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Urban Logistics Sites Concept: Methodology and Case Study

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Abstract

The displacement of logistics facilities from central urban locations is a continuing phenomenon. Indeed, in some very large cities market forces push logistics back into such locations, but coordination remains low. City governments are more aware of the increased mileage for urban freight transportation due to displacement, however, a general approach to how to decrease mileage and stop displacement is missing in most cities. We propose an Urban Logistics Sites Concept (ULSC) as a strategic guideline for city administrations to increase consolidation and thereby decrease mileage by measures that support logistics facilities development in urban locations as well as accompanying consolidation approaches. This paper presents the methodology, results, and limitations of a ULSC with a case study from the city of Berne.

Keywords: logistics sprawl; proximity logistics; policy making; urban, location optimisation; spatial planning

Introduction

Logistics sprawl is a phenomenon that has been detected in a broad number of publications in different countries around the world (Aljohani & Thompson, 2016; Dablanc & Rakotonarivo, 2010; Diziain et al., 2012). Sites for activities in logistics are disliked by the urban population because they generate emissions and traffic (Diziain et al., 2012). Moreover, the low margin logistics sector struggles to compete with highly returning real estate markets especially housing and office space (Diziain et al., 2012). Logistics sites are located far away from the core areas of cities today; however, central locations still consume lots of logistics services (Dablanc & Rakotonarivo, 2010; Taniguchi et al., 2016). Hence, the mileage to serve the core of cities is high, and high amounts of emissions are

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generated by high traffic volume (Dablanc & Rakotonarivo, 2010; Sakai et al., 2019). Reintegrating logistics facilities, e.g. micro hubs, into central areas can strongly decrease mileage and emissions from freight transportation (Sakai et al., 2019).

For five densely populated global cities with scarce land resources, Buldeo Rai et al. (2022) show a comeback of logistics facilities in central urban areas in the last years driven for example by rising shipping density due to e-commerce and market demand for quick or instant deliveries. Long-proposed two-stage logistics systems with regional or city hubs and micro hubs are now being realized at least for parcel logistics (Buldeo Rai et al., 2022). However, multiuser hubs remain a niche (Buldeo Rai et al., 2022). This trend was to the best knowledge of the author not yet largely identified in smaller and less dense cities. In Switzerland, deliveries via a second stage are seldom implemented. One exception is a newly founded quick-delivery online supermarket that operates multiple fast-delivery hubs in Zurich. While multi-user or company-owned urban micro hubs remain scarce, collection and delivery points (e.g. parcel lockers) flourish. However, network development is uncoordinated between different parcel logistics companies and their networks' catchment areas largely overlap as Beckers and Verhetsel (2021) show for Belgium[†]. A coordinated approach could improve network density and thereby increase the share of parcels collected by foot or bike (Beckers & Verhetsel, 2021).

Therefore, city logistics and especially tackling logistics sprawl and displacement of logistics from central locations climbed upwards on the agenda of policy makers in the last few years. The traffic volume caused by logistics services in cities increased further and became more visible because of the quickly and strongly increasing parcel delivery volume (Buldeo Rai et al., 2022). Researchers and cities recognized that the availability of space for logistics in and close to the city center is one crucial aspect for reducing mileage caused by logistics. A famous example is the city of Paris which founded a real estate development company named *Sogaris* together with French Post (Diziain et al., 2012; Sogaris, 2022). They develop real estate projects for logistics in and close to the city focusing also on space efficiency and concepts to combine multiple logistics companies in one area or the same building (Diziain et al., 2012; Sogaris, 2022). Although this approach is deemed largely a success, a general approach to how to decrease mileage and stop displacement is missing in most cities.

The city of Berne also has city logistics prominent on its agenda and developed a city logistics concept in 2020 (Kuchenbecker et al., 2020). The capital of Switzerland with around 143,000 inhabitants (Bundesamt für Statistik (BFS), 2019a) and 192,000 employees (Bundesamt für Statistik (BFS), 2019b) in 2019 faces a transport volume of 10.4 Mio t. per year in 2019 (Schmid et al., 2021)[‡]. Thereby it has a low share of rail transportation with 6% and high volumes of road freight traffic amounting to 15% of total traffic (Schmid et al., 2021). Experts prognose a growth in freight traffic volume especially because of further population and economic growth as well as further fragmentation of shipments for Berne (Kuchenbecker et al., 2020; Schmid et al., 2021). For Switzerland, the latest traffic and transport forecast reports an increase of 167% in parcel volume and an increase of 152% in mileage of parcel delivery vehicles from 2017 to 2050 (Justen et al., 2022). Similar rates are expected for Berne, yet no specific forecast exists.

Therefore, the city logistics concept provides several fields of action to reduce freight traffic volume on roads and thereby emissions, especially greenhouse gases. One field is the availability of hub space in central locations for consumer goods logistics to allow more mileage-efficient logistics approaches (e.g. two-stage deliveries). Here it is worth mentioning that the case study cities investigated by Buldeo Rai et al. (2022) support logistics facility development in their central areas to achieve similar targets as the city of Berne. The city administration thereof contracted out a sites concept for city logistics focusing on hubs for consumer goods, especially parcels. The concept is envisaged to state where logistics sites are situated today and where they should ideally be developed in the future (Question "Where?"). It also describes how the city administration can influence the market forces or take a more

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[†] This also holds for larger facilities in the study of Buldeo Rai et al. (2022).

[‡] This number is estimated by fusing data from national surveys. These surveys are not completely valid on a local level and hence this figure must be treated as an approximation.

direct role to increase the space for logistics in the city (Question "How?"). Furthermore, the city administration is also interested in how consolidation (and thereby a decrease in mileage) can be supported without providing further hub space following the argumentation of Verlinde et al. (2012) who searched for alternatives for urban consolidation centres which they rate largely unsuccessful.

We utilize the city of Berne to present the methodology for developing an Urban Logistics Sites Concept (ULSC) and to show how city administrations can answer the questions raised above without intensively modelling urban freight. We thereby assume and follow the literature findings that consolidation by providing hub space at central locations or other methods decreases mileage in urban freight transportation. The focus of this paper lies on a description of the methodology in the following section, the results of the study are presented only briefly thereafter. Finally, we discuss the positive and negative aspects of the implementation and highlight possible improvements when concluding the findings.

Research Design and Methods

A ULSC's purpose is **first** to equip the city administration with fundamental knowledge about city logistics generally and specifically about its respective city. That information enables the city administration to get an overview of city logistics concepts and to use targeted measures in influencing urban freight traffic. **Second**, it determines an order of magnitude of the number of hubs needed to implement specified urban delivery strategies. This information can be mirrored against for example locations the city has available or can mobilise for a certain hub type. Land is a scarce resource in cities and some city logistics strategies might fail because of too few available locations or lack of floor area. Evaluating land availability with a rough knowledge about how much floor area or locations are necessary helps to select an implementable strategy. **Third**, it defines potential areas for larger logistics facilities. This allows the city administration (eventually together with the canton) to quickly secure land that is already used by logistics and protect it from displacement or positively zone in areas for logistics with spatial planning instruments (Ruesch et al., 2020). **Fourth**, it develops strategic thrusts that are coordinated with relevant offices of the city administration and businesses. These strategic thrusts provide directions for developing and implementing measures for on the one hand supporting the development of more logistics facilities in central locations and on the other hand at least partially substituting consolidation effects by such facilities with other measures that foster consolidation. **Fifth**, its dialogue-oriented process ensures an early engagement with businesses that ultimately implement the measures either because they are forced by regulation or because they are incentivized. We develop a study design based on experience to answer the raised questions and fulfill the purpose of a ULSC including multiple methods. The focus lies on qualitative approaches which are enriched by quantitative elements. Table 1 presents an overview. The steps are described in more detail in the next paragraphs.

Table 1: Overview of methods

Research Question	Step	Result	Method
Where	1	Transport volume on the city quarter level	Generation rates, regression models, data fusion
	2	Estimation of necessary logistics sites	Design of regulation scenarios, Derivation of delivery models and their shares
	3	Identification of areas with potential suitability for logistics	GIS-analysis
How	1	Fundamental information on delivery concepts and collaboration models for hub operation	Literature research
	2	Identification of accepted ideas and concepts	Interviews, workshops
	3	Derivation of main challenges and goals	Workshops
	4	Design of strategic thrusts	Workshops, sounding board, desk research

"Where" Step 1: Transport volume on city quarter levels

To answer the question of where to locate hubs, the localization of the transport volume on a low scale level is necessary. In Berne, it is possible to achieve the level of statistical quarters, which divide the city into 32 quarters. They differ in size but have an area of 165ha and 4,477 (2019) inhabitants in mean. We then estimated the transport volume with multiple methods. First with generation rates, and second with regression models, both based on full-time equivalents (Bundesamt für Statistik (BFS), 2019b) in each quarter. The models are available from an ongoing Swiss research project (Todesco & Ruesch, to be published). The third method assigns freight traffic shares to the quarters from the known value for the whole city proportionally to their size of inhabitants and full-time equivalents. For a composed result, the single results of all three methods are fused. In addition, the share of consumer goods delivered in parcels is estimated, and a parcel volume is derived. By extrapolating the population and full-time equivalents at the project horizon of 2040, an estimation for the future is possible as well. For extrapolation, two scenarios from the national economic forecast are used (Cretegny & Müller, 2020). The scenarios differ mainly in change of consumption and reduction of production activities.

"Where" Step 2: Estimation of necessary logistics sites

To calculate the necessary number of hubs for the transport volume in each quarter, we assume that different delivery concepts exist that use different hub types. City hubs, micro hubs, and collection and delivery points for parcels are considered in this study. The usage of hub types depends on the delivery approaches which depend on business economics. The city government can influence the delivery approaches with regulation and other actions (see for example Xiao et al., 2021). Therefore, hub usage depends on transport volume and regulation. We design two regulation scenarios[§] (see Table 2) for which we assume usage rates per hub (see Figure 1). Thereby included are private actions by logistics businesses as well as state activities in city logistics. Thereof calculating an order of magnitude of the necessary number of hubs is possible by taking standard capacities (see Table 3).

Table 2: Regulation Scenarios

	«Today»		«Adjusted»	
	Regulation	Impact	Regulation	Impact
Home delivery	Obligation of postal and parcel delivery services to offer home delivery for mail and parcels up to 20kg.	No incentive for customers to choose a delivery option different from home delivery (no price differences)	If a suitable other option is available, there is no obligation to offer home delivery.	An incentive for parcel services to offer less costly collection and delivery point deliveries cheaper than home delivery. Incentive for small parcel services to only offer collection and delivery point deliveries.
Parcel deposit facilities	Obligation to install a parcel deposit facility for every household (min. 15x35x25).	Little incentive for parcel services, independent companies, or housing developers to install collection and delivery points.	Obligation to install and maintain independent parcel lockers for new housing developments with more than x flats.	More dense collection and delivery point network. If an obligation to install a parcel deposit facility for every flat is deleted as well, people have a higher incentive to order parcels to collection and delivery points.
City and micro hubs	No special regulation.	City and micro hubs only develop through market forces. Due to scarce land, only a few facilities exist. Spatial monopolies exist.	City hubs and micro hubs with sufficient capacity are supplied by the city government. Every logistics company can use them as transshipment facilities.	All logistics businesses can profit from consolidation in long-range transports to the city hub and eventually from rail access. Available micro hubs allow consolidation in urban transports Spatial monopolies dissolve.

§ Regulation scenarios in this study also include actions by the city government that are not strictly part of regulation by definition

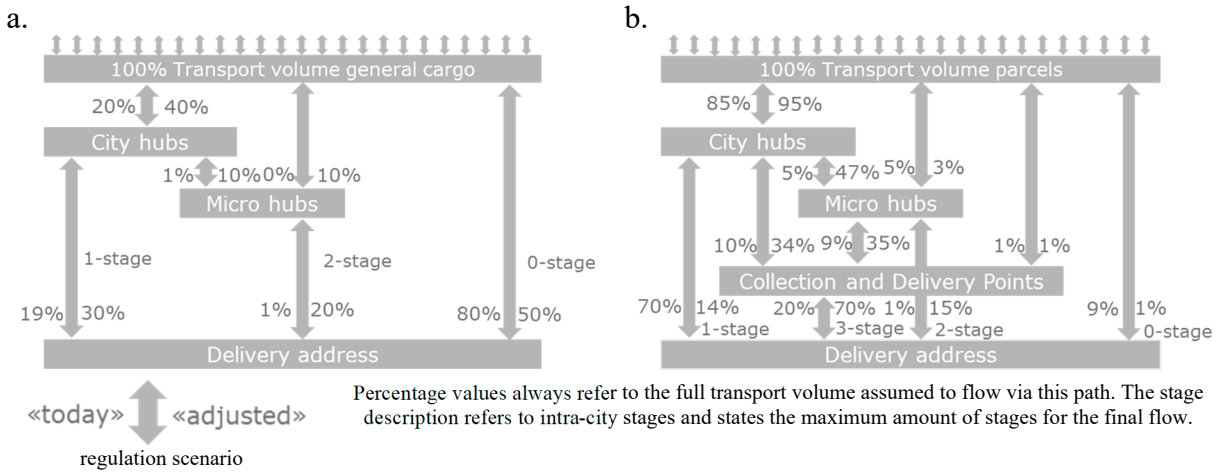

Figure 1: (a) Freight flows for parcels; (b) Freight flows for general cargo (consumer goods)

Table 3: Hub capacities

Facility	City-Hub	Micro-Hub	Collection and Delivery Point
Capacity	4000 general cargo shipments/d	300 general cargo shipments/d	150 parcels/d

40 parcels are equivalent to one general cargo shipment

Table 3 only relates to necessary capacity, however it is important to consider the facilities' accessibility. A very dense city might be accessed well by less but larger collection and delivery points whereas a less dense, spread city might need more of them. The administration needs to be sensitized that only very high accessibility of collection and delivery points leads to a desired reduction of mileage because people collect deliveries by foot or by bike instead of taking a car. We assume a catchment area of 300m radius, however, as Beckers and Verhetsel (2021) already note, more research is necessary, to determine what a realistic catchment area of collection and delivery points in cities is.

"Where" Step 3: Identification of areas with potential suitability for logistics

In this particular case study, the identification of suitable sites for logistics is limited to larger facilities, i.e. city hubs. We therefore use the results of the previous steps and three spatial requirements: closeness to rail yards (1km aerial distance), closeness to highway access points (1km aerial distance), and distance to noise-sensitive uses (outside of residential areas) to identify potential hub locations. These areas are generalized together with members of the city administration to fit the urban fabric. For the lower tier, we only propose requirements for hub location because they can potentially be located in the whole city.

"How" Steps 1 and 2: Basic knowledge of city logistics and accepted measures

To answer the question of how the city government can influence the development of hubs, first fundamental knowledge on how delivery concepts work and how cooperation models with logistics companies can be designed are presented to the city administration. The information is gathered from scientific literature and summarized for policymakers. In addition, city-specific information is gathered. This includes for example an overview of existing hubs and logistics businesses as well as development sites. Afterwards, we identify potential measures in a dialogue-oriented process with the city administration and the logistics stakeholders in Berne which fit the goals of the city administration and business principles.

"How" Steps 3 and 4: Derivation of main goals, challenges, and strategic thrusts

The results of the analysis of the local city logistics ecosystem together with the results of the workshops about potential measures are the basis for the city administration defining main challenges and goals. Thereof the concept can be developed. It is formed by strategic thrusts in the ten fields of action for state actors in urban logistics (Schmid et al., 2019, see Table 4). However, the city governments are limited in influencing city logistics in some fields of action because of a lack of financial resources for expensive economic incentives or funding of facilities and infrastructures as well as because of missing competencies in regulation, spatial planning, infrastructure planning, and education (Schmid et al., 2019). Nevertheless, in some strategic thrusts, city governments can have an impact and they can influence other state actors (canton or federation) to change e.g. regulation.

Table 4: Fields of action for state actors in urban logistics

	Field of action	Influence potential by city governments in Switzerland
1	Concepts and strategies	Entirely
2	Regulation	Limited
3	Spatial Planning	Limited
4	Infrastructure Planning	Limited
5	Infrastructure operation and management	Comprehensive
6	Financing	Limited
7	Cooperation and Partnerships	Comprehensive
8	Support and Incentives	Limited
9	Education and Traning	Limited
10	Fundamentals/Monitoring/Controlling	Entirely

Based on Schmid et al. (2019)

Results of the caste study in the city of Berne

The transport volume in Berne will stagnate or increase marginally until 2040. However, the consumer goods sector will grow because of rising consumption and population growth. Furthermore, the parcel market will grow strongly as well. Table 5 shows the results per growth scenario for the whole city. The two regulation scenarios in which we use different usage rates for hubs combined with the growth scenarios (see "Where" Step 2) result in different demand values for hubs in the city. Table 6 shows how growth in transport volume and a regulation change can drastically influence the necessary respectively demanded number of hubs. The identification of areas for hubs (see Figure 2) shows that great potential is still available because of very good access to transport infrastructure. The dialogue-oriented process resulted in multiple challenges, seven goals were formulated for the ULSC and 35 strategic actions were consulted to further investigate or directly implement. Most actions were identified in the fields of regulation, infrastructure planning, and operation as well as in partnerships.

Table 5: Transport volume estimations

	Scenario		
	Today (2019)	Limited change (2040)	Dynamic change (2040)
Transport volume (t/y)	9.7 Mio.	10.1 Mio.	9.9 Mio.
Parcels (# per weekday)	20,000	36,000	60,000

Table 6: Hub Demand 2040

	Collection and delivery points		Micro hubs		City hubs	
Growth scenario	Limited change (2040)	Dynamic change (2040)	Limited change (2040)	Dynamic change (2040)	Limited change (2040)	Dynamic change (2040)
Regulation «today»	48	79	1	1	1	2
Regulation «Adjusted»	167	278	15	18	2	3

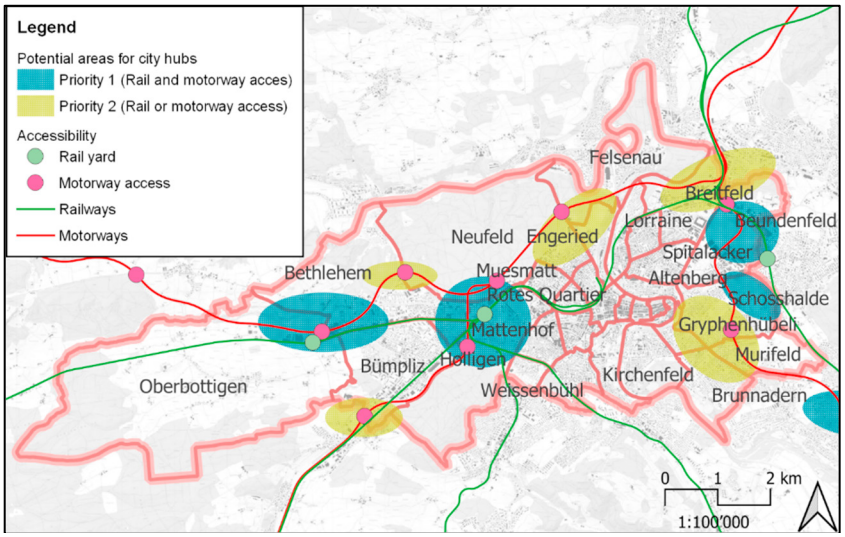

Figure 2. Potential areas for city hubs in Berne

Conclusion

The study shows an exemplary case study of the City of Berne administration developing a ULSC to tackle logistics sprawl and encourage the coordination of logistics firms to reduce the mileage of freight transport in the city. It answers both main questions of where to develop logistics hubs and how to support and accompany the development. Therefore, the study states strategic actions for the City of Berne which provide a concrete guideline for measuring development and implementation. It thereby combines approaches of providing more hub space in cities (see for example Xiao et al., 2021) and accompanying measures without space requirements (see for example Verlinde et al., 2012) to tackle logistics site displacement and high mileage with a holistic approach.

In this case study, the ULSC is not supported by an urban freight transportation model which would allow us to assess the measures specifically for the analyzed city in terms of mileage or emissions reduction and costs. On the one hand, the missing model simplifies (and reduces costs of) the development of the concept while all necessary information for measure implementation is still available. On the other hand, this limits prioritizing strategic actions over others and justifying measures by their impact. One clear disadvantage of not having a model available is that the effectiveness of some general city logistics strategies cannot be tested. In Berne for example, it is unclear if micro hubs are necessary respectively effective in reducing mileage because the spatial extent of the city is comparably small and city hubs are available very close to or inside the city borders. An approach similar to Sakai et al. (2020) seems promising for testing measures' effectiveness.

Depending on which strategic actions a city administration follows, the ULSC must later be substantiated by an analysis of where to locate city and micro hubs as well as collection and delivery points. An additional location optimization model, eventually based on the urban freight transportation model mentioned above, can support cities in choosing locations. Recently, for example, Kedia et al. (2020) proposed a model to optimally locate parcel lockers. However, searching and assessing sites beforehand can be worthwhile, especially for micro hubs. Suitable locations might be so few, that an optimization model does not provide any added value.

Further research on suitable instruments for city administrations to get involved in City Logistics can enhance the effectiveness of urban freight policy. A comparative study between different concepts in how cities act in the policy field of City Logistics could deepen the understanding which strategies deem most successful, how institutionalisation

of the topic of urban freight in the city administration works best and which instruments have the largest positive impact. A following generalization and evaluation of different strategies, structures, instruments and tools can help city administrations to deal with urban freight policy in an effective way.

The city administration of Berne is one of the first cities in Switzerland to develop such conceptual foundations to secure and support the development of logistics. The feedback from the logistics industry and delivery receivers was largely positive, especially appreciated was the participation in the process of the concept development. No other city administration builds knowledge, competencies, and room for action to such an extent. However, other cities face similar challenges, and the methodology of the ULSC can be applied to cities that aim to reintegrate logistics infrastructure back into the city.

References

Aljohani, K., & Thompson, R. G. (2016). Impacts of logistics sprawl on the urban environment and logistics: Taxonomy and review of literature. *Journal of Transport Geography*, *57*, 255–263.

Beckers, J., & Verhetsel, A. (2021). The sustainability of the urban layer of e-commerce deliveries: The Belgian collection and delivery point *networks. European Planning Studies, 29(12), 2300–2319. https://doi.org/10.1080/09654313.2021.1921118*

Buldeo Rai, H., Kang, S., Sakai, T., Tejada, C., Yuan, Q. (Jack), Conway, A., & Dablanc, L. (2022). 'Proximity logistics': Characterizing the development of logistics facilities in dense, mixed-use urban areas around the world. *Transportation Research Part A: Policy and Practice*, *166*, 41–61. https://doi.org/10.1016/j.tra.2022.10.007

Bundesamt für Statistik (BFS). (2019a). *Statistik der Bevölkerung und der Haushalte (STATPOP)*.

Bundesamt für Statistik (BFS). (2019b). *Statistik der Unternehmenstruktur (STATENT)*.

Dablanc, L., & Rakotonarivo, D. (2010). The impacts of logistics sprawl: How does the location of parcel transport terminals affect the energy efficiency of goods' movements in Paris and what can we do about it? *Procedia-Social and Behavioral Sciences*, *2*(3), 6087–6096.

Diziain, D., Ripert, C., & Dablanc, L. (2012). How can we Bring Logistics Back into Cities? The Case of Paris Metropolitan Area. *Procedia - Social and Behavioral Sciences, 39, 267–281. https://doi.org/10.1016/j.sbspro.2012.03.107*

Justen, A., Ancel, R., Mathys, N., Schiller, C., Jermann, J., Harder, F., Heath, C., Angliker, S., Buschor, O., Hoser, M., Uhlig, J., Landmann, J., Drugge, B., Weiß, C., Eichler, M., Lauper, S., Bodenmann, B., Bürki, P., Täschler, S., … Brutsche, A. (2022). *Schweizerische Verkehrsperspektiven 2050* (S. 346) [Grundlagen]. Amt für Raumentwicklung.

Kedia, A., Kusumastuti, D., & Nicholson, A. (2020). Locating collection and delivery points for goods' last-mile travel: A case study in New Zealand. *Transportation Research Procedia*, *46*, 85–92. https://doi.org/10.1016/j.trpro.2020.03.167

Kuchenbecker, M., Schmid, J., & Tschumper, L. (2020). *Konzept Stadtlogistik Bern* (S. 94). Amt für Umweltschutz Stadt Bern. *https://www.bern.ch/politik-und-verwaltung/stadtverwaltung/sue/amt-fur-umweltschutz/umwelt-und-energie/fachstelle-*mobilitatsberatung/projekte-und-berichte/konzept-stadtlogistik-bern-1/logistikkonzept-stadt-bern-abschlussbericht-def-1.pdf/view

Ruesch, M., Todesco, P., & Hegi, P. (2020). A positive planning approach to secure logistics facilities in urban areas. *Transportation Research Procedia, 46, 69–76. https://doi.org/10.1016/j.trpro.2020.03.165*

Sakai, T., Kawamura, K., & Hyodo, T. (2019). Evaluation of the spatial pattern of logistics facilities using urban logistics land-use and traffic simulator. *Journal of Transport Geography*, *74*, 145–160. https://doi.org/10.1016/j.jtrangeo.2018.10.011

Sakai, T., Romano Alho, A., Bhavathrathan, B. K., Chiara, G. D., Gopalakrishnan, R., Jing, P., Hyodo, T., Cheah, L., & Ben-Akiva, M. (2020). SimMobility Freight: An agent-based urban freight simulator for evaluating logistics solutions. *Transportation Research Part E: Logistics and Transportation Review*, *141*, 102017. https://doi.org/10.1016/j.tre.2020.102017

Schmid, T., Hegi, P., & Fischer, R. (2021). *Faktenblatt zum Güterverkehr* (S. 2). Amt für Umweltschutz Stadt Bern.

Schmid, T., Ruesch, M., & Bohne, S. (2019). *Städtische Handlungsfelder in der urbanen Logistik* (S. 40). Städtekonferenz Mobilität.

Sogaris. (2022). *Sogaris.fr*. https://www.sogaris.fr/

Taniguchi, E., Thompson, R. G., & Yamada, T. (2016). New Opportunities and Challenges for City Logistics. *Transportation Research Procedia*, *12*, 5–13. https://doi.org/10.1016/j.trpro.2016.02.004

Todesco, P., & Ruesch, M. (to be published). *Erzeugungsraten im Güterverkehr* [ASTRA VPT Forschungsprojekt].

Verlinde, S., Macharis, C., & Witlox, F. (2012). How to Consolidate Urban Flows of Goods Without Setting up an Urban Consolidation Centre? *Procedia - Social and Behavioral Sciences*, *39*, 687–701. https://doi.org/10.1016/j.sbspro.2012.03.140

Xiao, Z., Yuan, Q., Sun, Y., & Sun, X. (2021). New paradigm of logistics space reorganization: E-commerce, land use, and supply chain management. *Transportation Research Interdisciplinary Perspectives*, *9*, 100300. https://doi.org/10.1016/j.trip.2021.100300