ICLEI Local Governments for Sustainability

EcoLogistics

Low carbon freight for sustainable cities

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

IKI INTERNATIONAL CLIMATE INITIATIVE

EcoLogistics - Exploring future trends

Of Urban logistics decarbonization

ZLC | MIT GLOBAL SCALE NETWORK

Smart Freight Centre

despacio®

ABOUT ECOLOGISTICS PROJECT

Supported by the German Federal Ministry for the Economic Affairs and Climate Action (BMWK) through the International Climate Initiative (IKI). ICLEI's EcoLogistics project (2017 - 2022) aims to increase the capacity of governmental and non-governmental stakeholders to build strategies and policies to promote low-carbon and sustainable urban freight in Argentina, Colombia and India, involving nine cities and regions:
Argentina: Córdoba, Rosario, Santa Fe de la Vera Cruz (Santa Fe)
Colombia: Capital District of Bogotá (Bogotá), Metropolitan Area of the Aburrá Valley (AMVA), Manizales
India: Kochi, Shimla, Panaji
For more information, please visit: sustainablemobility.iclei.org/ecologistics

ABOUT ICLEI – LOCAL GOVERNMENTS FOR SUSTAINABILITY

ICLEI – Local Governments for Sustainability is a global network working with more than 2,500 local and regional governments committed to sustainable urban development. Active in 125+ countries, ICLEI influences sustainability policy and drives local action for low emission, nature-based, equitable, resilient and circular development. ICLEI's Members and team of experts work together through peer exchange, partnerships and capacity building to create systemic change for urban sustainability.

ACKNOWLEDGEMENT

ICLEI and the Sustainable Mobility Program team would like to acknowledge the work and support of the EcoLogistics project partners, Despacio, Zaragoza Logistics Center and Smart Freight Centre. Through their valuable comments and input, this report was made possible.

WORKING GROUP

Beatriz Royo (Zaragoza Logistics Center)
Ian Wainwright (Smart Freight Centre)
Alan Lewis (Smart Freight Centre)
Camilo Urbano (Despacio)
Vijay Saini (ICLEI South Asia Secretariat)
Carolina Mesa (ICLEI South America Secretariat)
Juliana Veléz (ICLEI Colombia)
Maria Julia Reyna (ICLEI Argentina)
Iván González (ICLEI Argentina)
Andres Gavilan (ICLEI WS)
Tu-My Tran (ICLEI WS)

DESIGN
Olga Tokareva ICLEI WS

DISCLAIMER

Any person who believes they may be harmed by an IKI project or who wishes to report corruption or the misuse of funds, can lodge a complaint to the IKI Independent Complaint Mechanism at IKI-complaints@z-u-g.org. The IKI complaint mechanism has a panel of independent experts who will investigate the complaint. During the investigation, we will consult with the complainant to avoid unnecessary risks. More information can be found at: https://www.international-climate-initiative.com/en/about-iki/values-responsibility/independent-complaint-mechanism/

CONTACT

ICLEI – Local Governments for Sustainability e.V.
Kaiser-Friedrich-Str. 7
53113 Bonn | Germany
Tel. +49-228 / 97 62 99-00
www.iclei.org

CONTENTS

Introduction 5

Trend #1: Data and digitalization (Logistics 4.0) 6

- Digital freight platforms 6
- Omnichannel (retail) 6
- Urban policymaking 7
- Blockchain in Logistics 7
- In-car delivery 8

Trend #2: Transition to net-zero technologies 9

- Hydrogen-powered / low-carbon fuels 9
- Last-mile vehicles 9
- Shared mobility systems 10

Trend #3: Collaborative logistics and new business models 11

- Agile storage management and fulfillment services 12
- Crowd shipping 14

Trend#4: Multi-stakeholder and co-creation practices 14

- Public-Private partnerships 14
- City labs 15

Trend #5: Inclusive logistics economics and customer change 16

- Social sustainability, job replacement and role of gig workers 16
- Consumer awareness and Purchasing habits 17

Conclusion 18

References 18

FOREWORD

Analyzing evolving trends is a complex challenge. The complicated nature of this endeavor demands a multi-layered approach that can accommodate the diverse interests of stakeholders. The present analysis takes a unique trajectory, drawing insights from the EcoLogistics experience, and revolves around three key frameworks: the evolution of business models, proactive actions cities can adopt to embrace upcoming models, and the strategic assimilation of technological advancements.

In an era of open innovation, catalyzing collaborative interactions among stakeholders is fundamental to guiding industries through the transformative waves sweeping across the sector. This spotlight on a just transition underscores the pivotal role of citizens and consumers as central figures profoundly influenced by the integration of new services and business models. This foreword sets the stage for an exploration into the trends that shape our trajectory toward sustainable urban freight.

ICLEI Sustainable Mobility

INTRODUCTION

Today's cities require efficient freight movement. With a projected 68 percent of the global population expected to live in urban areas by 2050 (UNDESA, 2018), urbanization is on the rise. This leads to increased service demands, greater goods movement, and higher energy consumption, putting more pressure on existing infrastructure and adaptive capabilities. As commercial trends continue to expand, the necessity for robust freight systems becomes even more evident. Recent impactful events, such as COVID-19 and geopolitical conflicts like the war in Ukraine, have severely disrupted supply chains. Countries must invest in reliable, resilient, and efficient supply chains to distribute essential goods and mitigate adverse effects. Strong collaboration across governance levels - national, regional, and local - as well as with private companies, is crucial for translating commitments into actionable strategies.

EcoLogistics – Explore the future trends of urban logistics decarbonization. This publication offers a deeper insight into next-generation technologies and business realities in the freight sector. An analysis of current and future trends in this sector can help in advising options for local governments to adapt their policies and adopt new systems to manage freight in cities. The report further describes the performance during trial phases of these new systems. This information is valuable to policymakers and other stakeholders in better understanding and aligning solutions according to their cities' needs.

Five key trends are highlighted in the following report:

- **Data and digitalization (Logistics 4.0)**
- **Transition to net-zero technologies**
- **Collaborative logistics and novel business models**
- **Multi-stakeholder and co-creation practices**
- **Inclusive logistics economics and customer relationships**

TREND #1: DATA AND DIGITALIZATION (LOGISTICS 4.0)

The key to the successful and early adoption of any new system lies in policymakers' acknowledgment of emerging trends and novel technologies. We have now entered a new stage of advancement – Logistics 4.0 - that addresses the evolving needs of consumers and their relationships with businesses. These new platforms and innovative services can enable accessibility and even further democracy in policymaking, improving not only consumers' lives but also conditions for workers and different stakeholders in the evolving supply chain. Technologies accompanying Trend #1 are defined below.

Digital freight platforms

Digital transformation and sustainability strategies have emerged as two major trends for companies in the 21st century. Capgemini defines a platform as "an online business that enables value-creating interactions between multiple parties." The remarkable growth and diversification of successful digital natives are prompting companies to reconsider their position within the platform economy. Last-mile logistics are particularly affected due to their close association with multiple parties interacting within cities' ecosystems. Platform-based business models streamline inter-organizational collaboration and foster public-private partnerships. The concept of interoperability, or "pluggability," facilitates open, flexible, demand-driven collaborative business models (van der Aalst et al., 2019). A wide array of digital platforms introduces new value propositions and business models for stakeholders in the ecosystem.

Omnichannel (retail)

Saghiri & Mirzabeiki, in 2021, compiled the most relevant requirements when developing a digital platform strategy for the retail sector. Robust platforms allow for formalizing data integration (Saghiri & Mirzabeiki, 2021). Capgemini has explored information and operational digital technologies such as smart sensors, data-sharing platforms (e.g., Wireless Sensor Networks (WSN)), horizontal and vertical data exchange technologies (e.g., Internet of Things (IoT) and Cyber-Physical Systems (CPS)), autonomous planning units (supported by artificial intelligence) and advanced data analysis methods (Big Data Analytics (BDA)) and shows the benefits for the retail sector concerning last-mile services (see Table 1).

Table 1. Retail sector: role of digital platforms for last mile distribution (Capgemini, 2021)

Value Proposition	Description	Examples
Customer experience	Collaborating with a platform can grant companies access to advanced last-mile services, which helps provide a valuable customer experience.	Bol.com JD.com
Branding	For retailers who want their brand to be at the forefront of technology, innovation, or sustainability, organizing the last mile through a platform for branding purposes	JD.com Amazon
Scale and costs	Increase the market share if there is not a strong presence or traffic, leverage consumer knowledge, and offer tailored marketing campaigns and cost reductions.	Deliveryhero

Urban policymaking

Urban freight transport is critical for sustainable and livable cities. Integrated platforms are emerging as enhanced decision support systems for improving policymaking, including construction of new areas, development of traffic controls or any other urban planning.

City logistics platforms integrate emerging technologies such as information and communication technologies (ICT), Intelligent Traffic Systems (ITS), Internet of Things (IoT), big data, Artificial Intelligence (AI), blockchain, and Robotics, with the opportunity for collaboration. Examples of this include city logistics solutions such as Urban Consolidation Centers (UCC) and Transshipment Centers (TC). These locations are highly related to urban land use plans, infrastructure provision and traffic management involving public-private partnerships (PPP) and enable data sharing from private companies and land developers.

Integrated platforms allow the development of city digital twins (CDT) a "virtual representation of a city's physical assets, using data, data analytics and machine learning to build simulation models that can be updated and changed (real-time) as their physical equivalents change." (European Commission, 2021).

More efficient communication and automated transactions

Integrated platforms allow for using ICT to track shipments by GPS, control the temperature during the entire distribution period with IoT, digitize or sign tender contracts reliably, and automate the receiving of the bill of goods. Blockchain-based platforms provide a tamper-proof database and smart contracts to track deliveries, verify transactions, automate payments, and reconcile for the shipper and the carrier. DLTLabs is a blockchain platform that Walmart Canada use. This platform is a national freight invoice and payment management standard for over 60 transportation carriers.

More efficient processes and operations

City platforms supporting local administrations and the logistics industry are compelled to optimize operations due to the exponential growth of e-commerce, online purchasing, and home delivery. The main issue with home deliveries lies in the organization of the delivery system. The lack of cooperation between different private companies leads to a loss of time for the enterprises since there may be unnecessary trips to the same place or partially empty delivery vehicles on the road. Especially in large cities, an organized urban logistics system with good cooperation between delivery companies is essential to solve and prevent issues affecting city areas (CIVITAS, 2022).

Other platforms gaining attention are Logistics as a Service (LaaS) and crowd shipping. (Klingebiel & Wagenitz, 2013) LaaS platforms are designed for individual combinability in a cloud marketplace. For defining crowd shipping, McKinnon references crowdsourcing, as the personalized delivery of freight. Crowd shipping has the potential to transform regular citizens into couriers, effectively creating new informal logistics networks for the distribution of small items. This innovative model harnesses the power of underutilized community resources to facilitate cost-effective and efficient last-mile delivery. A wide variety of online platforms offer different services depending on the mode of transport, travel type, commodity, customer base (such as B2B, B2C, C2C or C2B), price, and distance range (McKinnon, 2016).

Blockchain in Logistics

Blockchain in logistics helps to overcome challenges like the costs of collecting data, legal regulations, and the lack of tools

for analyzing data (Taniguchi, 2021). It improves the relationship among business partners who can then spend less time and energy protecting themselves. Blockchain technology builds a system on the foundations of so-called mutual mistrust, which can become trustworthy (Werbach, 2018). Blockchain removes the need for intermediaries previously required to act as trusted third parties to verify, record and coordinate transactions. By facilitating the move from a centralized to a decentralized and distributed system, blockchain effectively liberates data previously kept in safeguarded silos and allows anyone to participate.

According to Werbach, the most significant blockchain innovation is creating a new form of trust in which you put your confidence in a store of information without relying on any single person to authenticate it. The studies in blockchain business emerged in 2014 (Frizzo-Barker et al., 2020).

In the logistics domain, blockchain presents many opportunities. Data-sharing across the supply chain seamlessly increases the level of transparency. DHL classifies the potential use cases for logistics in three clusters; 1) empower consumers to choose a product based on accurate and reliable information (DHL, 2018); 2) drive efficiency by reducing paperwork and bureaucracy and automating services that require an intermediary; and 3) create new business models.

In-car delivery

Pickup points[1] and parcel lockers are innovative digital solutions for reducing missed deliveries with a potential impact of reducing traffic congestion and pollution and improving operator efficiency. In-car delivery has the same objective, but the key is to deliver the products directly to the consumer's car. Based on blockchain technology, the courier receives the location of the vehicle, the license plate, and a code with which can be used to access the car boot or trunk once. Volvo, Skoda, and Volkswagen have conducted pilot projects in collaboration with DHL[2].

Blockchain platform for last-mile logistics

VOLT is a blockchain platform for last-mile logistics. The platform connects customers and messengers and provides customized algorithms that leverage Big Data and a matching system that uses smart contracts for easy service delivery. VOLT can solve "hub & spoke" inefficiencies and enable same-day shipping solution that shortens delivery time to 1-5 hours, as opposed to the 1-3 days it takes in the existing online shopping mall.

1 UPS refers to pickup points as collection and delivery points or Access points. These are local shops in your neighbourhood, such as grocers or corner shops where you and your customers can drop off and collect parcels.

2 Learn more - https://www.dpdhl.com/content/dam/dpdhl/en/media-center/media-relations/documents/2018/dhl-whitepaper-shortening-the-last-mile.pdf

TREND #2: TRANSITION TO NET-ZERO TECHNOLOGIES

Investment decisions can have long lives, and the risks of stranded assets are high, so decisions should be guided by long-term logic. International Renewable Energy Agency (IRENA) recommends that the estimated USD 0.7 trillion in annual investments in fossil fuels should be redirected towards energy transition technologies. A sustainable energy transition is crucial to decarbonize the transport sector. The global energy crisis has raised the importance of renewable energy and a potential phase of accelerated adoption of cleaner technologies.

With the transition towards zero-emission vehicles becoming more prevalent, there is an ever-growing need for improving and researching optimal energy storage systems. Governments and Original Equipment Manufacturers (OEMs) are joining forces to create a larger knowledge base and increase the procurement of these systems.

In urban freight, the trends show that hydrogen-powered and low-carbon fuel vehicles offer practical solutions for the short to medium term, shaping mobility choices and promoting the adoption of last-mile vehicle technologies and shared mobility platforms.

Hydrogen-powered / low-carbon fuels

Hydrogen fuel cell systems in vehicles present low noise, higher efficiency, and higher specific power than traditional internal combustion engines. (Parra et al., 2019). The International Energy Agency (IEA) in 2019 showed that using hydrogen as the sole energy source in the vehicle leads to unaffordable costs, so it is necessary to analyze the use of hydrogen in hybrid configurations. The possibility of hybridization with hydrogen is a key sustainable solution for the decarbonization of transport, especially for use in long-distance heavy transport, sea transportation, rail transportation, and even aviation.

Last-mile vehicles

The benefits of zero-emission freight include healthy, livable, and accessible cities. Since trucks account for only 2% of vehicles on the road—yet they are responsible for 22% of road transport CO2 emissions in the EU. The massively increasing markets for on-demand deliveries and services and e-commerce, in general, solidify the need to integrate more sustainable means for the last-mile. There is an immediate need for accelerated development and adoption of sustainable technologies such as electric vehicles, shift to urban rail, boats, and cargo bikes. But it is equally important to have extensive cooperation among all stakeholders.

E-Mobility Hubs Quito - Ecuador

The city is organizing for the gradual decarbonization of transport, including making the historical center of Quito (HCQ) into a Low-emission Zone (LEZ). Within the LEZ is a multimodal e-mobility hub primarily accessed by clean public transport vehicles, pedestrians, and bicycles. The activities in Quito focus on improving the connectivity between public transport and stations with various e-mobility solutions to contribute to consolidating the LEZ in the HCQ. Furthermore, the commercial and touristic character of the HCQ require the introduction of light electric freight vehicles (LEFV) to transport goods within the area.

Shared mobility systems

Transport-related technologies and emergent business models geared towards sharing of assets are now leading the transformation of urban transportation through "shared mobility systems," which enable the shared use of vehicles, trips, or other transport assets and resources such as bike-sharing systems, car-sharing schemes, micro-transit, ridesharing, ride-sourcing, and other sharing systems.

This is also the case in urban freight, where we now see a significant rise in shared light electric vehicles aiding last-mile deliveries. These systems bring additional considerations regarding planning, regulations, and infrastructure provision. Some potential elements that decision-makers need to take into consideration are:

Planning - Authorities have the option to pre-define the areas where shared services can concentrate, and operate, based on the city's overall plans and priorities - for example, prioritizing areas with low connectivity to public transport nodes, or lower income areas.

Regulatory - There are several layers ona relate on the shared services such as providers, users, usage, vehicles, insurance, data privacy and sharing, and transactions management, among others.

Infrastructure - Sharing systems that feature electric vehicles require considering infrastructure requirements, particularly those relevant to charging (e.g. docked electric bicycle sharing). In some cases, there might be specific needs in providing space for the use of vehicles that are introduced.

Economic - The sharing concept is an innovative economic concept that is emerging in the field of urban transport, as it shifts the focus from owning assets (e.g. vehicles) towards paying for integrated services. Also, various economic can be used in order to aid the regulation of the provision and use of such services.

Integrating e-vehicles into sharing systems significantly impacts the environment, the economy (direct employment, reduced consumption of imported fuels), and society better access). However, such systems' potential risks and negative impacts should be addressed appropriately.

E-Trucks

E-delivery trucks provide higher efficiencies for the lower driving speeds that characterize urban delivery operations. Electric delivery trucks deliver many benefits when compared to the conventional alternative, such as decreased fuel price, increased operating efficiencies under real-life drive-cycles, as well as to the elements specific to electric trucks, such as electricity generation and costs, transmission efficiency, recharging infrastructure, and vehicle price.

E-motorcycles

E-motorcycles, including electric motorcycles, and electric scooters require a transition to complete electrification of urban transport, as charging infrastructure is not as capital-intensive as for light-duty vehicles. Electric motorcycles can play a big role in sustainable urban transport, especially when integrated adequately into traffic and connected to public transportation.

E-bikes

E-bikes and cargo bikes contribute to transforming urban freight and logistics. Research estimates that up to half of the motorized goods-related trips in cities can be substituted with cargo bikes. The shift from conventional urban goods vehicles towards such bikes requires minimal infrastructure investments.

E 3-Wheelers

E-3-wheelers (tuk-tuks, Keke, auto-rickshaws, tempo) are environmentally friendly and economical urban transport. Replacing fossil-fueled vehicles with e-tuk-tuks enhances urban air quality and reduces carbon emissions and urban noise pollution with similar or better services. They are good at serving first/last mile connectivity.

Public Cargo Bikes Rosario - Argentina

The city offer its citizens a sustainable and efficient mobility solution for transporting goods in the city center. The BiciPack public cargo bikes for sustainable logistics is an EcoLogistics demonstration project. Rosario has a visible and sustained policy to promote active mobility and a station base bicycle system that is working successfully to allow progress in a new service that can respond to the urban logistics needs of the city.

BiciPack aimed to be used by citizens, suppliers, entrepreneurs, and retailers in the city center. The system seeks to contribute to reducing trips and GHG emissions from motorized modes of transport. It incorporates 20 cargo bicycles in the "Mi Bici, Tu Bici" public system. The station base system allows users to take a cargo bike from the stations through a reservation made by an app, allowing them to use the bike and make the trip to perform the deliveries of goods and return the bicycle to the nearest terminal at the end of the journey.

Figure 1. Location of cargo bike stations in Rosario, Argentina.

Source: EcoLogistics, 2021

TREND #3: COLLABORATIVE LOGISTICS AND NEW BUSINESS MODELS

Business models are driven by the possibilities to innovate and generate value in a market differentiator activity. The combination of technology, infrastructure management, optimization and improving urban freight encourages the study of new logistics methods. Agile store management and fulfilment services take advantage of current infrastructures and optimize the space and use of vehicles and create an efficient supply chains. Likewise, the crowdshipping trend in some cities allows for collaboration between business and private users, reducing the empty kilometers of freight.

Agile storage management and fulfillment services

E-commerce growth, tight delivery times and environmental regulations combined with the definition of low emissions and calming traffic zones have accelerated adoption of more efficient digital technologies. New types of electric-based, smaller-sized and even autonomous vehicles and drones, combined with the construction of facilities that move goods closer to the consumers or delivery points, have further increased efficiency.

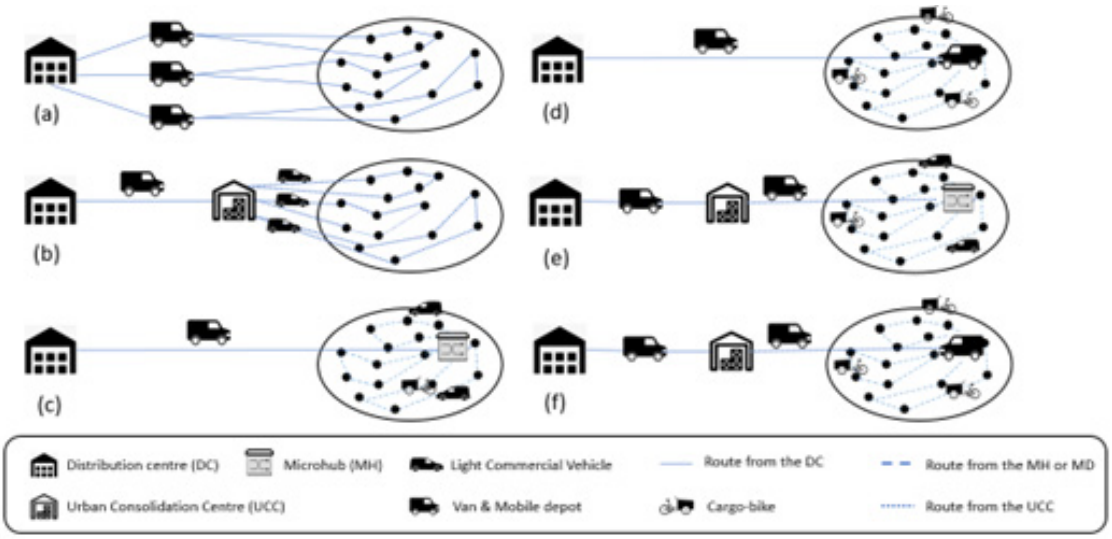
We can explore three types of facilities: the urban consolidation center (UCC), the transshipment center (TC), and the micro hub and mobile depots (MD). Figure 2 presents potential schemes for last-mile network configurations (Kin et al., 2018). Figure 2 (a) presents the conventional direct shipments. Figures 2(b) and 2(c) reflect a different design by combining the different types of facilities that can appear for distributing goods.

Urban consolidation center (UCC)

UCCs are "logistical facilities located relatively close to the area they supply from which consolidated deliveries depart" (Allen et al., 2007). It helps consolidate the cargo from different freight carriers to increase the load factor in delivery vehicles. Last-mile logistics is made up of stakeholders with different goals; however, all can benefit from the establishment of a UCC. Carriers who transport goods aim to reduce the costs of picking and delivering goods and minimize the delivery time. Receivers (such as retailers or the public authorities) want to minimize the cost, ensure on-time delivery and reduce the negative externalities of transport. Finally, suppliers expect to have low delivery costs and on-time delivery. UCCs can address all of these objectives.

Most of the analytical studies suggest that UCCs offer reduced route length, pollution and costs (Escuín et al., 2012), (Estrada et al., 2018), (Simoni et al., 2018). However, real implementation studies are scarce, and empirical research does not confirm these benefits yet. (Browne et al., 2011) One of the few studies analyzed the impact on logistics processes and costs before and after introducing it in London. It did not reduce the distance driven in the city but reduced the overall distance and transportation costs.

Figure 2. Last-mile distribution network configurations.



Source: Zaragoza Logistics Center, 2022

Transshipment centers (TC) or Microhubs (MH):

A transshipment center or microhub a logistical space inside the city but generally outside the central business district that assists with last-mile freight movement but does not necessarily focus on consolidation. They allow cargo vans or bicycles to deliver to the central business districts. The space required is up to 3,000m2 and does not necessarily replace the UCC but serves as an additional step focused on improving the efficiency of the last mile of the freight supply chain. These facilities can be easily set up in existing facilities (Columbia University, 2018). Transport providers utilize micro hubs for storage, transshipment, last-mile distribution, and home delivery (Schodl et al., 2019), (Lee et al., 2019).

Moreover, the location closer to the receiver allows using environmentally friendly vehicles and pedestrian transportation with shorter ranges than traditional vehicles (Lee et al., 2019), (Melo et al., 2014). The combination of UCC and micro hubs (Figure 2 (e) and Figure 2 (f)) may reduce the predicted distance and negative externalities (Katsela et al., 2022).

Mobile depots (MD)

Mobile depots are one of the most innovative initiatives in urban logistics. The basic idea is a portable means of transport (a bus, a caravan, a container) present within the city from which goods are loaded on light vehicles, cargo bikes, and van-electric or electric tricycles (LEAD Project, 2020). STRAIGHTSOL project (2011-2014) was a pilot of this concept, operated by TNT, a logistics company in Brussels. TNT used a truck to move the parcels and last-mile vehicles from the consolidation center at the Brussels freight airport to some fixed location within the city. Once parked, the cycles delivered the goods to the final destinations.

Mobile depots Brussels - Belgium

Offer great flexibility and require lower investment costs, making them ideal for meeting specific peak demands or covering specific areas. The pilot in Brussels revealed some drawbacks. TNT experienced a doubling of costs, including expenses for bikes, shipment of bikes, maintenance of the depot and the initial investment. (Verlinde et al., 2014).

Figure 3. TNT mobile depot and specific tricycles for last mile in Brussels.

Source: TNT, 2014

Crowd shipping

Crowd shipping (or crowd logistics) is an emerging platform technology that facilitates the connection of supply with demand (Le et al., 2019). It applies "crowdsourcing" to personalized freight delivery, emphasizing the actor who delivers the package. Alongside other emerging sharing-economy phenomena, the crowd shipping concept is still in transition, and researchers have defined the field in various ways. Mckinnon in 2016 states that crowd shipping "can be conceived as an example of people using social networking to behave collaboratively and share services and assets for the greater good of the community as well as their benefit." Lam & Christy Li in 2015 define crowd shipping as "a web or mobile-based courier service which leverages large groups of geographically dispersed individuals to match demand with supply digitally."

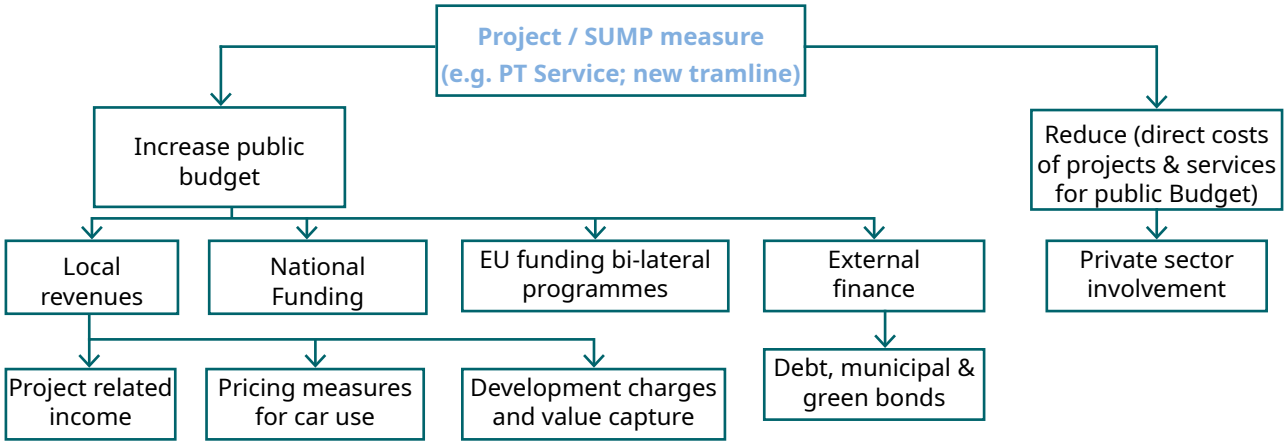
TREND#4: MULTI-STAKEHOLDER AND CO-CREATION PRACTICES

Stakeholder collaboration is the most challenging step in planning and policymaking to manage urban freight. This is due to the mix of private parties and low policy regulation. There is a need for all parties to create channels that improve this relationships. Public-private partnerships are one option to involve all parties and share risk in the execution of sustainable freight projects.

Public-Private partnerships

Local authorities may face several challenges when considering financing options for implementing sustainable mobility solutions. Those include a lack of capacities, no alternatives for finance or legal and technical expertise and abilities to prepare applications. Political and institutional barriers towards changing the status quo and lack of financial resources and bankable projects (Funding and financing of Sustainable Urban Mobility Measures, 2019). Figure 4 gives an overview of funding and financing instruments for sustainable urban transport measures. Which funding options can be used depends critically on the national legislative environment and the legal power of municipalities to raise taxes.

Figure 4. Overview of funding and financing instruments.



Source: Funding and financing of Sustainable Urban Mobility Measures, 2019

Developing and implementing new urban logistics solutions require considerable investments that are difficult to fund with traditional public finance. In this context, Public-Private-Partnerships (PPP) can be a solution to overcome the shortage of public finance and cuts on public spending. Establishing PPPs is a method of long-term cooperation between the public and private sectors in implementing projects to provide public services. This financing mechanism secures funding for the overall life cycle of the project.

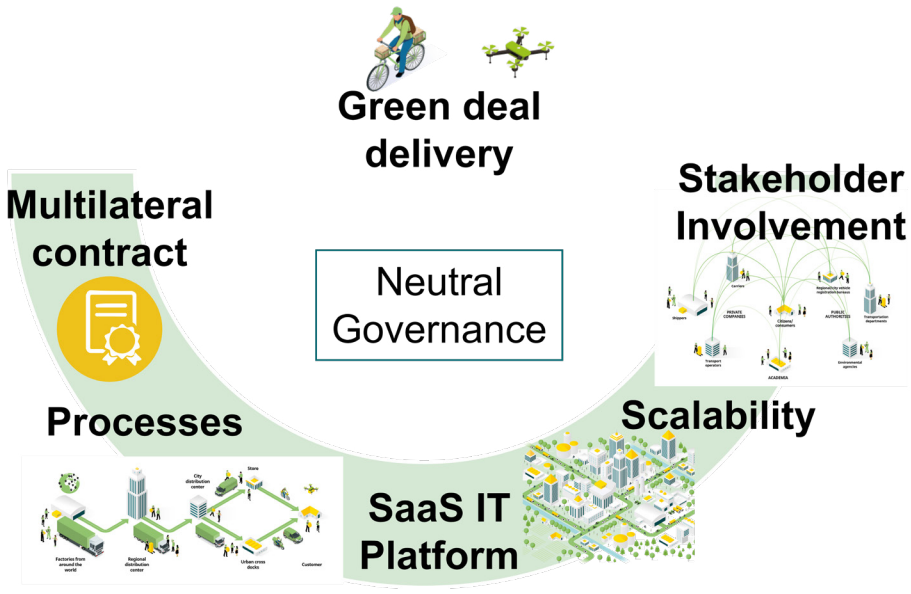
An example of a recent PPP in urban logistics is the CULT (Collaborative Urban Logistics & Transport) (see Figure 5) initiative launched in Antwerp. CULT brings leading companies together to deliver more efficient and greener parcels. The private company TRI-VIZOR acts as an orchestrator, guaranteeing neutral and impartial governance involving all relevant stakeholders of the city. The main aim is to combine the flow of goods from as many companies as possible on the city's outskirts and deliver the goods to the consumers, shops, and companies smartly, thereby reducing the number of journeys.

City labs

One An instance of collaborative efforts across various stakeholders can be observed in city lab-based communities of practice (CoPs). These CoPs play a pivotal role in identifying practical and valuable solutions among a range of alternatives that can be effectively implemented in real-world scenarios. A notable illustration comes from the European LEAD project. Communities of practice, as defined by Wenger et al. (2002), are groups of individuals who share a common interest or passion in a particular activity, enhancing their skills through regular interactions. This concept finds applications in diverse fields like business, organizational design, government, education, and development projects, among others.

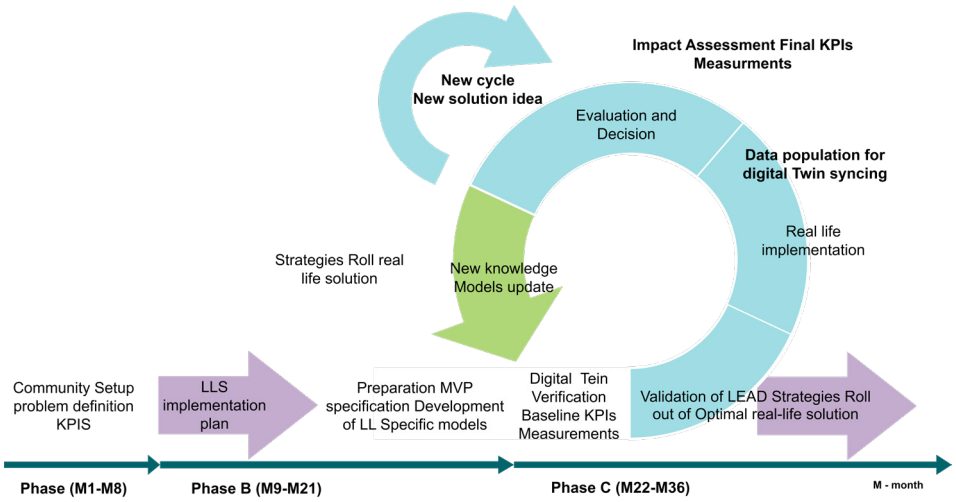
One of these applications is urban logistics, where the city lab approach involves a real-life setting with field implementations and the participation of multiple stakeholders. Literature shows different examples of how to establish communities of practice for future urban transport and city logistics.

Figure 5. EcoLogistics cities survey questions to build Urban Freight Transport baselines.



Source: EcoLogistics, 2021

Figure 6. EcoLogistics cities survey questions to build Urban Freight Transport baselines.



Source: LEAD project et al., 2020

CoP engage practitioners and researchers to define indicators to evaluate sustainable urban planning. LEAD aims at creating digital twins of urban logistics networks in six city labs to support experimentation and decision-making with on-demand logistics operations in a public-private urban setting.

The proposed innovative solutions for city logistics evaluated different case scenarios, associated with CoP to align competing interests and create value for all stakeholders. Living Labs' methodology is organized around three phases showed in Figure 6.

TREND #5: INCLUSIVE LOGISTICS ECONOMICS AND CUSTOMER CHANGE

In the modern supply chain, consumer behavior and relationships with customers are pivotal, driven by the varying digital adoption rates across generations. Achieving a more inclusive economy and accessible logistics requires stakeholders to assess the true costs and consequences of new delivery services. This involves acknowledging their effects on workers and the environment. Consumers also share the responsibility of covering the environmental impact of their deliveries, even if it means paying a premium for shipping. Simultaneously, companies must prepare their workforce for the impending wave of automation and embrace changing roles within the supply chain. This transformation underscores the significance of investigating social sustainability and advocating for ethical consumer practices.

Social sustainability, job replacement and role of gig workers

There is a significant increase in digital mobility solutions. All these solutions require access to a smartphone and minimum digital skills. The digitalization of mobility is one of the essential strategies for decreasing the negative impacts of last-mile deliveries (Noussan et al., 2020).

In Barcelona, a study conducted by Bosch in 2021 reveled that the older population and individuals with lower educational levels are less likely to use digital service, they experience discomfort and have a high level

of distrust when using digital services. In 2022, Durand reviewed the digital inequality in transport services and acknowledged that having physical access to technology does not guarantee that people can fully benefit from its offerings due to digital inequality.

Indimo is a project funded by the European Program (H2020). Its objective is to identify the needs of transport users from specific target groups and enhance digital mobility to be accessible for all users. It contributes to promoting digital inclusion and equity by standardizing digital access (Kolotouchkina et al., 2022). The project has demonstrated that these actions could contribute to transforming cities into more inclusive environments.

Pilot in Monghudiro a rural area of Bologna - Italy

This pilot introduces digital technology to enable e-commerce in rural areas by installing a parcel locker in the city council. The target group is composed of older people, communities of foreign residents, and people with a low level of digital knowledge and education.

Pilot in Madrid - Spain

It explores a digital solution consists of a cycle logistics platform for deliveries. The pilot aims to enable healthy e-food delivery for people with reduced mobility or vision, low income, lower digital connection, socially isolated, Covid19 isolated, and mentally impaired people.

Consumer awareness and Purchasing habits

Companies have adeptly met diverse consumer needs while influencing consumption patterns. Services like 10-minute delivery, same-day purchase-delivery, and exclusive membership offers have enabled companies to better cater to users and enhance engagement. Nevertheless, these new consumption trends have resulted in negative consequences, such as heightened emissions and urban traffic congestion. Moreover, the workforce encounters demanding working conditions, increased stress, reduced family time, and elevated accident risks, posing concerns for road safety and worker well-being.

Cities are addressing these issues by implementing company restrictions and exploring national regulations. CO2 subsidies are being explored to offset costs and environmental effects, while labor categories are under review to improve worker benefits. These subsidies are integral to a complex financial framework, requiring companies to navigate them for city permits.

In the global north, governments and cities are raising wages for last-mile delivery workers, with labor unions actively advocating for improved working conditions. Policy makers are taking robust steps to regulate delivery platforms by ensuring alignment with workforce rights and labor regulations. In contrast, platforms in the global south often exert significant control over driver conditions, leading to instances of workforce exploitation due to the absence of social security safeguards..

Cities are learning that engaging all stakeholders during the planning process is crucial for success. By incorporating diverse perspectives, policymakers can better understand the business, consumer, and urban landscape, and ensure proposed solutions meet community needs and goals. By fostering collaboration and inclusivity, we can strive towards more effective and sustainable solutions that address the evolving complexities of our interconnected world.

CONCLUSION

- Sustainability goals and new digital technologies are radically changing logistics management. Case studies have identified the importance of a clear set of overarching goals and a commitment to act in ways that enable innovation to flourish and simultaneously ensure the enhancement of public value.

- Multidisciplinary skills are required to ensure proper execution in the whole labor force focusing on the industry. Therefore, a continuous adaptation of the skills of professionals to the new requirements of smart logistics is necessary. Close cooperation between industry and academic institutions is recommended to ensure that a new generation of workers is gaining the skills needed for this new reality in logistics.

- Policymakers and the industry must partner to develop a complete set of data standards to support opportunities for data exchange. The measures must aim to enable the sharing of real-time operational data.

- Logistics service centers could increase livability and comfort for city inhabitants; it is a viable alternative to traditional distribution channels for high-volume parcel shippers. For retailers shipping directly to consumers, sending parcels through logistics service centers can be very beneficial from a financial point of view. For certain shippers employing parcel delivery channels also offers benefits, either in combination with third-party logistics providers or their vehicles to deliver the goods to logistics service centers.

REFERENCES

Allen, J., Browne, M., Woodburn, A., & Leonardi, J. (2012). The Role of Urban Consolidation Centres in Sustainable Freight Transport. In Transport Reviews (Vol. 32, Issue 4). https://doi.org/10.1080/01441647.2012.688074

Allen, J., Browne, M., Woodburn, A., & Leonardi, J. (2014). A review of urban consolidation centres in the supply chain based on a case study approach. Supply Chain Forum, 15(4). https://doi.org/10.1080/16258312.2014.11517361

Allen, J., Thorne, G., & Browne, M. (2007). Good practice guide on urban freight transport. Bestufs Administration Centre.

Barratt, M., Kull, T. J., & Sodero, A. C. (2018). Inventory record inaccuracy dynamics and the role of employees within multi-channel distribution center inventory systems. Journal of Operations Management, 63(1), 6–24. https://doi.org/10.1016/j.jom.2018.09.003

Björklund, M., Abrahamsson, M., & Johansson, H. (2017). Critical factors for viable business models for urban consolidation centres. Research in Transportation Economics, 64. https://doi.org/10.1016/j.retrec.2017.09.009

Bosch, E. R., Wybraniec, B., Lazzarini, B., Junyent, M. V., & Crespo, À. G. (2021). The DIGNITY Project-Toward a System of Inclusive Digital Mobility in the Barcelona Metropolitan Area. Transportation Research Procedia, 58, 134–141. https://doi.org/10.1016/j.trpro.2021.11.019

Brett, J., & Mitchel, T. (2020). How to build trust with business partner from other cultures. Harvard Business Review. https://hbr.org/2020/01/research-how-to-build-trust-with-business-partners-from-other-cultures

Browne, M., Allen, J., & Leonardi, J. (2011). Evaluating the use of an urban consolidation centre and electric vehicles in central London. IATSS Research, 35(1). https://doi.org/10.1016/j.iatssr.2011.06.002

Cai, Y.-J., & Lo, C. K. Y. (2020). Omni-channel management in the new retailing era: A systematic review and future research agenda. International Journal of Production Economics, 229, 107729. https://doi.org/10.1016/j.ijpe.2020.107729

Capgemini. (2021). THE IMPACT OF ONLINE PLATFORMS ON YOUR LAST-MILE STRATEGY. capgemini-invent. https://www.capgemini.com/insights/expert-perspectives/the-impact-of-online-platforms-on-your-last-mile-strategy/

Carbone, V., Rouquet, A., & Roussat, C. (2017). The Rise of Crowd Logistics: A New Way to Co-Create Logistics Value. Journal of Business Logistics, 38(4), 238–252. https://doi.org/10.1111/jbl.12164

CIVITAS. (2020). Local impacts of a new urban consolidation centre – the case of Binnenstadservice.

CIVITAS. (2022). LEAD develops last-mile digital platform: an innovation for freight.

Colliers International. (2015). From First Mile to Last Mile Global Industrial & Logistics Trends.

Columbia University. (2018). Going last-mile: Best practices of urban freight movement.

DHL. (2018). BLOCKCHAIN IN LOGISTICS.

Diordiiev, V. (2018). Blockchain technology and its impact on financial and shipping services. Economics, Ecology, Socium, 2(1). https://doi.org/10.31520/2616-7107/2018.2.1-5

DLTLabs. (2020). DL Freight for Walmart Canada: A New Role Model for the Industry. https://www.dltlabs.com/news/dl-freight-for-walmart-canada-a-new-role-model-for-the-industry-423799

Dreischerf, A. J., & Buijs, P. (2022). How Urban Consolidation Centres affect distribution networks: An empirical investigation from the perspective of suppliers. Case Studies on Transport Policy, 10(1). https://doi.org/10.1016/j.cstp.2022.01.012

Durand, A., Zijlstra, T., van Oort, N., Hoogendoorn-Lanser, S., & Hoogendoorn, S. (2022). Access denied? Digital inequality in transport services. Transport Reviews, 42(1), 32–57. https://doi.org/10.1080/01441647.2021.1923584

Escuín, D., Millán, C., & Larrodé, E. (2012). Modelization of Time-Dependent Urban Freight Problems by Using a Multiple Number of Distribution Centers. Networks and Spatial Economics, 12(3), 321–336. https://doi.org/10.1007/s11067-009-9099-6

Estrada, M., Campos-Cacheda, J. M., & Robusté, F. (2018). Night deliveries and carrier-led consolidation strategies to improve urban goods distribution. Transport, 33(4). https://doi.org/10.3846/transport.2018.6058

European Commission. (2021). Digital twins are dead! Long live the digital twin / Smart Cities Marketplace Forum 2021. European Commission website. https://smart-cities-marketplace.ec.europa.eu/news-and-events/news/2021/digital-twins-are-dead-long-live-digital-twin-smart-cities-marketplace

Fara, G., Hai, D., Hristov, S., Carmen Jiménez, M., Latopoulou, C., Ploumaki, M., Obermayr, T., Grassi, E., Herics, O., & Puricella, P.

(2018). Public Private Partnerships in the EU: Widespread shortcomings and limited benefits.

Fernández, R. Á., & Pérez-Dávila, O. (2022). Fuel cell hybrid vehicles and their role in the decarbonization of road transport. Journal of Cleaner Production, 342(January). https://doi.org/10.1016/j.jclepro.2022.130902

Ferrari, M. (2018). Caratteristiche del crowdshipping come sistema di trasporto urbano delle merci.

Frizzo-Barker, J., Chow-White, P. A., Adams, P. R., Mentanko, J., Ha, D., & Green, S. (2020). Blockchain as a disruptive technology for business: A systematic review. International Journal of Information Management, 51, 102029. https://doi.org/https://doi.org/10.1016/j.ijinfomgt.2019.10.014

Goetting, E., & Handover, W. N. (2016). Commerce and Communication to the Point .commCCrowd-shipping: Is crowdsourced the secret recipe for delivery in the future? German Industry and Commerce Ltd.

Gonzalez, A., Donnelly, A., Jones, M., Klostermann, J., Groot, A., & Breil, M. (2011). Community of practice approach to developing urban sustainability indicators. Journal of Environmental Assessment Policy and Management, 13(4). https://doi.org/10.1142/S1464333211004024

Gonzalez-Feliu, J., Taniguchi, E., & Faivre d'Arcier, B. (2014). Financing Urban Logistics Projects (pp. 245–265). https://doi.org/10.1007/978-3-642-31788-0_13

Government of Singapore. (2021). Virtual Singapore. https://www.nrf.gov.sg/programmes/virtual-singapore

Herhausen, D., Binder, J., Schoegel, M., & Herrmann, A. (2015). Integrating Bricks with Clicks: Retailer-Level and Channel-Level Outcomes of Online–Offline Channel Integration. Journal of Retailing, 91(2), 309–325. https://doi.org/10.1016/j.jretai.2014.12.009

Janjevic, M., & Ndiaye, A. (2017a). Investigating the financial viability of urban consolidation centre projects. Research in Transportation Business and Management, 24. https://doi.org/10.1016/j.rtbm.2017.05.001

Janjevic, M., & Ndiaye, A. (2017b). Investigating the theoretical cost-relationships of urban consolidation centres for their users. Transportation Research Part A: Policy and Practice, 102. https://doi.org/10.1016/j.tra.2016.10.027

Katsela, K., Güneş, Ş., Fried, T., Goodchild, A., & Browne, M. (2022). Defining Urban Freight Microhubs: A Case Study Analysis. Sustainability (Switzerland), 14(1). https://doi.org/10.3390/su14010532

Katsela, K., & Pålsson, H. (2021). Viable business models for city logistics: Exploring the cost structure and the economy of scale in a Swedish initiative. Research in Transportation Economics, 90. https://doi.org/10.1016/j.retrec.2020.100857

Kerfien, L. (2021). Building Trust And Relationship: How We Live And Work Together With Worldview Intelligence: Powerful Leader. Independently Published.

Kin, B., Spoor, J., Verlinde, S., Macharis, C., & Van Woensel, T. (2018). Modelling alternative distribution set-ups for fragmented last mile transport: Towards more efficient and sustainable urban freight transport. Case Studies on Transport Policy, 6(1). https://doi.org/10.1016/j.cstp.2017.11.009

Klingebiel, K., & Wagenitz, A. (2013). An Introduction to Logistics as a Service. In U. Clausen, M. ten Hompel, & M. Klumpp (Eds.), Efficiency and Logistics (pp. 209–216). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-32838-1_22

Kolotouchkina, O., Barroso, C. L., & Sánchez, J. L. M. (2022). Smart cities, the digital divide, and people with disabilities. Cities, 123, 103613. https://doi.org/10.1016/J.CITIES.2022.103613

Kościelniak, H., & Górka, A. (2016a). Green Cities PPP as a Method of Financing Sustainable Urban Development. Transportation Research Procedia, 16, 227–235. https://doi.org/10.1016/j.trpro.2016.11.022

Kościelniak, H., & Górka, A. (2016b). Green Cities PPP as a Method of Financing Sustainable Urban Development. Transportation Research Procedia, 16, 227–235. https://doi.org/10.1016/j.trpro.2016.11.022

Lam, T., & Christy Li. (2015). Crowdsourced delivery. Fung Business Intelligence Centre.

Le, T. v., Stathopoulos, A., van Woensel, T., & Ukkusuri, S. v. (2019). Supply, demand, operations, and management of crowd-shipping services: A review and empirical evidence. Transportation Research Part C: Emerging Technologies, 103, 83–103. https://doi.org/10.1016/j.trc.2019.03.023

LEAD Project. (2020). D1.1: City Logistics landscape in the era of on-demand economy.

LEAD project, Marcucci, E., & Gatta, V. (2020). City Logistics landscape in the era of on-demand economy - Main challenges, trends and factors influencing city logistics.

Lee, K., Chae, J., & Kim, J. (2019). A courier service with electric bicycles in an Urban Area: The case in Seoul. Sustainability (Switzerland), 11(5). https://doi.org/10.3390/su11051255

Marcucci, E., le Pira, M., Carrocci, C. S., Gatta, V., & Pieralice, E. (2017). Connected shared mobility for passengers and freight: Investigating the potential of crowdshipping in urban areas. 2017 5th IEEE International Conference on Models and Technologies for Intelligent Transportation Systems (MT-ITS), 839–843. https://doi.org/10.1109/MTITS.2017.8005629

McKinnon, A. (2016). Crowdshipping: a Communal Approach to Reducing Urban Traffic Levels? https://doi.org/DOI: 10.13140/RG.2.2.20271.53925

Mckinnon, A. (2016). Crowdshipping: a Communal Approach to Reducing Urban Traffic Levels? Logistics White Paper 1/2016. https://doi.org/10.13140/RG.2.2.20271.53925

Melacini, M., Perotti, S., Rasini, M., & Tappia, E. (2018). E-fulfilment and distribution in omni-channel retailing: a systematic literature review. International Journal of Physical Distribution & Logistics Management, 48(4), 391–414. https://doi.org/10.1108/IJPDLM-02-2017-0101

Melo, S., Baptista, P., & Costa, Á. (2014). Comparing the Use of Small Sized Electric Vehicles with Diesel Vans on City Logistics. Procedia - Social and Behavioral Sciences, 111. https://doi.org/10.1016/j.sbspro.2015.01.728

Noussan, M., Hafner, M., & Tagliapetra, S. (2020). The Future of Transport Between Digitalization and Decarbonization. Springer. https://doi.org/https://doi.org/10.1007/978-3-030-37966-7

Onal, S., Zhang, J., & Das, S. (2018). Product flows and decision models in Internet fulfillment warehouses. Production Planning & Control, 29(10), 791–801. https://doi.org/10.1080/09537287.2018.1469800

Parra, D., Valverde, L., Pino, F. J., & Patel, M. K. (2019). A review on the role, cost and value of hydrogen energy systems for deep decarbonization. Renewable and Sustainable Energy Reviews, 101(November 2018), 279–294. https://doi.org/10.1016/j.rser.2018.11.010

Punel, A., & Stathopoulos, A. (2017). Modeling the acceptability of crowdsourced goods deliveries: Role of context and experience effects. Transportation Research Part E: Logistics and Transportation Review, 105, 18–38. https://doi.org/10.1016/j.tre.2017.06.007

Saghiri, S., & Mirzabeiki, V. (2021). Omni-channel integration: the matter of information and digital technology. International Journal of Operations and Production Management, 41(11). https://doi.org/10.1108/IJOPM-04-2021-0262

Sahar, M. (2020). The Growing Trend of City-Scale Digital Twins Around the World. OPENGOV. https://opengovasia.com/the-growing-trend-of-city-scale-digital-twins-around-the-world/

Schodl, R., Eitler, S., Ennser, B., Schrampf, J., & Hartmann, G. (2019). Urban Logistics Micro Hubs: Standardisation Meets Uniqueness. Real Corp 2019.

Simoni, M. D., Bujanovic, P., Boyles, S. D., & Kutanoglu, E. (2018). Urban consolidation solutions for parcel delivery considering location, fleet and route choice. Case Studies on Transport Policy, 6(1). https://doi.org/10.1016/j.cstp.2017.11.002

Simoni, M. D., Marcucci, E., Gatta, V., & Claudel, C. G. (2020). Potential last-mile impacts of crowdshipping services: a simulation-based evaluation. Transportation, 47(4), 1933–1954. https://doi.org/10.1007/s11116-019-10028-4

Solution Plus project. (2023). SOLUTIONSplus. https://www.solutionsplus.eu/

Steer Group. (2020). The potential for Urban Logistics Hubs in Central London.

Taniguchi, E. (2021). City logistics for sustainable and liveable cities. Https://Hal.Archives-Ouvertes.Fr/Hal-03313187/Document. https://hal.archives-ouvertes.fr/hal-03313187

van der Aalst, W., Hinz, O., & Weinhardt, C. (2019). Big Digital Platforms. Business & Information Systems Engineering, 61(6), 645–648. https://doi.org/10.1007/s12599-019-00618-y

Van Rooijen, T., & Quak, H. (2010). Local impacts of a new urban consolidation centre - The case of Binnenstadservice.nl. Procedia - Social and Behavioral Sciences, 2(3). https://doi.org/10.1016/j.sbspro.2010.04.011

Verhagen, T., & van Dolen, W. (2009). The influence of online store characteristics on consumer impulsive decision-making: a model and empirical application.

Verlinde, S., Macharis, C., Milan, L., & Kin, B. (2014). Does a Mobile Depot Make Urban Deliveries Faster, More Sustainable and More Economically Viable: Results of a Pilot Test in Brussels. Transportation Research Procedia, 4, 361–373. https://doi.org/https://doi.org/10.1016/j.trpro.2014.11.027

Vitasek, K., Bayliss, J., Owen, L., & Srivastava, N. (2022). How Walmart Canada Uses Blockchain to Solve Supply-Chain Challenges. Harvard Business Review. https://hbr.org/2022/01/how-walmart-canada-uses-blockchain-to-solve-supply-chain-challenges

Wenger, E., McDermott, R., & M. Snyder, W. (2002). Cultivating Communities of Practice: A Guide to Managing Knowledge - Seven Principles for Cultivating Communities of Practice.

Werbach, K. (2018). The blockchain and the new architecture of trust. The MIT Press.

Funding and financing of Sustainable Urban Mobility Measures, (2019)..

DANE. “National Accounts.” *National Administrative Department of Statistics (Colombia) website.* March 27, 2020. https://www.dane.gov.co/index.php/en/statistics-by-topic-1/national-accounts.

Department of Commerce, Ministry of Commerce and Industry. 2019. https://commerce.gov.in/InnerContent.aspx?Type=leftmenu&Id=364.

Fehrentz, Petra. *Transport performance and energy consumption in road transport 2007 – 2017.* Statistisches Bundesamt (Destatis)/ Federal Statistical Office (Destatis), 2019.

Gonzalez-Feliu, Jesus, Frédéric Semet, and Jean-Louis Routhier. *Sustainable Urban Logistics: Concepts, Methods and Information Systems.* Springer Berlin Heidelberg, 2013.

Hernandez , Ulises, and Cristiano Façanha. "Expanding and aligning green freight programs in Latin America - Proceedings of the Latin America Workshop on Green Freight Programs." *International Council on Clean Transportation website.* 2017. https://theicct.org/sites/default/files/publications/GF-Latin-America_ICCT-Workshop-Summary_23102017_vF.pdf.

Holguín-Veras, José , et al. "Direct impacts of off-hour deliveries on urban freight emissions." *Transportation Research Part D: Transport and Environment*, 11 2016.

ICLEI - Local Governments for Sustainability. "EcoLogistics Self-Monitoring Tool User Guide version 2.0." Bonn, Germany, 2020.

India GHG Program. *India specific road transport emission factors: For stakeholders consultation.* Mumbai: WRI India, 2015.

International Energy Agency. *The Future of Trucks: Implications for energy and the environment.* Paris: IEA, 2017.

sustainablemobility.iclei.org/ecologistics