricing, incentives research, cost optimization, demand forecast, emissions and supply planning, for: 1. Food Delivery (instant deliveries, like a "take-away" with the original brand) 2. Rescheduling (e-commerce new service/BM: to solve important delivery issues in the same day. After the boom of e-commerce, solid delivery service is needed capable of ensuring service quality levels similar to the pre-Covid standards)
Stakeholder cooperation, Governance model, PPP	Partnership with public entities.
Regulation requirements	Innovative and green delivery vehicles must operate under a legal, regulatory framework to avoid accidents and traffic congestion.

Ethics requirements	For the operators which do not own the fleet, it works with external logistics partners. Check services levels, including ethics topics
Privacy requirements	Retailers' digital platform to capture additional growth, with new services to consumers should be GDPR compliant.
Enablers	Capillarity and convenience of retail stores networks (in Portugal Sonae operates + 700 stores). The pilot mixes energy distribution, retail, logistics and transport, leveraging and integrating synergies.
Barriers	Positioning the EDV charging stations. Routing optimization (as they will be related with charging station`s locations as well as with the EDV`s batteries). The cost factor. Load limitation of mopeds and EDVs.

3.2.6 The Hague

Table 7 - The Hague LL

LEAD Value Case	The Hague
Category (from table 1)	Delivery mode: crowdshipping; Delivery locations: parcel lockers; New technologies: platform development for last-mile logistics service integration.
Existing or emerging business models	Development of new BMs for collaborative urban logistics. Development of a platform to integrate companies increasing visibility, information sharing, their market share and efficiency of UFT.
Stakeholder cooperation, Governance model, PPP	Partnerships between private organizations with complementary BMs. The strong involvement of the municipality in the LL will ensure alignment with the city's plans and objectives.
Regulation requirements	Labour force regulatory framework Municipality regulations for use of public space. Liability between partners
Ethics requirements	Crowdshipping does not increase job irregularities
Privacy requirements	Information sharing between platforms without compromising personal or business-sensitive data. Data privacy regulation. Data privacy sharing and security.
Enablers	LL partners experience on integrating service platform development. Participation of the municipality; Participation of SMEs with specialisation of collaborative/shared urban logistics solutions such as open locker business LL in line with planned urban space development (CID) Deployable crowdshipping platform
Barriers	Competition between different BMs Different implementation speeds and needs Data sharing protocols Public space restrictions

3.3 Findings on common enablers and barriers of the LEAD value cases

Each LEAD LL focus on different value cases, which involve different types of SHs and in urban areas that have non-comparable characteristics. This is precisely the added value of the project, that is to test a common approach in heterogeneous contexts.

From the analysis of the last-mile logistics solutions models applied in practice in the LLs' local contexts, however, some common elements emerge, in particular with regard to the enablers and barriers of the applications.

As for the enablers, from a governance and SH cooperation point of view, LL owners consider it essential that the LL participants are all well involved and include all the relevant and interested parties in developing an urban logistics environment. The local authority participates as an initiator of the experimentation or as an enabler for securing contacts and facilitating and solving practical issues. In addition, public authorities can provide logistic hub areas or underground parking facilities that can potentially become consolidation centres, which reduces upfront costs for service deployment.

Participation of SMEs with specialization of collaborative and shared urban logistics solutions creates a proactive environment providing a solution-driven approach. The pilots mix objectives for Policy Makers, energy distribution, retail, logistics and transport, leveraging and integrating synergies, making the project interesting from both a public and private perspective. A common element to the success of the value cases seems to be the deployment of the solutions in densely populated areas, with short distances to cover. This is due to the use, in many cases, of small vehicles.

As for the barriers, a problem of identifying the area for the positioning of the peri-central hubs clearly emerges, due to the scarcity of available space and the high rental rates of suitable locations. In fact, allocating a central area for residential use is much more profitable than for warehousing or cross-docking use per square meter. This could be solved with the use of publicly owned locations, but they are not always available or positioned where it is relevant to operators. Furthermore, often these structures, not initially designed for logistical operations, have relevant limitations, such as entry gauge and manoeuvrings.

As for the use of electric light freight delivery vehicles, there are issues related, on one hand, to the accessibility of the infrastructure charging as well as to the charging time, and, on the other, to load limitations, which can affect the BM and increase travel time thus having a negative impact on traffic.

Authorisations for experimenting autonomous vehicles, data sharing protocols and routing optimization have been also identified as barriers to address for a proper testing environment.

In general, all these trials require specific analysis of the BM from the earliest stages, because the costs for operators can increase rapidly if the solutions are not co-created with them. Furthermore, the urban logistics world presents a huge diversity of shippers/delivery companies, whose needs and interests, sometimes conflicting, must be considered.

4 Actors map and information exchange requirements

This section, by adopting a 'bottom-up' approach for gathering data, provides a mapping of information exchange requirements between heterogeneous SHs within each LL. To facilitate the description and comprehension we have adopted a systematic way of reporting all the data for each LL. More in detail, for each LL, this section reports: (1) a pie chart representing a breakdown of membership per sector distinguishing LEAD partners and non-partners; (2) a table summarising potential information exchanges between SHs in the LL so to provide an initial mapping at the beginning of LL's activities. It is important to underline that, due to the dynamic nature of the pertinent activities of the LLs, where needs, participants, and availability to provide information can change, the information reported in this table might evolve once the LL starts producing its effects on the logistics ecosystems. The table below describes three possible combinations that might characterise the phenomenon at hand.

Table 8 - Example of the matrix for information exchange requirements

Information	Available	Not available
Requested	1	3
Not requested	2	n.a.

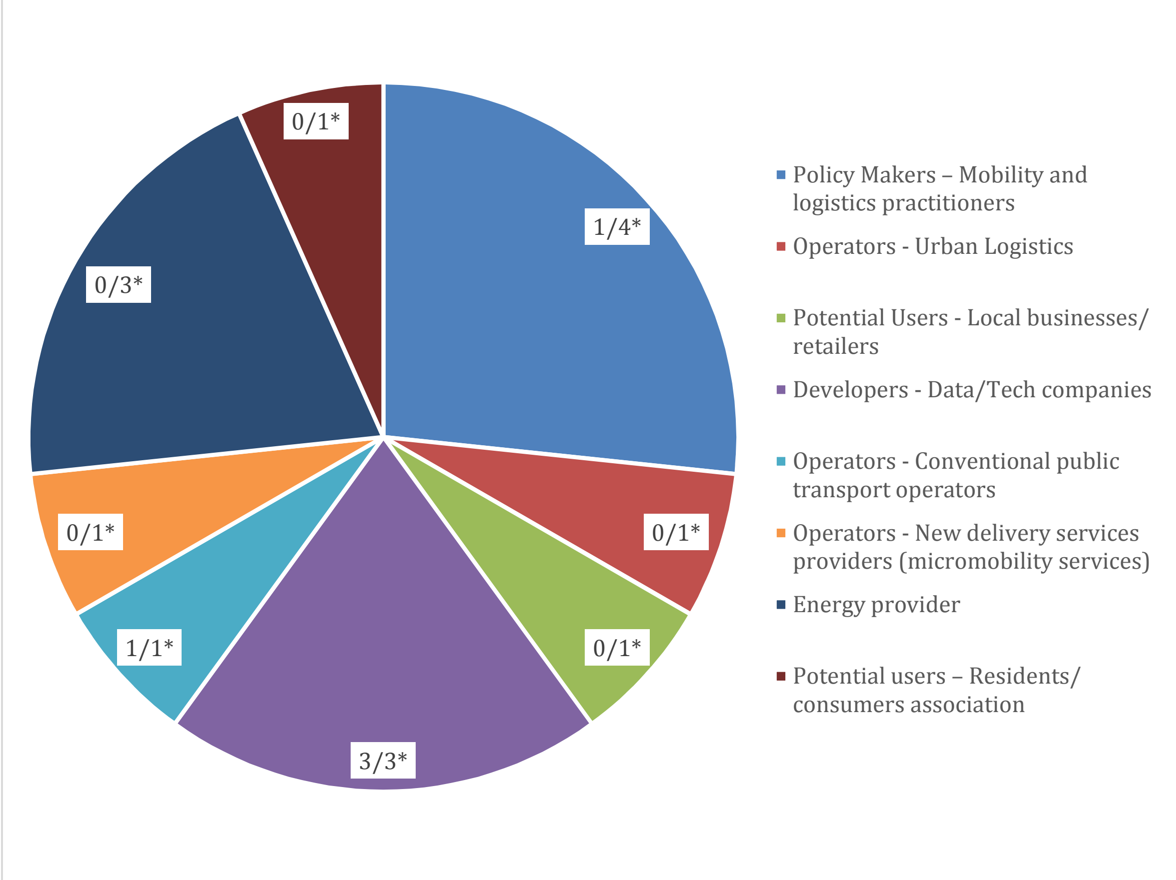
Legend:

1) **Requested and available information** (this applies when given information is both required and available)
2) **Available but not explicitly requested information** (this applies when given information is available but not requested)
3) **Requested but not explicitly available information** (this applies when given information is requested but not available)

4.1 Budapest

This sub-section provides a preliminary mapping of Budapest LL showing both membership and information that participants potentially require and are willing to share.

Table 9 - Budapest LL: actors mapping



* x/y = lead partner (x) out of stakeholders (y) per sector

Table 10 - Budapest LL: information exchange requirements

Data demand and supply	Information on	Supplier	Inquirer
Requested and available information	Acceptance	Residents	Policy Makers (PMs), University
	Cost	New Delivery Service Provider (NDSP)	PMs, University, Operator-Urban Logistics (UL)
	Environmental impact	NDSP, UL, energy supplier	PMs, UL, NDSP, University
	Traffic data (loop detectors, camera data, traffic counting)	Budapest Roads (public road operator)	PMs
	Traffic policy	Mobility Manager	PMs
Available but not explicitly requested information	Number of suppliers	Energy Provider	
	Logistic service provider aspects	UL	
Requested but not explicitly available information	Revenues		PMs, University, UL
	Demand and optimal planning		UL
	In time deliveries Time for delivering Number of failed deliveries		NDSP
	Network electricity needs		Energy Provider
	Population served		Residents
	Number of business served		Business owners

From a preliminary assessment of the needs and willingness to share data, it emerges a match for all data pertaining cost (internal, external) of the operations and traffic data.

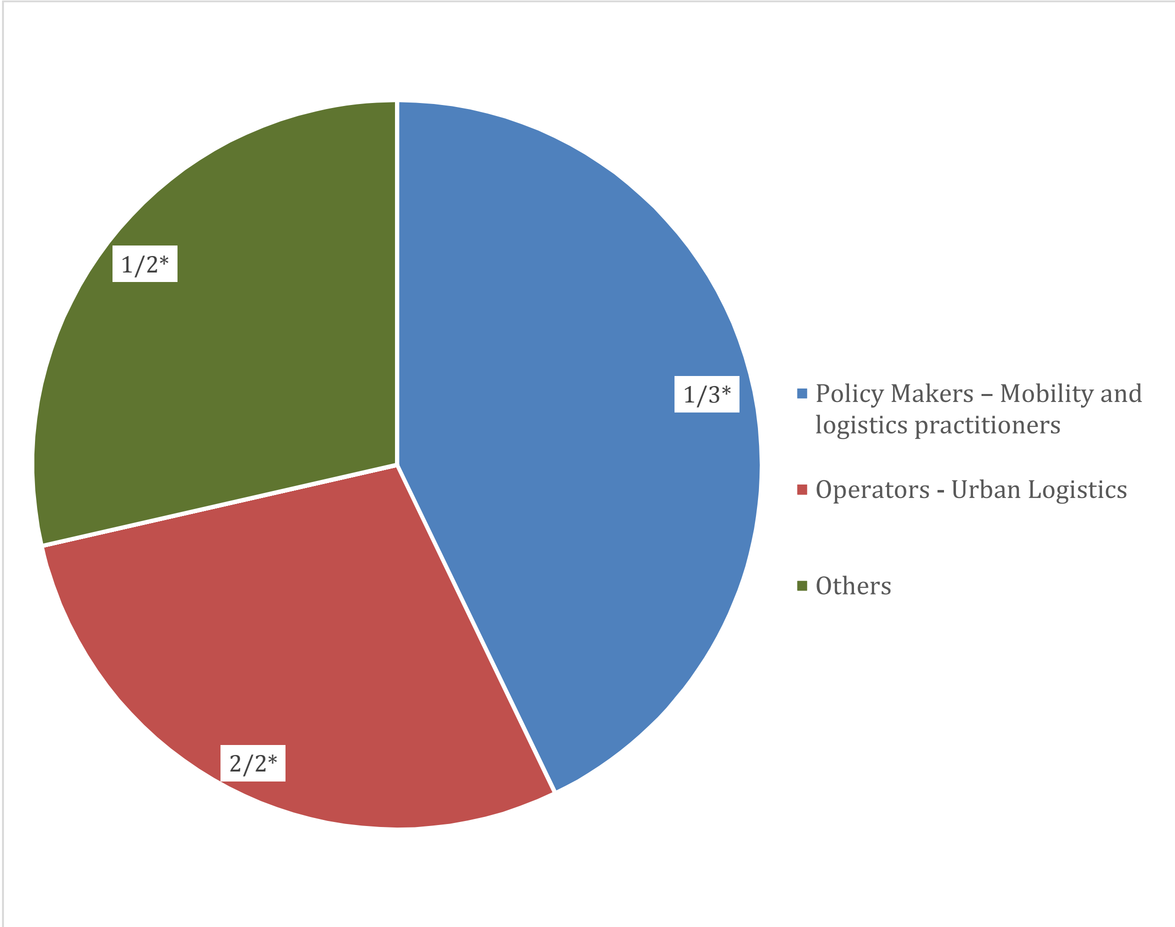
Instead, LL partners could effectively exploit the information on data that SP and the Energy provider are willing to share, notwithstanding no SH has explicitly mention the need for this type of data at this first stage of the LL activities. For instance, NDSP could utilise data concerning the location of the facility structure.

Furthermore, the LL manager should find the most appropriate SHs who can satisfy data demand concerning, e.g., deliveries, revenues, electricity needs.

4.2 Lyon

This sub-section provides a preliminary mapping of Lyon LL showing both membership and information that participants potentially require and are willing to share.

Table 11 - Lyon LL: actors mapping



* x/y = lead partner (x) out of stakeholders (y) per sector

Table 12 - Lyon LL: information exchange requirements

Data demand and supply	Information on	Supplier	Inquirer
Requested and available information	Acceptance	University	Operator-Urban Logistics (UL)
	Simulations and digital twin output	University, UL	Logistics Consultant University
	Logistics and mobility data	Logistics Consultant	University
Available but not explicitly requested information	Metropolitan strategy and policy	Policy Maker	
	Literature review	University	
Requested but not explicitly available information	Customer acquisition Demand and optimal planning Number of trips Number of parcels delivered Number of businesses served Population served Cost		Logistic Research Centre

From a preliminary assessment of the needs and willingness to share data, it emerges a perfect match for all data pertaining feedback from SHs, simulation and digital twin output as well as logistics and mobility data.

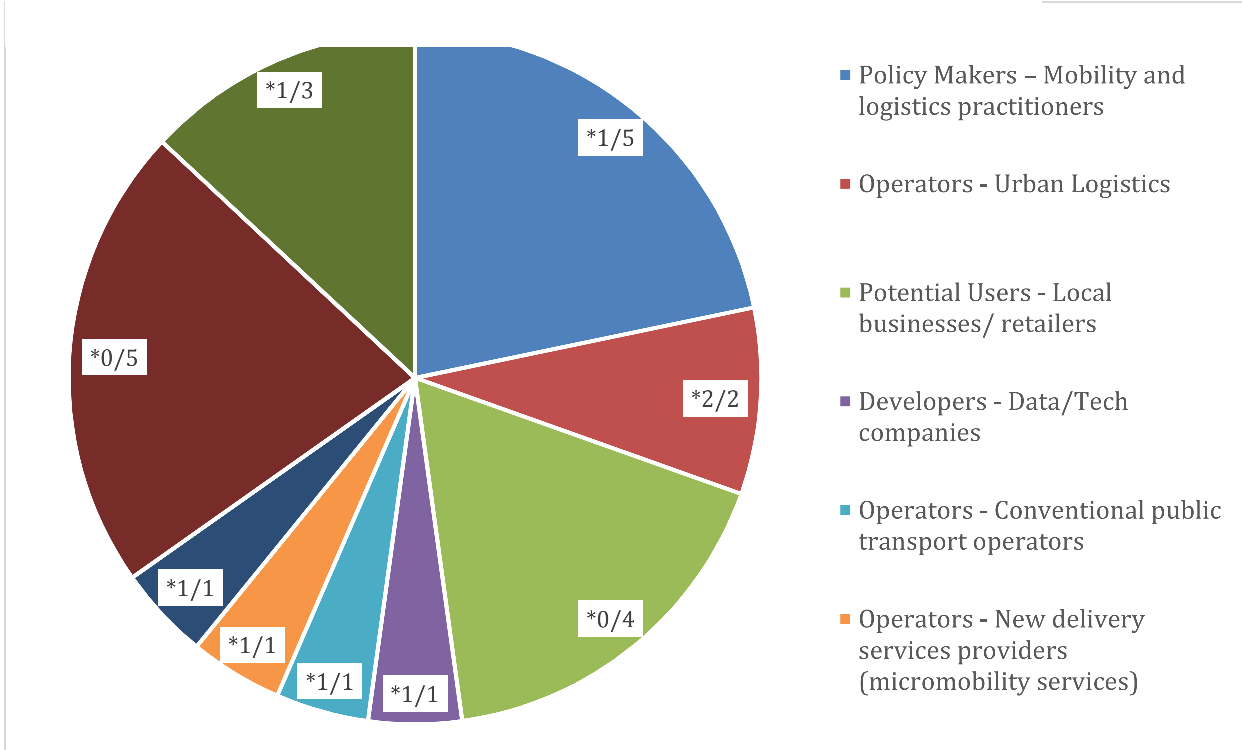
Instead, LL partners could effectively exploit the information on data that Policy Makers and University are willing to share, notwithstanding no SH has explicitly mentioned the need for this type of data at this first stage of the LL activities. For instance, Policy Makers could use information on literature review.

Furthermore, the LL manager should find the most appropriate SHs who can satisfy data demand concerning, e.g., number of trips, number of parcels delivered, number of businesses served. Along this line, it could be useful to involve a last-mile logistic operator within the LL.

4.3 Madrid

This sub-section provides a preliminary mapping of Madrid LL showing both membership and information that participants potentially require and are willing to share.

Table 13 - Madrid LL: actors mapping



* x/y = lead partner (x) out of stakeholders (y) per sector

Table 14 - Madrid LL: information exchange requirements

Data demand and supply	Information on	Supplier	Inquirer
Requested and available information	Cost	New Delivery Service Provider (NDSP)	Policy Maker (PMs), Operator-Urban Logistics (UL), NDSP
	Environmental impact	NDSP	University
	Acceptance	Residents	
Available but not explicitly requested information	Detailed optimised routes information	Developer	
	Knowledge to support in the definition of the new reference models identify data sources literature review	University	
	Location of the facility and capacity Deliveries done Cartographic data	UL	
	Service requirements	Local Associations Policy Maker Resident/Consumer Association Merchant Association	
Requested but not explicitly available information	In time deliveries, Time for delivering, Number of failed deliveries Revenue		NDSP, Developer
	Network electricity needs		Energy Provider
	Impact of stakeholders needs on new BMs		University
	Population served		Resident/Consumer Association
	Returns		UL

From a preliminary assessment of the needs and willingness to share data, it emerges a match for all data pertaining cost (internal, external) of the operations.

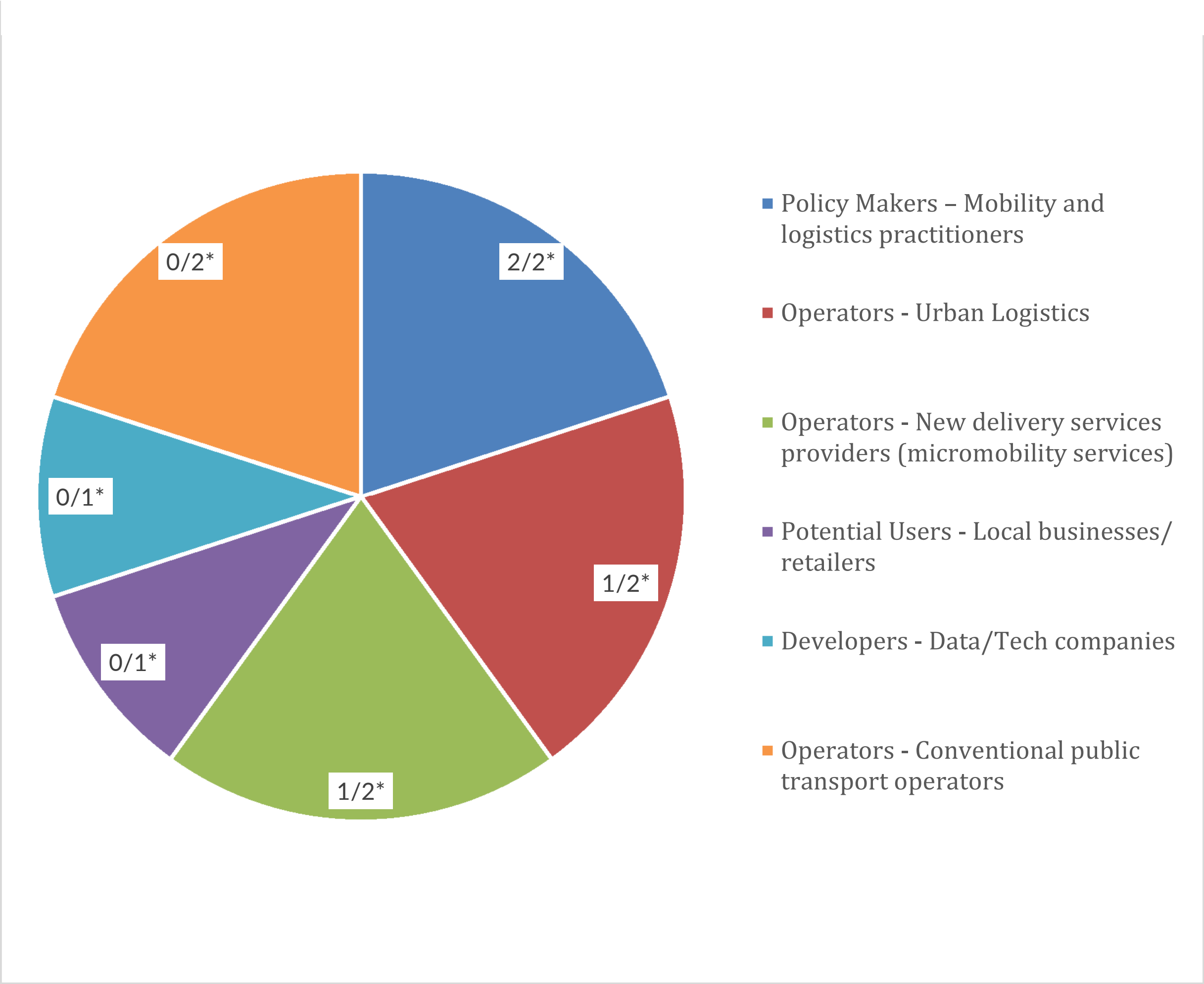
Instead, LL partners could effectively exploit the specific information that Policy Maker, University and urban logistics operator are willing to share, notwithstanding no SH has explicitly mentioned the need for this type of data at this first stage of the LL activities. For instance, NDSP could utilise data concerning the location of the facility structure.

Furthermore, the LL manager should find the most appropriate SHs who can satisfy data demand concerning, e.g., deliveries, revenues, electricity needs, and the impact of the SHs needs on new BMs.

4.4 Oslo

This sub-section provides a preliminary mapping of Oslo LL showing both membership and information that participants potentially require and are willing to share.

Table 15 - Oslo LL: actors mapping



* x/y = lead partner (x) out of stakeholders (y) per sector

Table 16 - Oslo LL : information exchange requirements

Data demand and supply	Information on	Supplier	Inquirer
Requested and available information	Environmental impactUrban freight items characteristics	Operator-Urban Logistics (UL)	Policy maker University
	Crowdshipping potential Expertise/SH behaviour	University	UL
Available but not explicitly requested information	Infrastructure Traffic	Policy Maker	
	Broker experience, management and planning	UL University	
Requested but not explicitly available information	Space for logistic operations		UL
	Senders/bringers database Matching platform adjustment		University

From a preliminary assessment of the needs and willingness to share data, it emerges a match for data pertaining to travel patterns and crowdshipping behaviour.

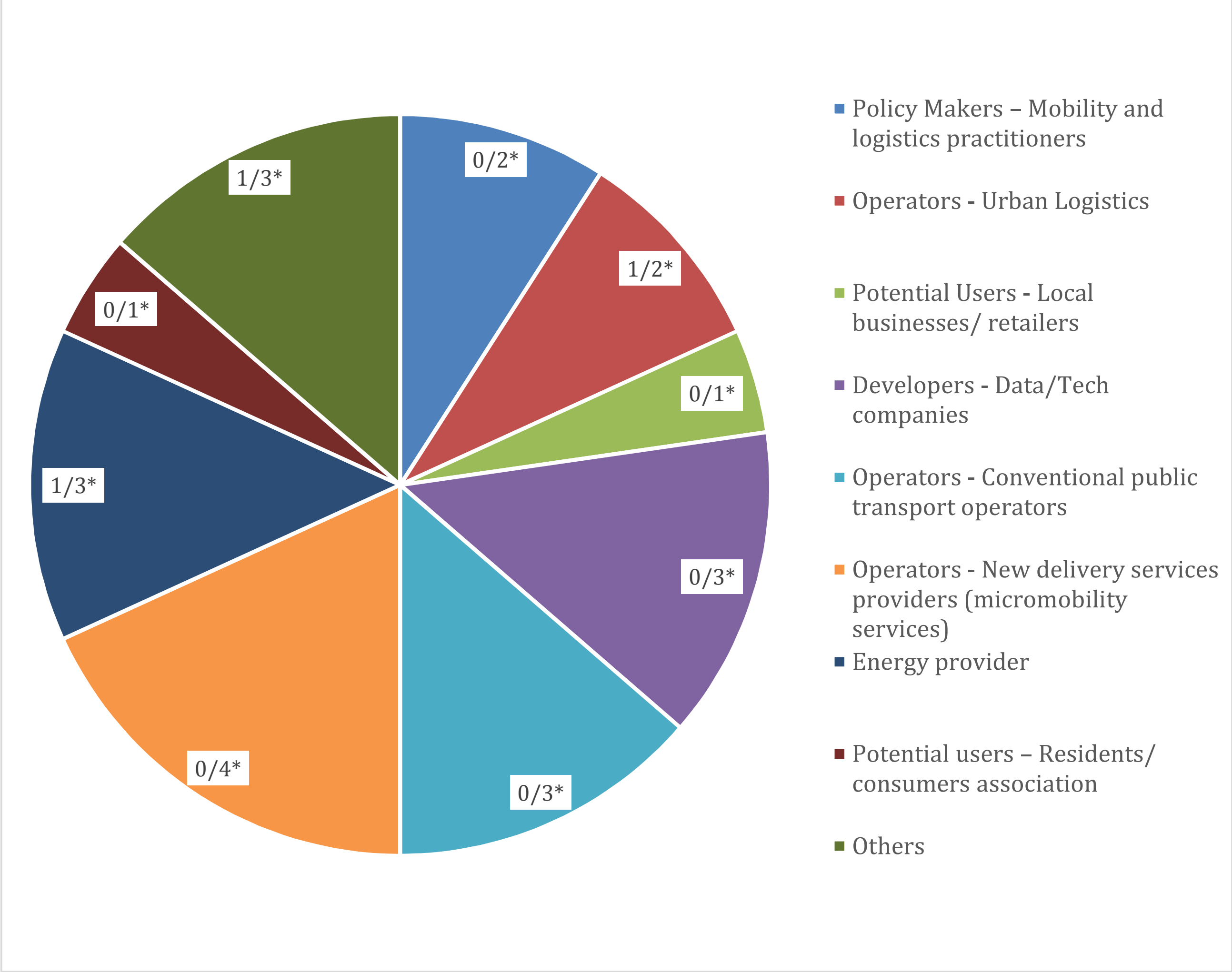
Instead, LL partners could effectively exploit the specific information that Policy Maker, University and the operator are willing to share, notwithstanding no SH has explicitly mentioned the need for this type of data at this first stage of the LL activities. For instance, the operator could use data on traffic and infrastructure to better define the service to provide.

Furthermore, the LL manager should find the most appropriate SHs who can satisfy data demand concerning, e.g., space for logistic operations and senders/bringers databases. The private logistics operator and the public entity could, respectively, provide that information.

4.5 Porto

This sub-section provides a preliminary mapping of Porto LL showing both membership and information that participants potentially require and are willing to share.

Table 17 - Porto LL: actors mapping



* x/y = lead partner (x) out of stakeholders (y) per sector

Table 18 - Porto LL: information exchange requirements

Data demand and supply	Information on	Supplier	Inquirer
Requested and available information	Cost	New Delivery Service Provider (NDSP)	Operators - Urban Logistics (UL)
	Environment impacts	NDSP	UL NDSP
	EDVs (capacity, type, autonomy, time for charging, speed empty and loaded)	NDSP	UL
	Locations of the new EV charging stations	Energy Provider, UL	UL
Available but not explicitly requested information	Knowledge (technology) to support in the definition of the new reference models identify data sources literature review	University	
	Location of the facilities and stores; Capacity or other types of constraints	UL Technological Partner	
Requested but not explicitly available information	Locations of the new EV charging stations		UL
	Population served		Potential users – Residents
	Network electricity needs		Energy Provider
	In time deliveries failed deliveries time for delivering		NDSP

From a preliminary assessment of the needs and willingness to share data, it emerges a match for all data pertaining cost (internal, external), revenues and EDVs of the operations.

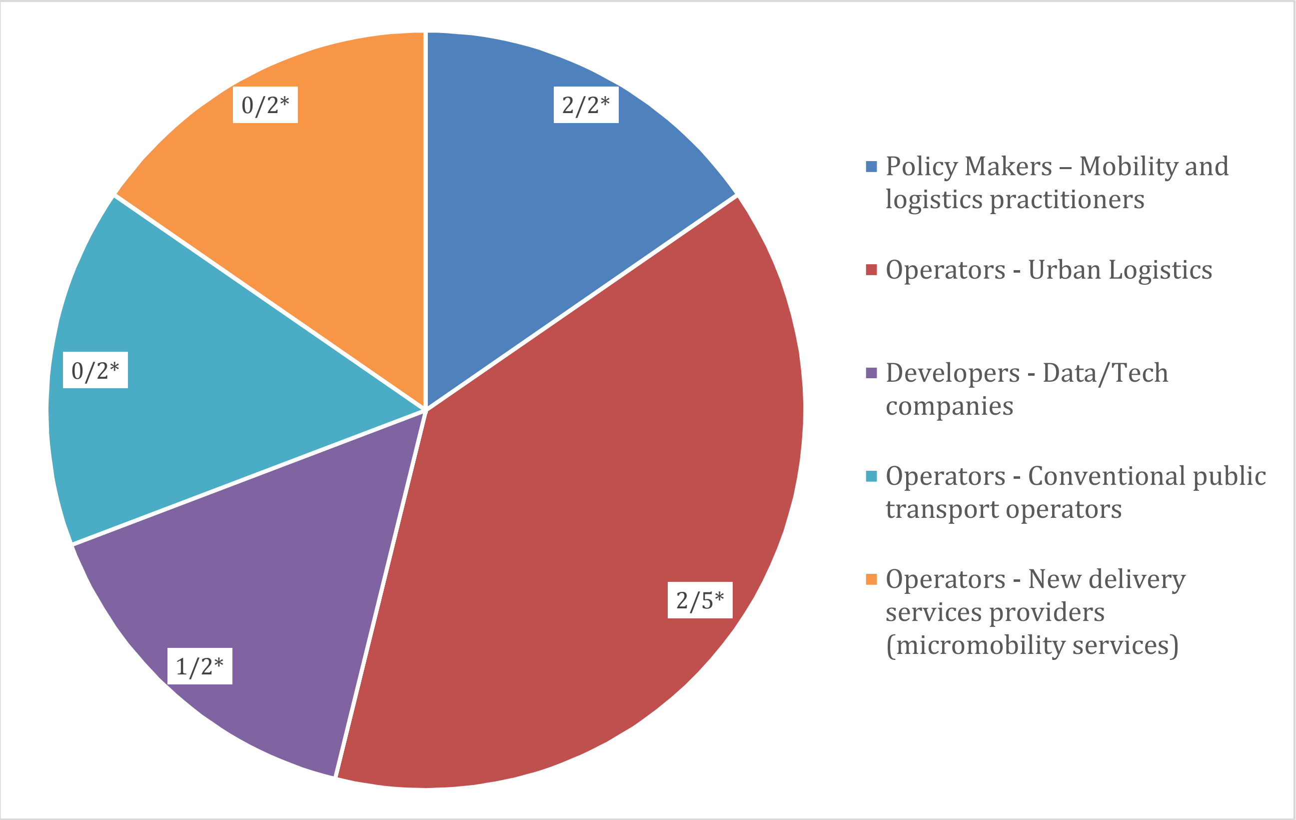
Instead, LL partners could effectively exploit the specific information that University and the urban logistics operator are willing to share, notwithstanding no SH has explicitly mentioned the need for this type of data at this first stage of the LL activities. For instance, NDSP could utilise data concerning the location of the facility structure.

Furthermore, the LL manager should find the most appropriate SHs who can satisfy data demand concerning, e.g., deliveries, electricity needs, and the population served by the pilot.

4.6 The Hague

This sub-section provides a preliminary mapping of Porto LL showing both membership and information that participants potentially require and are willing to share.

Table 19 - The Hague LL: actors mapping



* x/y = lead partner (x) out of stakeholders (y) per sector

Table 20 - The Hague LL: information exchange requirements

Data demand and supply	Information on	Supplier	Inquirer
Requested and available information	Environmental impact	Operator-Urban logistics (UL)	UL, Policy Makers, University
	Demand change Crowdshipping behaviour	UL	University
	Level of service		University, Developer
	Total demand	Developer	University
	Demand for platform	UL	Developer
Available but not explicitly requested information	Road network configuration and network measurements	Policy Maker	
	Scenario forecasts	University	
	Optimised local supply and demand matching	Developer	
Requested but not explicitly available information	Load factors		UL
	Number of trips		University
	Travel times		Developer
	Supply and demand data of deliveries		Developer

From a preliminary assessment of the needs and willingness to share data, it emerges a match for data pertaining to service demand and behaviour.

Instead, LL partners could effectively exploit the specific information on simulations and optimizations that Policy Maker, University and developer are willing to share, notwithstanding no SH has explicitly mentioned the need for this type of data at this first stage of the LL activities. For instance, the urban logistics operator could use information on optimised local supply and demand matching.

Furthermore, the LL manager should find the most appropriate SHs who can satisfy data demand concerning, e.g., number of trips, travel time and load factors.

5 Wrap-up

LEAD facilitates the integration of innovative solutions in last-mile deliveries by investigating the optimal combination of vehicles, infrastructure, services, financial incentives, innovative sharing schemes, environmental awareness, and SH consensus, also accounting for consumer preferences.

The changing consumer habits and their expectations for same or next day deliveries put pressure on last-mile logistics networks, carriers and supply chain SHs to replace legacy and conventional BMs and achieve faster, less expensive and more efficient delivery services. In this regard, Section 2 identifies the critical aspects for BMs aimed at the rationalisation of the distribution process, i.e. the reduction of goods flow yet keeping the adequate level of distribution to satisfy consumer's needs. This exercise serves as a theoretical basis to support the definition of BMs for the LEAD LLs and related Value Cases, which can find the lessons learned and adapt them according to their own experimentation. The analysis first looks at the different classification criteria of the various BMs, also considering the gains for and the inputs from the different customers. Efficiency and business drivers for the companies are considered, as well as value creation for the society. Technology and Infrastructures are assessed with respect to their enabling role.

Engaging the private sector and citizens in the decision-making process and thereby developing accountable partnerships among all SHs have become important in the policy-making process. In this sense, multi-faceted cooperation among public and private sector can help building a new "collective" awareness and stronger cooperation models. This is not an easy task, since different users may be in competition for the same infrastructures, and the heterogeneity of preferences of the SHs is even more relevant and significant for the decisions making process. The work examines in detail the various issues at stake when it comes to the cooperation between SHs and the search for their consensus in policy design and measures implementation. These elements will be of help for the LEAD LLs, requested to establish a multi-SH community, involving supply chain actors (Freight Forwarders, Transport Operators, Shippers, Retailers, Shop owners), Public Authorities, Associations and experts in a co-creation process. This serves to foster collaboration and the sharing of assets, when possible, and enable healthy and fair competition at the same time.

However, although in theory these mechanisms and models appear to be the most effective and straightforward solutions, there are several regulatory implications, privacy and ethics requirements that need to be carefully considered. In fact, new technologies, although they present countless advantages in terms of efficiency and sharing possibilities, expose the actors and the system itself to risks of attacks and violation of privacy. Innovative solutions, therefore, must be properly regulated, and accompanied by a well-defined policy framework at the local level, and aligned at the European and national level. Indeed, innovation must be stimulated, but rules and incentives ensure that it is upscaled. For this reason, the research provides an analysis of regulatory and collaboration barriers, data sharing and privacy concerns as well as PPP incentives from different SH perspectives. Identification of enablers and barriers for the development of cost-effective innovative city logistics solutions complements the overview.

Sections 3 and 4 focus on LEAD LLs. Starting from the description of the Value Cases that will be tested in the six partner cities, these are then systematised according to the categories outlined in

Section 2. Therefore, for each of them, the local partners have identified the BM approaches that will be undertaken, if they already know it, the SH cooperation mechanisms, regulation, ethics and privacy requirements, as well as enablers and barriers. In general, satisfaction emerges for the composition of the local SHs communities formed so far, as well as for their proactive approach and the holistic configuration of the pilots. At the same time, some issues emerge, related to the use of space and infrastructure, financial constraints on the long term and the need to define proper data sharing protocols. As for the latter, Section 4 adopts a 'bottom-up' approach for gathering data, and it provides a mapping of information exchange requirements between heterogeneous SHs within each LL. This work provides a snapshot of a flexible situation and serves LL owners to take stock of the status quo and immediately identify areas where information sharing proceeds smoothly, and where, in contrast, work needs to be done to anticipate any critical issues.

Acknowledgements

This deliverable has been realised with the contribution of Transport Research Lab (TRElab), University of Roma Tre, of which the authors Edoardo Marcucci and Valerio Gatta (Molde University College) are co-directors. In particular, we would like to thank the TRElab members Ila Maltese and Gabriele Iannaccone for the precious contribution in the scientific literature review (Section 2) and for the actors' map and information exchange requirements (Section 4).

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