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The Impact of Last-Mile Logistics: a Case Study on the Optimisation of Commercial Fleets through the European Union

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Abstract: Over the last decade, many cities in the world have been facing the impact of urban population growth and rapid e-commerce spread on freight volumes and consequently on the number of road freight vehicles. These dynamics have fostered the central role of last-mile logistics. The transport sector is responsible for around 25% of total GHG global emissions, 30% of which are related to freight road transport. Urban freight transportation has remarkable implications in terms of air pollution, noise, and road security. In this context, the electrification of urban fleets could represent a viable and efficient solution to mitigate the environmental footprint of last-mile logistics. Furthermore, last-mile logistics also involves high organization costs and time inefficiencies for transportation firms and customers. The technological development of routing processes through a new optimized IT system (e.g., by means of digital twins) may play a key role in "greening" the last-mile logistic sector. In this research, we consider a case study of investments in Electric Vehicles, aiming at assessing their environmental and monetary costs and benefits, and the scalability of such a policy.

Keywords: Logistics; Traffic management; Fuel efficiency; Minimize travel time and CO2 consumption and price; Parking control.

1. INTRODUCTION

By 2050, there will be 6.7 billion people living in urban areas, more than 70% of the world's population. To this extent, metropolitan areas will account for 90% of the world's GDP at that time (United Nations, 2019; The World Bank Group, 2022). The urban transportation and, particularly, freight logistics will thus become increasingly crucial to the commercial and residential functions of cities, but it will also have significant impacts on population, sustainability and traffic management. (Digiesi et al., 2012; Demir et al., 2015). For example, in 2014, 23% of the global greenhouse gasses (GHG) emissions were related to the logistics sector, while in 2021 it reached 25%, 75% of which are related to road transport (IEA, 2018; IEA, 2021).

Convincing shippers to internalise environmental targets in their business models is rather challenging in the absence of supportive governmental policies (Simoni et al., 2020). That is why the European Union (EU) – and other supranational institutions – have devoted particular efforts to regulate traffic pollution and management. Relevant examples are the EU Directive 2014/94/EU on the deployment of alternative fuel infrastructures that set the target of transport electrification; The EU program *Fit for 55*, aimed at cutting GHG emissions by at least 55% by 2030. Among the measures that are considered to achieve such challenging targets a key role is played by the switching of Internal Combustion Engine Vehicles (ICEVs) to Electric Vehicles (EVs) and zero- and low-emission vehicles (ZLEV).

Focusing on urban freight transportation, the electrification of the last-mile logistics fleets is one of the most promising solutions proposed by the EU programs, as well as by academics and practitioners. Freight vans account for between 16–50% of all vehicle emissions in urban areas, being one of the main pollutants (Thompson, 2015). Hence, switching to EVs might considerably reduce the negative externalities generated by ICEV fleets, including air pollution, noise, and road security (Oliveira et al., 2017). The circulation of freights to (and from) their warehouses – or Urban Consolidation Centres (UCCs) – and to the delivery point are managed by delivery services, which choose means of transport, routing and consequently the resulting financial, economic, and social effects.

In addition to reducing GHG emissions, urban freight transportation is crucial for cities' business and residential operations. However, last-mile logistics vehicles also result in additional negative externalities, such as congestion, lower road capacity, reduced safety, and unauthorized parking (Giuliano, 2013; Demir et al., 2015; Schmid et al., 2018). The Vehicle Routing Problem (VRP) plays a crucial role in the appropriate trade off of economic and environmental costs and benefits of last-mile logistics, e.g, by decreasing fuel consumption and road travelled. In the perspective of last-mile fleet electrification it is essential to embed in the VRP the

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optimal design of recharging policies and facilities (Juan et al., 2016).

At the same time, last-mile delivery is the least-performing stage of the supply chain, from the logistics firm's perspective, that account for 30% of freight transportation costs (Castiglione et al., 2022). According to Xiao and Feng (2010) and Suzuki (2011), the inefficiency of last-mile logistics is mainly caused by the lack of routing optimization, automation, and cooperation among different (competing) firms that, particularly, brings to under-utilisation of fleets' capacity. Implementing and applying algorithms for automated warehouses and VRP to improve the number of parcels delivered and, on the other side, vertical and horizontal collaboration through different mechanisms among competitors are important levers to improve the efficiency of logistics service delivery while, at the same time, reducing its environmental impact.

The past literature have investigated the impact of last-mile logistics on the so-called light-electric freight vehicles (LEFVs), belonging to the N1 category according to EU vehicle classification, which includes electric cargo bikes and tricycles, electric cargo mopeds and small electric distribution vans (Lebau et al., 2013; Oliveria et al., 2017). The loading capacity of these means of transport is their principal constraint. Deliveries for small shops and small and medium enterprises (SMEs) in city centres typically involve heavier parcels and then vehicles with a higher loading capacity. In this paper, we focus on electric vans belonging to the N2 category, weighing more than 3.5 tons but not greater than 12 tons, and being authorized to be driven with a C1 European driving license, thereby reducing the size of this group to those that weigh no more than 7.5 tons (from now on *electric vans*) for B2B deliveries. To our knowledge, this phenomenon has not been investigated for several reasons, starting from the fact that last-mile logistics services have difficulties integrating electric vans into their fleets. Consequently, the primary purpose of our research is to investigate the schemes that could incentivize companies to switch their fleets to electric beyond the available technical solutions and the purchasing cost, as well as how the implementation of technological development (i.e., automated sorting system and VRP) may further improve environmental and costs impacts.

2. METHODOLOGY

In order to answer our research question, we conduct a preliminary case study to better understand the major present and future challenges that last-mile logistics firms face in switching their fleets and implementing technological algorithms and facilities, with the support of external consultants and practitioners. The case study methodology is frequently applied to examine the contextual variables that explain a particular phenomenon by creating a theoretical sample and using a variety of sources to gather information (Yin, 2017).

We direct a preliminary exploratory case study through the comparison of two last-mile logistics transportation firms (hereinafter LMLS1 and LMLS2), two IT management firms (IT1 and IT2), and two software houses (SH1 and SH2). LMLSs purpose is to switch their fleets to electric and, on the other side, ITs and SHs purpose is to optimise the sorting system and VRP of the logistics firms and advise them on the most efficient way to switch the fleets. The six companies in our sample, which come from four European countries, are kept anonymous through these acronyms.

The information is gained through semi-structured interviews both in person and via video call, corroborated with direct observation and documents. Table 1 lists the managers who participated in the interviews in summary form.

Table 1. Interviews

Current Role – Firm	Education	Experience
Logistics and Deputy General Manager – LMLS1	MSc	>15 years
IT Manager – LMLS1	MSc	10 years
Regional Manager – LMLS2	MSc	12 years
Senior Project Manager – IT1	PhD	>15 years
Head of Analytics – IT2	PhD	5 years
Head of R&D – SH1	PhD	>15 years
Scientific Researcher – SH1	PhD	3 years
Senior Project Manager – SH2	MSc	10 years
R&I Manager – SH2	MSc	10 years

The main topics covered in the interviews were focused on the costs and benefits of LMLSs specific concerns, i.e., electric fleet switching, the embeddedness of technological development for sorting systems and VRP, urban centres policies and facilities.

3. RESULTS: BARRIERS TO IMPLEMENTATION

The interview results, according to the analysis of documents, provided us with useful evidence, by virtue of the wide experience of most of the participants and the firms' long history. The barriers to the implementation of topics investigated are categorised into three main second-order themes (Paddeu, 2017): operational, safety, and economic (as illustrated in Table 2).

EVs' size and capacity foster important threats to LMLSs' operations. The main risk factors are related to the structural constraints of EVs, i.e., the inability to carry medium-large parcels, the necessary equipment for the goods' (un)loading process (e.g., the hydraulic tail), and batteries' capacity. Hydraulic tails and cold rooms need a significant amount of energy, putting under pressure the battery capacity. These features are necessary to accomplish deliveries to small shops and SMEs. Due to the high battery cost and the lack of technological innovation, switching batteries during deliveries was not taken into consideration.

Table 2. Data structure

First-order themes	Second-order themes	Aggregated dimension
Vans' capacity	Operational	Increased sustainability and technological development
Technological development	Operational-Economic	
Cost of purchasing	Economic	
Working conditions	Operational-Safety	
Energy infrastructure	Operational-Safety	
Energy costs	Economic	

EVs' purchasing cost constitutes a key issue, as underlined by both LMLSs' managers. The estimated cost of an equipped EV is on average €40.000 more than an ICEV one, making the switching process very challenging for transportation firms, without recourse to external funding. Through reliable EVs are not currently available on the market, due to a lack of the necessary features. EVs may reduce operational costs – compared to ICEVs – thus providing an incentive to technological switch. ITs reported that operating expenses for traditional ICEVs are four times greater than for EVs, as proved by Digiesi et al. (2012) too.

The VRP process is crucial from an environmental, economic, and operational perspective. Regardless of the type of vehicle, optimized routes would reduce delivery paths, fuel consumption, and the associated GHG and noise emissions. The optimization approach may incorporate both the shortest and least polluting routes, in addition to all the variables needed by transportation firms, as illustrated by Napoli et al. (2021).

Implementing VRP is essential in dealing with plug-in EVs: the optimised path can include charging points in the most efficient locations. The optimisation may be accomplished by using digital twins to build a traffic simulation model that incorporates also congestion patterns (Coulombel et al., 2018).

The automated parcel management system is an essential technological advancement that transportation firms must achieve. Currently, many transport firms' workers organize the parcel composition without the employment of an optimising algorithm.

The importance of working conditions should not be underestimated: employing EVs enhances drivers' health through the reduction of noise and GHG emissions. A routing optimisation algorithm may reduce both the drivers' working hours and the paths' length. Considering the more sustainable path, the benefits are not only for the driver but also for the entire population, as indicated by the SHs and the ITs. Automated parcel management systems improve labour conditions for warehouse employees both from safety and economic standpoints (e.g., cutting down working hours, higher levels of security, and increasing productivity), as pointed out by ITs and Meneghetti and Monti (2015).

The absence of energy infrastructures in the considered countries fosters a central role in EVs switching, both from operational and VRP perspectives, as pointed out by ITs. Considering the poor energy infrastructural performance of most European countries, the vehicle electrification procedure – and its scalability – may involve considerable hazards related to energy scarcity, as emphasized by IT1 and IT2. When national policies are aimed at encouraging the conversion of public and private fleets to fully electric, the risks are even larger. The negative externality produced by EVs may be hindered by limited charging infrastructure capacity. According to Schögl (2017), if the energy source for EVs charge is not entirely produced by Renewable Energy Sources (RESs), the amount of carbon dioxide released into the atmosphere will increase by 50%.

Eventually, potential increases in the electric market volatility cannot be disregarded, raising the level of uncertainty the company faces on the costs side. Specifically, as was stated by both LMLSs and ITs, uncertainty shocks in the electricity prices are nowadays an issue even when energy is internally produced due to potential spillover effects on the supply side.

4. DISCUSSION: COST AND BENEFITS

To deepen our understanding of costs and benefits of investments in electric fleet switching and technological developments (i.e., automated sorting system and VRP), we addressed a SWOT Analysis based on the information obtained by the interviewed managers (as illustrated in Table 3). The results vary slightly among the LMLSs, ITs, and SHs managers because of the heterogenous perspectives that characterize their works and firms. LMLSs have a more conservative approach, as opposed to ITs and SHs, which is compelled by the lack of confidence in EVs' reliability and the emphasis on switching costs of technology advancements. ITs and SHs are more trustworthy on electric switching and on the implementation of sorting and routing algorithms because of their technological orientation and business interests.

Table 3. SWOT Analysis

Strengths	Weaknesses
- Lower operational costs - Better working conditions - Time savings	- EV battery and features - EV purchasing costs - Energy infrastructures
Opportunities	**Threats**
- Reduction of environmental impact (GHGs, noise, safety)	- Cost of technology development - Energy price

Furthermore, the perceptions of the interviewed managers are likely to be influenced by the economic and social characteristics of their home countries. Northern European states are generally more technologically oriented, rather than Mediterranean nations, with few exceptions.

The criticalities mentioned were enlightened by most of the drivers of the LMLS1 because they conducted an electric pilot test more than 10 years ago: EVs with hydraulic tails tend to exhaust batteries just after a few deliveries. Although many EVs manufacturers are developing new models, high-performance batteries cost is still relatively expensive, compared to ICEVs. Insufficient battery development is a key disincentivising factor for fleet switching, since the last-mile segment is the least profitable and efficient in terms of operating costs in the logistics sector. As a result, LMLSs favour investing in overall technological developments. LMLS2 is undertaking the hydrogen track too: but it is not scalable yet because of infrastructural and policy implications that must be investigated deeply.

LMLSs managers are deterred from transitioning the company fleet from ICEVs to EVs because of high initial investments. Besides this reluctance, the interest in these investments is to set up more environmentally sustainable logistics, especially the last-leg, which is taken into account by different stakeholders (e.g., transport firms, municipalities, and regions). Public-Private Partnerships (PPPs) and institutional financing (e.g., national ministries and European funding) are likely to be two of the most viable options identified by LMLSs managers. Collaboration with public institutions is one of the main levers that LMLSs may use to share investment risks and expenses. LMLS1 has already implemented collaboration with public entities for other critical infrastructures and services.

Sorting systems and routing optimisations have a direct impact on delivery time. In LMLSs these applications are dependent on the actions of highly skilled employees – with more than ten years of expertise. Implementing automated sorting management systems and VRP algorithms may improve delivery times while reducing service and environmental costs and increasing collective benefits. Many transportation firms – including LMLSs – refuse to employ automated sorting systems and VRP algorithms because of high switching costs, as claimed by ITs. Technological developments will improve working conditions while raising safety and reducing warehouse issues and traffic hazards, as noted by ITs.

Through digital twins, the development of VRP algorithms will significantly reduce operational costs, including energy expenses and the required time for each delivery. VRP algorithms create benefits mainly on environmental and noise levels, avoiding congestion. An efficient routing optimisation imposes cities' and industrial zones' redesign: developing UCCs and mid-delivery points aims at shortener vans' paths, before efficient them, according to IT1.

Switching fleets will significantly improve population life quality by reducing environmental externalities (i.e., GHG emissions, improved safety, and noise pollution). The magnitude of the negative externalities' reduction due to EVs depends on the source of energy employed in electricity production. In this paper, both LMLS1 and LMLS2 are endowed with proprietary Renewable Energy Sources (RES) infrastructure. LMLS1 has its own production of energy through proprietary infrastructures, while LMLS2 has facilities for the supply of energy and hydrogen. However, these facilities are hardly replicable because of their financing and composition.

Energy infrastructure includes more than just in-house charging and involves charging stations in urban areas as well. In the case of intermediate stops for recharging plug-in EVs, routing optimisation will play a crucial role. The LMLSs require mixed environmental impact and route efficiency: energy columns integration in delivery routes requires SHs to develop both an Environmental VRP (EVRP) and a Recharging VRP (RVRP). Energy infrastructure systems are a major component in minimising the costs of last-mile logistics. Charging station installation in city centres is not exclusively dependent on transportation firms' willingness; rather, the main decisions are imputable to municipalities and energy providers. Charging stations' positioning may be easier through cooperation with local governments, regions, and interested firms and organisations. In two municipalities where LMLS1 delivers (from now on MUN1 and MUN2), various initiatives have been implemented to improve the recharging columns service. However, the initial investment in electric facilities in the city centres is considerable: business plan implications must be investigated deeper.

Energy prices might constitute a significant problem in considering comprehensive electrification of the fleets, even if LMLSs involved in the paper do not incur any criticalities related to the quantity of energy demanded. Increasing the amount of energy required may result in capacity issues that expose the operators to market instability. According to LMLSs and ITs, the market variability poses a serious risk to the operational costs as well as the firms' regular operational viability.

LMLS1 delayed decisions to switch the entire fleet and LML2's adoption of both electric and hydrogen vehicles are aimed at being independent of external energy sources and global issues.

5. CONCLUSIONS AND FUTURE INSIGHTS

From the interviews and the documents analysed, the high EVs initial investment cost is the major discouraging factor for LMLSs from switching fleets. The great interest in these investments and innovations is aimed at anticipating the future needs of more sustainable urban freight transportation and facing the actual and future EU Directives and Regulations. The first investment costs might be overcome by different sources of financing provided by national and supra-national institutions, although these programs are strongly competitive (e.g., Connecting European Facilities). Another considered path may be the implementation of PPPs with municipalities, regions, or institutions, not only to co-finance the fleet switching but also to share the risk of the investment.

Collaborations with municipalities and regions were not specifically addressed in the interviews even if these institutions may support the implementation of PPPs, Urban Vehicle Access Regulations (UVARs), and Low Emission Zones (LEZs). In MUN1 and MUN 2 UVARs and LEZs have already been carried out to decrease freight traffic, congestion, and GHG and noise pollution. MUN2 has developed the exclusive entrance for specific freight transportation in specific areas. The LMLS1 acts as a neutral vector, combining different parcels of competing firms, avoiding environmental pollution of empty travels, and lowering the number of noisy and polluting vehicles in downtown.

Neutrality is one of the most interesting aspects of the LMLSs to study, even if it was not elucidated in the interviews. Neutrality is essential in reducing transportation firms' operational expenses and environmental costs (i.e., GHG and noise pollution). Collaboration among competitors can be tough because individuals and firms are often driven by private gains at the expense of collective benefits. LMLSs are challenging to scale because of the numerous actors involved in the scheme (i.e., transportation firms, municipalities, small shops, and SMEs).

EVs recharging process is dependent on energy service providers and municipalities. Only MUN1 has recharging facilities in the urban area and the energy supplied is not sufficient. Although the expenses of providing transport firms with a dedicated energy infrastructure are high, collaborations with the energy providers and municipalities are a possible lever to implement recharging systems. LMLS2 conducts a hydrogen pilot in addition to the electric one, which necessitates a more sophisticated and expensive recharging infrastructure. The municipality served by LMLS2 is equipped with more efficient electric infrastructures. Regardless, LMLS2 is going to face the equivalent issues. To deepen our understanding of the costs and benefits of investments in dedicated infrastructure is necessary analysing the full implementation of EV charging stations in cities and urban centres.

Including only the LMLSs in the interviews is one of the main limitations of our paper. Widening the range of actors involved in the interviews (e.g., customers, municipalities, or energy supply firms) is necessary to have a complete overview of the phenomenon investigated.

UCCs and mid-delivery points are critical infrastructures whose implementation might represent a key success factor for a last-mile transport firm. While LMLS2 is situated farther from the urban area served, LMLS1 is provided with a peculiar UCC infrastructure and business plan. The past literature shows that the existence of UCCs reduces both urban traffic and movements from warehouses to/from small businesses and SMEs. Implementing the investments analysis might be of great interest, especially focusing on the realisation of UCCs, mid-delivery points, and (un)loading parking lots in the city centre. These phenomena are currently studied by different disciplines (e.g., economics, engineering) because UCCs and mid-delivery points increase environmental benefits and implement services cost-effectiveness.

LMLSs' unwillingness to install and employ software and hardware for the automated sorting system and VRP is a main barrier. The hesitancy drivers are the lack of confidence in the technology and the potential loss of knowledgeable workers. ITs and SHs guarantee that these motivations are baseless: on one hand, the technology is implemented and studied deeply thanks to digital twins and improvements they have already applied with past pilots, and, on the other, the employees are going to be relocated inside the firms with new tasks. Inherently, until these systems are not directly tested on LMLSs, all the managers' questions are going to be open.

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REFERENCES

Castiglione, M., Comi, A., De Vincentis, R., Dumitru, A., and Nigro, M. (2022). Delivering in Urban Areas: A Probabilistic-Behavioral Approach for Forecasting the Use of Electric Micromobility. *Sustainability*, *14*(15), 9075.

Coulombel, N., Dablanc, L., Gardrat, M., and Koning, M. (2018). The environmental social cost of urban road freight: Evidence from the Paris region. *Transportation Research Part D: Transport and Environment*, *63*, 514-532.

Demir, E., Huang, Y., Scholts, S., and Van Woensel, T. (2015). A selected review on the negative externalities of the freight transportation: Modeling and pricing. *Transportation research part E: Logistics and transportation review*, *77*, 95-114.

Digiesi, S., Mossa, G., and Rubino, S. (2012). Sustainable order quantity of repairable spare parts. *IFAC Proceedings Volumes*, *45*(31), 181-186.

Directive 2014/94/EU of the European parliament and of the council of 22 October 2014 on the deployment of alternative fuels infrastructure.

Giuliano, G. (2013). *Synthesis of freight research in urban transportation planning* (Vol. 23). Transportation Research Board.

IEA – International Energy Agency (2018). World Energy Outlook 2018, Paris. https://www.iea.org/reports/world-energy-outlook-2018, last accessed: 2022/10/20.

IEA – International Energy Agency (2021). Global CO2 emissions from transport by sub-sector in the Net Zero Scenario 2000-2030, 270. Paris. https://www.iea.org/data-and-statistics/charts/global-co2-emissions-from-transport-by-sub271sector-in-the-net-zero-scenario-2000-2030, last accessed: 2022/10/20.

Juan, A. A., Mendez, C. A., Faulin, J., De Armas, J., and Grasman, S. E. (2016). Electric vehicles in logistics and transportation: A survey on emerging environmental, strategic, and operational challenges. *Energies*, *9*(2), 86.

Lebeau, P., Macharis, C., Van Mierlo, J., and Maes, G. (2013). Implementing electric vehicles in urban distribution: A discrete event simulation. *World Electric Vehicle Journal*, *6*(1), 38-47.

Meneghetti, A., and Monti, L. (2015). Greening the food supply chain: an optimisation model for sustainable design of refrigerated automated warehouses. *International Journal of Production Research*, *53*(21), 6567-6587.

Moolenburgh, E., Duin, J.V., Balm, S., van Altenburg, M., and van Amstel, W.P. (2020). Logistics concepts for light electric freight vehicles: a multiple case study from the Netherlands. *Transportation Research Procedia*.

Napoli, G., Micari, S., Dispenza, G., Andaloro, L., Antonucci, V., & Polimeni, A. (2021). Freight distribution with electric vehicles: A case study in Sicily. RES, infrastructures and vehicle routing. *Transportation Engineering*, *3*, 100047.

Oliveira, C. M. D., Albergaria De Mello Bandeira, R., Vasconcelos Goes, G., Schmitz Gonçalves, D. N., and D'Agosto, M. D. A. (2017). Sustainable vehicles-based alternatives in last mile distribution of urban freight transport: A systematic literature review. *Sustainability*, *9*(8), 1324.

Paddeu, D. (2017). The Bristol-Bath Urban freight Consolidation Centre from the perspective of its users. *Case Studies on Transport Policy*, *5*(3), 483-491.

Schlögl, R. (2017). E-Mobility and the Energy Transition. *Angewandte Chemie International Edition*, *56*(37), 11019-11022.

Schmid, J., Wang, X. C., and Conway, A. (2018). Commercial vehicle parking duration in New York City and its implications for planning. *Transportation Research Part A: Policy and Practice*, *116*, 580-590.

Simoni, M. D., Marcucci, E., Gatta, V., and Claudel, C. G. (2020). Potential last-mile impacts of crowdshipping services: A simulation-based evaluation. *Transportation*, *47*, 1933-1954.

Suzuki, Y. (2011). A new truck-routing approach for reducing fuel consumption and pollutants emission. *Transportation Research Part D: Transport and Environment*, *16*(1), 73-77.

The World Bank Group (2022). *Urban Development*. https://www.worldbank.org/en/topic/urbandevelopment/overview, last accessed: 2022/10/06.

Thompson, R. G. (2015). Vehicle orientated initiatives for improving the environmental performance of urban freight systems. *Green Logistics and Transportation: A Sustainable Supply Chain Perspective*, 119-129.

United Nations (2019). Department of Economic and Social Affairs, Population Division, *2018 Revision of World Urbanization Prospects.* New York. https://population.un.org/wup/, last accessed: 2022/10/22.

Xiao, Z., and Feng, Z. (2010, May). Research on Growth Mechanism of Industrial Cluster of Logistics in Coopetition. In *2010 International Conference on E-Business and E-Government,* IEEE, pp. 2503-2506.

Yin, Robert K. (2017). Case Study Research and Applications: Design and Methods. *6th ed. SAGE Publications Ltd.*