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Sustainable urban logistics concepts – a collaborative design approach considering stakeholder perspectives

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Purpose: *Goods flows in cities increase due to urbanization and growing e-commerce. Deliveries become more fragmented and more difficult to consolidate and control. This leads to an ever-increasing strain on urban infrastructure and logistics systems. With our work, we aim to design a stakeholder-oriented urban logistics concept to improve sustainability and relieve urban infrastructure.*

Methodology: *We chose a design thinking approach augmented by proven scientific methods. First, we analyzed the requirements of urban logistics stakeholders by conducting both a literature review and twenty-one qualitative interviews. Second, we carried out ideation workshops with different stakeholder groups to elaborate new solutions for urban goods flows.*

Findings: *The findings offer deep insights into urban logistics stakeholders' challenges, requirements and wishes and outline a clear point of reference for the development of sustainable urban logistics concepts. The results show stakeholders' strong focus on consolidation, on intermodal transport and on a better connectivity between relevant IT applications as well as a strong interest in autonomous transportation systems.*

Originality: *The work evaluates innovative urban logistics concepts empirically that have not yet been developed, designed or further investigated in this combination before. Thus, numerous opportunities for further work using modelling, simulation or field-testing are offered.*

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1 Introduction

Urban logistics can be described “as the means over which freight distribution can take place in urban areas as well as the strategies that can improve its overall efficiency while mitigating congestion and environmental externalities” (Rodrigue, 2020). For the scope of this paper, the authors’ similar but simplified definition “the optimized flow of goods into, within and out of urban agglomerations” will be used.

The Covid-19 pandemic beginning in 2019 shed light on the importance of urban logistics systems (BIEK e.V., 2021). Besides Covid-19, the relevance of urban logistics has been driven by various factors in recent years. In general, goods flows in cities increase (BIEK e.V., 2019) due to urbanization and growing e-commerce (Stölzle and Schreiner, 2019). Deliveries become more fragmented and more difficult to consolidate and control. This leads to an ever-increasing strain on urban infrastructure and logistics systems (Seeck and Engelhardt, 2021).

Current urban logistics systems, optimized in economic terms only, also come with a high price tag in other than infrastructural aspects, generating traffic jams, vehicle noise, environmental pollution and evoking perceived and/or factual reductions in quality of living for urban inhabitants (Van Audenhove, De Jongh and Durance, 2015). This resulted in a demand for urban logistics systems to be compatible with a sustainable development approach, i.e. being evaluated in terms of economic, social and environmental dimensions (United Nations, 1992). Achieving such environmental and social goals in addition to preserve economic viability actually means to satisfy more stakeholders’ interests and their respective requirements. Those additional stakeholders include municipal, regional and federal government agencies.

The state-funded project “Warenströme in Städten – Paket und Stückgut” (flow of goods in cities – parcel and general cargo; WAS-PAST) was launched in 2021. First, it aims to design a stakeholder-oriented urban logistics concept that improves sustainability as well as urban infrastructure utilization while being economically viable. The second objective is to test this concept during a 6-month field test in Berlin. The stakeholder analysis, that is part of the project, will be elaborated upon in this paper.

2 Foundations

The challenge of planning and implementing goods flows in urban agglomerations has been a scientific subject even before the turn of the century. Various projects and pilot tests were conducted, but without significant success. These projects however were mostly limited to the supply of major points of sales and/or small- and medium-sized brick-and-mortar stores. As such, they lacked a holistic approach to urban logistics and/or a viable business case. More recent projects also tend to concentrate on individual aspects of urban logistics.

A focus on technical prerequisites/individual means of transportation such as developing delivery trucks for urban applications can be found e.g. in EU-sponsored projects FIDEUS (Schönewolf, 2007) and FURBOT (European Commission, 2015a) and some industry-driven research, e.g. DHL trying to replace fossil-fueled delivery trucks (Schuh, 2020) using small e-cars to reduce carbon footprint. Other projects focused on underground transportation as in Cargo Sous Terrain Project (Cargo Sous Terrain AG, 2020), cargo bikes as in KoMoDo in Berlin (LNC LogisticNetwork Consultants GmbH, 2020) or robots/drones as in DHL-Paketkopter (Deutsche Post AG, 2018), Starship (Hermes Germany GmbH, 2016) and BUGA:log (Hochschule Heilbronn, 2019). Using trams for urban goods flows was addressed for Brussels (Strale, 2014), Poland (Pietrzak and Pietrzak, 2021) and Istanbul (Gorcun, 2014).

Projects CITYLOG (Fraunhofer-Gesellschaft e.V., 2011) and STRAIGHTSOL (European Commission, 2014) looked at case-specific solutions for goods flows in cities. The SMARTFUSION project (2012-2015) focused on reducing emissions on the last mile in general (European Commission, 2015b).

Autonomous transportation was evaluated in the VanAssist project (ZENTEC, 2020). Ecological sustainability was addressed in LaMiLo (PTV Planung Transport Verkehr GmbH, 2015) and NKI: Klimafreundlicher Lieferverkehr (BUND e.V., 2020). LoMaCro+ (TU Wien, 2018) dealt with using crowd delivery concepts, whereas ”Verkehrsfreie Friedrichstraße“ tested road access limitations in Berlin (Changing Cities e.V., 2020) and a UPS pilot test in Hamburg (United Parcel Service Deutschland S.à r. l. & Co. OHG, 2020) used micro hubs. Recent last mile projects KoMoDo (LNC LogisticNetwork Consultants

GmbH, 2020) and FONA – Stadtquartier 4.0 (LNC LogisticNetwork Consultants GmbH, 2020a) also provide relevant input for our project.

Jacyna and Szczepanski (2013), Kin et al. (2018), Amaya, Arellana and Delgado-Lindeman (2020) as well as Pronello, Camusso and Rappazzo (2017) followed a more holistic approach; the last two papers also include a stakeholder analysis.

It can be derived that the challenge of how to manage urban logistics in a sustainable, socially acceptable and still economically viable way remains unresolved for the time being. Recent conferences deal explicitly with this challenge, e.g. "Tag der Verkehrswirtschaft – Vernetzte Citylogistik", "Digital und Intermodal" (2018 and 2019) and "International VDI Conference – Smart Last Mile Delivery" (2018) and "Wissenschaftsforum Mobilität" (2020).

All efforts to improve efficiency and service quality in urban logistics systems are of present relevance. Thus, project WAS-PAST intends to design an urban logistics system that incorporates relevant technological, legal and organizational requirements as well as especially stakeholder-related aspects in a holistic approach.

3 Methodology

3.1 Methodological Framework: Design Thinking

We selected a design thinking approach as overarching method to collect and display stakeholders' requirements to develop afterwards collaboratively with industry experts new urban logistics solutions. The design thinking approach can be divided into four phases: empathize, define, iterate and prototype (Gerstbach and Gerstbach, 2020):

- Empathize: Develop an understanding of stakeholders' issues and challenges.
- Define: Define an accurate user-oriented problem definition.
- Iterate: Generate as many ideas as possible, evaluate, prioritize, and select suited ideas.
- Prototype: Create a prototype based on ideas, get feedback.

The design process is not straightforward but rather an iterating process. You can always go back to the previous phase or skip a phase (Gerstbach and Gerstbach, 2020).

Figure 1 assigns the design thinking phases to the research methods applied and refers to the respective chapter. Based on project review (3.2.1), qualitative interviews (3.2.2) and ideation workshops (3.2.3), a field trial is planned to validate the results. An outlook on the field trial can be found in chapter 4.2.2.

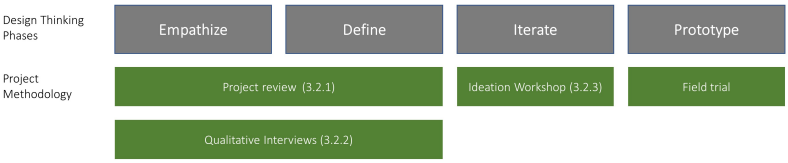

Figure 1: Allocation of design thinking phases to project methodology

3.2 Data Collection and Analysis

To start the design thinking process, a solid data groundwork is necessary. We selected the following methods:

- Review the latest scientific and practical projects and scientific papers as it helps to identify and prioritize requirements, measures and systems along the research process (3.2.1).
- Conduct qualitative expert interviews with a heterogeneous group of relevant stakeholders to explore new urban logistics concepts and their related challenges as well as to identify new aspects not yet mentioned in the literature (3.2.2).
- Conduct ideation workshops, considering the latest developments in industry and science, with the aim of developing new concepts for urban logistics to increase sustainability (3.2.3).

3.2.1 Project Review

The project review was conducted as part of the design thinking phases “Empathize” and “Define”. The strategy to identify practice-oriented projects and field trials related to urban logistics was to search in Google, Google Scholar and ResearchGate after keywords like “urban logistics projects”, “urban cargo”, “urban cargo projects”, “urban cargo

transport", "cargo tram", "cargo boat", "alternative city logistics projects", "city tram", "city train", "city boat", "urban logistics systems". The identified projects were assessed based on 17 criteria, e.g. logistics system characteristics, reason for failure or success and project metadata.

By using this approach, we could identify and better understand the relevant outcomes of these projects and field trials as well as extract stakeholder requirements on sustainable urban logistics concepts, reasons for failure, used logistics systems and modes of transport. Based on the project results, we were able to exclude or include different means of transport for our field trial.

3.2.2 Qualitative Interviews

To conduct semi-structured qualitative interviews, a questionnaire was developed for all stakeholder to be interviewed based on the literature review. The questionnaire consists of five sections:

1. General information about the interviewee
2. Questions about the status quo in logistics
3. Experiences with alternative means of transport (compared to "classic" diesel van/truck)
4. Ideas of what an alternative logistics system could look like
5. Ways and means to support the use of alternative means of transportation

Each interviewee received the questionnaire 1-2 days before the interview took place. Depending on the type of stakeholder, the questionnaire was slightly adjusted, e.g. for politicians questions like "How do you deliver today?" were unsuitable. The interviews took place between June and August 2021 and lasted 60 minutes on average.

Figure 2 presents the number of interviews per stakeholder group. Logistics service providers include courier, express and parcel (CEP) companies, cycle logistics and general cargo companies. Mobility includes local public transport companies and "Other" includes companies like manufacturers of cargo bikes or last mile software companies.

Each interview was conducted by two interviewers and was recorded as well as transcribed afterwards. To analyze the interviews a qualitative content analysis according to Mayring (Mayring and Fenzl, 2019) was applied. Thereby, the interviews were coded deductively based on the interview questions. They were then analyzed to identify overall statements and patterns within and across stakeholder groups.

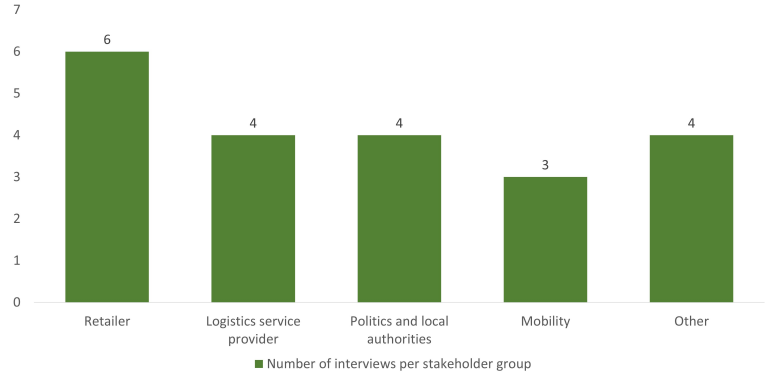

Figure 2: Number of interviews per stakeholder group

3.2.3 Ideation Workshops

Within the design thinking phase “Iterate”, different ideation workshops were held to avoid thinking bias and to work collaboratively with industry experts to gain their perceptions and ideas related to new urban logistics concepts. Therefore, these workshops also play an essential role when it comes to discuss feasibility of theoretical urban logistics concepts.

The ideation workshops took place every two months in a ninety-minute workshop between September 2021 and March 2022. Due to the Covid-19 pandemic, they were mostly held online. The workshops were moderated and consisted of the main question: “How can we design an innovative, sustainable and economic viable urban logistics system that benefits all stakeholders in urban areas?” In the first two workshops, ideas were generated and afterwards further elaborated. The concepts were proposed and

discussed in the following workshops. In the course of the workshops, one concept was selected from which all urban logistics stakeholders could benefit from.

Each ideation workshop was documented and evaluated. The results were shared with all participants after each workshop so they could add further thoughts.

4 Findings and Discussion

Based on the research findings of the project review and the qualitative interviews (4.1) a proposal for a new urban logistics solution will be presented (4.2).

4.1 Requirements for Urban Logistics Solutions

Firstly, the findings of the project review are outlined (4.1.1) and afterwards the findings of the qualitative interviews are displayed (4.1.2) and lastly summarized in ten central findings (4.1.3).

4.1.1 Results of the project review

Table 1 presents past and ongoing urban logistics projects with the following information: transported goods, project goals and key insights.

Table 1: Review of past and ongoing sustainable urban logistics projects

Project	Goods	Goals	Key insights
Car Go Tram, Dresden 2001-2020	Automotive Parts	Efficient and ecological supply of glass manufacturer close to the city	Change of logistics concept for Dresden plant which no longer needs the tram
Cargo Tram, Zurich 2003	Waste disposal for city habitants	Ecological disposal of e-waste and recyclable waste	Ecological savings, good citizen acceptance, no additional burden for citizens

Project	Goods	Goals	Key insights
Güter Bim, Vienna 2004-2005	Supplies such as batteries, wheel tires, driver's side	Use of public transport network for freight transport	Missing customers, unloading in parallel to passenger service at stops, unloading times too long, as forklifts have been used
City Cargo, Amsterdam 2007-2008	Supplies for pubs, restaurants, hotels	Reduction of truck traffic and of emissions, delivery to the city center, also after 11 a.m. (existing delivery restriction in Amsterdam, 7 -11 a.m.)	Project company had to finance itself without public funds, was not supported politically, had to build new tracks and pay for them itself, did not receive any funds due to the financial crisis, but high ecological savings possible, could make sense economically
Cargo Hopper, Utrecht 2011	Supplies for pubs Restaurants, Hotels	Utrecht wanted to remove commercial traffic from narrow streets, reduce environmental pollution	Created a separate company for operations, politics strongly supports this project, but is not as efficient as it could be because some companies don't share transport space with competitors, even if it is cheaper
Tramfret, Saint Etienne 2017-2018	Supplies for grocery stores	Use of discarded streetcars for freight transport on existing public transport infrastructure	Lack of financial resources of the project company, in particular for the operation of the distribution center, despite positive results, but according to the food retail casino, the transport led to efficiency gains and profitability

Project	Goods	Goals	Key insights
Last Mile Tram, Frankfurt am Main 2020	CEP parcels	Efficient and ecological supply of an urban neighborhood with high stop density using trams and existing city infrastructure	Transport of parcels via tram in combination with vans and bikes is possible under certain preconditions e.g. separate tracks and trams
Hôtel logistique, Paris 2021	All kind of goods and supplies	Enhance ecological delivery options	No results available yet

Finding 1: Based on the project review, the key requirement for the success of an urban logistics project is the commitment of different stakeholders. The key difference between successful and the non-successful projects is the strong commitment of all relevant parties. In Zurich, the project could generate benefits for all stakeholders and therefore all parties (politics, citizens and operator) are committed to success (Johnsten, 2021). In Utrecht there is also a big commitment by the local authorities and politics as well as from local pubs and restaurants (de Jong, 2013). However, there are also bigger shipping companies who are not willing to use a collaborative system, which makes it harder to operate a collaborative system economically (Eltis, 2015). The inclusion of these parties is a critical success factor for the prospects of this system. When politics, public authorities and relevant shippers are not willing to cooperate, a project will fail, as it occurred in Amsterdam (Arvidsson and Browne, 2013). Even though the calculated savings, economically and ecologically, were promising, the whole project failed in the end due to the lack of commitment of relevant stakeholders.

4.1.2 Results of the qualitative interviews

As mentioned in chapter 3.2.2, 21 interview partners answered the same basic questionnaire adjusted to their industry. In contrast to our expectations, we could not observe patterns along stakeholder groups, e. g. “all logistics service providers demand

wider streets and less bike lanes", but we were able to find similar answers that were given across all stakeholder groups. In general, we observed that each stakeholder group was well aware of the challenges in urban logistics and are keen to find solutions.

Finding 2: In general, all interviewed experts agreed that all urban logistics stakeholder groups need to intensify the dialogue in order to find suitable solutions. The dialogue between e.g. logistics service providers (LSP) and local authorities is regarded as too slow and too little. In particular, the LSP, but also the retailers and mobility companies demand clear and long-term regulations for traffic organization in urban areas. They point out that they can work with less space e.g. through extended bike lanes. However, they need the commitment of the authorities that rules will apply for the next years. All stakeholders favor loading zones and most of them would replace car parking lots with loading zones. Furthermore, they also expressed their concern of the feasibility to control the usage of loading zones.

Finding 3: Each interview partner made demands which could accelerate zero-emission urban logistics flows. The following demands were made by nearly every interview partner: More space for hubs, more knowledge about urban logistics in local governments, more financial commitment, more charging points for electric vehicles / cargo bikes and substantially more incentives for companies and consumers to use ecological means of transport and therefore urban logistics systems.

Finding 4: However, when it comes to white label transports and depots, the opinions of the interviewees differ a lot. Some interview partners demand more cooperation and collaboration between the different market actors; others reject these demands by referring to local optimization and pointing out that their trucks are already filled-to-capacity. In general, conditions for collaboration between market actors need to be created by local governments, associations and joint ventures.

Finding 5: Data transmission, standardization and interfaces to enable collaboration along the urban supply chain. Every interview partner formulated the requirement to define and use open-source standards in data transmission between supply chain partners. This would enhance the idea of collaboration and would give small market actors a fair chance to establish alternative urban logistics systems.

Finding 6: Some interview partners mention night delivery as a big chance to relieve city traffic and demand from politics and local authorities to approve those, e.g. for supermarkets. Others see night deliveries critical as long as noise problems are not solved.

Finding 7: The critics of night deliveries suggest testing a concept of retiming deliveries. The key aspect of this concept is to deliver to e.g. supermarkets in smaller batches with smaller vehicles and more often per day. The store's inventory will be moved to e.g. an urban/macro hub. The macro hub functions as the central goods-in point for the city and can store goods for a certain period. Smaller vehicles can start their tours at the macro hub and deliver the stores with the required goods.

Finding 8: A requirement all interview partners agreed on is a change in consumer expectation. Consumers need to accept higher delivery charges for sustainable deliveries. They shall accept three-day deliveries to enhance bundling effects as well as the end of door deliveries and the use of parcel lockers instead. However, the consumer perception is a completely different one. They prefer fair working conditions for delivery drivers (Engelhardt, Seeck and Malzahn, 2021; Spectos GmbH, 2022), they want bundled deliveries and not one delivery per service provider (Seeck and Göhr, 2018; Seeck and Engelhardt, 2021), and they prefer to differentiate delivery options by price and performance (Quiter et al., 2021). Especially in this respect, there is a huge gap between companies and consumers expectations for an alternative urban logistics solution.

Finding 9: The use of the right mode of transport is important for all stakeholder groups. Many interviewees mentioned they already tried electric trucks, cargo bikes and hydrogen trucks as well as liquid natural gas (LNG) trucks. Depending on their use cases, they had mixed results and experiences with alternative modes of transport. For smaller cargo, most interviewees had good experiences with the use of cargo bikes. For heavier cargo, most interviewees said there is no sustainable alternative to the diesel truck yet.

Finding 10: One mode of transport currently broadly discussed is the use of railway transportation in urban areas, e.g. the use of trams. Based on our research it can be deduced that cargo trams are only a useful alternative if operated on an own network with dedicated trams (Strale, 2014; Pietrzak and Pietrzak, 2021). For this purpose, strong political willingness, investment readiness and long-term planning is necessary

(Arvidsson and Browne, 2013; Strale, 2014). The requirements for the usage of railway transportation are strong and durable trains as well as network availability (Strale, 2014; Pietrzak and Pietrzak, 2021). Therefore, cargo transportation needs its own network which requires a lot of investment in city infrastructure (Arvidsson and Browne, 2013; Strale, 2014).

4.1.3 Summary of requirements for new urban logistics concepts

In the following, the findings will be summarized:

1. Key requirement for the success of an urban logistics project is the commitment of the involved stakeholders
2. Intensify dialogue between all relevant stakeholders
3. More infrastructure support from local governments and more incentives for sustainable transport solutions
4. Conditions for more collaboration between willing market actors need to be created by local governments or associations
5. Define and use standards in data transmission and interfaces
6. Define conditions for night deliveries
7. Test retiming of deliveries with the use of macro hubs
8. Consider gap between consumer expectations and practical system performance
9. Companies already made experiences with alternative modes of transport with mixed results
10. Use of railway transportation depends on strong political willingness, local investment readiness and long-term planning

4.2 Proposal of new urban logistics solutions

This chapter presents a proposal for a new urban logistics solution and explains how it can be tested in a field trial. The proposal is based on the findings presented above and was elaborated within the ideation workshops.

4.2.1 Solution structure

The intention was to consider as many findings as possible when creating the network. Based on that, seven key targets for the new systems were derived:

1. B2C as well as B2B consignments
2. As many different modes of transport as possible
3. Central delivery point which can receive goods via road, rail and riverine waters as well storing items for a certain period, so night deliveries or retiming concepts can be tested
4. Network of micro hubs across the city to be able to supply a large area within the city
5. Include as many stakeholders as possible, e. g. public local companies, local authorities, big shippers and technology manufacturers
6. Use existing infrastructure
7. Use standards in data transmission

The heart of the new distribution system is a so-called macro hub. All shippers participating in the field trial are requested to deliver their items to the macro hub. There, the items will be handled, picked, sorted and distributed to their destination tours. If the destination is reachable directly from the macro hub, the last mile tour starts from the macro hub. Else, there is an intermediate transport from macro to micro hub. For the field trial, it is planned to operate two micro hubs across the city. The micro hubs will be used as handling points. Intermediate transport is carried out using medium sized vehicles like an E-Van or a cargo bike train.

At the micro hub, the items will be transferred to smaller vehicles like cargo bikes. The micro hub will be used as short-term storage site, but typically, no item will be stored longer than six hours. Finally, cargo bikes will deliver the items to their individual destinations. Each hub has its dedicated delivery area, differentiated by postcodes. The final sorting of items to tours will be done at the macro hub. In addition, it is planned to try the usage of small, unmanned cargo boats to carry goods via rivers and canals across the city, which will be carried out in collaboration with another scientific project. This research project already tested the general feasibility of these boats. This model can only be applied to cities that have suitable rivers and canals. Figure 3 shows the structure of the derived solution.

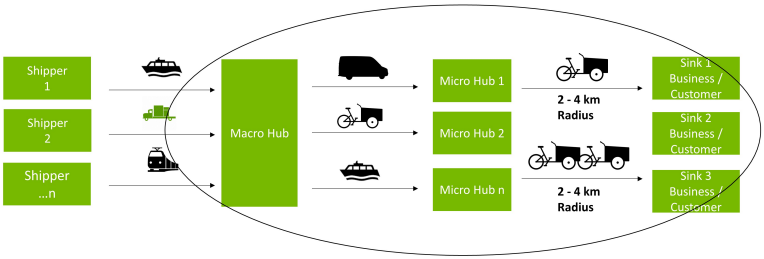

Figure 3: Structure of an alternative urban logistics system

The scope of this project only considers deliveries and not disposal transport. A fully comprehensive urban logistics concept should also include disposal logistics.

4.2.2 Design of the field trial

The last step of the design thinking process is prototyping, which is implemented as a field trial of the derived concept. The design of the field trial, which is currently in the planning status, is explained below.

For the macro hub, two prerequisites should be met: The possibility to store, pick, sort and distribute goods within a relatively small space, and a good traffic connection via more than one transportation way. Therefore, Berlin Westhafen was chosen as macro hub.

Two micro hubs were selected: One at Berlin Alexanderplatz, and the other at Berlin Tempelhofer Damm. In combination with the macro hub, around 60 postcode areas in Berlin can be serviced by cargo bikes or E-Van. The overlap in delivering areas between the three hubs is low.

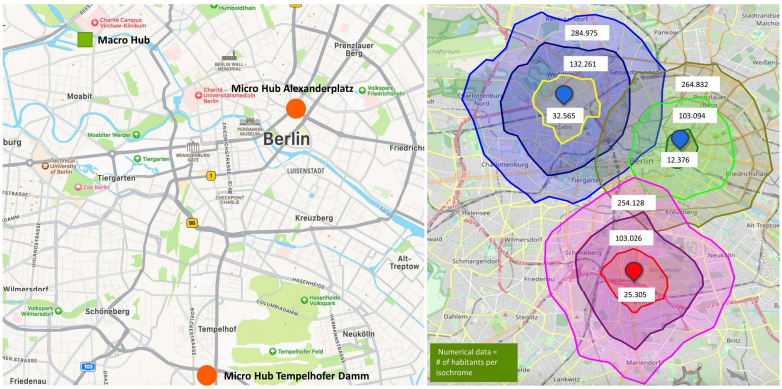

Figure 4: Location of micro hubs in Berlin and presentation of the isochrones from each hub

Figure 4 shows the exact locations of the micro hubs in berlin (left picture) as well as the isochrones per location. The values within the isochrones indicate the number of habitants which can be reached within five minutes (inner isochron), ten minutes (middle isochron) and fifteen minutes (outer isochron) by bike. A ride longer than fifteen minutes (one way) causes low tour productivity and is therefore not considered. Ca. 800.000 habitants respectively nearly the entire inner subway circle of Berlin can be reached by these three locations.

4.2.3 Expected results from the field trial

The basic requirements for the field trial are the same as for every logistics network: To deliver the right goods at the right time at the right place with the right quality and in the right quantity.

Additionally, the field trial needs to prove that a two-stage urban logistics solution can cope with the logistics requirements, is far more ecological than todays' solutions and can meet economic efficiency criteria. The most crucial aspect in terms of delivering the items in time is the delivery time of incoming goods at the macro hub. In terms of economic efficiency, there are three important aspects. First, a high level of collaboration

between the shippers to ensure an optimum capacity usage of the hubs and transportation vehicles is necessary. Second, the labor costs for personnel at the macro and micro hubs are to be considered. The key driver for minimizing the costs is the capacity limit of the different transportation modes. This field trial tests a variety of different transportation modes, all capable of loading at least one euro pallet, sometimes even more. Third, the field trial needs to prove a significant drop in emissions per delivered item as well as a reduction in heavy duty trucks.

However, this field trial does not cover first mile operations like “how will the goods be delivered to the macro hub?”. This question is object of further research projects.

5 Conclusion

It can be concluded from the design thinking process that although there are many approaches to the problem of the last mile, a final solution has not been found yet, or is not even on the horizon. However, the results of the process reveal requirements and conditions for such a solution.

On the one hand, it can be stated that purely theoretical concepts have little chance of success without practical testing in the context of field trials or case studies. Practice-oriented projects, on the other hand, often focus on individual aspects of the problem and do not represent an overall solution. This is especially true for practical projects on the use of alternative means of transport (trams, e-mobiles, cargo bikes, drones, robots). In these projects, valid statements are made on the usability, such as a good practicability of cargo bikes in urban areas or the lack of practicability by using trams or similar passenger transport by rail for transporting goods. However, the integration of such results into an overall concept for urban logistics, which has a special focus on sustainability, urban compatibility and resilience while at the same time being easily realizable and economically feasible, is still pending.

Such a solution concept must therefore include the use of different means of transport, but use them depending on their meaningfulness in the respective context. Another result of the design thinking process is the absolute necessity of cooperation between

the various stakeholders in the last mile process. Only through overarching cooperation, the success of urban logistics solution concepts can be achieved. This is not only clear from the examination of past projects, but also from the evaluation of the expert interviews. The success of holistic urban logistics solutions is often based on the implementation of bundling, which can only be sensibly realized through cooperation between the logistics service providers involved. However, other stakeholders, such as the municipal and political bodies of a city, are also imperative for the success of such projects.

Based on these results, a field trial is conceptualized for the implementation of a possible holistic urban logistics concept. This concept is based on the use of different means of transport for the different parts of the urban supply chain as well as the bundling in macro hubs and micro hubs. The concept presented will be implemented in Berlin in the second half of 2022. The results of the field test will be published after completion of the project.

Financial Disclosure

Berlin senate is funding the described project through the Berlin Institute for Applied Research (IFAF).

Appendix

Questionnaire

Question category 1:

Questions about the person and the company

1. In which company do you work?
2. What is your position in your company?
3. How long have you been employed by the company?
4. In which industry does your company operate?
5. In which industry do your customers operate?

Question category 2:

Information on the status quo in logistics

1. How is your logistics system structured?
2. In which loading equipment will your goods dispatched? / How do you receive?
3. How will be shipped in general? / How do you receive in general?
4. What are your key figures for delivery / supply?
5. Are there any special requirements for shipping and receiving goods?
6. Do you have time restrictions for receiving and/or issuing goods?
7. What quantities in QU (quantity units) do you ship per day? What is the delivery cycle?
8. How do you organize and control your logistics system?
9. What software do you use to control your logistics system?

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Question category 3:

Field reports of alternative modes of transport (compared to the "classic" diesel van/truck)

1. What do you see as the biggest challenges in supplying cities?
2. How could these problems be solved?
3. Do you have experience with the use of alternative modes of transportation?
4. Do you know any projects using alternative logistics systems?
5. If yes, can you briefly describe your experience? What were the advantages and disadvantages?

Question category 4:

What could an alternative logistics system look like?

1. What could an alternative logistics system look like for you?
2. Are you already working on a new system? If yes, why?
3. What are components of an alternative logistics system?
4. What are your requirements for alternative modes of transportation?
5. What are the requirements for you to consider using the alternative modes?
6. What are barriers / requirements for a CO2 free delivery?
7. What requirements do you see for a software for planning, control and optimization in urban logistics?
8. To what extent do you see the possibility to cooperate with other market participants to realize an alternative logistics system (e.g. by sharing data, sharing freight space, realizing intermodal transport chains)?

Question category 5:

Ways and means to support the use of alternative modes as a means of transportation

1. What needs to happen to organize commercial transport in a sustainable, environmentally and urban friendly way?

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