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URBAN LAST-MILE SUPPLY CHAIN

Identifying and Dealing with External Factors

Miguel de Carvalho Lopes

Dissertation

presented as partial requirement for obtaining the Master Degree Program in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

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By

Miguel de Carvalho Lopes

Master Thesis presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Knowledge Management and Business Intelligence

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Fátima Trindade Neves

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STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledge the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Miguel de Carvalho Lopes

Lisbon, 17th November 2022

DEDICATION

I dedicate my dissertation work to my family and friends, who motivate me during all this process. A special feeling of gratitude to my loving wife, Ana, whose words of encouragement and daily support allowed me to push forward and to conclude my Master thesis.

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ABSTRACT

In the last few decades, the city centers have been transformed into a magnet for public and private activities that require a constant flow of goods delivered efficiently. The need for daily supply and the optimization of the delivery routes puts tremendous pressure on logistic operators to improve the sustainability of supply chain models, preventing increased costs, traffic, noise, and pollution. Despite the importance of the topic, the literature is scarce in systematic and structured research that evaluates the urban last-mile supply chain. In this work, we address this gap by presenting a Systematic Literature Review (SLR) and propose a segmentation of its complex ecosystem into three main categories (Models, Sustainability, and Trends) to further understand this topic and contribute to the growing literature on this domain. In addition, a PEST analysis was carried out and identified the push for a sustainable urban last-mile supply chain, the need for less expensive and more time-efficient models, and technological innovations in new ways to deliver goods in city centers. Finally, our study contributes to the last-mile supply chain planning and management, providing theoretical insights for further research and experimentation on how it can be leveraged to contribute to sustainable urban development.

KEYWORDS

Supply chain management; Urban last-mile; Transportation management; Sustainable urban development; PEST analysis; Systematic Literature Review

Sustainable Development Goals (SGD):

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This thesis was submitted as a manuscript to a top journal.

1. Introduction

Urban areas have always been an attraction magnet throughout the centuries due to their capacity to promote new ideas, trends, and businesses, generate added wealth, and build more dynamic, cultured, and inclusive societies (Neves et al., 2020). By 2021, the number of citizens living in urban areas was 57% of the world population (World Bank, 2021). For Portugal, the same figure was 6,83 million, or 67% of the total population, below the European Union average of 75% (World Bank, 2021). In the last few decades, the city centers have been transformed into a magnet for public and private activities, requiring a constant flow of goods delivered most efficiently and therefore it is required to create a supply chain model that addresses the need for daily supply and the optimization of the delivery routes by logistic operators, but not at the expense of more costs, more traffic, more noise, and more pollution. It is fundamental to joint efforts and builds a collaborative supply chain strategy between all the players, where logistic resources, costs, and revenues would be shared by suppliers, logistic operators, and business outlets in an effort supported by academia, local authorities, and citizen groups.

The objective of this work is to understand better the factors impacting the last-mile supply chain in the urban context. To achieve this goal, we conducted a Systematic Literature Review (SLR) to make an updated compilation of the key issues and case studies available in the scientific literature about urban last-mile supply chain models, to compare and segment them, and present a comprehensive analysis of the theme, with the added value of a PEST analysis concerning the external factors affecting this topic. There is a lack of empirical and structured research in the body of literature on the supply chain, last-mile supply chain, and collaborative strategies logistic models' domain for both B2C and B2B business models. In most cases, these studies are supported by theoretical concepts based on scenario models that are very difficult to replicate in the real world. There has been a growing interest in the study of the different last-mile supply chain models, particularly on the key variables and the main hurdles to implementing a successful operation. There has been made a relevant effort by authorities, both local and national, to promote international cooperation programs to study and test the best ways to create urban last-mile supply chain models that can match the sustainable smart city concept with a positive economic return for all the partners (both public and private) involved in such a model.

The next section introduces issues and characteristics concerning supply chain management, last-mile supply chain, and their consolidation strategy in urban centers. An SLR on the studies published over the last five years is presented in Section 3, proposing a segmentation into three main categories for the domain in study, addressing the research gap and contributing to the growing literature on this topic. In Section 4, a PEST (Political, Economic, Social, and Technological) analysis is performed, discussing the main external factors affecting the last-mile supply chain in the urban context, raising the main contributions and the implications for both research and practice. The final section presents the conclusions and future work proposals.

2. Theoretical background

2.1. Supply Chain Management

Supply chain management was first introduced by consultants in the early 1980s (Stock & Lambert, 2001). However, it is only since 1990 that it began to be the focus of attention by the top executives of most companies. As a result, they began to recognize the power and potential to make organizations more competitive globally, allowing increased market share and improving shareholder value (Langley et al., 2020).

According to CSCMP (Council of Supply Chain Management Professionals), "*supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, such as suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies*" (CSCMP, 2022).

In the study of Chopra & Sodhi (2014), the authors claim that in every business transaction, there is a supplier and a customer, as well as activities and processes that link them. Also, according to these authors, the entire process of management of linkages to generate the most value for the customer, at a minimum cost and effort for the supplier, is the definition of supply chain management.

2.2. Last-Mile Supply Chain

The term "last-mile" was born out of the telecommunications industry and was associated with the last leg of a network. Nowadays, "last-mile" is related to the final part of the delivery process, which is considered the most expensive, the least efficient and the part of the supply chain with more environmental issues (Gevaers et al., 2011). The phrase "last-mile logistics" or "last-mile supply chain" refers to the last leg of the process of transporting goods from the last transport hub to the destination, independently of the distance, and it is the biggest cost item and for sure the most challenging issue corporations must face concerning the supply chain.

Last-mile delivery is a major factor of market differentiation. It has encouraged retailers to invest in consumer delivery innovations, like solutions of autonomous delivery, pickup in-store or lockers as well as free delivery when there is a minimum value purchased (Lim et al., 2017) and consumers to expect the same or next-day delivery service. Also, in the B2B model, expectations are increasing, with companies expecting the same level of delivery service as the one applied in B2C models. For example, 55% of those surveyed in a Capgemini Research Institute report (2020) claimed they would switch to a competing brand if it offered a more efficient and faster delivery service. However, the added complexity and costs of B2B last-mile logistic service make it difficult to meet corporate delivery demands. On one side, consumers care about last-mile delivery because it offers convenience and flexibility, and for these reasons, same-day and on-demand delivery services are becoming more popular in such sectors as those of groceries products, pre-prepared meals, and retail purchases

(Lopez, 2017). To meet customer demands, logistic carriers companies are raising investments in urban last-mile delivery systems and automated distribution hubs systems, but sometimes these experimental models do not generate an effective positive return and so last-mile service innovation will struggle to survive within an increasingly complex and fragmented distribution network because of the need for an optimal balance between pricing, costumers expectations and service levels (McKevitt, 2017). Although several contributions have been made in the last-mile supply chain domain in the last years, the literature on last-mile supply chain models remains fragmented and without an integrated understanding of the topic to support further academic research efforts.

2.3. Urban Consolidation Center (UCC)

The collaborative urban logistics concept is a different vision of the last mile supply chain model where the processes have a better consolidation and synchronization of existing resources because it is based on sharing resources and the revenues in the last mile delivery. To determine tiers of delivery pattern in which goods are delivered from outside of urban to inner urban areas based on existing consolidation facilities in the distribution network (Staricco & Brovarone, 2016), city logistics schemes can be classified as: a) Conventional distribution (without consolidation), b) Urban consolidation centers, c) Micro consolidation centers, and d) Mobile Depots.

The Urban Consolidation Center (UCC) concept is at the base of a consolidation strategy in the distribution network and has been vastly adopted because of its alignment with smart logistics solutions. The basic logic of the consolidation facilities is based on finding solutions to problems such as urban traffic congestion and high costs of a low number of shipments with the understanding of scaling up goods to increase the load factors in the final distribution leg. UCC has a central role in many solution concepts as a collaborative model to reduce the impact of urban freight transport (Van Duin et al., 2010).

The four prerequisites for a UCC to be economically viable are a critical mass of users and volumes, a willingness by main stakeholders to use the UCC, additional services to gain extra revenues, and no dependence upon subsidies. However, despite these theoretical benefits, the vast majority of UCCs have failed in practice (Browne et al., 2005) because of the added costs introduced in the supply chain and of the overdependence on subsidies, which have proven to be major hurdles to overcome in such a logistic model. Research also demonstrates that combining bundling with initiatives such as off-hour deliveries and appropriate incentives for users might increase the commitment of logistic suppliers to the UCC concept (Marcucci et al., 2017). This is also true for retailers, who considered the combined measures as feasible and convenient (Holguín-Veras, 2008).

3. Methodology

To address the research gap and fulfill the study objective, this work follows a Systematic Literature Review (SLR), a research methodology that is of critical relevance to all types of research, as defended by Snyder et al. (2019) and already used in studies related to supply chain management, such as those by Hohenstein et al. (2014) on human resource management, Durach et al. (2017) on the use of SLR, and de Oliveira et al. (2018) on green supply chain management. To conduct the SLR, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, a set of guidelines or steps developed by Moher et al. (2009), was applied.

In the first stage, we identified the most suitable dataset of the body of literature. First, the appropriate sources to identify relevant studies for urban last mile and supply chain fields of research were determined, and the following databases were assessed: Science Direct, Sage, Web of Science, Scopus, and IEEE. After that, the specific combination of the keywords "last mile, "supply chain", and "urban" were selected to retrieve the most important studies joining those themes. Thirdly, the criteria for inclusion/exclusion of studies were defined by selecting only English language sources peer-reviewed, specifically journal and conference articles. A specific combination of the keywords was required to appear in the article's title, abstract, or author keywords, and the literature search was determined to be carried out between 2016 and 2021. In the second stage, we performed the search on the selected databases having the specific combination of the keywords, the time frame filters, and the inclusion/exclusion criteria previously defined. As a result, a sample of 214 studies was retrieved. In the third stage, we refined the sample of studies to be reviewed by excluding 88 studies that were considered out-of-scope since they were not considered significantly relevant to the research. Finally, 30 duplicate studies detected during the screening process were also excluded (see Table 1).

Table 1 – SLR result set summary

Search query	Database	Studies	Out of scope	Final
"Supply chain" AND "Last mile" AND Urban	Sage	93	63	30
	Scopus	69	17	52
	Web of Science	24	3	21
	Science Direct	19	2	17
	IEEE	9	3	6
Total		**214**	**88**	**126**
Duplicate articles				**30**

The remaining sample comprehending 96 studies was further refined during iterative review rounds, first, by screening the abstract, introduction, and conclusions of each article and by reading the full text of the remaining sample to dismiss studies that did not specifically focus the topic on the review or were not significantly meaningful and pertinent to overall review topic. This procedure eliminated 43 articles and more seven from 2022 that were not considered. The final subset of 46 articles consisted of 30 scientific articles and 16 conference papers, with a time frame dispersion of 14 articles published in 2021, 9 articles published in 2020, 6 articles published in 2019, 9 articles published in 2018, 5 articles published in 2017 and 3 articles published in 2016 (see Figure 1).

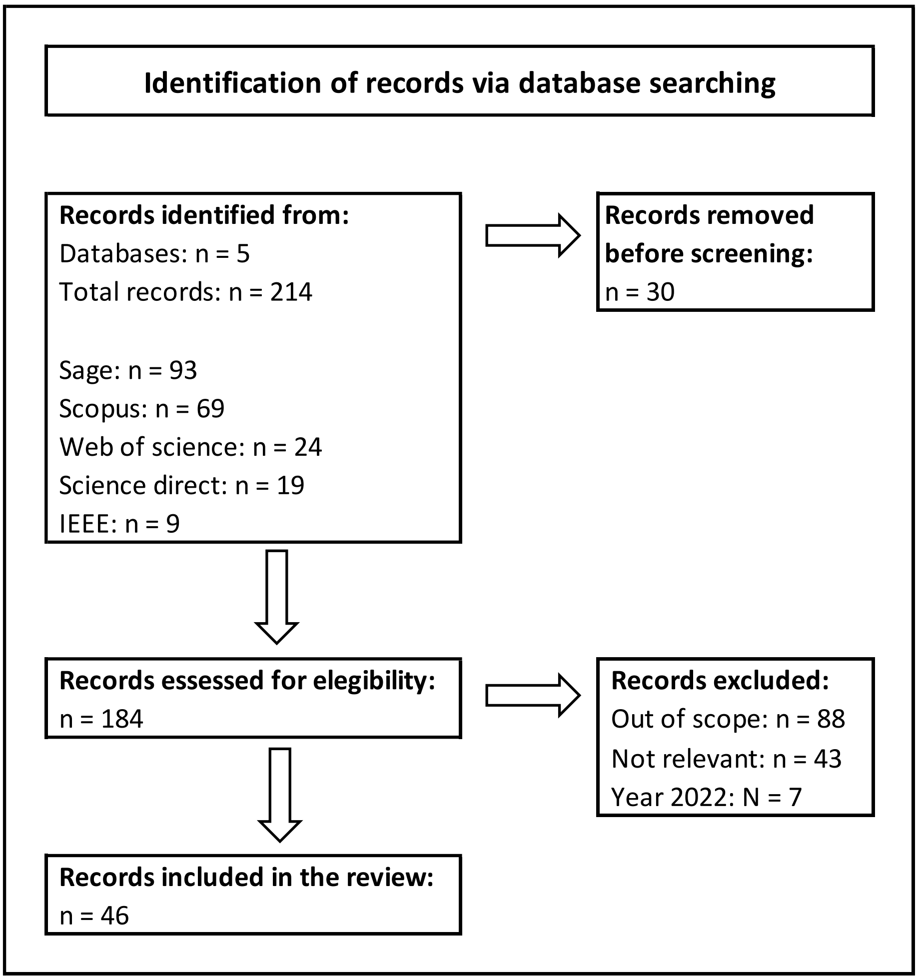

Figure 1. – PRISMA flow diagram of the SLR

In the fourth stage, after searching, screening, and selecting the final sample fit for analysis, to obtain a more comprehensive understanding of the subject, we categorized the 46 individual studies based on their domain research into three separate categories that naturally emerged from the body of the text, as explained below:

- Sustainability: Articles and conference papers that mainly address issues related to sustainability and environmental awareness of urban last-mile supply chain models (10 studies);
- Models: Articles and conference papers that present new theoretical proposals and business models to conceptualize urban last-mile supply chain models (24 studies);
- Trends: Articles and conference papers focusing on case studies and literature reviews on urban last-mile supply chain models (12 studies).

As for the geographical focus of each study, the final set of 46 studies is distributed with the following pattern in Table 2:

Table 2. – SLR result set by geographical location and year

Geographic Location	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Europe	2	0	5	2	3	7	19
Asia	0	1	0	2	2	4	9
North America	0	1	2	0	2	2	7
Worldwide	0	2	2	1	2	0	7
South America	1	1	0	0	0	1	3
Oceania	0	0	0	1	0	0	1
Total	**3**	**5**	**9**	**6**	**9**	**14**	**46**

4. Results and Discussion

4.1. Last-Mile categorization

After searching, screening, and selecting the final sample fit for analysis to obtain a more comprehensive understanding of the subject, we categorized the 46 individual studies based on their research domain into three separate categories that naturally emerged from the body of the studies, named ‘Models’ (24 studies), ‘Trends’ (12 studies) and ‘Sustainability’ (10 studies) (see Figure 2.).

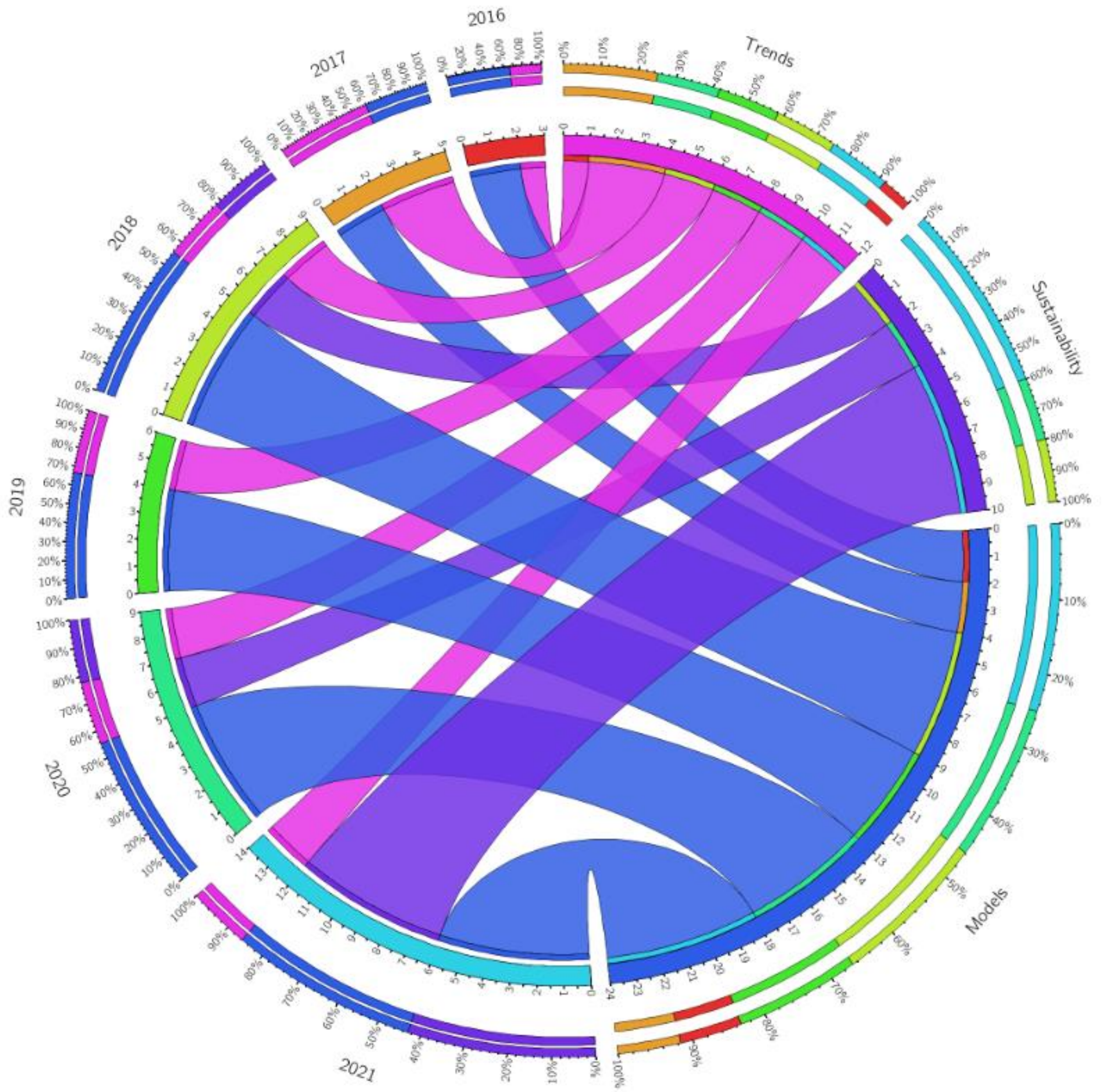

Figure 2. – Representation of the literature sample by category and year.

Figure 2 shows that models and trends topics have been both relevant during all the years in analysis, with an upper hand for papers addressing models for the urban last-mile supply chain. In 2021, there was also a relevant number of papers addressing themes related to the sustainable last-mile supply chain, which is related to the fact that the COVID-19 pandemic forced both companies and authorities to find new solutions for the delivery of goods in the city centers.

In the next section, we will address the key findings identified in the field of study concerning the different types of models developed during the last years to be applied to urban last-mile supply chain activities based on the systematic literature review performed.

4.1.1 Models category

The rapid growth of e-commerce and online retail business has increased customer demand and the consequent need for innovation in last-mile logistic services. The paper by Pacchayappan et al. (2021) introduces a drone-based pickup and delivery service model for small-size/lighter packages to minimize the distance traveled by the drone to complete the scheduled services. This model is based on a case study in Delhi and avoids the ground vehicle support for the delivery and overcomes the battery capacity limitation of the drone by incorporating a docking station facility. The authors use a MILP (Mixed-Integer Linear Programming) to obtain the maximum possible reduction in the distance traveled. In the study of Gabani et al. (2021), which deals with the importance of drones in the urban last-mile supply chain in the case of India, two models of drone-delivery technology are proposed to serve as a potential replacement for the truck-delivery system. The first model, a drone-truck hybrid delivery model, is proposed with trucks carrying multiple drones. The second model proposes a stand-alone drone-delivery model with separate charging infrastructural facilities at specific points. The two proposed 'models' findings present the advantages of significantly reducing carbon emissions, delivery costs, and time compared to truck-based delivery. Also concerning the particularities of the last-mile supply chain in the Indian subcontinent, the study of Prajapati et al. (2020), proposes a clustering-based routing heuristic (CRH) to manage the vehicle routing for the last-mile logistic operations of fresh food in e-commerce. CRH is a clustering algorithm that performs repetitive clustering of demand nodes until the nodes within each cluster become serviceable by a single vehicle. The algorithm's computational complexity is reduced due to the downsizing of the network through clustering and due to that, it produces an optimum feasible solution with less computational time.

Other models for city logistics optimization use a Meta-Heuristic clustering as the one proposed by Ahmed et al. (2017) where standard clustering techniques such as partitioning-based clustering (k-means, k-medoids), hierarchical clustering (agglomerative, divisive) and density-based clustering (dbscan, optics) are applied and are aimed at building hybrid clustering models to generate time-constrained and resource-constrained clusters. Another way to address the optimization of the urban last-mile supply chain is proposed by Lemardelé & Estrada (2021), where it is estimated the total operation cost, of a carrier based in Barcelona, in a dual delivery channel model, where if the size of the package is smaller than a given threshold, the parcel is delivered to the customer via a logistics micro-hub and ADD (Autonomous delivery device). Otherwise, if the parcel is bigger than the given threshold, it is delivered through a conventional supply chain with delivery vans. Another approach to an urban last-mile supply chain optimization model is proposed by Leyerer et al. (2020), and is based on a case study of the German city of Hannover, where it is possible to simulate by using a multi-echelon optimization model the supply of city dwellers through a network of optimized located refrigerated grocery lockers so that customers than either collect their orders, or the products are delivered to them using ECB (Electric Cargo Bicycles).

Also, on the issue of how to deliver goods in an urban last-mile context, there is the proposal by Allen et al. (2018), based on the case study of the London city center, on the concept of "portering", where vans have meeting points with porters who operate within a defined urban area so that they can deliver goods to end clients on foot, saving driving distance and time to delivery vehicles. Also, in a case study utilizing real-world data from the Portland region and its transit facilities, made by Keeling et al. (2021), accessibility and equity trade-offs are addressed, and the conclusion is that various facility types have the requirements to host a locker system. However, stakeholders and policymakers must consider accessibility and equity trade-offs when prioritizing locations. In another case study based on the city of Bogotá, the authors Gutierrez-Franco et al. (2021) propose a new data-and model-driven framework to support decision-making for urban distribution. The methodology uses complementary techniques integrated by a decision support system using key features of the urban supply chain, such as socio-demographic diversity, high congestion factors, the density of commercial areas, and logistic fragmentation. The execution of the model made possible the reduction of the number of vehicles utilized, the increase of the resource capacity utilization, and the reduction of the cost of operations of the fleet. Another theoretical model for the study of the urban last-mile supply chain is the one proposed by Choudhari et al. (2021), using the Analytical Hierarchy Process (AHP) to select the right logistic alternative, allowing the capability to deal with both ordinal and cardinal information. This integrated approach is an effective tool for the decision-making process in industrial environments, and five examples are illustrated in their work to show the method's effectiveness.

The study by Stinson et al. (2020) summarizes the implementation of an agent-based freight modeling system with a global representation of agents and detailed modeling of a large-scale transportation network for the city of Chicago. The model evaluates the transportation and energy impacts of goods movement across urban and national scales. The framework is implemented within POLARIS, a C++-based Planning and Operations Language for Agent-based Regional Integrated Simulation, which consists of an activity-based modeling (ABM) and dynamic traffic assignment (DTA) system that has robust features for passenger travel. Another case study for the USA, in this case for the New York City area, is presented in the paper by Schnieder et al. (2020), where the authors use a simulation tool to evaluate different parcel delivery strategies and customer movements based on real parcel delivery trip data and statistics about the parcel receiving habits. Also using as a case study the New York City area and addressing the theme of CSL (Crowdsource Logistics) for logistics effectiveness is the paper by Castillo et al. (2018), whereby using a contingency theory model, the authors manage to simulate same-day delivery services from a distribution center to 1.000 customer locations throughout New York City under dynamic market conditions and by comparing the results to those of a traditional dedicated fleet of delivery drivers, concluding that CSL model may provide added value in the reverse supply chain and can quickly expand delivery capacity in response to unexpected demand surges as part of a mixed fleet.

The theme of shared logistic in the context of urban last-mile supply chain models is also defended by Dallasega et al. (2018), assuming the authors that shared resources is the only solution for city logistics to increase the sustainability of transport in urban areas. To better understand the theme of shared logistics in an urban environment Kin, Ambra, Verlinde, & Macharis (2018) used the Synchronization Model for Belgian Inland Transport (SYMBIT), a computational model that computes freight movement based on schedule and decentralized behavior rules. Information flows of entities/agents, for a case study in the city of Brussels area, by allowing the transport of FMCG (Fast Moving Consumer Goods) freight to nano stores in vehicles of service-driven companies with spare transportation capacity and are driving around in our cities. Results showed that kilometers could be reduced when deliveries to both customers of service-driven companies and stores are conducted from a distribution agent located within or very close to the delivery area.

The theme of UCC (Urban Consolidation Center) has been pivotal in the scientific literature on urban last-mile supply chains. The paper by Kin, Spoor, Verlinde, Macharis, & Van Woensel (2018) demonstrates that when applied to a real case in which an FMCG company supplies nano stores in a megacity in an emerging economy via a distributor, the relevancy of a UCC varies since directly supplying nano stores is the most cost-effective option when drop sizes are large and distances short. When only distances become long, cross-docking becomes interesting, whereas collaborating in a UCC is more viable at smaller drop sizes. Using a UCC also becomes interesting when authorities implement more restrictions, such as narrower time windows, and when the volume increases with other companies. When drop sizes are small, and distances are short, deploying smaller vehicles becomes interesting. A study that addresses a key issue for the urban last-mile supply chain, one of the optimal locations of UCC in urban areas, was presented by Combes (2019), using the case study of the city of Paris. The proposed model considers commodities delivered in an urban area by vehicles starting from a logistic platform located on the outskirts of the urban area. The location of the logistic platform is assumed to be a trade-off between land rent and transport costs, and several distinct types of constraints are analyzed and compared. The sensitivity of the location of the logistic platform to the model parameters is investigated, and finally, policy measures are proposed. Another study on UCC is by Caldarelli et al. (2019), on a case study for the Italian city of Perugia where it is presented a preliminary model for a feasibility study for the sizing of a UCC (urban consolidation center), defining IF (Index Figures) and using 30-month traffic data given by cameras placed at several points in the city and the manual counting carried out for two weeks.

Zhong et al. (2019) studied revenue sharing in a collaborative supply chain based on Stackelberg game theory. This paper first studies the decision-making of two-stage logistics service supply chains, consisting of the e-commerce mall and the logistics service provider without cooperative distribution, in which decentralization and centralization are analyzed, respectively. Then, it is extended to the decision-making of three-stage logistics service supply chains, consisting of e-commerce malls, express delivery companies, and terminal distributors. The results show that the profit, sales volume, and logistics service effort of the centralized decision-making system are higher than those of the decentralized decision-making system, regardless of the two-stage or three-stage logistics service supply chain. Therefore, the authors consider it vital to formulate a reasonable profit distribution scheme based on a revenue-sharing contract to achieve cooperation among the logistics service supply chain partners. Also considering the reality of the mainland China market, the paper by Song et al. (2019) uses a case study for the town of Tiantongyuan, considering 200 residents, and compares the costs of three supply chain models: a traditional one with home delivery, a pickup point model and a self-delivery boxes model. The conclusions are that both the pickup point model and the self-delivery boxes model improve delivery efficiency, profit for the delivery company, and customer satisfaction.

The optimization of the urban last-mile supply chain is transversal to all geographic realities, and in the paper by Merchan et al. (2016), the concept of transshipment networks, a collection of strategically located transshipment platforms for efficient and flexible last-mile delivery in congested urban areas, is applied to Bogotá, Colombia. A two-echelon location-routing model formulation is proposed, combining a mixed-integer linear programming model with a closed-form continuous approximation of routing cost. The results suggest that transshipment platforms can significantly improve delivery process efficiency given proper fleet type and capacity. Also in Colombia, the case of Cali built by Peláez et al. (2017) concluded that often last-mile operations have inconsistencies due to the way the supply chain is managed, which makes it difficult to consumers to receive the products and so proposed a bi-helix model, with a mathematical component that minimizes operating delivery costs.

The theme of how last-mile deliveries can be considered in a supply chain simulation by using distance metrics was addressed in the paper by Rabe et al. (2020), where the authors presented the possibility of integrating last-mile deliveries to end customers in urban areas into supply chain simulation. For this purpose, whether a satisfactory distance metric exists for calculating distances without integrating an external route planning Web service was analyzed. It was concluded that the rescaled Euclidean distance was the best approximation metric in all applications considered in the paper. It produced the smallest sum of absolute deviations. Another theme that urban last-mile supply chain models must deal with, namely those based on a B2C model, is one of failed deliveries. This theme was studied by Cardenas et al. (2016) in a case study of Belgium cities in Flanders and Brussels regions. The conclusions are that the zones within the cities are heterogeneous, that it is important to define logistics zones, and that the demand for deliveries should be explained from socio-economic variables.

In conclusion, the scientific literature is well documented on different kinds of models that try to understand the urban last-mile supply chain system, and that can be theoretical and supported in mathematical or computational models, tested in limited space and period case studies, or can be experienced models already tested in the real world, some successful and others not.

4.1.2 Sustainability category

In this sub-section, we will address the key findings that have been identified in the field of study concerning the relationship between urban last-mile supply chain models and sustainability issues, based on the SLR and considering the ten studies categorized as ‘Sustainability’.

Over the years, central and local governments have identified the need to implement policies to regulate supply chains and delivery activities of companies that supply their products to stores and customers located in different city areas so that congestion and noise levels can be reduced, as well as CO_2 emissions and other hazardous fine particles and by doing so achieve a sustainable equilibrium between economic and social activities within city boundaries. One of the issues that are a growing trend in the urban last-mile supply chain is how national and local authorities can deal with the exponential growth of e-commerce and how B2C deliveries can be taxed to stimulate more sustainable delivery methods and generate revenues that can be used to support a transition to greener delivery models.

In the paper by Majoral et al. (2021), the authors made a CBA (Cost Benefits Analysis) of the introduction of a tax to e-commerce deliveries in the city of Barcelona, Spain. They considered three main externalities abatement mechanisms: a) demand reduction, b) fleet upgrade towards electric vehicles, and c) consolidation and maximization load factors. They conclude that such a tax, with an increase for urgent deliveries and a reduction for deliveries made on electric vehicles, could generate an NPV (Net Present Value) in 5 years between 12M€ and 15M€ and have a strong impact on the reduction of CO_2, noise, and other externalities. Another example of sustainable design of urban last-mile supply chains is presented by Ramirez-Villamil et al. (2021) as a case study for a sustainable local pickup and delivery network for the case of the city of Paris, France. In this study, the distribution network was composed of two Echelons, where four depots located outside the city are used to deliver the packages to a set of facilities called satellites, and from there distributing to each district of Paris, and then to the final customers. The authors have concluded that by using simheuristic, a solution approach based on a combination of simulation and optimization, they could solve a two-echelon vehicle routing problem with stochastic travel times and that a global optimum gives better results than a local optimum, both in traveling times, CO_2, and fine particles emissions. They also concluded that companies would benefit in terms of cost per working hour by having shorter route times.

Muñoz-Villamizar et al. (2021) address the same theme of reducing the negative effects of the urban last-mile supply chain, but this time in another geographical location, specifically in the region of Culiácan, in México. In modern supply chain models, the customers are subject to different incentives to drive them to wait longer for their home deliveries. These incentives allow companies to pool and ship in more cost-efficient and energy-friendly alternatives, and this paper used real data from one of the largest retail companies in Mexico to analyze the impact of different time slot extensions for three different criteria: a) distance, b) transport costs, and c) CO_2 emissions. Their results showed that the common approach of minimizing distance is not recommended for any of the scenarios under study. On average, having up to 4 days (rather than 1, 2, or 3 days) for deliveries leads to savings of 57% in total distance, 61% in total costs, and 56% in fuel consumption and/or CO_2 emissions. Therefore, there is a mismatch between “just on time delivery” policies and the environmental impact of such policies in urban areas.

One way to reduce the CO_2 emissions produced by urban last-mile supply chain activities is to use more EFV (Electric Freight Vehicles), as is addressed in the study by Galati et al. (2021). In this study a multi-stakeholder approach is adopted based on interviews of several stakeholders in EFV (Electric Freight Vehicles) suppliers and SFSC (Short Food Supply Chain) agents in the Sicily region of Italy. Their aim is to identify the obstacles and potentialities in the adoption of EFV in the SFSC and the existence of a shared strategy at the system level able to support their adoption. The authors concluded that EFV appears to be a feasible option, although more efforts are still needed at the governmental level, namely public measures of support for purchasing costs or rental rates for EFV and more services of technical expertise.

In the last two years, the COVID-19 crisis has increased deliveries in urban areas and forced both companies and local authorities to look for solutions that not only optimize costs and reduce CO_2 production but also reduce the risk of infection of delivery workers and customers. One of the solutions to this challenge is investing in AV (Autonomous Vehicles) for urban last-mile deliveries, as Feng (2021) proposed. Using the data from 20 selected supermarkets and 91 customer zones in Great London, in the UK, this research takes account of the delivery risk of infection during pandemic periods and calculates the accumulated infection risk under four logistics patterns. In their study, the calculation result of the infection risk shows convincingly that the wide use of AV can reduce the transmission of the COVID-19 virus.

To increase the sustainability factor of urban last-mile supply chain activities, it is important to have a set of studies that can simulate the impact of urban planning and transport decisions of local authorities on this economic sector. One good example of a scenario-driven approach is the one presented by De Bok et al. (2021), where the authors analyze the impact of the decision by the city of Rotterdam, in The Netherlands, to introduce a zero-emission zone (ZEZ), in combination with urban consolidation centers (UCC) on the outskirts of the city to generate a shift to zero-emission vehicles. This case study has shown that the impact of UCC is not trivial: emissions within the ZEZ were reduced because all transport used ZE vehicles, but there was also a small increase in vehicle kilometers traveled outside the ZEZ, which can be attributed to the rerouting of shipments through the UCC. As a result, emissions were reduced dramatically, by 90%, inside the ZEZ. At the city scale, this value corresponds to a reduction of almost 10%, as most freight-related traffic is generated by the Rotterdam port and involves long-haul HGV (Heavy Goods Vehicle) transport that does not enter the city center. Consequently, the city-level impacts were significantly reduced and a good step toward the ambition of the city authorities to reduce CO_2 emissions by 49% by 2030.

In the scope of the study of how to reduce the environmental impact of urban last-mile supply chain activities, the study by Trott et al. (2020) presents a simulation model to reproduce supply chain operations in grocery shopping and what are the impact of mileage and CO_2 production of an increase in the percentage of e-shopping. The case study was based on a major retail organization in Hanover, Germany, and it showed that increasing the use of e-grocery offers the potential to decrease both mileage and traffic-related emissions, especially for utilization rates above 20 % for the e-commerce channel when compared to the scenario exclusively including brick and mortar grocery shopping.

Another two papers by Ranieri et al. (2018) and Bosona (2020) made a Systematic Literature Review on how to improve the sustainability of last-mile logistics, identifying smart logistics aspects (logistics digitization, production, and use of relevant data), taking innovative measures in technological aspects (adopting and improving electric vehicles and ICTs), building structural aspects (restructuring last-mile logistics networks, introducing proximity stations and facility location), and also addressing management issues (adopting collaboration, cooperation, coordination, and integration via developing a shared digital platform, and stakeholder commitment).

Additionally, the study by Wygonik et al. (2018), a case study on the Seattle area in the USA, showed which factors must be considered to design an urban last-mile supply chain model that may be effective in the reduction of negative environmental impacts were. The authors concluded that increasing road density or decreasing the distance to a central warehouse reduces the impacts as measured in the dependent variables of the model (VMT- Vehicles Miles Traveled, CO_2, NOx, and PM10 – Hazardous Particles) and that last mile goods movement relying on delivery services result in the lowest generation of CO_2 per customer, except in road-dense locations. On the other hand, last-mile goods movement relying on passenger vehicles (traditional model used in urban areas) always result in the lowest generation of NOx and PM10.

In conclusion, there are different ways to increase the sustainability of urban last-mile supply chain in the context of increasing demand for e-commerce deliveries by customers. That can take the form of increased use of EV (electric Vehicles), a reduced focus on just-in-time deliveries, an implementation of ZEZ (Zero Emissions Zones) coordinated with UCC (Urban Consolidation Centers) in city centers and, in a broader sense, the agreement by all stakeholders of the supply chain that future models have to focus not only on the financial cost of deliveries but also taking into consideration the environmental costs of urban supply chain activities.

4.1.3 Trends category

In this sub-chapter, we will address the most relevant trends that have been identified in the SLR, considering the 12 studies categorized as 'trends'.

The urban last-mile supply chain trends, namely those related to e-commerce, are similar worldwide but are obviously in different development stages depending on whether we analyze mature or emerging markets countries. For example, in the paper by Janjevic et al. (2020) it was presented a study that combines a literature review and a case study analysis to allow the characterization of urban last-mile e-commerce distribution strategies and highlight the variables impacting the choice of network design in different stages of development of the e-commerce market around the world. Also, a critical point to developing a coherent body of scientific knowledge concerning the urban last-mile supply chain is to have a common set of definitions and frameworks, and these matters are addressed in the paper by Cardenas et al. (2017).

One major trend identified is one of Industry 4.0 and supply chain is the growth of e-commerce during and after the COVID-19 crisis as stated in the study of Kumar et al. (2021). According to these authors, this phenomenon has caused a major shift in the supply chain industry towards adopting the major concepts of Industry 4.0, namely those of IoT (Internet of Things), CC (Cloud Computing) and BD (Big Data). Ferrari et al. (2021) agree that the adoption of Industry 4.0 technologies can play a critical role in optimizing the logistic service by using digitalization, automation, and interconnection along the supply chain. To deepen the scientific knowledge on the issue these authors developed an empirical model based on regression analysis on a sample of 105 city logistics projects, concluding that the GDP (Gross Domestic Product), Foreign Direct Investments, R&D expenditure, Employment rate, and the number of inhabitants are significant drivers of the development of 4.0 technologies in city environments for the last-mile supply chain. Also, another key feature of the Industry 4.0 concept, when applied to urban last-mile supply chain themes, is the one of LBS (Location Based Services), as it is showed by Venkataraman et al. (2020), which carried out a detailed analysis of the present patent landscape of the key technologies of LBS, namely those of drone-based last-mile connectivity for a complex supply-chain solution or of a fully autonomous driver-less car.

Another trend identified is how companies may thrive in an omnichannel economy. For example, in the last decade, the increased relevancy of B2C models derived from the growth of e-commerce, accelerated in the past two years by the COVID-19 crisis, has delivered new challenges both to traditional brick and mortar retail companies but also the newborn ones that are 100% digital-based. In the paper by Lim et al. (2019), the authors developed a typology consisting of four ideal forms of last-mile supply networks, differentiated by the speed of delivery responsiveness and level of product variety and this theoretical model aimed at allowing companies to have a tool to guide the path in an omnichannel world. The trend of omnichannel logistics was also raised in a paper by Rai et al. (2018), where the authors stated that digitalization has pushed retailers to redefine their business models towards the cross, multi and omnichannel retail, and that in this new way of doing business, the role of LSP (Logistic Service Providers) have become pivotal in the relationship between retail companies and their clients and a competitive advantage to be used. According to the study, LSP can adopt different strategies to become a player in an omnichannel market, through business-to-business partnerships, expansion of their geographical presence, acquisitions, and customer service, by acquiring a deep knowledge of their client's and end consumer's transaction patterns.

Another line of study that has been a trend for quite a while in urban last-mile supply chain scientific knowledge production is how to develop the cooperation between the different shareholders of a supply chain system. This trend objective is to achieve a cost-effective, sustainable, and viable solution. In the paper by Harrington et al. (2016), a conceptual framework was developed to capture the key design factors to be considered by industrial, institutional, and consumer groups in the configuration of a last-mile solution. This in-depth case study draws insights on the design criteria and performance attributes that have a multi-stakeholder input and operationalized. The key findings have demonstrated the critical role of institutional players in supply chain innovation, suggesting that new policy approaches are required to facilitate and support the design and implementation of new solutions as part of a more partnered (as opposed to regulatory control) approach, evaluating common interest and trade-offs between each stakeholder positions.

The same trend of how to manage multiple interest supply chain systems is studied in the paper by Paddeu et al. (2018). The authors address the issue of how to improve collaboration between different stakeholders, using as case studies the Urban Consolidation Center (UCC) schemes in Bristol, UK, and Cagliari, Italy. The drivers identified to the implementation of such collaborative schemes are related to the economic advantages of sharing logistics and practical advantages related to timesaving, trusted operations, and delivery times. Drivers related to the protection of the environment due to public awareness or ethical concerns of the companies were also identified. On the side of the barriers to the implementation of such a collaborative supply chain scheme, the authors recognized financial and practical barriers, namely the cost and viability of such a scheme, and social and cultural barriers, namely a non-innovative mindset by the companies related to the fear of losing business to competitors once the competitive advantage of the last-mile supply chain would be equal to all market players. Finally, the authors found that factors concerning the type of goods delivered, related to the use of cold chain to frozen and perishable goods, not adequate to other types of products, also constitute financial and practical barriers.

Another example of how critical the cooperation between different players in an urban last-mile supply chain model is presented in the study by Butrina et al. (2017) These authors present a case study on American cities centers made to address not the last-mile but the last few hundred meters in the delivery process for packages in the urban environment. As stated above, the trend of collaborative last-mile supply chain models brings advantages and disadvantages. However, it is for many authors the way forward toward a cost-effective and sustainable urban supply chain. This fact is stated in the study by Gogas et al. (2017), where two evaluation methodologies are proposed to support decision-makers and policy planners when making decisions on future investments on a UCC. The proposed methodological frameworks are flexible and may be used in all city contexts. For example, in the urban environments, the results and findings are independent of trade-offs and external factors, as according to the authors, they are checked against the subjective judgment and further validated through the elaboration of sensitivity analysis.

One more trend identified in the SLR is the use of scenario thinking models. These are aimed to be used in the design of urban last-mile supply chain models, as proposed in the study of Ewedairo et al. (2019) applied to the case of Melbourne, Australia. The authors identify four plausible urban scenarios with two dimensions: infrastructure supply and intensive land use. In their study, the worst scenario highlighted the need for strategic planning to mitigate risk associated with damaged products, congestion, last-mile delivery stagnation, and aging infrastructure.

In conclusion, the trends presented are those that may be classified as the most relevant for future work on urban last-mile supply chains, namely the interaction between technology and supply chain, the increased need for collaborative solutions, and the capacity to have a common language and holistic vision that allow a complete understanding of the future path to be taken.

4.2. PEST Analysis

In this section we will further address our study objective trying to highlight Political, Economic, Social, and Technological factors uncovered during the SLR analysis. The insights found to be more pertinent for each factor are described in Table 3.

According to Sammut-Bonnici et al. (2014), PEST is "*an acronym for four sources of change: Political, Economic, Social, and Technological. PEST analysis is a powerful and widely used tool for understanding strategic risk. It identifies the changes and the effects of the external macro environment on a firm competitive position*". In our study, a PEST analysis is made to examine the urban last-mile supply chain ecosystem and highlight the importance of the external factors affecting this topic in the urban context. A content analysis was conducted to identify which factors are predominant for the 46 studies of the final SLR set, grounded on a similar analysis made by Neves et al. (2011). The results are described in Table 3.

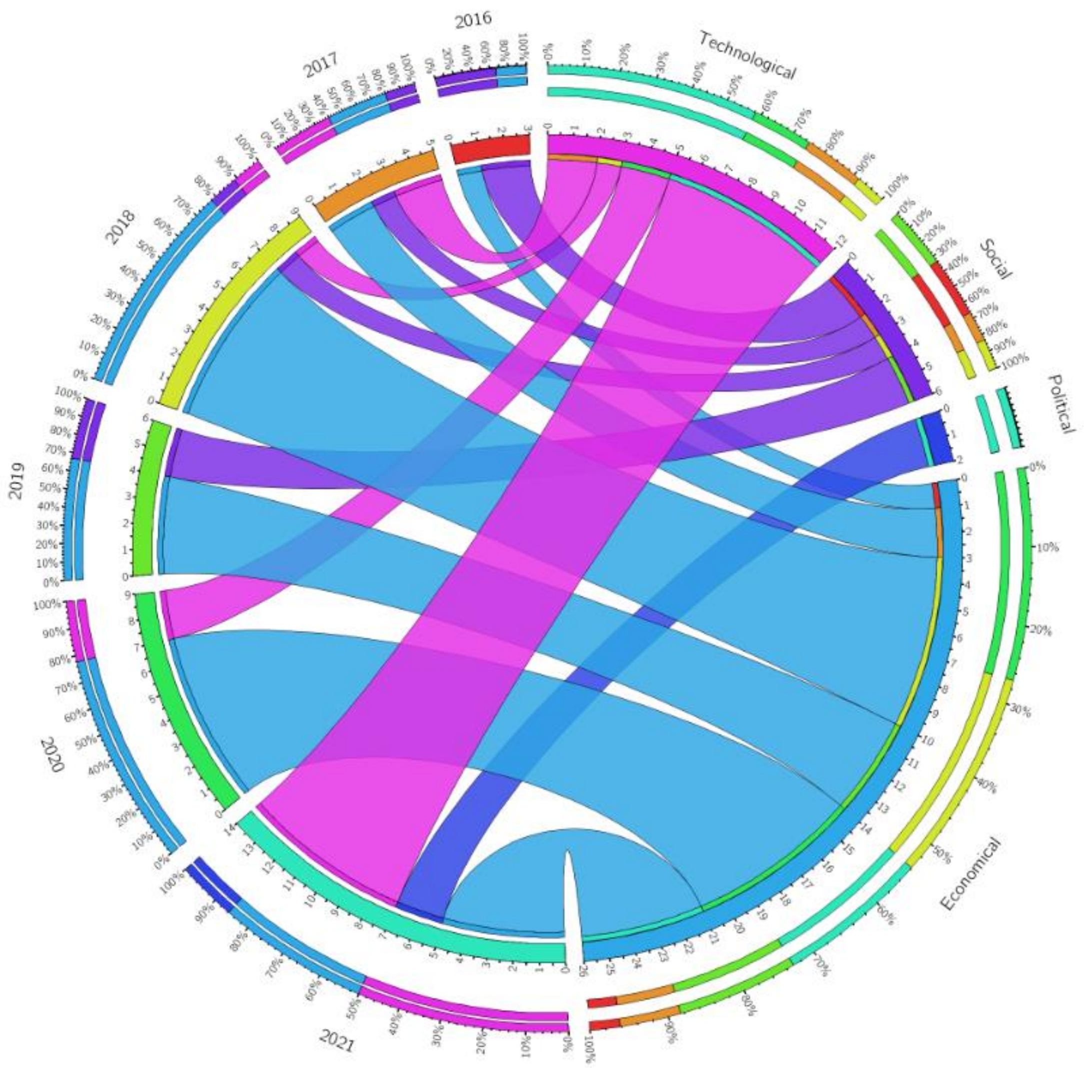

Figure 3. – Representation of the PEST analysis on the SLR performed on the last-mile supply chain in the urban context

In Figure 3 it is visible that the economic factors prevail throughout the years under analysis, mainly in the years 2018 and 2020, followed by the technological factors that have reached their highest relevancy in the year 2021. Another conclusion that can draw is that social factors are present only in the first years of the analysis (2016 to 2019) and that political factors are only relevant in the year 2021.

Table 3. – PEST analysis on the last-mile supply chain in the urban context

Political Factors	Authors
• Introducing tariffs is a way to monetize the externalities of last-mile delivery schemes.	De Bok et al. (2021); Majoral et al. (2021)
• E-commerce is a growing source of revenue for local and national authorities.	De Bok et al. (2021); Majoral et al. (2021)
Economic Factors	**Authors**
• Shipment consolidation is a cost-effective strategy to use in an urban last-mile supply chain model.	Merchant et al. (2016); Schnieder et al. (2020); Muñoz-Villamizar et al. (2021)
• E-commerce can have a positive impact on urban last-mile delivery mileage and gas emissions reduction.	Wygonic et al. (2018); Trott et al. (2020); Leyerer et al. (2020)
• Using simulation models can make an urban last-mile supply chain more cost-effective.	Rabe et al. (2020); Prajapati et al. (2020)
• Reducing days of delivery have a positive impact on the urban last-mile supply chain delivery cost.	Keeling et al. (2021)
• Urban last-mile supply chain models must be adjusted to the economic development of each country.	Kin et al. (2018); Song et al. (2019); Janjevic et al. (2020)
• 4.0 industry technologies have a positive economic impact on the last-mile supply chain.	Ferrari et al. (2021)
• Cooperation is relevant to a more efficient urban last-mile supply chain, but it needs economic return evaluation and a revenue-sharing scheme with all stakeholders.	Gogas et al. (2017); Castillo et al. (2018); Paddeu et al. (2018); Caldarelli et al. (2019); Combe (2019); Zhong et al. (2019)
• COVID-19 has changed and increased the last-mile cost structure.	Feng (2021)
Social Factors	**Authors**
• Social indicators like demographics and lifestyle trends must be considered in the evaluation of urban last-mile supply chain schemes.	Cardenas et al. (2016); Harrington et al. (2016)
• Last-mile supply chain externalities like traffic congestion, pollution and noise have a social impact in an urban area.	Butrina et al. (2017); Ranieri et al. (2018)

• Retailers must address the needs of all stakeholders in last-mile supply chain models.	Lim et al. (2019); Ewedairo et al. (2019)

Technological Factors	**Authors**
• Data-driven technologies are at the base of urban last-mile supply chain activities.	Ahmed et al. (2017); Stintson et al. (2020); Choudhari et al. (2021); Gutierrez et al. (2021); Kumar et al. (2021)
• Drones can be a useful tool in urban last-mile supply chain models.	Venkataraman et al. (2020); Gabani et al. (2021); Pachayappan et al. (2021)
• Electric Freight Vehicles (EFV) can reduce the environmental footprint of last-mile activities.	Galati et al. (2021)
• Parcel size is a factor for last-mile supply chain modelling.	Lemardelé et al. (2021)

In the PEST analysis, there are only two studies of the result set of the SLR that were considered as having political issues as the main driver. The subject in both papers is related to the fiscal policy of local and national governments, aimed at promoting a more efficient and sustainable last-mile supply chain industry.

One of the main drivers in producing scientific knowledge in the domain of the urban last-mile supply chain is to understand the market's economic interactions between private companies, public institutions, and consumers. Also, a deeper understanding is needed regarding if there is or is not common ground between private and public interests, and how is feasible for both to deliver a good service keeping an economical and sustainable sound operation. In our study, the economic influences are the major reasons emerging from the PEST analysis and are core in 25 out of the 46 studies used in the SLR. They can be divided into two categories: a) those which that are based on the economic value that private companies must improve their last-mile operations, and b) those that came from the need of public entities to understand how to build and manage a more sustainable urban last-mile model, that complies with the smart city guidelines.

As for the social factors in the PEST analysis, it is stated that they were less relevant in the SLR, having six papers identified as endorsing the social factors on this topic. These papers relate to the constant feedback between buyer pattern behaviors and social trends. These studies encompass a growing sense of belonging to a global community, pushing official authorities to question the way goods are delivered in cities centers, and aim to achieve environmental sound and socially balanced ways to operate an urban supply chain model.

Finally, in the PEST analysis, the technological aspects are also relevant in the papers retrieved from the SLR. 13 out of 46 papers present new technological solutions and models for the urban last-mile supply chain. They have a close link to industry 4.0 themes, such as digitalization, automation, and the interconnection of different parts of the supply chain to meet the needs of efficiency. Also, in the last two years, adding the urge to assure the delivering of goods through COVID 19 epidemic.

5. Conclusions

In this study, we conducted a systematic literature review (SLR) on the urban last-mile supply chain, and a unique segmentation was proposed that underpins the current body of knowledge. This SLR was complemented by a PEST analysis performed on the SLR's result set, addressing the external factors affecting the complexity of this domain. This work has practical implications, as the SLR and PEST analysis intent to clarify the discussion on this topic and guiding future research and experimentation. Indeed, the subjects of the studies in the SLR covered a full spectrum of proposals, from those born from mathematical and computational theories to those practical case studies that take it from day-to-day operations and try from that data to conceptualize a better way to address the challenges of the last- mile supply chain. On the other hand, the PEST analysis gathers the external factors for joint efforts in a collaborative supply chain strategy between all the players, where logistic resources, costs, revenues, policies, and technologies would be shared by suppliers, logistic operators, and business outlets, in an effort supported by academia, local authorities, and citizen groups, making it possible to build a true winning holistic solution for a better sustainable urban development.

Our work demonstrates that the urban last-mile supply chain has been a relevant topic of study in the last five years and that this relevancy is due to the push of local and national authorities to establish a more sustainable urban last-mile supply chain to comply with smart city guidelines. It highlights that there is a need for private companies, both retailers and logistic service providers, to find less expensive and more time-efficient models to deliver goods in city centers, to the technological innovation that occurred on both software for last-mile supply chain models and on new ways to deliver in city centers (Drones, EV vehicles, cargo bikes, UCC, pickup installations). In addition, since the year 2020, the COVID-19 epidemic has forced everyone to think of innovative solutions to allow delivery without human contact and to provide an answer to the exponential growth of B2C deliveries caused by it. Also, our study shows that last-mile supply chain is on the rise as a relevant topic of study in all geographical areas, with scientific work being done for different stages of development of cities around the world, having European cities' case studies more focused on environmental and social issues and American and Asian research work more focused on efficiency issues for the urban last-mile supply chain.

This study is not without limitations. One of the limitations is related to the database used to perform the SLR. Surely, choosing other databases would lead to a different result set of studies and maybe other type of findings would be obtained. Also, choosing different keywords or study periods would naturally produce different results. In future work, a holistic and integrated model of an urban last-mile supply chain should be developed and experimentally tested in a city center area, taken as the base ground for the good practices identified in our systematic literature review.

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Appendix A. Reviewed research studies with relevance for the urban last-mile supply chain and related PEST analysis

Nr	Authors	Year	Geographic location	Country	City	Topic	Concepts	PEST Political	PEST Economic	PEST Social	PEST Technological
1	Ramirez-Villamil et al.	2021	Europe	France	Paris	Sustainability	Two-echelon vehicle routing				X
2	Pachayappan et al.	2021	Asia	India	Delhi	Models	Neighbor search heuristic				X
3	Muñoz-Villamizar et al.	2021	North America	Mexico	Culiacán	Sustainability	Environmental impact, Urban distribution		X		
4	Majoral et al.	2021	Europe	Spain	Barcelona	Sustainability	Taxation e-commerce	X			
5	Lemardelé et al.	2021	Europe	Spain	Barcelona	Models	Autonomous delivery robot				X
6	Kumar et al.	2021	Asia	India	Nagpur	Trends	Mobility, Industry 4.0				X
7	Keeling et al.	2021	North America	US	Portland	Models	Common carrier parcel lockers		X		
8	Gutierrez et al.	2021	South America	Colombia	Bogotá	Models	Customer-centric supply chains, Hybrid methods				X
9	Galati et al.	2021	Europe	Italy	Sicily	Sustainability	Electric freight transport, Food last-mile supply chain				X
10	Gabani et al.	2021	Asia	India	n.a.	Models	Uncrewed Aerial Vehicle (UAV)				X
11	Ferrari et al.	2021	Europe	Italy	n.a.	Trends	Regression analysis, 4.0 technologies		X		
12	Feng	2021	Europe	UK	London	Sustainability	AV (Autonomous Vehicles), CLC (City Logistic Center)		X		
13	De Bok et al.	2021	Europe	The Netherlands	Rotterdam	Sustainability	Zero-Emission Zones, LEZ (Low Emission Zone)	X			
14	Choudhari et al.	2021	Asia	India	n.a.	Models	(AHP) Analytic Hierarchy Process				X
15	Venkataraman et al.	2020	Asia	India	n.a.	trends	Location-based Services (LBS)				X
16	Stintson et al.	2020	North America	US	Chicago	Models	activity-based modeling (ABM), dynamic traffic assignment (DTA)				X
17	Rabe et al.	2020	Europe	Germany	Berlin	Models	Distance Metrics; Urban logistics simulation		X		

Nr	Authors	Year	Geographic location	Country	City	Topic	Concepts	PEST Political	PEST Economic	PEST Social	PEST Technological
18	Prajapati et al.	2020	Asia	India	n.a.	Models	Clustering-based routing heuristic (CRH)		X		
19	Trott et al.	2020	Europe	Germany	Hanover	Sustainability	Simulation-based research		X		
20	Schnieder et al.	2020	North America	US	New York	Models	Parcel lockers; parcel delivery trip data; simulation tool		X		
21	Leyerer et al.	2020	Europe	Germany	Hannover	Models	Smart transport system; VRP with time windows (VRPTW)		X		
22	Janjevic et al.	2020	Worldwide	Worldwide	n.a.	Trends	Distribution network design; Delivery Service Design		X		
23	Bosona	2020	Worldwide	Worldwide	n.a.	Sustainability	Last Mile logistics sustainability; Freight LML configuration		X		
24	Zhong et al.	2019	Asia	China	n.a.	Models	Stackelberg game theory; logistics service supply chain (LSSC)		X		
25	Song et al.	2019	Asia	China	Tiantongyuan	Models	Pick-Up Point Model; Self-Delivery Box Model; GAAA		X		
26	Lim et al.	2019	Worldwide	Worldwide	n.a.	Trends	Last Mile Supply Networks (LMSN)			X	
27	Ewedairo et al.	2019	Oceania	Australia	Melbourne	Trends	Scenario Thinking Model			X	
28	Combes	2019	Europe	France	Paris	Models	Optimum location; Operational constraints, Demand density		X		
29	Caldarelli et al.	2019	Europe	Italy	Perugia	Models	Urban Consolidation Centers (UCCs); Index Figures (IF)		X		
30	Wygonik et al.	2018	North America	US	Seattle	Sustainability	Regression modeling, VMT		X		
31	Ranieri al.	2018	Worldwide	Worldwide	n.a.	Sustainability	Externalities Reduction Problems			X	
32	Rai et al.	2018	Europe	Belgium	Brussels	Trends	Logistic Service Provider (LSP); Business Model		X		
33	Paddeu et al.	2018	Europe	UK	Bristol	Trends	Urban Consolidation Centers (UCCs); Stakeholders' perceptions		X		
34	Kin, Spoor, Verlinde, Macharis, & Van Woensel	2018	Worldwide	Worldwide	n.a.	Models	Urban freight transport (UFT); alternative distribution setups		X		
35	Kin, Ambra, Verlinde, & Macharis	2018	Europe	Belgium	Brussels	Models	Agent-based Modelling (ABM); Spare transportation capacity; Nano stores		X		
36	Dallasega et al.	2018	Europe	Italy	n.a.	Models	Logistics shared-resources approach				X
37	Castillo et al.	2018	North America	US	New York	Models	Crowdsourcing Logistics (CLS); Stochastic discrete event simulation model		X		

Nr	Authors	Year	Geographic location	Country	City	Topic	Concepts	PEST Political	PEST Economic	PEST Social	PEST Technological
38	Allen et al.	2018	Europe	UK	London	Models	Nearby delivery areas; Porter		X		
39	Pálaez al.	2017	South America	Colombia	Vale del Cauca	Models	Bi-Helix model; on-site information collection instruments				X
40	Gogas al.	2017	Worldwide	Worldwide	n.a.	Trends	UCC evaluation; Stakeholders; Impact areas		X		
41	Cardenas al.	2017	Worldwide	Worldwide	n.a.	Trends	Geographical framework; Scope of literature; Terms definition		X		
42	Butrina al.	2017	North America	US	n.a.	Trends	Complete street concept; Load-unload zones			X	
43	Ahmed et al.	2017	Asia	India	n.a.	Models	Clustering techniques; meta-heuristic method				X
44	Merchan et al.	2016	South America	Colombia	Bogotá	Models	Two-echelon location-routing model		X		
45	Harrington et al.	2016	Europe	UK	London	Trends	Consumer Choice Portal and Package Consolidation Centre (CCP-PCC)			X	
46	Cardenas et al.	2016	Europe	Belgium	n.a.	Models	Geographic Information Systems (GIS), e-commerce deliveries in urban areas			X	