



Urban Logistics

How to unlock value from last mile delivery for cities, transporters and retailers

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1. Challenges and opportunities for last mile delivery of goods in cities

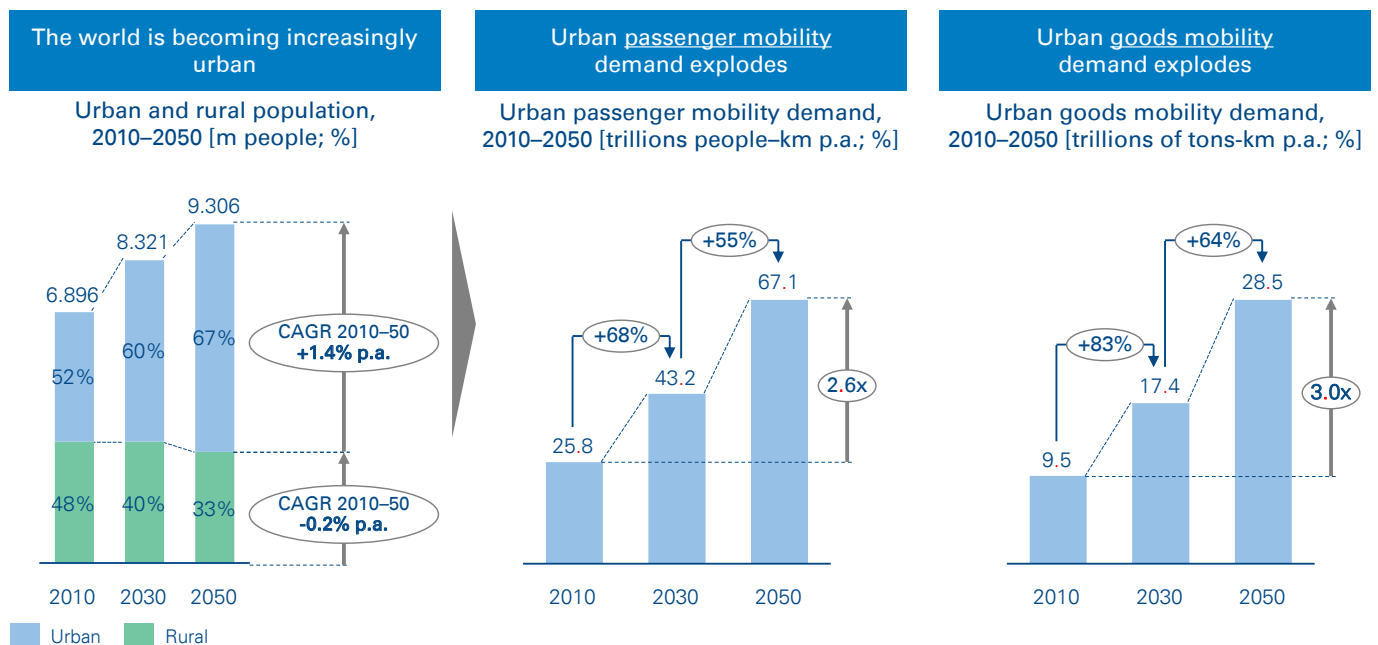
The world's population is concentrating in cities, which, as a result, are ever growing. Fifty-two percent of the population currently lives in urban areas, and by 2050 this number is expected to reach 67%. Today, 64% of all travel happens within urban environments, and the total amount of urban kilometers traveled is expected to triple by 2050. A similar trend is anticipated in terms of urban goods distribution, with e-commerce being the fastest-growing driver of urban deliveries, which also impacts the length and fragmentation of urban logistics flows. As a growing number of vehicles in urban areas implies increased congestion, air pollution and noise, which negatively impact traffic safety, quality of life and urban economic competitiveness, more and more cities are experiencing issues related to last mile delivery of goods.

Many cities have started to understand and address the challenges associated with passenger mobility issues by developing urban mobility visions and strategies for passenger transportation at regional or city level. On the other hand, comprehensive strategies for last mile delivery of goods at city level are often missing.

Last mile delivery of goods is a difficult issue to apprehend, as it involves several levels of complexity. In addition to the heterogeneity of the goods transported and of the means of transportation, urban logistics encompass diverse levers and multiple stakeholders. The most important stakeholders are public authorities, transportation companies and retailers, each of which may have diverging interests and objectives. Often these stakeholders lack shared understanding of the status quo, priorities and most appropriate action levers. While local authorities are interested in opportunities to reduce congestion, pollution and noise, transportation companies and retailers are mainly concerned with keeping costs under control while maintaining or increasing service levels. This complexity may very often lead to enforcement of partial, sub-optimal or even counter-productive decisions and solutions.

A comprehensive urban logistics strategy can typically contribute to several objectives, each of which can be influenced by different factors. Some of these objectives may even conflict, thereby requiring careful prioritization:

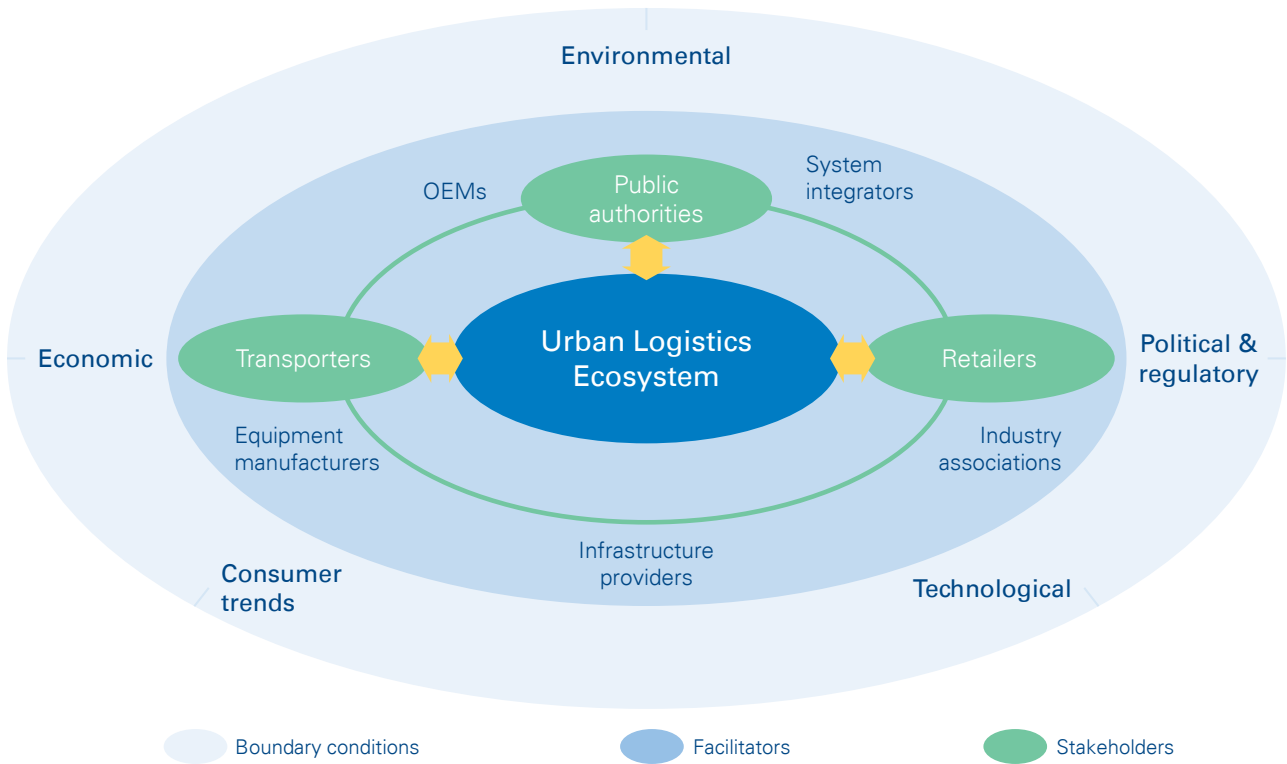
Figure 1: Increased urbanization and its impact on passenger and goods mobility demand



Source: UN, Worldbank, OECD, ITF, Schäfer/Victor 2000, Cosgrove/Cargett 2007, Schäfer 2007, Arthur D. Little

- **Urban congestion reduction**, influenced by distance traveled, vehicle capacity & length and ease of coming to a halt
 - **Reduction of number of trucks in the city**, influenced by vehicle capacity, vehicle filling ratio and congestion level
 - **Pollution reduction** (i.e. NOX and PM), influenced by vehicle type, distance traveled and congestion level
 - **Energy conservation** (including CO2 reduction), influenced by vehicle type & age, distance traveled and congestion level
 - **Noise reduction**, influenced by vehicle type, distance traveled and congestion level
 - **Development of local retail**, influenced by solution costs, which are defined by service quality (speed, delivery time slots, flexibility/reactivity, etc.)
 - **Contribution to housing policy** (increasing housing space within city limits), influenced by the footprint of the inner-city logistics platform
- Furthermore, many boundary conditions will impact the definition of an appropriate strategy for last mile delivery: economic, environmental, political & regulatory, technological and consumer trends.

Figure 2: Stakeholders, facilitators and boundary conditions in an urban logistics ecosystem



2. A cocktail of solutions can be applied to devise appropriate strategies for urban logistics

A cocktail of solutions can be applied to improve last mile delivery of goods in cities. Each of these solutions has already demonstrated benefits in selected cities, as illustrated in Figure 3. Several of these solutions have existed for many years, but the complexity lies in selecting the right combination of solutions, taking into account the local context and the solution's contribution to the defined objectives at local level.

We can distinguish four main categories of solutions:

1. Regulatory and land planning: These measures allow authorities to impose certain rules and restrictions on the use of urban transportation and land planning for logistics within the city. Typical examples are:

- **Restricted access** to certain areas, based on a set of criteria for vehicles (e.g. emissions, weight, size)
- **Time slots** for when certain vehicles can enter certain streets
- **Exclusivity zones** for urban deliveries (in which only one or a limited number of transporters can perform deliveries)
- **Urban land planning to cluster zones of retail and logistics** in order to reduce the logistics sprawl

All of these measures are usually applied in combination with other last mile delivery levers as they can steer the behavior of transporters towards better last mile delivery solutions. Restrictions and time slots are mature levers, as they have been applied for a number of years in many cities. As these measures imply a large capital cost for transporters (e.g. new or retrofitted vehicles), cities need to align in order to make the compliance costs for transporters as low as reasonably possible. Due to the size of these compliance costs, implementation favors large transport operators over smaller ones. Authorities must also ensure that these levers are effective by enforcing them (e.g. by using fines), and prioritize enforcement of existing measures over introduction of new ones.

2. Infrastructure: Alternative transportation and logistics infrastructures are created, or existing infrastructures are adapted, to better suit the needs of urban freight transport.

- An **urban distribution center (UDC)** collects shipments in a specialized warehouse at the edge of the city, where they are consolidated before being shipped into the city for last mile delivery. The objective is to increase truck usage to optimize the total distance traveled by trucks, which benefits the city's congestion level and air quality. The UDC's impact depends mainly on the extent to which it can increase truck usage, which is influenced by the nature of the goods, the transporters and the local density. Although many are no longer in operation due to lack of financial viability, we expect to see a second wave of UDC implementations, building on the lessons learned from the previous implementations
- **Direct Injection** brings goods directly into the city using alternative mass transportation means (e.g. ships and freight trains), after which vans and other last mile delivery transportation means must cover only very short distances. This measure is not cost-effective for transporters at this moment due to the increased cost of the added transshipment, but it enables urban delivery of goods in restricted areas
 - By using much softer delivery modes (such as tricycles)
 - Where truck access to historical city centers is highly restricted
 - When strong urban congestion charges are imposed
- Cities can also **reserve dedicated parking spaces for (un)loading trucks** in the city, or let trucks use bus lanes during certain times of the day. While this measure is already widely adopted, recent implementations of this lever use dynamic reservations of parking spots or dynamic access allocation of bus lanes for trucks, depending on the time of day or the current traffic conditions
- The recent surge in e-commerce has led to an increase in parcel deliveries. **E-commerce pick-up points**, such as Amazon's Lockers, enable transporters to deliver parcels to single locations without having to go from door to door. They also allow customers to pick up their packages at their own convenience, from locations close to their homes

Figure 3: Most common measures to improve urban delivery of goods

1	Regulatory and land planning	Restrictions on vehicles	<ul style="list-style-type: none"> Access restrictions to selected small areas and/or roads for transportation vehicles based on emissions (Low Emission Zone), weight, size and/or age of the vehicle 	Berlin: Low-emission zone since 2008
		Time slots	<ul style="list-style-type: none"> Opening/shutting of certain areas using specific time slots for specific types of trucks 	Paris: Time slots per type of truck in Paris city center
		Exclusivity zones	<ul style="list-style-type: none"> Exclusivity for a single or limited number of transportation companies within certain areas Can be limited to some truck sizes and/or time slots 	London: Exclusivity zone for DHL around LHR
		Creating specific zones for retail and logistics	<ul style="list-style-type: none"> Clustering of retail and logistics zones in urban land planning 	Bologna: Interporto Bologna freight village
2	Infra-structure	Urban distribution center (UDC)	<ul style="list-style-type: none"> Shared logistics facilities for consolidation of goods for transport into the city Can be located within the city or just outside the city 	Ningbo: DHL UDC Antwerp: bpost city logistics
		Direct injection	<ul style="list-style-type: none"> Preparation of delivery routes in containers Transport of containers by massified transport (ship, heavy rail) into the city 	Paris: Direct injection via canal through central injection point
		Traffic lane/drop-off space reservation	<ul style="list-style-type: none"> Creation of dedicated loading/unloading areas and traffic lanes for freight transport 	Barcelona: Bus lanes used for goods drop-off during nights
		Network of e-commerce pick-up points	<ul style="list-style-type: none"> Self-service pick-up points for the delivery of parcels 	USA: Amazon Lockers
3	(Financial) Incentives	Urban congestion charge	<ul style="list-style-type: none"> Implementation of congestion fee to be paid when entering the city or a number of certain areas 	London: Congestion charge
		Smart fare	<ul style="list-style-type: none"> Implementation of a variable fee based on the distance traveled within the city, the volume shipped, or the current traffic conditions 	San Diego: I-15 Hot Lanes
4	Equipment and technology (enablers)	Greener trucks	<ul style="list-style-type: none"> Lower or Zero Emission Trucks (Euro NCAP 5, electric, gas) Often applied in combination with regulatory and land-planning measures 	Denmark: Pilot for use of EV by Post Denmark
		Alternative transportation means	<ul style="list-style-type: none"> Usage of alternative transportation means (bicycle, tricycle,...) Often combined with UDC or direct injection 	Paris: Urban rail logistics used by retailer Monoprix
		Big Data analytics and intelligent traffic systems (ITS)	<ul style="list-style-type: none"> Optimization of freight distribution due to traffic information systems, freight capacity exchange systems, centralized route planning, route optimization 	Hamburg: Smart city system connecting port logistics and city traffic
		Crowdsourced delivery solutions	<ul style="list-style-type: none"> Sourcing of delivery services through social networks and crowd-based concepts 	Paris: Deliver.ee platform of professional couriers

3. **Financial incentives:** Public authorities can give financial incentives to urban transportation providers based on a supply-demand mechanism, to steer their transportation decisions and lower the externalities caused by urban freight transport:
- **Urban congestion charges** for certain roads or areas in the city can incentivize transporters as well as car users to reduce traffic in those areas, which leads to lower congestion. Secondary benefits include reduced air pollution and greenhouse gas emissions. The charges can be made using toll booths or automated fare collection systems based on license plate recognition, or by installing a signaling device in the vehicle. Implementing this measure requires hefty investments, which are usually made via public-private partnerships and can be politically sensitive
 - A **variable smart fare** depending on a set of variables, such as distance traveled, volume shipped, or the time of the day can optimize a tolling system. Pricing schemes based on global satellite navigation systems can allow for accurate, usage-based pricing instead of plain “access fees,” charging only those vehicles that contribute the most to congestion. Pricing mechanisms can also be demand driven, meaning that the toll is zero when there is no traffic, but increases in relation to traffic volume. This type of scheme is used in San Diego (I-15 Hot Lanes)
 - **Subsidies, tax deductions and other incentives** to foster the implementation of infrastructure, equipment or technology levers. Typically, these measures are installed on a local or regional level and targeted to transportation providers, retailers and infrastructure providers. OEMs and equipment manufacturers may benefit from incentives on regional or national level
4. **Equipment and technology:** New or improved equipment and technologies reduce the impact created by last mile deliveries, and are enablers for implementing last mile delivery strategies:
- **Greener trucks** (electric, plug-in hybrid, hydrogen or natural gas) reduce the impact on the environment caused by freight trucks driving in the city. Several logistics providers, such as DHL and UPS, are already deploying electric trucks and vans on a small scale or in pilot projects. However, the total cost of ownership for electric trucks in Europe is still around 40% higher when compared to similar internal combustion engine trucks, according to the World Economic Forum. In China, the total cost of ownership is comparable due to strong government incentives for electric trucks
 - Innovative **alternative transportation means** can be used to reduce the impact of last mile delivery in terms of environmental impact (GHG emission, air pollution, noise) as well as road safety. There are myriad alternative transportation means available, such as bikes for freight, electric scooters, small electric urban vehicles, tricycles and drones. These transportation means are often combined with other last mile delivery levers such as urban distribution centers and direct injection
 - **Big Data analytics and intelligent traffic systems (ITSs)** are ICT solutions that enable optimization of deliveries at individual (e.g. transporters) as well as system level (e.g. traffic flows in the city). This allows for route optimization according to real-time traffic information, and load factor optimization through freight capacity exchange systems between different logistics actors. Most major logistics providers use these types of systems for route optimization, but the first initiatives for a system-level ITS for freight are still in an early phase. The optimization of goods flows should be part of a holistic smart city platform that also takes other verticals into account
 - **Crowdsourced delivery solutions** are last mile delivery solutions based on crowdsourcing (to either transportation professionals or private individuals). They provide pickup solutions from a local stock (usually directly from the shop) and deliver over a short distance (intra-city) to the e-commerce shopper

3. Key success factors for defining urban logistics strategies at system level

A prerequisite for improvement of last mile delivery is thus alignment between the different stakeholders to define shared objectives underlying the last mile delivery strategy.

In order to select the most appropriate set of solutions, there needs to be a shared understanding of their impact on the local context as well as their contribution to the defined objectives. The chosen solutions should also take into account the geographical area and the mix of different goods categories in scope. This requires an innovative ecosystem that may consist of several players, both private and public, that have a shared vision, as well as common objectives in order to select the right set of levers to reach this shared vision.

To tackle the last mile delivery issue at system level, such an ecosystem may involve a combination of up to seven key actors that play different roles:

- **Public authorities and policy makers** are core members of the ecosystem and take the lead at system level, as they impose regulations and introduce incentives for maximizing the system-level value of last mile delivery
- Usually, **the transportation and infrastructure providers** will take the lead for several initiatives. As these actors distribute the goods, implementing last mile delivery levers has an important impact on their core business
- **Retailers** will play a critical role in making the urban logistics strategy successful. Retailers could make transportation more efficient and tap into possibilities for brand marketing. The improvement potential is, however, larger for small and independent retailers than for big-box retailers, which often already optimize their supply chains, including the last mile delivery within their cities

Figure 4: Contributions and rewards for the potential actors in a last mile delivery ecosystem

Actors	Contributions	Rewards
1 Public authorities (local, regional, national)	<ul style="list-style-type: none"> ■ Core members of the ecosystem and leading role in defining urban logistics strategies at system level ■ Incentivize through (indirect) funding of initiatives or adjustments / introduction of regulations 	<ul style="list-style-type: none"> ■ Reduction of externalities caused by last mile delivery (sociological, economical and ecological)
2 Transportation providers	<ul style="list-style-type: none"> ■ Efficient and sustainable transportation of goods ■ Collaboration between different providers to offer optimized and multimodal last mile delivery solutions 	<ul style="list-style-type: none"> ■ Increased cost efficiency of transport ■ Decreased risk for investments ■ Improved brand image
3 Retailers	<ul style="list-style-type: none"> ■ Active participation in urban logistics ecosystem ■ Collaboration between small and independent retailers giving access to new transport and infrastructure solutions 	<ul style="list-style-type: none"> ■ Increased cost efficiency of transport ■ Improved brand image
4 Infrastructure providers	<ul style="list-style-type: none"> ■ Building/operating Urban Distribution Centers ■ Create infrastructure allowing for new last mile delivery solutions (e.g. network of pick-up points, transshipment infrastructure,...) 	<ul style="list-style-type: none"> ■ Increased efficiency ■ Access to untapped revenue potential
5 Industry associations	<ul style="list-style-type: none"> ■ Representation of the retail and transportation sector ■ Distribution and exchange of innovative ideas, initiatives and best practices across stakeholders 	<ul style="list-style-type: none"> ■ Concerns of their members understood and taken into account
6 OEMs and equipment manufacturers	<ul style="list-style-type: none"> ■ New ecological transportation vehicles or components (EV, reduced emission, battery technology) ■ Innovative routing technologies 	<ul style="list-style-type: none"> ■ Access to untapped revenue potential ■ Improved brand image
7 Connectivity and ICT system integrators	<ul style="list-style-type: none"> ■ Providing connected ICT platforms and innovative technology solutions (e.g. Big Data analytics) allowing for freight distribution, freight capacity exchange,... 	<ul style="list-style-type: none"> ■ Access to untapped revenue potential ■ Improved brand image

- **Industry associations** may be part of the last mile delivery ecosystem as they represent the involved industries to policy makers, distribute best practices among their members and promote adoption of common standards
- **OEMs and equipment manufacturers** may be suppliers to the ecosystem, as they provide the transportation means and introduce new technologies that reduce the impact of urban freight
- **Connectivity and ICT system integrators** may play an important role when technological solutions are involved, (e.g. dynamic route planning and consolidation of loads between different transporters)

In this complex stakeholder landscape, several considerations need to be taken into account **when selecting the appropriate levers** for solving the last mile delivery issue:

- There needs to be a **shared understanding of the impact of the different levers on the local context**. The activation of a specific lever can positively influence one objective, while negatively influencing another. For example, switching all deliveries to electrical trucks would imply a reduction of noise and emissions (CO₂, NO_x and PM), but could simultaneously increase congestion levels due to their smaller load, as well as negatively impact overall logistics costs
- Some solutions imply **higher capex requirements or increase total transportation costs**, driven by added transshipments or usage of more costly transportation modes. They are economically viable only if they have sufficient volumes and generate significant operational gains in last mile delivery (e.g. through increased truck usage). Alternatively, they require subsidies or privileged access to the city center
- **Not all levers are attractive for all types of end customers**. For example, UDCs are less interesting for big-box retailers as they already optimize truck loads before delivering to stores in cities. This lever is only applicable

when there is a sufficient presence of (independent) retailers without an optimized last mile supply chain

- **Financial interventions from public and local authorities are often required** to support the economic viability of urban logistics strategies that have positive impact on the objectives important to local authorities (e.g. urban congestion, air pollution and noise reduction)

Taking these elements into account, there are a number of **key success factors** for the development of an **appropriate urban logistics strategy**:

- **Define a shared vision and common objectives supported by all stakeholders in the ecosystem**. Each actor has its own set of objectives. Generally speaking, retailers, transporters and infrastructure providers want to safeguard service levels for their clients, while maintaining healthy profit margins. Policy makers, on the other hand, want to install policies that are beneficial for both city residents and businesses. In the context of last mile delivery, these objectives can be conflicting. As such, it is paramount to align on the objectives that the ecosystem needs to achieve before selecting and implementing a set of last mile delivery levers
- Perform a **careful cost-benefit analysis** of each lever individually and in combination with other levers, allowing for assessment of synergies as well as conflicting impact. This would also consider the right set of regulations, as well as incentives to put in place in order to foster their deployment
- Use **pilots and experiments** in restricted areas to reach an agreement on the most appropriate strategy before starting a full implementation
- **Harmonize regulations** to make implementation at city or district level possible. It is important to strive for harmonization of regulations across cities and regions, in order to ensure that nationally active logistics companies can reduce their compliance costs as much as possible

Key insight for the executive

The need to rethink and rationalize urban logistics is being pushed into the front scene by the boom in the number of shipments (exacerbated by the growth of online shopping). It is also influenced by the general public's growing focus on the negative environmental and societal impact of fuel-driven deliveries in already saturated urban centers.

However, urban logistics is a difficult issue to apprehend, as it encompasses several levels of complexity. Next to the heterogeneity of the goods transported and of the means of transportation, urban logistics encompass multiple stakeholders, each of which may have diverging interests and objectives. Often these stakeholders lack shared understanding of the status quo, priorities and most appropriate action levers.

Several solutions for improving urban delivery of goods exist, each having proved to deliver benefits in a number of instances. The key to success for the development of an appropriate urban logistics strategy lies in performing a careful cost-benefit analysis of each lever individually and in combination with other levers. This will allow assessment of synergies as well as conflicting impact between levers. The applicability and relevance of each set of solutions should at the same time be assessed against the local context. Moreover, it also requires devising the right set of regulations and incentives to put in place in order to foster successful deployment. Finally, once an agreement has been reached about the most appropriate urban logistics strategy, the agreement should be tested via pilots in restricted areas before full implementation.

Regional and local public authorities should:

- Determine last mile delivery macro objectives and align them with other city verticals and (when existing) the overall smart city strategy
- Define the most relevant last mile delivery strategy based on the understanding of city characteristics (city size, population, urban density, access infrastructure...) and engage with transporters, retailers and other stakeholders to steer identification of the right combination of levers to achieve this strategy.
- Strive for harmonization of regulations at local level (e.g. delivery hours, environmental regulations) within and across cities and regions to ease implementation of measures within city and regional boundaries
- Develop financial and operational incentive and penalty schemes to foster adaptation of last mile delivery processes towards more sustainable solutions (e.g. co-modality and urban distribution centers)

Transporters and retailers should:

- Engage with public authorities and other actors at region and country level to develop a shared framework and objectives for last mile delivery
- Assess costs and benefits of existing last mile delivery solutions depending on the city characteristics
- Identify potential operational partners and set up multi-stakeholder ecosystems with other actors to identify new business models and implement innovative last mile delivery solutions (at city, regional or country level)
- Identify key assets to acquire in the city or region to efficiently deploy solutions
- Determine potential operational and business model amendments in which to incorporate last mile delivery solutions

ICT providers, system integrators and Big Data analysis service providers should:

- Proactively support identification of innovative last mile delivery solutions and standards, leveraging new technologies
- Contribute to creating awareness of innovative urban logistics schemes
- Identify the most attractive regions and cities for identified solutions based on understanding of city characteristics and last mile delivery maturity levels
- Participate in multi-stakeholder ecosystems to develop and implement innovative last mile delivery solutions

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Arthur D. Little

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