

What's in store for sustainable last-mile logistics?

ULaDS D2.3: Provisional trend report - *based on a stakeholder perspective on trends shaping urban logistics in Western Europe between 2020 and 2035*

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Abstract

ULaADS sets out to offer a new approach to system innovation in urban logistics. Its vision is to develop sustainable and liveable cities through re-localisation of logistics activities and re-configuration of freight flows at different scales. Specifically, ULaADS will use a combination of innovative technology solutions (vehicles, equipment and infrastructure), new schemes for horizontal collaboration (driven by the sharing economy) and policy measures and interventions as catalysers of a systemic change in urban and peri-urban service infrastructure. This aims to support cities in the path of integrating sustainable and cooperative logistics systems into their sustainable urban mobility plans (SUMP). ULaADS will deliver a novel framework to support urban logistics planning aligning industry, market and government needs, following an intensive multi-stakeholder collaboration process. This will create favourable conditions for the private sector to adopt sustainable principles for urban logistics, while enhancing cities' adaptive capacity to respond to rapidly changing needs. The project findings will be translated into open decision support tools and guidelines.

A consortium led by three municipalities (pilot cities) committed to zero emissions city logistics (Bremen, Mechelen, Groningen) has joined forces with logistics stakeholders, both established and newcomers, as well as leading academic institutions in EU to accelerate the deployment of novel, feasible, shared and ZE solutions addressing major upcoming challenges generated by the rising on-demand economy in future urban logistics. Since large-scale replication and transferability of results is one of the cornerstones of the project, ULaADS also involves four satellite cities (Rome, Edinburgh, Alba Iulia and Bergen) which will also apply the novel toolkit created in ULaADS, as well as the overall project methodology to co-create additional ULaADS solutions relevant to their cities as well as outlines for potential research trials. ULaADS is a project part of ETP ALICE Liaison program.

Keywords

Urban logistics, stakeholders, trends, cooperation, regulation, resources, Policy Delphi

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Executive summary

This provisional trend report discusses the potential changes in last-mile city logistics up until 2035. Its aim is to make sense of the possible developments ahead, rather than to predict the future of city logistics. The exploration is structured along various decisive themes for the sector, such as transportation, accessibility, cooperation, regulation and innovation. Building upon the expertise and expectations of local logistics stakeholders from sustainable logistics in the ULaaDS lighthouse cities - Bremen (Germany), Groningen (The Netherlands), and Mechelen (Belgium), major trends and likely developments are identified. The report aims to contribute to knowledge on zero emissions city logistics and forms the basis for future scenario creation and sustainable urban logistics policy assessment.

The analysis shows that major changes are anticipated between now and 2035. Stakeholders almost unanimously expect that:

- Sustainable modes of transport will be dominant, due to growing shares of emission free vehicles and the use of cargo bikes.
- New delivery models, such as urban consolidation centres, micro hubs and parcel lockers, will have a structural function in the organization of urban freight flows.
- Today's large courier, express and parcel service players will consolidate their market dominance, but that up to 30% of the parcel delivery market will be handled by new players. Big tech companies and innovative start-ups are expected to be the main disruptors, forcing other players to adapt and further innovate.
- Local governments will have an active role in the transition towards sustainable urban logistics through a combination of restrictive and facilitative policies.

On other potential changes, such as autonomous vehicles, resource cooperation, and data sharing, the stakeholder groups have more diverse expectations.

Despite the fact that major changes are expected, stakeholders also indicate that the lack of critical pre-conditions, societal acceptance, investment capacity, and/or a lack of knowledge may hold urban logistics innovations behind.

The expected active role of local governments is another remarkable finding. Typically, the urban logistics sector is one in which private actors are leading and governmental interventions are limited. Recently, (local) governments started to take a more active role in pursuing more sustainable urban logistics, exemplified by the investigated lighthouse cities. It is therefore relevant to note that the participating stakeholders consider an active role of city administrations self-evident, for instance in the regulation of transport modes, city access, and the implementation of parcel lockers.

Effective public policies are however threatened by local governments' limited knowledge of logistics processes and practical implications of policies, a lack of alignment of policies and regulations between cities, and lack of clear and stable policy frameworks. These challenges require capacity building between governments themselves and between governments and local logistics stakeholders, through the exchange of knowledge, experiences and new developments.

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1. Introduction

City logistics systems are concerned with organizing the transportation of goods by and for commercial entities in urban areas. Different developments impact city-logistics-as-we-know-it, both today and in the decades to come. To support actors in city logistics in their strategic decision making as well as public policy making, this report identifies expected trends in city logistics in Western Europe in the period 2020-2035 from a stakeholder perspective.

Growing levels of urbanization spur a growing demand for urban logistics, while adding to the complexity of operating the transport of goods in an increasingly dense and contested urban space. Due to the growth of e-commerce, more and more people are comparing and shopping online. Customers also expect faster and more individualized services at low cost. As a consequence, the retail sector needs to shift business models to cater to this demanded flexibility: shipping smaller quantities in flexible (if possible same-day) delivery schemes, posing higher requirements to the system (Quak et al., 2018).

Meanwhile, an increasing number of city authorities in Europe tries to foster sustainable urban practices. Citizens, community organizations and specific interest groups call for good quality public space, clean air and safe streets. Simultaneously, national and international climate agreements require cities to reduce their carbon footprint. Not surprisingly, city administrations therefore require changes in city logistics to contribute to realizing these desired qualities and reduce their environmental impact. Cities are working to realize zero-emission city logistics by introducing regulatory or market-based measures, new planning schemes, experimenting with new technology or fostering stakeholder engagement (CIVITAS, 2015). Many private actors in city logistics also strive for further innovation, for instance by testing new delivery models, setting up collaborative consolidation centres, and updating operation and business models which include environmental impact considerations (see D3.1). Hence, while city logistics activities are growing in size, there is also an increased awareness and effort to ensure that this growth evolves in a more sustainable way.

To guide these developments, city administrations are creating urban freight plans that outline a vision, targets, objectives and associated policy measures to realize more sustainable urban logistics. These plans often come as part of wider mobility plans or as stand-alone strategies or action plans. Sustainable urban logistics plan (SULP) guidelines are a policy support tool that facilitate policy assessment and decision-making in cities and assist them on their path towards reaching zero emission (ZE) logistics goals (ELTIS, 2018; European Commission, 2019).

To inform these policies and guidelines as well as urban logistics practices, there is a need to better understand the potential pathways to a zero emissions future for city logistics. In this trend report, we identify themes that will shape last-mile urban logistics in cities in the years to come, and include the views from local logistics stakeholders active in the last-mile to identify relevant trends and likely developments.

1.1 Objectives

In this provisional trend report we look at three sustainable logistics frontrunners: the cities of Bremen (Germany), Groningen (The Netherlands) and Mechelen (Belgium), from now on referred to as lighthouse cities. The three cities share similar characteristics:

- All three cities have set ambitious goals for realizing zero emissions urban logistics and are actively working towards realizing them.
- There is active and ongoing dialogue and cooperation between the city governments and logistics stakeholders.
- The cities share similarities in their urban structures, such as historic inner-city centres and high population densities.
- Their modal split is characterized by high levels of non-motorized transportation.

A brief characterization of the three lighthouse cities is made in Table 1. For an in-depth description, please refer to ULaaDS deliverable 5.2: “Factsheet baseline and city profiles”.

Table 1 - Characterization of lighthouse cities.

	Bremen	Groningen	Mechelen
No of inhabitants	570.000	220.000	88.000
Policy strategy	SUMP (2014, partial update in 2019, final update 2021)	SUMP (Q3 2021); Space for ZE City Logistics (Q1 2021, SULP)	SUMP 2015; Sustainable and Efficient City Logistics Covenant Mechelen 2020
Goals	<u>Work on logistics emission reductions within SUMP.</u> • 20-25 % increase in bicycle traffic • 15-20 % increase in public transport (bus and tramway) • 50 % increase in rail transport (suburban railway) • 20 000 car-sharing users • Completion of the ring motorway A 281 • Make city centre car-free by 2030.	<u>ZE logistics in city-centre by 2025; within the municipality by 2035.</u> • Expand the time-window area for logistics in 2022, • Potentially use automatic number Plate Recognition • Introduce a ZE zone for urban logistics in 2025 • Introduce digital enforcement in 2022 • Implement smart and strict exemptions policy in 2022	<u>Become a ZE city by 2030.</u> Work towards a more sustainable and efficient freight transport, with a primary focus on the city centre and the station environment: • A reduction in the number of transport movements & km driven • Better air quality and reduction in CO² emissions by 40% by 2030 • Zero-emission urban distribution by 2030
Current bicycle mode share	Cycling: 20% (depending on trip purpose) ¹	Cycling: +40% (depending on trip purpose) ²	Cycling: 32% ³

¹ https://www.bauumwelt.bremen.de/sixcms/media.php/13/SUMP_Bremen2025_web.pdf

² http://web.minienm.nl/mob2014/2_1.html#:~:text=De%20fiets%20is%20vooral%20populair,is%2030%20procent%20of%20minder.

³ <https://www.mobieltvlaanderen.be/docs/beleidsplannen/2016-04-28-fietsbeleidplan.pdf>

Studying these cities and their approach in realizing zero emission urban logistics provides valuable lessons on the themes and trends that are likely to affect last-mile logistics in the forthcoming years. By doing so, we aim not to predict but rather make sense of different trends that will shape zero emission city logistics.

The objective of this report is to contribute to knowledge on zero emissions city logistics and forms the basis for future scenario creation and sustainable urban logistics policy assessment. It complements existing trend reports (expert driven and approaching the subject from a general level) by analysing the perspectives of stakeholders that are involved at the local level. This produces unique insights that are relevant to those involved in urban logistics in the cities and countries under study, and western European cities working to realize similar ambitions.

1.2 Focus

This provisional trend report is the first product of a wider effort of future scenario creation and assessment in collaboration with the lighthouse cities' logistics stakeholders. To this end, thirty-four logistics stakeholders from the three cities have been included to explore the possible states of last-mile city logistics in 2035 are examined.

The stakeholders that are included in the study are shown in Figure 1. They are logistics operators, local authorities, logistics experts, residents and businesses. During interviews stakeholders were asked to reflect on different logistics trends, and on the likely and their preferred developments in the next fifteen years. This revealed stakeholders' stances on a variety of themes such as developments in mobility, technology, city accessibility, the supply chain, customer preferences, delivery methods, data and resource sharing, and the role of local authorities.

This fifteen-year-time frame was chosen in order to inspire and encourage stakeholders to think beyond policy goals and actions plans that have deadlines set for the years 2025 or 2030. The answers provide a better understanding of the views of various logistics stakeholders involved in the last-mile: what do different stakeholders expect the future to look like, and how does this differ from their ideal future? Do these views differ between stakeholders, and if so, how?

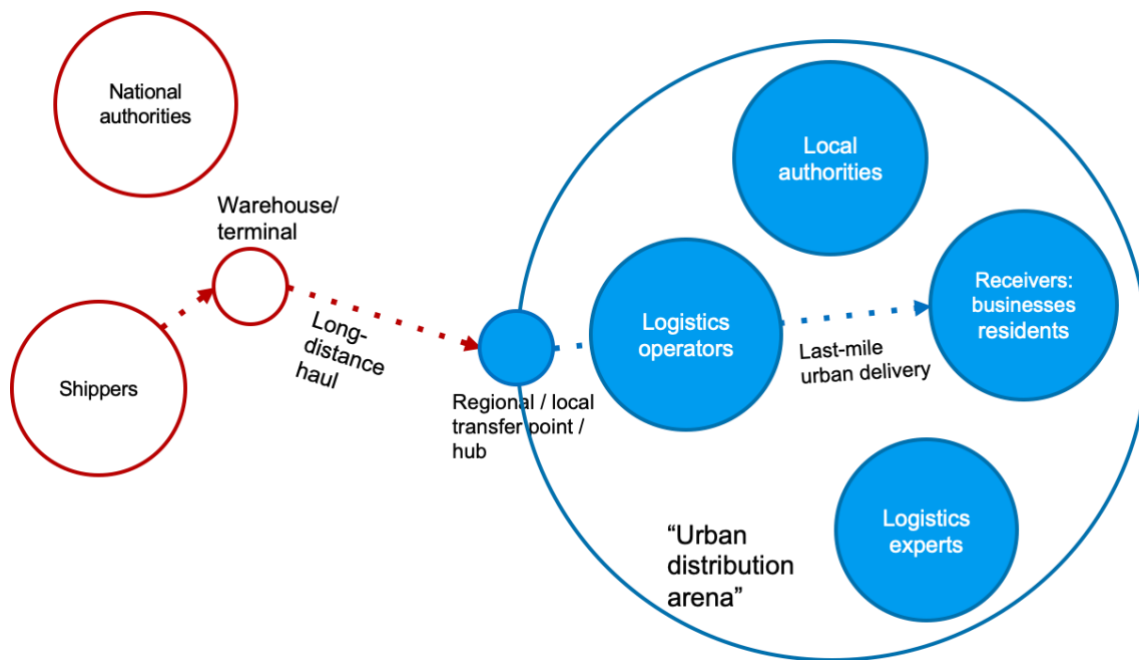


Figure 1 – Stakeholders included in the study (blue) and their relation to the wider global logistics network.

1.3 Relation to other ULaaDS work packages

Apart from serving as a source of information and knowledge for all project partners and potential interested readers, this deliverable will also have a clear role in relation to other WPs in the ULaaDS project. The report serves as an important in-between step in the scenario development in WP2. The identified trends will be presented to the participants in the scenario development, for a second round of data collection. Moreover, its aim is to contribute to dissemination and outreach activities of ULaaDs by identifying potential changes from a stakeholder's perspective. Doing so, it complements other trend reports in the ULaaDs project and beyond, which are generally expert-driven and rather abstract in their level of analysis. As such, insights from this report will inform the stakeholder engagement strategies that will be developed in local freight fora in Task 2.2.

1.4 Reading guide

Section 2 provides an overview of the methodology, describing the research process, identified themes, participant selection and ethical considerations. Section 3 discusses the main trends identified in last-mile transport, city accessibility, resource cooperation, regulation, delivery models, innovation and organization. The main conclusions are presented in Section 4.

2. Methodology

2.1 Research process

The steps that have led to the contents of this report are outlined in Table 2. The basis for this report was formed by conducting a policy and trend report analysis. This revealed different themes to address in the study, which were validated with a broad range of experts. Based on this validation, a questionnaire structure was built that simultaneously served as the interview guide. In this way both quantitative data (questionnaire) and qualitative data (interviews) were collected simultaneously.

Table 2 - Steps in the research process leading up to provisional trend report

Research steps	Description
1. Policy analysis	A desk study of logistics policy documents of the Lighthouse Cities (Bremen (DE), Groningen and Mechelen) was conducted to get acquainted with themes relevant to these cities.
2. Trend report analysis	A desk study was conducted of global trend reports authored by logistics operators and research and policy institutes.
3. Research team brainstorm	A brainstorming was conducted with the university research group (RUG), which led to an initial selection of relevant themes to address in research.
4. Validation of themes	The initial selection of themes was narrowed down to a selection of themes to address in research. This selection was validated with a broad range of experts in the following ways: • Internal validation: by the university research team. • External validation: by the ULaaDS lighthouse cities. • External validation: by the ULaaDS work package task leaders.
5. Designing the questionnaire	Based on the validated themes, a questionnaire was built to collect data on the developments of trends in last-mile city logistics.
6. Live-interviews	Using the questionnaire, 33 logistics stakeholders in three lighthouse cities were

	interviewed on their expectations and preferences regarding the future of last-mile logistics. The interview was based on the themes addressed in the questionnaire, and the questionnaire was filled-out by the stakeholders during the interview. As such, both quantitative data (questionnaire) and qualitative data (interviews) were collected simultaneously.
7. Identification of trends	Based on the quantitative and qualitative data collected, trends were identified on the future of last-mile logistics.

2.2 Identified themes

Research steps 1-4 outlined in table 2 resulted in a selection of themes that formed the basis for data collection through a questionnaire and interviews. We operationalized each theme by addressing subthemes. For instance, within the theme "mobility" we addressed the subthemes "motorized transport in the last-mile", "non-motorized transport in the last-mile" and "level of autonomy of vehicles in the last-mile". A complete overview of all themes and sub-themes addressed in this report is shown in table 3.

Table 3 - Themes shaping sustainable city logistics between 2020 and 2035

Themes	Sub-themes addressed
1. Mobility – “transport modes used in the last-mile”.	Types of motorized transport used in last-mile transport
	Types of non-motorized transport used in last-mile transport
	Level of autonomy in last-mile transport
2. Accessibility – “access restrictions and their influence on CEP-operations”.	Extent to which large CEP-logistics players will remain active in last-mile amidst stricter access regulations
	Extent to which small CEP logistics players will remain active
3. Resources – “level of cooperation between logistics operators”.	Degree of B2B-cooperation on storage space
	Degree of B2B-cooperation on vehicles use
	Degree of B2B-cooperation in unattended delivery technology
	Degree of active regulation by city authorities

4. Regulation – “amount and type of regulation of last-mile logistics by city authorities”.	Type of last-mile policies issues by city authorities
5. Delivery - “types of delivery models that will arise in the near future?”.	Future of business-to-consumer deliveries
	Future of business-to-business deliveries
	Role of different stakeholders in new delivery models
6. Innovation – “type of newcomers to expect and their market share”.	Share of last-mile deliveries handled by logistics newcomers
	Types of logistics newcomers to expect
7. Organization – “Degree of business-to-business (B2B) and business-to-government (B2G) cooperation”.	Degree of B2B cooperation in supply chain operations.
	Degree of B2G cooperation in city wide smart logistics management system
	Degree of B2B and B2G data-sharing

In the remainder of this report, we will discuss these themes and discern relevant trends that arise from the data. To do this, we compare the data based on the types of logistics stakeholders included in the study and address important differences and similarities in perspectives between these stakeholders.

2.3 Study participants

As mentioned in section 1.2. over thirty logistics stakeholders from the three lighthouse cities have been included in a Disaggregated Policy Delphi-study in which the possible states of last-mile city logistics in 2035 are examined. Study participants were first approached by lighthouse city contact persons, and then asked by e-mail to participate in the study by the researchers. The total number of participants from different cities is shown in Table 4.

Table 4 - No. of participants per city

Lighthouse city	No. of study participants
Bremen	7
Groningen	14
Mechelen	13
Total	34

As shown in Figure 1, five types of stakeholders were discerned and included in the study. These are the logistics experts, local authorities, logistics operators, local businesses and

residents. An overview of the number of study participants per respondent category is shown in Table 5.

The logistics experts included in the study either worked on scientific and applied research in logistics or as logistics advisers, and were familiar with and active in the respective cities through their research programmes or advisory work. Study participants from local authorities were either policy makers or policy administrators in charge of mobility and logistics in their respective cities. The group of logistics operators consisted of both global logistics operators with local subdivisions in the respective cities and logistics operators that were only active locally. Finally, on the receiving end, representatives of residents and local businesses in the respective cities were included in the study.

Table 5 - No. of participants per respondent category

Respondent category	No of study participants
Logistics experts	4
Local authorities	7
Logistics operators	15
Local businesses	6
Residents	2
Total	34

2.4 Ethical considerations

As mentioned in section 2.1., the interviews that form the basis for this trend report were based on the themes addressed in a pre-designed questionnaire. This questionnaire was filled-out by the stakeholders during the interview.

Oral and written instructions were provided by e-mail before the interview. Prior to the interview, participants were informed on their rights and data privacy. They were informed that there were no consequences if they decided not to participate in this study. They were free to stop participating at any moment without giving a reason for doing so. They were informed that data they provided in this research would be anonymized after the data analysis and could not be traced back to them as an individual, and that personal information would remain confidential and would not be shared. They were also informed that data would be analysed by the researchers that collected the information, and that completely anonymized data might be shared with other researchers or published in a scientific journal.

All participants gave their written informed consent to this approach prior to the study, and gave permission for their anonymized data to be used for research purposes.

3. Themes and trends

3.1 Last-mile transport

Transport modes are central to logistics operations in the last-mile. Three sub-themes were discerned: types of motorized transport used in the last-mile, types of non-motorized transport, and the level of autonomy of self-driving vehicles. A detailed account of the wide range of vehicle technologies in use in last-mile logistics is presented in ULaaDS deliverable D3.1: “Benchmarking business/operating models and best practices”.

3.1.1 Motorized transport

Lighthouse cities’ logistics stakeholders were asked to express their expectations regarding the types of motorized transport used in last-mile logistics in their city in 2035. A distinction was made between fossil fuel vehicles, fuel cell vehicles, battery-electric vehicles (BEV) and new technologies that are yet unknown or not in use.

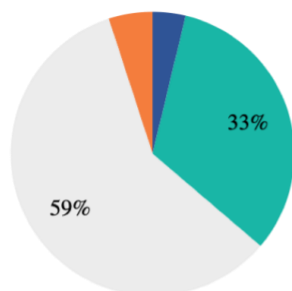
The expectations of different stakeholders are shown in Figure 2. Logistics stakeholders have high hopes for the potential of battery-electric and fuel cell vehicles. Especially logistics operators and logistics experts foresee a high combined share for both fuel types. Battery electric vehicles will likely have a higher share in last-mile operations than fuel cell vehicles, as their use is already more common today. Nevertheless, some important barriers still need to be overcome to fully support the roll-out of battery electric vehicles, such as the development and provision of sufficient high-speed charging infrastructure.

Fuel cell vehicles are expected to gain a significant share in last-mile operations, but will lag behind on battery electric vehicles due to current technological limitations and high innovation costs. Moreover, in the long term, stakeholders expect fuel cell vehicles to be more common in long-distance freight haul between cities. Some distinct features, such as fuelling speed and ease of use, may however prove to be an important benefit over battery electric vehicles in the long term.

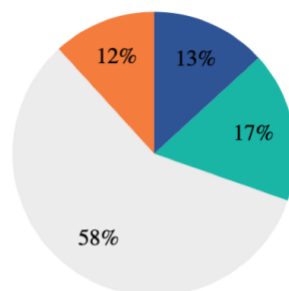
The expectation that battery-electric and fuel cell motorised transport will become dominant is in line with the ambitious goals that cities have set to reduce the use of fossil fuel in last-mile logistics. However, as mentioned above, stakeholders see various practical concerns that potentially will jeopardize the realization of these goals. Next to the lack of or slow innovation of alternative fuel sources and a lack of sufficient charging or fuelling infrastructure in and near cities, high costs of renewing the last-mile fleet are also seen as an important hurdle.

Stakeholders therefore question whether last-mile logistics will be 100% fossil fuel free in 2035. Most of them expect that fossil fuel vehicles will still be operated and used in last-mile logistics to some extent. Hybrid technologies may support this transition phase.

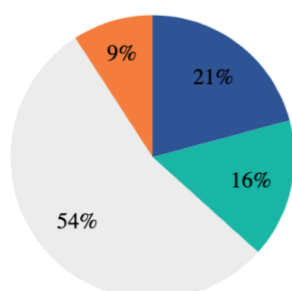
logistics experts



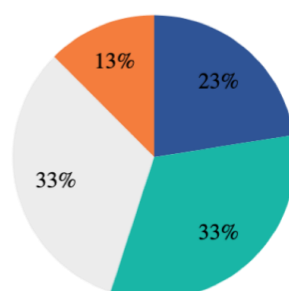
logistics operators



local authorities



residents



businesses

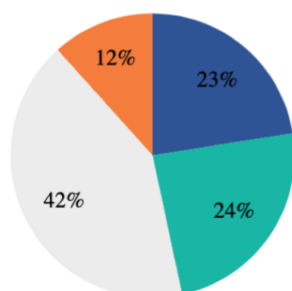
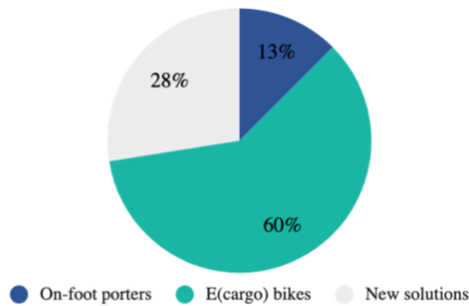


Figure 2 - What will the motorized transport fleet of last-mile logistics consist of in 2035? (% average expectation)

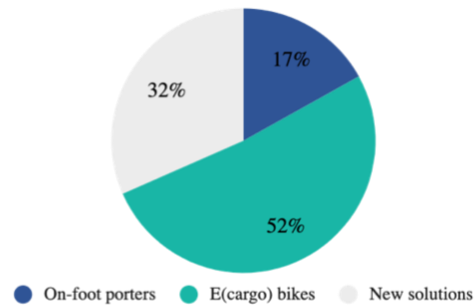
3.1.2 Non-motorized transport

Stakeholders were asked to reflect on the types of non-motorized transport modes used in last-mile logistics in the different Lighthouse cities in 2035. Here, a distinction was made between on-foot porters or couriers, (e-)cargo bikes and other solutions. Stakeholder expectations are visualized in Figure 3. Please note that the responses are independent for the expectations in the previous question about motorized transport modes.

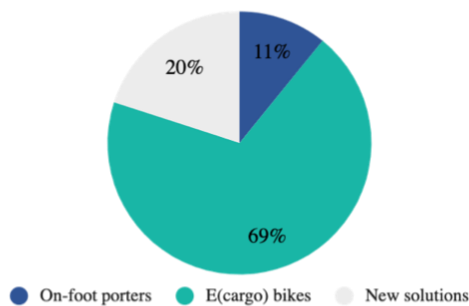
logistics experts



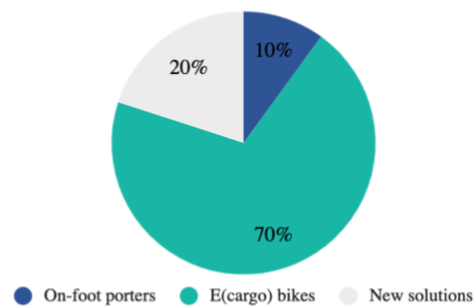
logistics operators



local authorities



residents



businesses

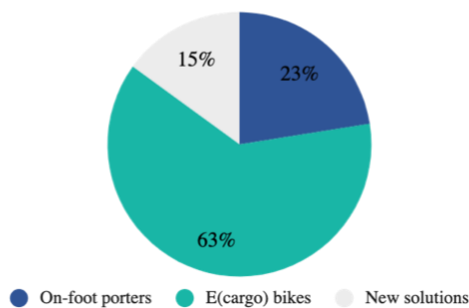


Figure 3 - What will the non-motorized transport fleet of last-mile logistics consist of in 2035? (% average expectation)

The share of non-motorized transport used in last-mile logistics is expected to grow. However, the limited carrying capacity of foot/bike cargo, and nuisance and safety issues caused by the large fleet of non-motorized vehicles that are possibly needed, pose important limitations to this growth.

According to stakeholders, the future share of foot/porter solutions is largely dependent on the technological developments in this domain. Traditional deliveries by foot are expected to be limited to a minimum. However, they are expected to gain a significant share of last-mile deliveries if combined with “semi-automated” trailers that are moved by hand. As foot-

deliveries mostly occur in the last leg of the last-mile journey, their use is further increased when foot-trailer-deliveries are coupled with movable micro hubs placed in inner cities.

(E-)cargo bikes are expected to take up the largest share of non-motorized deliveries in 2035 according to stakeholders. They are currently “top of mind” of local authorities and logistics operators, whose support further accelerates their use. Their relative low costs, emission and health benefits and flexibility are important advantages over other delivery forms in dense and congested urban areas (see also Thoma & Gruber, 2020). E-cargo bikes combine propulsion by user pedalling with assistance through a computer-guided electronic motor. This enables cycling at augmented and constant speeds using reduced physical effort and covering longer distances in shorter amounts of time. E-cargo bikes thus also form a viable alternative to motorized transport, even on some distances that most people would consider too far to cover by regular cargo bike (Rudolph & Gruber, 2017).

However, (e-)cargo bike are perceived less promising for transporting large volumes and handling of odd-sized cargo (see also Bosona, 2020). Furthermore, depending on future developments, stakeholders expect that the larger fleet of (electrically assisted) cargo bikes might negatively impact pedestrian and cyclists’ safety and comfort in inner cities (see also Thoma & Gruber, 2020). This will likely further stir up the debate over shared space, shared speed, and speed limits of slow modes versus fast modes in urban areas.

3.1.3 Automation

Stakeholders were asked to reflect on the expected level of driving automation of transport modes used in last-mile logistics in their cities in 2035. This was limited to road-based autonomous vehicles (AVs). A detailed account of the wide range of AV types in use in last-mile logistics is presented in ULaaDS deliverable D3.1: “Benchmarking business/operating models and best practices”. Here, the distinction was limited to the general level of automation of large vehicles (e.g. trucks and large vans) and small vehicles (e.g. LEVs). The society of automotive engineers discerns five levels of automation of self-driving vehicles (Table 6).

Table 6 - Levels of driving automation discerned by the Society of Automotive Engineers.⁴

Description	
0 – No autonomy	-
1 – Driver assistance	These systems assist drivers but still require the driver to be in control (e.g., cruise control and lane assist).
2 – Partial automation	Vehicle assist in controlling speed and steering, but driver must keep hands on the wheel.
3 – Conditional automation	Vehicles are capable of driving themselves, but human driver is still required to take over should road conditions fall below ideal.

⁴ www.sae.org

4 – High automation	Can drive themselves without human interactions (besides entering your destination) but are restricted to specific areas and locations.
5 – Full automation	Vehicles are able to monitor and maneuver through all road conditions and require no human interventions whatsoever.

Stakeholder expectations of the level of automation of different types of vehicles in the last mile are summarized in Table 7.

Table 7 - Expected level of automation of large and small vehicles operated in the last-mile, based on levels in Table 6 (averages).

	logistics experts	logistics operators	local authorities	residents	businesses
Large vehicles	3.3	2.7	2.2	2.0	2.5
Small vehicles	4.0	3.1	3.2	2.5	3.0

Overall, a higher level of automation is expected in small vehicles than in large vehicles. Automation of large vehicles in the last-mile is expected to be partial or conditional at best, whereas small vehicles are expected to move towards conditional or high automation.

Whereas stakeholders mention that the basic technology “will likely be ready”, an important role is still foreseen for drivers. On the one hand, complex environments in dense city centres challenge fully automated operation of last-mile delivery vehicles, which need to be both timely and flexible and require improvisation in the face of unexpected events. On the other hand, face-to-face contact with customers is highly regarded by both logistics operators and receivers. Overall, more potential is seen for automated transport in less complex environments, such as designated districts in cities or stretches of highways outside city centres.

Limited knowledge of and experience with liability issues around AVs, and public acceptance of AVs are perceived as another barrier to a full automation scenario. Liability issues are mentioned by both logistics operators and local authorities. They stress that their willingness to experiment with AVs depends on whether traffic safety can be guaranteed. Responsibilities and liability of different actors in case of traffic accidents are still uncharted territory to many involved.

Acceptance by the public of AVs is particularly relevant to local policy makers and residents. The cities included in the study are working hard to increase the share of active and “slow” modes in the city, while reducing levels of motorized transportation to the strictly necessary. Limited knowledge of the subject and negative associations with AV traffic safety furthermore do not help.

Considering the above, it seems that logistics operators and local authorities should give careful thought to their communication strategies and level of information provision to

businesses and residents, should AVs be introduced in their cities in the years to come. If automated driving is to be made reality, these cities also need to rethink the spatial configuration of their city centres and ways of reducing complexity for these vehicles. Semi-autonomous solutions, such as fixed itineraries or tracks, are building blocks for potential solutions.

3.2 City accessibility

A growing number of cities are implementing access restrictions for freight transport. Courier, express and parcel service (CEP) players are challenged to invest and innovate their business models in order to retain access to inner cities. Stakeholders were asked to reflect on how this will affect the current state of business: will CEP players currently active in the last-mile be able to retain access to the city amidst stricter access conditions?

To provide for more detail in the responses, a distinction was made between the performance of small and medium and large CEPs. "Small" CEPs were defined as businesses with under 50 employees (or under €10mln turnover), and medium and large players as businesses with over 50 employees (or > €10mln turnover)⁵. Stakeholder expectations are shown in Table 8.

Table 8 - What share of current small and medium & large CEPs will have been able to retain access to the city? (% averages)

	logistics experts	Logistics operators	local authorities	residents	businesses
Small CEPs	43%	56%	59%	50%	53%
Medium/large CEPs	63%	79%	87%	90%	69%

In a context of thin margins on last-mile deliveries, stakeholders expect that those able to retain access to the city are either CEPs that dominate the market through their sheer size and handling volume, or those that can offer highly specialized services. This is explained in further detail below.

3.2.1 Larger CEPs

Stakeholders expect larger CEPs to be better able to deal with tighter access restrictions than smaller CEPs. This is largely attributed to their financial means, which allows them to be highly innovative and make significant investments, for instance in new operating schemes, cleaner modes of transportation or strategic acquisitions. This way they can secure their access to low/zero emissions zones in cities.

⁵ https://ec.europa.eu/growth/smes/sme-definition_en

However, not all large CEPs are currently equally active in all cities. In some cases, restrictions such as limited time windows will make it harder to make deliveries in cities, especially if the amount of deliveries is low and the operations base of CEPs in those cities is small. Therefore, a potential scenario is that of geographical specialization: larger businesses will pick and choose cities in which they will remain active, and withdraw from others. In case of the latter, they might team up with local partners.

3.2.2 Smaller CEPs

Smaller CEP players are expected to have a harder time dealing with new access restrictions, as they have limited means and knowledge to optimise their operational systems and business models to new access conditions. More small CEPs are expected to go out-of-business between now and 2035. These parties are expected to either perish or be acquired by the larger CEPs.

However, smaller players can maintain a competitive advantage over large CEPs if they are highly specialized or can offer distinctive services that are highly relevant to the local customers. For instance, if they can provide flexible and high-speed delivery of goods across town on a very short notice (e.g. 1hr-deliveries). Or if they are able to add value beyond the logistical process, by not only delivering a product but also setting it up and making it ready-for-sale. Such distinct and customized services will provide them with more capabilities to adapt and thus make them less vulnerable for tighter access restrictions.

The number of smaller CEPs that will remain active in the last mile is also expected to be dependent on local authorities' policies aimed at SMEs and the extent to which these policies will support CEPs in their transition to a zero emissions future. For instance, by setting up subsidy schemes for the purchase of clean vehicles.

3.3 Resource cooperation

The rise of the sharing economy raises the question whether a future development pathway for last-mile logistics is that of closer cooperation between logistics stakeholders (Roland Berger, 2018). Therefore, we inquired stakeholders' views on the future level of resources sharing such as storage space, vehicles and unattended delivery technology, such as parcel lockers. To what extent are last-mile logistics players expected to cooperate in the use of these resources in the future? (Table 9).

Table 9 - What will be the degree of cooperation in storage space, vehicle use and unattended technology? * (-2 low levels of cooperation, +2 high levels of cooperation).

	logistics experts	logistics operators	local authorities	residents	businesses
Storage space	0.3	0.6	0.8	1.0	1.0
Vehicle use	0.5	-0.4	-0.5	-0.5	1.2
Unattended tech	1.3	1.1	1.0	1.0	1.2

3.3.1 Cooperation on storage space

Overall, a moderate increase is expected in the level of cooperation on storage space. Viewpoints on this issue vary between stakeholder type. Logistics experts and operators are more reserved, while local authorities, residents and businesses have higher hopes. Among the logistics operators, large and established CEP players claim to have optimized their workflows, and that their use of warehousing and storage space is already highly efficient. Thus, their interest and need to share storage space to operate their processes is low, which might influence their willingness to do so. However, some larger CEPs also see an opportunity: when their storage occupation rates are low, renting out and sharing their storage space with other businesses might be a valuable addition to their business model.

Smaller CEPs are expected to be more open to cooperation in storage space. According to inquired stakeholders, smaller CEPs dependent more on cooperation in order to avoid having to make large investments in storage space.

3.3.2 Cooperation on vehicles

According to the consulted stakeholders, cooperation on vehicles is generally expected to be somewhat lower than the cooperation on storage space. An important reason mentioned for this is that vehicles act as companies' "business cards", and visibility in the streets is an important aspect of company branding. Furthermore, liability issues need to be addressed in order to work out vehicle-sharing between companies.

As with storage space, small CEPs generally seem positive about sharing vehicles. For some, embracing new business models with a stronger focus on cooperation is a must in order to offer disruptive solutions and compete with established CEPs. For others, cooperation offers easier access to vehicles and enables them to grow their business potential while avoiding large-scale investments. Furthermore, some mention to be driven by more idealistic motives, such as contributing to more walkable, safe and liveable cities, and the urge for collective action to innovate in the last-mile.

3.3.3 Cooperation on unattended delivery technology

The future of unattended technology (e.g. parcel lockers) is perceived as bright across the board. It is seen as a crucial step needed to reduce costs and lower emissions in the last-mile. To achieve this, more cooperation is seen as an important step in order to prevent

segmentation of the market resulting in a sprawling amount of parcel lockers from different suppliers. Stakeholders expect this cooperation to increase in the next 15 years, including attempts to still provide company specific consumer services and experiences within the frame of collectively provided technology. A discussion on the role of different stakeholders driving the development of unattended delivery technology is provided in section 3.5.3.

3.4 Regulation

City administrations are making urban freight plans that outline a vision, targets, objectives and associated policy measures to realize more sustainable urban logistics. Stakeholders were asked about the level of regulation and types of policies they expect from city authorities between now and 2035, on the topics discussed in the previous sections: regulation of the different types of transportation (motorized and non-motorized), regulation of automated vehicles, regulation of city access and regulation of resource sharing.

In order to answer this, we first asked whether stakeholders expect local authorities to be *active* or *passive* in making policies on a particular subject between now and 2035. An active role means that local authorities have identified a certain topic as relevant, have formulated goals, and are developing and executing policies in order to address the topic accordingly. A passive role means that the city is not undertaking action on a certain topic. This can be because a particular issue has not yet been identified as relevant to address, local authorities feel underequipped, or because they are awaiting policy frameworks or guidelines from regional, federal or national governmental authorities.

Second, in case an active role is assumed for local authorities on a certain topic, we asked whether stakeholder expect local authorities to take on a *restrictive* or *facilitative* stance on this topic. A restrictive role for local authorities means that policies will mostly be aimed at restricting particular operations or behaviour in their cities. For instance, by implementing access restrictions for certain types of vehicles or beyond certain time windows and actively enforcing these measures. A facilitative role for local authorities means that policies will mostly be aimed at facilitating certain operations or behaviour, for instance by setting up subsidy schemes, through active dialogue and cooperation with other stakeholders, and by showing exemplary behaviour.

Generally, the expectation is that local authorities will take on active roles in the regulation of last-mile logistics in their cities. This view is shared broadly among all stakeholders. In part, this results from the fact that these city administrations already take on active roles in last-mile logistics today. According to stakeholders, this increases chances that they will continue to do so towards 2035.

Furthermore, stakeholders generally expect facilitative and restrictive policies to go hand in hand. They stress the need for a clear vision on the future of last-mile logistics in their cities and development of strategic and tactic pathways to realize this vision. A combination of

high levels of restriction (“tell us what we can’t and can do”) and facilitation (“help us realize what we can do”) therefore seems welcomed.

3.4.1 Regulation of transport modes

Cities develop ambitious goals for a future without fossil fuel transportation, but also seem to lack the knowhow on how exactly to realize this vision (e.g., regarding charging infrastructure for EV and fuel cell vehicles). Some logistics experts suggest that this part of a wider problem, which is a lack of experience of local authorities in the governance of major transitions. This will possibly hinder the realization of long-term goals.

All stakeholders expect city authorities to take on an active role in the development of policies regulating the types of transport modes in last-mile logistics (Table 10). Most stakeholders mention the fact that the three cities already have or currently are in the process of formulating policy goals for last-mile logistics.

Table 10 - What role will city authorities have in regulation of different types of transportation in the last-mile, and what types of measures will they issue?

	logistics experts	logistics operators	local authorities	residents	businesses
Type of regulation <i>(-2 passive, +2 active)</i>	1.5	1.3	1.3	2.0	1.2
Type of measures <i>(-2 restrictive, +2 facilitative)</i>	-0.8	-0.4	-0.3	-1.0	0.3

Apart from this active role, stakeholders generally expect the measures regarding transport modes to be somewhat restrictive. They mention the access restrictions that cities are implementing, such as zero emissions zones in city centres and time windows for inner city deliveries. While stakeholders differ in their view on how progressive such access restrictions should be, most of them share the principle that governments set ‘the rules of the games’ and let others (re)invent ‘the play of game’.

3.4.2 Regulation of autonomous vehicles

Stakeholder expectations of local authorities’ stance on autonomous vehicles is somewhat more mixed (Table 11). Whereas logistics experts expect a neutral stance, operators, authorities and businesses expect a slightly more active role for cities in developing policies around autonomous vehicles.

A possible explanation for this is that cities will rely on policy frameworks developed at higher government levels. Aligning local policies to the policies of other cities and regions is also highly preferred by logistics players, as consistency on what is and is not allowed is important.

However, the role of the cities in policy development at other governmental levels is unclear. Authorities themselves mention the lack of knowledge on legal aspects of autonomous driving as an important barrier to overcome.

Table 11 - What role will city authorities have in regulation of self-driving technologies in the last mile, and what types of measures will they issue?

	logistics experts	logistics operators	local authorities	residents	businesses
Type of regulation <i>(-2 passive, +2 active)</i>	0.0	0.9	0.8	-1.0	0.8
Type of measures <i>(-2 restrictive, +2 facilitative)</i>	1.3	-0.1	0.3	0.5	1.2

3.4.3 Regulation of city access

The cities included in this study are already working on the implementation of access restrictions to their inner cities, and this is expected to continue in the foreseeable future (Table 12). All stakeholders agree that city authorities will take on an active role.

Table 12- What role will city authorities have in regulating access to the city? And what types of measures will city authorities take?

	logistics experts	logistics operators	local authorities	residents	businesses
Type of regulation <i>(-2 passive, +2 active)</i>	1.8	1.6	1.8	1.5	1.7
Type of measures <i>(-2 restrictive, +2 facilitative)</i>	-1.0	-0.7	-0.7	-1.5	0.2

Regarding the types of policies, stakeholders generally agree that these will tend to be restrictive (except for businesses, who expect a more neutral stance). This is largely in line with the findings on regulation of transport modes in cities in section 3.4.1.

However, how these city access restrictions will be operationalized is still largely unknown. Practical measures are being laid out, such as time windows and zero emissions zones. But stakeholders other than authorities still seem to question if and how logistics operators and receivers will be guided through this transition phase. For instance, will authorities attempt to level the playing field for larger and smaller CEPs? Under what circumstances will stakeholders be exempt from certain measures? And what role will authorities play to help and stimulate innovation to guide the transition towards stricter access rules?

3.4.4 Regulation of resource cooperation

Less of a role is foreseen for local authorities on resource cooperation (Table 13). Cooperation on resources (such as storage, vehicles and unattended delivery technology) is largely seen to be worked out by logistics players themselves. Local authorities could facilitate this by thinking along in terms of logistics areas in cities and the space needed to deploy logistics activities in for last-mile operations.

Table 13 - What role will city authorities have in regulating resource sharing, and what types of measures will they issues?

	logistics experts	logistics operators	local authorities	residents	businesses
Type of regulation <i>(-2 passive, +2 active)</i>	0.8	0.4	0.5	0.5	1.0
Type of measures <i>(-2 restrictive, +2 facilitative)</i>	0.3	0.6	0.7	-1.0	0.8

3.5 Deliveries

New delivery models, such as collection and delivery points, are challenging last-mile logistics' business-as-usual and are increasingly important for parcel delivery companies (Zenezini et al., 2018). For instance, business-to-consumer delivery through parcel lockers is increasingly considered as a viable alternative to home delivery. Delivery companies place parcels in unmanned reception boxes that can be opened by the customer with a reference code or an application on their phone (Iwan et al., 2016).

Cities are also increasingly experimenting with last-mile delivery through urban consolidation centres (UCCs) or hubs (Allen et al., 2012). Here, packages from all (national and local) carriers are centralized, and last-mile delivery is bundled and executed with sustainable modes. Such hubs or urban consolidation centres can help to make traditional door-to-door delivery, organised by individual couriers, express and parcel services, more sustainable.

Stakeholders were asked whether they expect B2C-deliveries in the future to be done through traditional door-to-door delivery or through parcel lockers. Then, they were asked whether they expect B2B-deliveries in their cities to be done through traditional delivery to shops, or through hubs or UCCs (Table 14). Section 3.5.3. then discusses the role of different stakeholders in developing these new delivery models.

Table 14 – How will B2C and B2B deliveries be made?

	logistics experts	logistics operators	local authorities	residents	businesses
B2C (-2 entirely via traditional door-to-door delivery, +2 entirely via parcel lockers)	0.5	0.4	0.8	0.5	0.5
B2B (-2 entirely via traditional delivery, +2 entirely via hubs / UCC's)	0.3	0.1	0.3	0.5	0.0

3.5.1 B2C-deliveries

Last-mile delivery in 2035 is anticipated to be based on unmanned delivery / parcel lockers, although “traditional delivery” straight to home will remain an option in exceptional cases. For instance, for odd-sized deliveries, or for when recipients are unable to leave their home. Stakeholders expect this development in part to be driven by pricing strategies by logistics operators: conventional delivery to home will become more expensive than deliveries via parcel lockers. The success of these parcel lockers will be defined by the extent to which they will be strategically located: visible to users, able to attract new users, and adhere to greater city planning objectives related to transport, sustainability, and equity in opportunity for residents (Lachapelle et al., 2018). Stakeholders stress the need to make sure that recipients travel to the parcel lockers using sustainable modes of transport in order to fully capitalize on the potential sustainability benefits of this delivery model.

3.5.2 B2B-deliveries

The shift from conventional to new delivery models via hubs or UCCs is expected to be less strong in the context of B2B deliveries. While a relatively greater amount will be handled through hubs, as opposed to B2C deliveries, stakeholders expect that more deliveries will still also be done the conventional way.

While local authorities are pursuing the development of hubs, businesses are more concerned about timely and secure delivery of their cargo than about delivery through a hub for reasons of sustainability. For them the delivery via hubs of UCCs does not add any ease of use. On the other hand, logistics operators stress that they often already operate through an in-house hub model: they bring goods to cities, and consolidate them in their own service centres in city outskirts. Every additional hub-stop or transfer of their goods adds to the costs. Therefore, they seem more likely to work on sustainability in-house than to cooperate in a city-wide system.

3.5.3 Role of stakeholders in unattended delivery

Table 15 - Role of different stakeholders in the development of unattended delivery models (-2 passive / +2 active) (average expectation)

	logistics experts	logistics operators	local authorities	residents	businesses
Local authorities	1.5	0.3	1.7	0.5	1.0
Logistics operators	1.0	1.4	1.3	2.0	1.2
Customers	1.3	0.9	-0.5	-0.5	0.7

Cities will likely have an active role in the development of new delivery models. Their main concern will be to allocate sufficient and adequate urban space to these delivery points in order to facilitate the realization of adequate networks of parcel lockers. This is emphasized by logistics experts and recognized by local authorities themselves.

Logistics operators are aware that unattended delivery is an important future pathway for last-mile logistics, and that they will have to play an active role in development of dense and reliable networks that are easy to use. For this they will seek to cooperate with other logistics operators as discussed under 3.3.3. They are equally aware however that cooperation in delivery might lower their visibility and image branding compared to other operators. Viable solutions for all parties involved will have to be worked out to deal with this.

The perceived role for consumers is less clear. They potentially have an important role to play through their shopping preferences. For instance, when choosing the delivery type in the online order check-out, they might choose parcel locker delivery more often in the future if they are nudged by benefits such as cost or ease of use. If demand for this type of delivery grows, operators will have to follow suit. However, customers might remain passive if they are unaware of these new delivery models. For instance, if not enough emphasis is placed on this option when choosing the type of delivery at check-out, or if they are unaware of potential benefits.

3.6 Innovation

New courier, express and parcel service players are likely to enter the last mile logistics playing field between now and 2035 (McKinsey & Company, July 2018). New players have the potential to disrupt the current state-of-affairs. Stakeholders were asked to share their expectations on the share of last-mile package deliveries that will be made by these new players (Table 16). They were also asked what types of new CEP players they expect to enter the market (Figure 4).

Table 16 – Share of deliveries made by new CEP players in 2035 (% average)

	logistics experts	logistics operators	local authorities	residents	businesses
% of deliveries made by new CEP players	31%	25%	18%	30%	26%

Regarding the share of last-mile deliveries made done by new players, roughly two trends were identified. First it is expected that newcomers will disrupt the last-mile market, such as large tech companies (e.g. Google) that can quickly realize large shipping volumes and acquire large market shares. The expansion of Amazon from a webstore into a fully-fledged logistics company shows how rapid such transitions can evolve⁶.

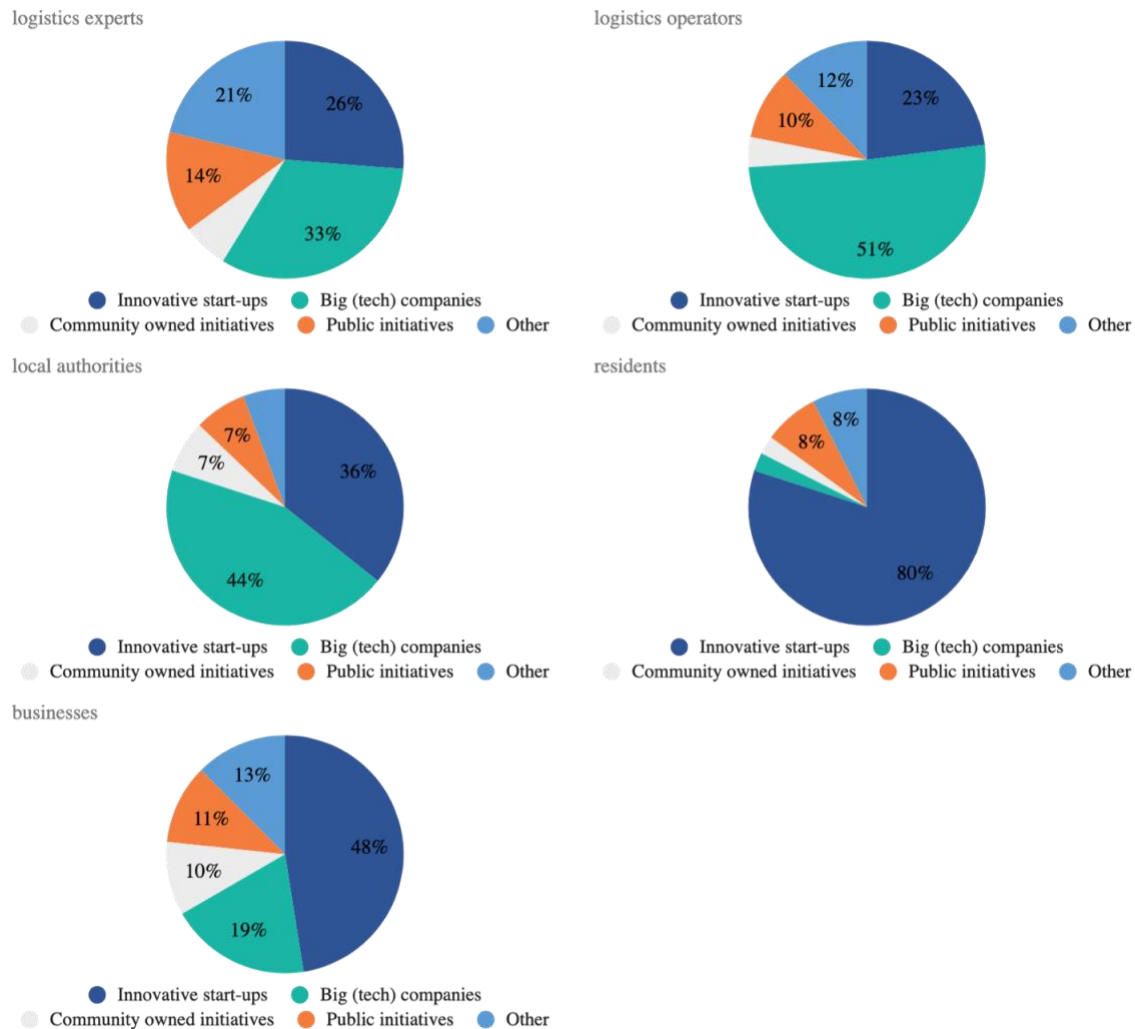


Figure 4 - Range of logistics newcomers to be expected in 2035.

⁶ <https://jungleworks.com/how-amazon-leverages-last-mile-delivery-for-its-logistics/>

Another expected trend is that of continued innovation of current established players. They are assumed to consolidate their current dominant positions and acquire the smaller and innovative newcomers. According to stakeholders, and depending on the developments of these trends, 20 to 30 percent of deliveries in 2035 is expected to be done by new CEP players.

With regard to the type of new CEP players that stakeholders expect to enter, large tech companies and innovative start-ups are expected to be the most prominent in the period towards 2035 (Figure 4). Large tech companies already own a lot of data on customers, which can help them to quickly enter the urban logistics sector (e.g., by offering highly individualized services). One of their interests to become a player in urban logistics is to be in charge of their entire supply chain (from shipping to delivery to your door, like Amazon). Also, adding delivery to their service portfolio enables them to collect even more data from customers.

Innovative start-ups are expected to be another group of newcomers. They are envisioned to bring about new innovations that are embraced by customers, or which make them interesting for larger CEP to strategically partner with. Less is expected from community-owned initiatives, that seemingly stand little chance due to a lack of volume and limited knowledge of the market. The entry of public initiatives is also likely to remain to a minimum due to a lack of knowhow, and logistics not being the “core business” of the public body managing the initiative (such as city authorities).

3.7 Organization

Growing levels of urbanization spur a growing demand for urban logistics, while adding to the complexity of operating the transport of goods sustainably in an increasingly dense and contested urban space. One future pathway to realize sustainable last-mile delivery is that of increased cooperation between logistics stakeholders.

First, we asked whether stakeholders expect more strategic partnerships to arise between private logistics stakeholders to realize sustainability benefits. Second, we asked the extent to which they expect that private parties will work together with local government in a city-wide city logistics management system. Results are shown in Table 17.

3.7.1 B2B cooperation in supply chain

The expectations on B2B cooperation are somewhat mixed. Overall, cooperation will likely increase, but only slightly. According to some stakeholders, strategic partnerships between global players and parties with local knowledge are indispensable in the face of stricter local requirements on last-mile deliveries. In other words, knowledge of the local situation and the ability to offer highly specialized service are seen as increasingly valuable. Others, however, mention that instead of forming strategic partnerships, larger CEP players might also resort to mergers and acquisitions to gain this local knowledge on last-mile operations.

Table 17 – Degree of cooperation between private parties and between private parties and local government.

	logistics experts	logistics operators	local authorities	residents	businesses
Degree of B2B cooperation in strategic partnerships <i>(-2 low, +2 high)</i>	0.3	0.6	0.7	0.0	-0.2
Degree of B2G cooperation in city-wide system <i>(-2 low, +2 high)</i>	1.3	0.6	0.8	-1.0	0.7

3.7.2 B2G cooperation in a city-wide logistics management system

Future cooperation between private logistics players and the local government (B2G) could take the form of a citywide logistics monitoring and management system. Closer cooperation such as in traffic flow management to reduce congestion and emissions could benefit all stakeholders involved and is widely viewed as both likely and preferable. However, it is mentioned that local authorities might lack the know-how to set-up a city-wide management system. Also, they are often unaware of what cooperation in such a system demands from individual logistics operators: for instance, the need to share data and or to be transparent on their operations might pose a risk to the individual competitiveness to private parties such as logistics operators.

3.7.3 Data-sharing

Cooperation can take many forms. One of these is B2B and B2G data sharing, which can help improve operational efficiency and contribute to various goals, as discussed under 3.7.1. and 3.7.2. Therefore, stakeholders were asked to what extent they expect private parties to share data with each other (B2B data sharing) and with the government or a trusted third party (B2G data sharing) (Table 18).

Table 18 - Degree of data sharing between private parties and between private parties and government or trusted third party.

	logistics experts	logistics operators	local authorities	residents	businesses
Degree of B2B data sharing <i>(-2 low, +2 high)</i>	-0.5	-0.6	-0.3	0.0	-0.2
Degree of B2G data sharing <i>(-2 low, +2 high)</i>	1.0	0.1	-0.2	0.5	0.2

Data, and specifically data-sharing, is widely regarded as a sensitive topic as it is at the core of modern-day logistics operations. Overall, stakeholders expect B2G data-sharing to be slightly more likely in the future than B2B data sharing.

The general view is that “data is money”, and that data will only become more important in the future. Therefore, the degree of data-sharing is entirely dependent of the goals and use of that data. Logistics operators mention their reluctance to share data with each other in relation to potential accusations of forming cartels. Therefore, this is expected to remain neutral to low.

4. Conclusions

The aim of this provisional trend report is to make sense of the potential changes in urban last-mile logistics up till 2035. Unique about the analysis is that it builds on knowledge, expectations and reasoning of logistics stakeholders of three lighthouse cities on sustainable urban logistics in Western Europe - Bremen (Germany), Groningen (The Netherlands), and Mechelen (Belgium). The distinguished stakeholder groups are logistical experts, logistics operators, local authorities, residents and local business.

The analysis shows that major changes are ahead in urban logistics. Stakeholders almost unanimously expect that in 2035:

- Sustainable modes of transport will be dominant, due to a substantial increase of modal shares of emission free vehicles in combination with the use of cargo bikes.
- Urban consolidation centres, micro hubs and unattended delivery technology (e.g. parcel lockers) will have a structural function in the organization of urban freight flows.
- Today's large courier, express and parcel service players have been able to consolidate their market dominance, but that up to 30% of the parcel delivery market will be handled by new players. Especially big tech companies and innovative start-ups are expected to disrupt urban logistics practices, forcing other players to adapt and further innovate.
- Local governments will have an active role in the transition towards sustainable urban logistics through a combination of restrictive and facilitative policies.

On other potential changes, such as autonomous vehicles, resource cooperation, and data sharing, the stakeholder groups have more diverse expectations.

While major changes in urban logistics are expected, stakeholders have concerns about feasibility of specific innovations. Logistics experts, those who are professionally involved in thinking through long term changes in the logistics sector, are most progressive in their expectations. They foresee structural changes in almost all investigated themes. Other stakeholders are more conservative. They expect the lack of critical pre-conditions, insufficient societal acceptance, investment capacity, and/or a lack of knowledge may slow down or prevent urban logistics innovations. For instance, they wonder whether sufficient charging infrastructure will be available to support a large fleet of electric vehicles, have concerns about liability issues around autonomous vehicles and vehicle sharing between logistics operators, and doubt whether sufficient investments can be made in time to realize zero emission goals.

Identifying these feasibility issues is believed to be one of the strengths of the presented analysis. By systematically inquiring a diverse range of stakeholders that are active in urban logistics on a day to day basis in this report and in future studies, the interdependencies

between technology, business models, operational systems, public policies, and consumer behaviour are brought to the forefront.

The expected active role of local governments is another remarkable finding. Typically, the urban logistics sector is one in which private actors are leading and governmental interventions are limited. Recently, (local) governments started to take a more active role in pursuing more sustainable urban logistics, exemplified by the investigated lighthouse cities. It is therefore relevant to note that the participating stakeholders consider an active role of city administrations self-evident, for instance in the regulation of transport modes, city access, and the implementation of parcel lockers.

However, they do note three caveats for productive public policies. First, in their eyes, local governments have relatively limited knowledge about the logistics sector and therefore tend to formulate policy goals without properly considering the practical implications and required conditions for success. Knowledgeable civil servants and fora to exchange experiences and new developments thus seem to be key for effective public policy. Second, alignment of policies and regulations between cities is considered essential as many logistical operators are active in multiple cities and too much variation would lead to unworkable situations and hamper investments and innovation. Some call for regional or national policies in order to prevent such policy fragmentation. Finally, local governments are asked to provide clear and stable policy frameworks on which activities are allowed and which changes in regulations on city access, transport mode restrictions and subsidy schemes can be expected. Hence, they are mainly expected to set boundaries and provide clarity. Stakeholders do not expect nor prefer local governments taking the lead in developing new logistics services or logistics systems. While the request for stability and guidance is an understandable desire from the perspective of logistic operators, residents and businesses, it puts governments in a difficult position as the future of urban logistics and its implications for cities are still very much to be explored (see D6.2 on how policy makers on urban logistics are confronted with uncertainties).

The presented trend analysis has certain limitations. As highlighted before, the focus on three lighthouse cities in Western Europe allows for a detailed preview of the changes that might shape urban logistics up till 2035. Meanwhile the focus on these specific cities implies that one should be careful generalizing these findings to other contexts. Cities with different urban forms and less intense exchange and collaborations between public and private actors may follow different future pathways. While this report shows that residents might hold distinct views on the future of urban logistics, they were underrepresented in this analysis. Moreover, the report does not provide an analysis on how changes on individual themes may, in combination with each other, amplify or dampen the transition toward sustainable urban logistics. In other words, the expected changes are only discussed in relation to each other to a limited extent. The development of scenarios, incorporating individual changes into coherent potential pathways, is a next step that will be carried out as part of Deliverable 2.4 'Future scenarios based on Disaggregative Policy Delphi'.

Acronyms

Acronym	Meaning
AI	Artificial Intelligence
AV	Autonomous Vehicles
B2B	Business-to-business
B2C	Business-to-consumer
B2G	Business-to-government
D	Deliverable
EC	European Commission
CEP	Courier-, express- and parcel services
GA	Grant Agreement
ICT	Information and Communication Technology
LF	Load Factor
LSP	Logistics Service Provider
O	Objective
ODD	On-demand Delivery
P	Product
PPP	Public Private Partnership
PM	Person Month
SUMP	Sustainable Urban Mobility Plan
SULP	Sustainable Urban Logistics Plan
T	Task
UC	Use Case
UCC	Urban Consolidation centre
UFT	Urban Freight Transport
ULaDS	Urban Logistics as an on-Demand Service
WBS	Work Breakdown Structure
WP	Work Package
VUR	Vehicle Utilisation Rate
ZE	Zero Emissions
ZEV	Zero Emission Vehicle

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