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Microhubs and socially responsible urban logistics. European insights and future development perspectives

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Abstract

Microhubs and micro-consolidation centres are becoming increasingly important elements of urban logistics, especially in European cities that aim to reduce congestion, emissions, and public space pressure. Their growing relevance is strongly connected with the dynamic expansion of e-commerce, which intensifies last-mile transport activity and challenges traditional distribution patterns. In recent years, microhubs have been presented as flexible solutions that enable shorter delivery distances, facilitate the use of low-emission vehicles such as cargo bikes, and support more socially responsible forms of freight distribution. These developments reflect wider efforts undertaken by cities to improve the environmental performance of urban freight transport, strengthen safety in central districts, and ensure a more efficient use of limited metropolitan space.

The aim of the paper is to provide a structured analysis of studies related to microhub concepts and practices described in recent EU-funded initiatives (e.g. ULaaDS, URBANE and DECARBOMILE) as well as available scientific literature. The reviewed project activities, taken in European cities, demonstrate a strong emphasis on data collection, operational monitoring and digital platforms that support planning and modelling of freight distribution. Many of the reviewed solutions include simulation tools, digital twins and comprehensive KPI frameworks, which allow cities and logistics operators to better understand transport flows and evaluate the effects of microhub deployment.

The paper also presents the microhub pilot, developed within the GRETA project, in Poznań as an example of how micro-consolidation concepts are approached in a medium-sized Central European city. The Poznań case illustrates the observations from European practice, including the role of spatial context, cooperation between public authorities and logistics service providers, and the use of small-scale infrastructure integrated with cargo-bike delivery. The Polish demonstrator strengthens the desk research outcomes by showing how microhub principles can be adapted to local conditions and incorporated into existing last-mile processes.

The evidence gathered in the research indicates that microhubs offer clear potential to reduce van traffic in city centres, lowering emissions and improving the overall quality of life. The shift towards cargo-bike delivery may also enhance safety, particularly in pedestrianised or compact urban areas. Effective implementation, however, depends strongly on digitalisation, including shared data and monitoring tools, as well as on close cooperation between logistics operators, local authorities and infrastructure owners. At the same time, significant challenges that need to be investigated further were identified. Many cities still lack stable financial models for long-term microhub operation, and social outcomes (such as residents' acceptance, perceived safety or noise reduction) are not yet systematically assessed. Behavioural aspects of consumers and couriers also require deeper investigation, and microhubs are frequently implemented as isolated pilots rather than elements of a broader strategic freight distribution plan, which limits their scalability and long-term impact.

The study uses a qualitative comparative research design based on structured desk research of scientific literature and materials from EU-funded projects. This is complemented by an in-depth case study of the GRETA microhub pilot in Poznań. Overall, the study concludes that microhubs represent a promising direction for developing greener and more socially responsible urban logistics. Lessons drawn from European initiatives and from the GRETA Poznań pilot indicate that future development should focus on stronger integration with urban planning processes as well as the assessment of social and behavioural impacts. These insights may support cities and logistics actors in shaping more effective last-mile delivery systems adapted to current sustainability challenges.

Keywords: urban logistics; microhubs; micro-consolidation; sustainable transport; EU projects; last-mile deliveries

1 Introduction. Growing importance of microhubs in European cities.

Contemporary urban freight transport is ongoingly transformed due to the effects of rapid urbanisation, continuous expansion of e-commerce and the growth of omnichannel retail systems. These processes directly affect the last-mile delivery operations, making them much more intense, despite their reputation as the most harmful part of urban logistics, stemming from their complexity, expensiveness and negative environmental effects (Bosona, 2020; Pourmohammadreza et al., 2025). These mostly include the increasing parcel volumes, high delivery frequency and growing customer expectations, which lead to traffic congestion, more greenhouse gas emissions, noise, road safety risks and competition for limited public space in dense city areas. At the same time, new retail models change the environmental impact of distribution systems and influence how goods move within municipalities (Klein, 2023; Asplund et al. 2025; Danach et al. 2025). As a result, urban freight transport can no longer be seen only as an operational task and is becoming a strategic part of sustainable urban development and climate-neutral policies (Kim et al. 2021).

In response to these challenges, cities and logistics operators are looking more closely at distribution models that use local nodes to organize freight flows closer to final demand, with microhubs and micro-consolidation centres as the newest developments in this approach (Hribernik et al. 2020). While earlier Urban Consolidation Centres (UCCs) showed both potential and economic limitations, the microhubs are designed as smaller-scale, proximity-oriented and more flexible facilities that can be located directly inside the city (Katsela et al., 2022). The delivery system organised around microhubs usually consists of two steps: goods first arrive at a nearby hub by conventional trucks, and then the final delivery is done with low-emission vehicles e.g. cargo bikes or light electric freight vehicles (de Bok et al., 2024). From a theoretical point of view, microhubs can be seen as a way to reorganize urban space. They allow both reducing negative transport effects by shortening the final delivery distance and shifting to cleaner transport modes in dense zones. Moreover, the growing discussion (Karaoulanis, 2024) about micro-fulfilment centres shows that decentralised logistics infrastructure is becoming of high significance in modern cities.

Regardless of the above, the microhub concept is not homogeneous. Existing studies show significant variation in ownership structures, operational models and levels of public sector involvement (Katsela et al., 2022). Moreover, the environmental and operational results depend strongly on where the hub is located, how big its service area is, and how well it connects with the delivery fleet (Novotná et al., 2022). Thus, microhubs cannot be assessed as one single type of solution, because their effects always depend on local conditions.

Evidence from real-world cases and simulations, found in the existing literature, suggest that microhubs can reduce vehicle kilometres and emissions in central areas, especially when they use cargo-bike delivery systems (de Bok et al., 2024; Katsela et al., 2022). The favourable outcomes are, however, heavily reliant on the resupply vehicle characteristics, goods consolidation efficiency, the quality of digital coordination and the wider regulatory environment and, thus, cannot be considered as granted. For this reason, reliable assessment requires standardised monitoring tools and strong emission-calculation methods, adaptable to dynamic e-commerce flows (Dubisz et al., 2022). In addition, the long-term success of microhubs is closely linked to governance models and data-sharing systems, as fragmented stakeholder coordination may limit scalability and systemic integration.

While environmental and operational aspects of microhubs are getting more academic attention, their wider social responsibility impacts are still not well identified. Urban freight sustainability frameworks mention social factors such as safety, liveability and the use of public space (Bosona, 2020). There is still limited empirical evidence on how residents accept microhubs, perceived safety improvements, noise levels changes or labour conditions quality in microhub-based delivery systems. At the same time, behavioural research indicates that consumers may alter their delivery preferences when provided with transparent information on environmental and social impacts, which leads to the conclusion that sustainability outcomes are not only dependent on infrastructure, but also on behavioural mechanisms (Ignat & Chankov, 2020). The behavioural context is highly relevant for microhub systems, which often require changes in delivery timing, preferred locations or service expectations. Thus, the European cities that are pursuing green transition, climate neutrality and improved urban life quality, need to focus not only on physical locations of microhubs, but also on social effects related to the environmental performance.

In this context, the paper argues that microhubs should be seen not only as operational logistics solutions, but also as governance tools within sustainable urban freight systems. The aim of the study is to provide a structured review of the microhub concepts and practices described in selected recent EU-funded projects and scientific literature, and to support this analysis with findings from the GRETA microhub pilot, implemented in the City of Poznań. By analysing reported environmental and operational results together with financial, governance and social challenges, the paper aims to show how microhubs can move from small experimental pilots to strategically integrated elements of cleaner and more socially responsible urban logistics, in line with the broader goals of sustainable city development.

The study adopts a qualitative approach, combining desk research and case study analysis. The method consists of three components: (1) a review of EU-funded projects, with specific focus on existing pilot implementation reports, (2) comparative analysis of different microhub configurations, digital tools, governance structures and operational results they achieved, and (3) an in-depth case study of the GRETA microhub in Poznań.

Scientific literature was found through keyword searches in major academic databases. The comparative analysis relies mostly on publicly available deliverables, technical reports and descriptions of pilot activities. Information was synthesised using an analytical framework covering covered microhub design, digital tools, governance, operations, environmental results, and economic aspects. The GRETA case study complements the desk research by providing empirical validation based on pilot data, stakeholder cooperation and operational monitoring conducted during the six-month living lab.

2 Comparative analysis of microhub implementation in recent EU-funded initiatives

The growing interest in microhub implementation and usage goes beyond theoretical considerations and is deeply supported by the EU-funds. Recent projects like URBANE, DECARBOMILE, ULaaDS and GREEN-LOG allowed turning various concepts into real operational pilots with defined governance models and digital monitoring architecture. While, at the moment of the analysis, the pilots differed in scale and maturity (from early-stage co-creation and blueprint development to fully operational micro-consolidation centres operating cargo-bike deliveries within low-emission zones), an in-depth study of the initiatives allows identifying common implementation patterns and structural conditions that influence microhubs integration into urban freight systems, despite the diverse urban context of such implementation (from large metropolitan areas such as Barcelona and The Hague to medium-sized cities such as Bologna, Logroño, Bremen and Mechelen).

Table 1. Comparative overview of microhub implementation layers in selected EU-funded projects (Source: developed by the authors)

Project	Microhub configuration	Digital layer	Governance structure	Operational & environmental dimension	Economic & organisational dimension
URBANE	Micro-consolidation centres supporting cargo-bike deliveries in dense urban areas	RFID parcel identification; real-time tracking; KPI dashboards; Digital Twin-based assessment tools	Living Labs; multi-actor cooperation; formal agreements between municipalities and operators	Demonstrated substitution potential of vans by cargo bikes; KPI-based monitoring; context-dependent performance	Pilot-scale testing; viability dependent on parcel volumes and operator commitment
DECARBOMILE	Nano-hub on public space enabling consolidation and cargo-bike last mile	Defined data collection rules; KPI monitoring; structured validation framework	Strong municipal involvement; stakeholder collaboration; regulatory and spatial integration	Cargo-bike deployment from central hub; adaptive adjustments due to spatial and participation constraints	Structural barriers: high fixed costs; limited access to central locations; scalability dependent on municipal support
ULaaDS	Containerised transhipment hub outside inner city supporting zero-emission deliveries	Digital service orchestration; performance monitoring; integration within platform-based coordination system	Structured stakeholder mapping; shared target systems; formal cooperation arrangements	Operational shift toward zero-emission last mile; implementation guidelines for scalable deployment	Emphasis on cost-sharing mechanisms; minimum volume guarantees; long-term operator commitment required
GREEN-LOG	Micro-Consolidation Centres embedded in multimodal delivery systems (e-cargo bikes, EVs, mobile depots)	Planning and optimisation tools; digitally coordinated multimodal ecosystem; business model design tools	Quadruple Helix approach; co-creation processes; Living Labs	Multimodal system optimisation; integration of consolidation within wider logistics networks	Development of shared business models; ecosystem-based revenue structures; viability dependent on cooperation

First of all, neither of the pilots considers microhubs as stand-alone infrastructure, but rather as an element of wider last-mile restructuring strategies. For example, in Logroño (DECARBOMILE Consortium, 2024), a nano-hub placed on public space was used to combine parcels from various logistics operators and allow e-cargo bikes last mile delivery. The goal was supported by city authorities that ensured the exact location of the hub, stakeholders engagement as well as basic ICT systems. On the other hand, in Bremen (ULaaDS Consortium, 2024) the focus was on a container-based transhipment hub located outside the inner city allowing zero-emission deliveries and a close collaboration between local authorities and logistics service providers. Similarly, GREEN-LOG (2024) places micro-consolidation centres (MCCs) within a broader group of delivery systems, combining e-cargo bikes, electric vehicles, mobile depots and digital coordination tools. The systemic approach applied within the EU initiatives is in line with the findings by Katsela et al. (2022) that microhubs cannot be considered as uniform model as they differ in ownership, operational design and the level of public sector involvement. Practical examples show that they are rather nodes that help reorganising urban freight flows on a systemic level.

Secondly, the analysed projects make substantial use of digitalisation, considering it a key layer supporting microhub operations in monitoring, modelling and structured performance assessment. Parcel level identification and real time monitoring with KPI-based evaluation tools were key elements for the living labs held in URBANE. For example, the pilot in Barcelona, apart from evaluating the micro-consolidation centre and cargo bike deliveries, focused on RFID parcel identification and tracking with automatic data transfer to cloud platforms. Dashboards and digital-twin based assessment tools supported the operational and environmental assessments (URBANE Consortium, 2025). The latter also supported microhub operations in Helsinki, which allowed testing different vehicle types, operating zones and consolidation levels before large-scale implementation (URBANE Consortium, 2024a). Performance monitoring and digital orchestration tools were also part of the containerised microhub pilot in ULaaDS, which allowed connecting the existing infrastructure with a wider platform-based coordination system. In a similar manner, the nano-hub tests in DECARBOMILE included data collection rules, KPI monitoring and clear defined validation steps that aimed to assess scalability and environmental performance. In the same way, GREEN-LOG positions micro-consolidation centres inside digitally coordinated multimodal delivery systems supported by planning, optimisation and business-model design tools. The abovementioned developments correspond with the growing academic recognition that urban freight decarbonisation requires harmonised emission accounting methods and integrated data architectures to enable strong impact assessment and efficient system optimisation (Dubisz et al., 2022; de Bok et al., 2024). The analysed projects demonstrate that technological capability alone is insufficient and institutional agreements on information exchange are necessary.

Thus, the third important conclusion from the conducted analysis is that efficient microhub implementation requires establishing solid governance structures that ensure close cooperation between local authorities, logistics service providers, property owners and civil society actors. For example, in order to manage (often conflicting) economic, environmental and societal goals, GREEN-LOG introduced Quadruple Helix approach that enforced co-creation and partnerships between public bodies, industry, academia and citizens (GREEN-LOG Consortium, 2024), while ULaaDS established stakeholder mapping and shared target systems (ULaaDS Consortium, 2024). Collaboration and data exchange are also the core of DECARBOMILE approach, where the crucial role of local authorities in enabling access to urban space, existing mobility and logistics practices, as well as providing regulatory support is underlined. It is important to highlight that, in most of the analysed EU projects, the governance arrangements were anchored in formal cooperation agreements between the aforementioned stakeholders, which provides further evidence that microhubs cannot be considered as isolated infrastructure or simply an operational change.

When it comes to the operational efficiency of hubs, the evidence gathered within the EU-funded projects shows indeed that their introduction can support reducing van-kilometres and related emissions, mostly through the usage of cargo bike delivery models. A crucial example of such effects is the URBANE project where the systematic assessment of such effectiveness and sustainability were enabled through the deployment of performance monitoring frameworks and KPI dashboards within the conducted pilots. Both in Barcelona and Bologna the magnitude of effects remained strongly dependent on parcel volumes, operator participation and the consistency of cargo bike deployment during the pilot phases (URBANE Consortium, 2025; URBANE Consortium, 2024b). This goes in line with the research outcomes by Novotná et al. (2022) and de Bok et al. (2024), showing operational and environmental performances are highly context dependent and further reinforce the image of microhubs deployment as a complex process rather than an infrastructural intervention. The ongoing dialogue and dynamics could be observed e.g. under DECARMOBILE (2024), where configurations were refined, relocated or rescaled when parcel volumes proved insufficient or when competing claims over urban space emerged.

Operational efficiency of microhub solutions within the analysed EU projects is strictly connected to the economic sustainability. Therefore, both ULaaDS and GREEN-LOG put a strong focus on developing viable business models and organisational structures that could support activities conducted by various logistics service providers operating from one consolidation centre (ULaaDS Consortium, 2024; GREEN-LOG Consortium, 2024). The pilot actions managed to confirm the importance of clearly defined cost-sharing mechanisms, predictable revenue streams, and long term commitments from the involved logistics service providers in order to ensure financial efficiency exceeding the demonstrations. This was especially highlighted in ULaaDS implementation guidelines, stating that stable long term operations require maintaining a balance between fixed infrastructure costs with sufficient parcel volumes, but is also in line with the outcomes of DECARBOMILE pilots, which also allowed proving that scalability and financial performance are shaped mostly by high fixed investment prices, limited access to conveniently situated urban sites and the support from local authorities. These findings are backed up by Karalounis et al. (2024), who demonstrates that consolidation-based solutions frequently struggle with insufficient parcel volumes and unstable funding structures unless embedded within supportive regulatory and market frameworks. In practice, shared microhub models often require ongoing negotiation over the allocation of infrastructure costs and the distribution of revenues, reflecting the reality that economic sustainability depends not only on operational efficiency but also on the alignment of commercial incentives and the presence of enabling institutional support mechanisms.

While environmental and operational aspects of microhub implementation are increasingly quantified with the use of digital monitoring tools, the social dimension of such interventions remains insufficiently supported by research and analysis. Even though the sustainability strategies implemented within the analysed EU projects mention goals related to better liveability or safer streets, there is no systemic track of issues such as citizen acceptance, perceived safety or working conditions in last mile deliveries. Initiatives such as ULaaDS and GREEN-LOG make some progress in this field as they try to include stakeholder engagement and participatory activities, nevertheless, social indicators are still rarely included in their designed and utilised KPI frameworks. This gap shows the need to expand evaluation frameworks beyond technical efficiency and to include behavioural and social aspects more clearly. Although several Living Labs organised activities with citizens, these insights were not systematically included in formal monitoring systems, meaning that social impacts are still not measured in a consistent way.

As evidenced, the scalability of microhubs is directly connected to four main factors: digital tools tracking their performance, regulatory and spatial integration, economic incentives and early coordination between key stakeholders. This supports the claim that they should be understood as socio-technical solutions which long term success relies both on economic and environmental outcomes and good governance and cooperation. This analytical perspective provides the basis for examining how the GRETA microhub pilot in Poznań reflects and adapts these wider European developments into a medium-sized Central European urban context.

3 The GRETA Microhub Pilot in Poznań

Given the considerations above, Poznan – as one of Poland's major logistics regions, located between Berlin and Warsaw - offers a unique setting for testing microhub solutions. The metropolitan area has over one million inhabitants and almost 4,3 million square metres of warehouses (Jones Lang LaSalle, 2025), which generates a large number of last mile deliveries. In consequence, the growing freight transport causes congestion, air pollution and ignites competition for curb space in the historic city centre, where operations remain difficult due to shops concentration and narrow streets design. Despite growing zero-emission vehicles, they still constitute only a small share of delivery fleets. These conditions make Poznan a useful place to observe how microhub concepts are adapted to Central European regulations, spatial limitations and market realities.

The GRETA living lab was localised in a 5,2 km² area in the northern part of Poznan's inner city, consisting of both shops and residential buildings. The area was selected due to its proximity to busy delivery zones and accessibility for supply vehicles from logistics service provider's distribution centre, the results of which appeared to be similar to the Stokkink et al. (2025) works. Moreover, the location allowed placing the microhub on municipal land, managed by the City Roads Administration, which helped ensuring compliance with local regulations and allowed the City of Poznan to supervise the pilot. As for the infrastructure, the hub offered 36 m² of indoor space with additional outside area for operations.

Formal regulations related to building law and spatial planning proved to be extremely important in the allocation of the entire construction and determined its shape. The hub had to meet specific conditions in terms of its connection to the ground and had to fit into the existing space. In particular, pedestrian safety and parking spaces had to be ensured. It was also important to comply with the landscape resolution. The project requirements also specified that the hub had to be built from recyclable materials and be energy efficient (photovoltaic panels were installed on the roof). A key element of the design was to ensure the efficient implementation of transshipment processes. It is very important to highlight that the hub, which was created and tested as part of the GRETA project, has a modular and therefore scalable design. One separate module was tested in the pilot in Poznań, but it can ultimately be multiplied if a larger number of logistics operators are to use it.

Thus, from the operational point of view, the hub acted as a transshipment node between delivery vans and cargo bikes. Once the parcels were transported to the premises, they were sorted and stored briefly before the deliveries by cargo bikes with a carriage radius of up to 3,5 km. The setup allowed for up to four bicycles, nevertheless three cargo bikes were operating daily. The approach, thus, resembles the two-steps logistics model identified within the EU-projects analysis in which the consolidation outside the most congested area is followed by zero-emission last mile deliveries in dense urban areas.

Similarly as within other analysed projects, crucial attention was given to the digital layer of the Poznan pilot. The operator's parcel management system, installed on couriers' terminals, and GPS sensors on the cargo bikes enabled tracking of route length, travel time, speed, delivery status, and operational milestones. In addition, the digital setup allowed estimating the avoided emissions through comparison with baseline van-based deliveries and ensuring that switching to cargo bikes would not reduce the service quality. The latter was assessed by recipients within the piloting phase and the results have shown that they did not notice any change in how their parcels were delivered. Another important aspect of the digitalisation layer of the GRETA pilot in Poznań was the fact that it contributed to the data sharing between freight companies and local authorities. The digital layer therefore served not only as a technical tool, but also as a governance tool that helped build better, data-based management of urban freight.

This further proves that institutional cooperation was equally crucial to the pilot. First of all, without city's involvement, it would be impossible to place the microhub in the inner city under the existing legal and spatial conditions. The City of Poznań provided access to the site and handled the regulatory steps, with crucial implications for the design and operation of the infrastructure.

Table 2. Key implementation dimensions of the GRETA microhub pilot in Poznań (Source: developed by the authors)

Implementation dimension	Pilot characteristics	Observed strengths	Identified constraints
Spatial configuration	36 m² temporary hub on municipal land; 3–4 cargo bikes; 5.2 km² service area; 3.5 km delivery radius	Inner-city proximity; regulatory embedding; replicable modular design	Temporary construction limit (6 months); spatial scalability dependent on land availability
Digital layer	Integration of operator IT system, GPS tracking, route and emission monitoring	Reliable performance tracking; quantified emission reduction; evidence-based governance support	Data-sharing dependent on operator cooperation; no long-term institutionalised data platform
Governance structure	Strong municipal involvement; alignment with SUMP and electromobility strategy; transnational exchange	Regulatory facilitation; access to public space; institutional legitimacy	Implementation dependent on political support; no permanent regulatory framework for hubs
Operational & environmental outcomes	~20,000 shipments; ~30% shift from vans to cargo bikes; ~30% emission reduction	Significant reduction of van traffic; maintained service quality	Impact sensitive to parcel density and operator participation
Economic & organisational model	Single operator; <20% capacity utilisation; emission reduction cost €1.80–3.04/kg eCO_2	Demonstrated environmental value; proof of operational feasibility	Financial fragility under single-operator model; need for shared cost structure
Social dimension	No service disruption; positive anecdotal feedback	Neutral customer perception; reduced vehicle presence	Lack of systematic social KPI measurement

Overall, almost 20,000 parcels were delivered through the microhub system during the six month pilot with approximately 30% of deliveries shifted from van based distribution to cargo bike delivery in the demonstration area. This, in turn, led to an estimated 30% reduction in delivery traffic within the service zone, as well as a comparable reduction in harmful emissions. As mentioned before, the delivery quality and customer service remained at the same level. These results match findings from other European pilots, which show that cargo bikes can bring strong environmental benefits when there are enough parcels in a compact area. At the same time, the size of the impact in Poznań depended on parcel volumes and how concentrated the delivery routes were. This confirms that the performance of microhubs is highly context-dependent, as shown in previous paragraphs.

From an economic and organisational perspective, the GRETA pilot showed several limitations. First of all, due to cooperation with a single operator (GLS Poland), the hub's potential utilization was determined to be below 20%. During the remaining period, the hub served only as storage and parking space. The low utilization of the hub's potential had a negative impact on the financial efficiency of the solution. The cost of emission reduction was between €1.80 and €3.04 per kilogram of eCO_2, depending on whether the reduction was in electric or combustion engine delivery vehicles. Thus, although the system worked well environmentally, it was more expensive to run than standard van deliveries. The results are, therefore, similar to the other analysed EU projects, where microhubs become financially sustainable only when they are used by several operators, parcel volumes are high and cost-sharing rules are clearly defined. The Poznan case shows that good environmental results are not enough on their own and require requires economic alignment and shared commitment from multiple actors.

4 Discussion and conclusions

The conducted research and analysis clearly underline that microhubs cannot be considered strictly as an infrastructural intervention and shall rather be seen as socio-technical governance instruments. The reviewed EU initiatives have shown that there are four main elements necessary for successful consolidation centres implementation: digital monitoring tools, clear regulatory and spatial integration, economic and operational cooperation between logistics service providers as well as structured cooperation between public authorities and private sector. An efficient management of these layers is decisive on whether the hubs strive after the piloting phase and can continue as part of wider urban logistics strategy.

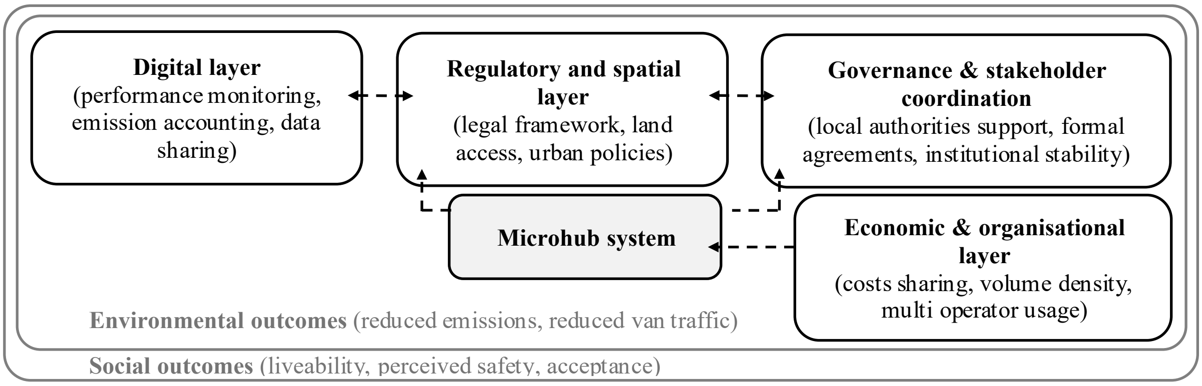

Fig. 1. Framework for scalable microhub implementation (Source: developed by the authors)

The outcomes of the considerations show that the digital layer is becoming more and more crucial to the hubs performance. The overall performance of the installation is assessed e.g. through tracking operational performance, calculating emissions and sharing the data. This, however, requires mature cooperation processes and established governance structures to balance the economic, spatial and environmental goals of specific stakeholders. This goes in line with the claim that efficient microhubs require linking them to existing policies and strategic documents like Sustainable Urban Mobility Plans or Clean Transportation Zone rules or municipal land use strategies.

Another key finding is the limited measurement of social impacts. While environmental data is detailed and supported by digital tools, indicators related to safety, liveability, working conditions or citizen acceptance are largely missing in both the analysed EU projects and the GRETA Poznan pilot. If microhubs are to support socially responsible logistics, monitoring systems need to include these aspects more consistently.

Moreover, the future research on the analysed topic should also focus on ensuring long-term performance of the microhubs, revolving around the topics of multiple logistics service providers operations and business models. To ensure the effective functioning of urban hubs in European cities, cooperation between independent logistics operators is necessary. The transshipment hubs created should be part of standardized transshipment spaces, consistent in terms of the type of location where they are created, the appearance and technical specifications of the hub, its construction, etc. Such spaces should be shared, i.e., used by multiple operators, where each can operate in a specific part of the space.. It is necessary to eliminate competition in this area, which would result in each operator setting up or creating their own hub anywhere. The creation of shared transshipment spaces in cities will also enable the collection and comparison of a wider range of independent data. Larger datasets collected over longer periods would help evaluate economic and environmental outcomes under different parcel volumes and regulatory conditions. This could also be accompanied by including behavioural and societal indicators into future assessment frameworks.

Future research related to the development of urban hubs should also take into account the possibility of expanding the functionality of these installations. While the parcel transshipment function will remain the key and determining idea behind the operation of such installations, it is also possible to examine the need and legitimacy of implementing functions such as: enabling individual customers to send and receive parcels and dispose of or return packaging from received parcels, and providing servicing for cargo bikes stationed at hubs. An important element of the research should also be the analysis of the location of hubs or hub spaces in cities, e.g., in terms of locating them in the vicinity of important transport hubs or railway stations.

Spatial conditions are, thus, another important field of suggested research focus. The use of cargo bikes for last-mile delivery requires the provision of spaces where goods can be transhipped from cars to bikes. Logistics operators' distribution centres are usually located several or even dozens of kilometres away from city centres, so using bikes for the entire route was not only inefficient but impossible. On the other hand, not every location that allows for transshipment can be considered an urban hub. However, it is crucial that the design of the hub or the specific nature of the place where the transshipment takes place is closely adapted to the type of logistics operations carried out, the possibilities for storing and loading bicycles, and that it provides appropriate social conditions for bike couriers operating at the hub.

Overall, microhubs offer a promising way to support greener and more socially responsible urban logistics. Nevertheless, their success depends not only on technological and environmental gains, but also requires well-established governance rules, solid economic incentives and thorough monitoring systems. The European experiences, including the GRETA living lab in Poznań, show that moving from pilots to permanent solutions requires clear integration into policy, regulatory frameworks and market structures.

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