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The future of urban freight transport: Shifting the cities role from observation to operative steering

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Abstract

Urban freight transport is characterised by an increasing frequency of shipments into urban spaces. These shipments are carried out by a variety of freight carriers that operate independently and keep their operative information within their organisations. However, an unfortunate chaining of independent shipment operations affects the urban transportation network negatively. Establishing a data-based cooperation between these companies promises benefits for both the companies and the overall transportation network. In this context, an impartial and fair mediator is needed to bring together the data of each actor at a central point in order to steer the urban freight transport from a system perspective.

This paper lays the fundament to prepare cities for taking over this responsible task. By creating a data foundation for the operative steering of the urban freight transport system, it contributes to national and supranational objectives regarding the sustainable development and a worldwide pioneering role for Europe.

Keywords: urban logistics; smart city; freight transport; data-driven; decision support systems; sustainability

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1. Introduction and Motivation

Today, around 72% of the European population work or live in urban areas (EEA 2017). It is assumed that this number will grow in the course of the next decades (European Commission 2019a), as urban areas provide an accumulation of goods and services (e.g., shops, restaurants, theatres, sport studios) as well as educational (e.g., schools, universities, language courses) and workplace offers. The fact that all these offers converge in urban areas leads to various demands with regard to the urban space which subsequently results in a competition for urban spaces and their usage. One share of this urban space is demanded by the mobility of goods. Intensified by an increasing frequency of freight deliveries and a higher number of urban freight transport trips (Letnik et al. 2018), cities are more than ever challenged to improve the liveability and enjoyability for residents and visitors. At the same time, they aim at increasing the efficiency of the transportation network and minimising the negative effects of the resulting traffic volume (e.g., impairment of traffic flows, wear and tear of the infrastructure, emission of noise and pollutants) (Brůhová Foltýnová et al. 2018).

In orientation to the work of Letnik et al., the main challenges in the field of urban freight are an increasing demand for urban freight deliveries, emissions and low utilisation rates of urban delivery vehicles, energy consumption, an inadaquate road transport infrastructure (e.g., narrow streets and physical barriers in city centers), increasing congestion in urban areas, high delivery cost for last mile delivery options as well as a lack of transhipment facilities (e.g., leading to inefficient circulation, double parking or other violations of established traffic regulation policies such as blocking taxi lanes or bus stops) (Letnik et al. 2018). In addition, these challenges are amplified through established logistics approaches such as just-in-time or just-in-sequence delivery into the process (e.g., in production industry). From the perspective of the urban transportation network, this can be seen as an unregulated relocation of storage space to the transportation network that leads to an increase of freight transport including the associated side effects – e.g., increasing traffic flow, density of vehicles and emissions as well as the perception of these effects by traffic participants, residents and municipal decision makers. One subsequent consequence of these developments is an increasing load factor for the urban transportation network and an increasing importance of the traffic quality inside the urban areas, which describes the effects of the interaction between traffic demand and traffic supply (e.g., in the form of a resulting traffic flow) (Steierwald et al. 2005).
Looking at the situation in Germany, around 70% of the freight transport happens through the street network and the revenue inside the logistics sector grew from 154 billion Euro in 2000 to 267 billion Euro in 2017, which represents an increase of approx. 73% (Statista 2019).
Through the above-mentioned developments within the last two decades, the importance of the urban freight transport field for our society has increased sharply, which has as well led to an increase in research activity all over the world. This has also been the starting point for a continuous deepening of related thematic fields, the scientific exploration of various sub-themes that are directly related to the overall system of urban freight transport as well as the motivation behind our work.

Our approach is based on the main hypothesis that the quality and added value of decisions regarding a targeted maximum traffic quality for the overall system is higher from the system perspective than the benefit in the case of individual decisions (e.g., from one logistics company) with individual interests. The information situation in logistics companies (e.g., fleet management systems of freight carriers with positions, routes and load factors of vehicles) is treated so far as an individual resource of the company and used in order to reach the individual goals (e.g., profit maximisation). However, an unfortunate chaining of uncoordinated individual decisions of multiple logistics companies will have a direct, negative influence on the traffic quality and thus also a direct effect on the profitability of the individual intentions. At the same time, the higher population density (consumer density) in urban areas leads to a higher demand for freight transport into these areas. Through an intelligent linking of the resulting delivery services, an added value can be achieved for both the companies (e.g., by increasing the load factor of their delivery vehicles and saving resources by exploiting bundling potentials among different logistics companies) and for the overall urban freight transport system (e.g., reduced single trips, improved traffic flow). In order to achieve this win-win situation, we aim at a data-driven, cooperative approach between logistics companies and municipalities in which logistics companies (e.g., freight carriers) share information (e.g., planned deliveries including routes and allocated vehicles) with the city. In exchange, the city offers combined information regarding the urban transportation network (e.g., suitable time frames for deliveries into certain districts of the city) and demands the involved actors to behave accordingly (e.g., by avoiding rush hours of individual transport). In order to enrich the municipal role towards an operative steering of the urban transportation network, it is necessary to exploit the potential behind the digitalisation of logistics and transport processes making use of public and corporate data to derive information from it.

Recent advances in other fields of application (e.g., production technology) with regard to the transparency and availability of data as well as information (e.g., *Internet of Things*) underline the relevance and highlight the potentials of centralized data streams (Pomp et al. 2018). Transferred to the field of urban mobility, the exchange of data between the relevant actors in the system of urban freight transport can be a promising prerequisite for cooperative approaches and incentives (e.g., measurable added values) and can lead to participation (e.g., contribution of data) of the involved actors. Incorporating the system of urban freight transport with information generated from actual in-time data enables the deduction of relationships (e.g., between actors, measures), of actions as well as the assessment of their potential impacts. In addition to a comprehensible communication of the potential multilateral added values and the development of further incentive systems, there is currently a particular need for corresponding information models (e.g., interrelations of available data, sources of information), which in the next step will lay the foundation for implementation in software systems for municipal decision makers (e.g., data platforms, decision support systems).

As the initial situation regarding the competition for urban spaces is a complex one (e.g., different actors, few coordination), an approach from system perspective is needed, which takes into account the versatility of the framework conditions and influencing factors. Our goal behind this work is to identify the requirements regarding the necessary information (e.g., relevant key performance indicators) as well as their preparation for a decision support system for municipal decision makers to be configured based on the individual situation of a city. It follows the purpose to identify and estimate the impacts (e.g., benefitial potentials) of operative decisions in the field of urban freight transport in Germany considering the regional, national as well as international context (e.g., mobility strategies, sustainability goals). This data-driven approach contributes to solving the above-mentioned, main challenges in the field of urban freight transport (e.g., by coordinating demands in order to increase the load factor of the vehicles and reduce the overall emissions) so that the urban transportation network stays capable to process the incoming demands in an efficient, city- as well as environment-friendly manner.

Our work was carried out along the following research questions:
(1) What are the international and national framework conditions (especially political targets) from Germany's point of view? (Chapter 2)
(2) What are the main components, inputs, influence parameters and outputs of the urban freight transport system? (Chapter 3)
(3) Which data are or should be available in the future for municipal decision makers in order to gain deeper insights and derive information or operative decisions (e.g., actions) for the urban freight transport system? What are potential data sources? Which are existing interrelations between the data? (Chapter 4)

2. International and National Context

In this chapter, the international and national context of our work will be described from the perspective of Germany with regard to political objectives and measures. Starting with worldwide goals from the United Nations, we give a selective overview about the supranational context in Europe, the national context in Germany as well as the regional context in the City of Aachen.

States all over the world share connecting, supranational responsibilities and pursue common goals based on them. For instance, the *Sustainable Development Goals* (SDG) of the United Nations aim at ensuring a sustainable development of the planet on economic, social as well as ecologic level (United Nations 2015). With regard to urban freight transport, different of the mentioned goals are either directly or indirectly related to the examined field (e.g., *good health and well-being*; *economic growth and productive employment*; *cities and communities*).

In Europe, different initiatives to contribute to the overall sustainability goals are being undertaken by the European Commission. Besides the *Whitepaper in Transport*, in which an overall cut of the CO_2 emissions from transport activities as well as CO_2-free city logistics in urban centres are targeted by 2030 (European Commission 2011), two further examples are mentioned here: *HORIZON Smart Green and Integrated Transport* and *Sustainable Urban Mobility Plans*. The latter aim at "improving the accessibility of urban areas and providing high-quality and sustainable mobility and transport to, through and within the urban area" (European Commission 2013), while the above-mentioned HORIZON module aims at "resource efficient transport that respects the environment", "better mobility, less congestion, more safety and security", "developing new concepts of freight transport and logistics" and supporting "a global leadership for the European transport industry" (European Commission 2019b).

At the national level for Germany, different initiatives that underline the need for innovative approaches to solving urban challenges in freight transport can be mentioned as examples. First, the environment-oriented *National Climate Action Plan*, that persues the implementation of a greenhouse gas-neutral system in Germany by 2050 and in which "transport" was identified as one of the five focal points of action (BMU 2019). Secondly, Germany has introduced the *High-Tech Strategy* with a focus on mobility. Driven by the rise of new technologies, changing mobility behaviors and a progressive digitalisation, this strategy aims at promoting corresponding research activities as well as seeing the mobility of the future as an integrated overall system (German Federal Government 2018).

Based on the supranational and national objectives, such as the examples mentioned above, regional decision makers develop approaches for a contribution to the overall objectives. For example, the city of Aachen developed the *Mobility Strategy 2030* including a dedicated section focusing on the freight delivery situation in the city centre. This strategy document mentions the raising number of parcel deliveries as well as their increasing share in total traffic volume and concludes a lack of exploitation of significant bundling potential because of the existing competition inside the freight transport market (City of Aachen 2015).

For our work, we extract that national and supranational objectives and measures aim at a sustainable development of urban spaces. In this context, urban freight transport has essential contribution opportunities by increasing its efficiency (e.g., by reducing the resource usage), reducing the negative side effects (e.g., impairment of traffic flow, emissions of pollutants) and optimizing the load of the transport infrastructure (e.g., by bundling shipments through cooperation). In order to steer the urban freight transport system in a targeted way, municipal decision makers need to be provided with data-based insights regarding the current state of the urban transportation network (e.g., in the form of key performance indicators) as well as the potential effects of decisions on that network (e.g., bundling selected deliveries). With special regard to the necessary data foundation, the current framework conditions (e.g., the running *High Tech Strategy* in Germany) indicate a supportive environment for our approach.

3. Urban Freight Transport System

In this chapter, we first define the underlying research object of *urban freight transport*. This includes a definition of the term, an overview of synonymous terms found in the literature as well as an insight regarding the range of sub-topics that have been discussed scientifically within recent years. Based on that, we describe our systemic approach with special regard to the inner components of the urban freight transport system, its inputs, outputs as well as internal and external parameters influencing the system behavior.

The field of urban freight transport has already been a research topic for at least two decades. Around the year 2000, Taniguchi et al. defined *City Logistics* as "the process for totally optimizing the logistics and transport activities by private companies with the support of advanced information systems in urban areas considering the traffic environment, its congestion, safety and energy savings within the framework of a market economy" (Taniguchi et al. 2003). Besides that, further synonymous terms can be found in the literature. These are, for example: *Urban Logistics* (cf. Lagorio et al. 2016; Behrends 2016; Gonzalez-Feliu et al. 2014), *Urban Freight Transport* (cf. Letnik et al. 2018; Le Pira et al. 2017; Cui et al. 2015; Lindholm 2013), *Urban Goods Movement* (cf. Russo and Comi 2010) or *Urban Freight Distribution* (cf. Cepolina and Farina 2015).

Regarding this field of studies, systematic literature reviews have been undertaken, for example, by Dolati Neghabadi et al. 2018 and Lagorio et al. 2016. Furthermore, research in recent years has covered a wide range of sub-topics. Exemplarily, these are the following overviewing works:
- actors and stakeholders (cf. Lindholm 2013)
- city planning (cf. Sánchez-Díaz and Browne 2018)
- collaboration (cf. Cleophas et al. 2019)
- decision support (cf. Bozzo et al. 2014)
- delivery schemes (cf. Sánchez-Díaz et al. 2017; Nemoto, Toshinori and Browne 2014)
- financing (cf. Gonzalez-Feliu et al. 2014)
- modelling and simulation (cf. Anand et al. 2015; Taniguchi et al. 2014; Jong et al. 2013)
- policies and measures (cf. Letnik et al. 2018)
- routing and optimization (cf. Sun et al. 2015)
- sustainability (cf. Nenni et al. 2019)
- transport planning (cf. SteadieSeifi et al. 2014; Lindholm and Behrends 2012)

In our work, we take a control system perspective on the urban freight transport system from the view of municipal decision makers aiming at maximizing the traffic quality inside the city by steering the freight transport into, within and out of the city. The system itself experiences inputs as well as influence parameters (of internal and external nature) and generates outputs as well as systemic losses (cf. Fig. 1), which will be described in detail in the further course of this chapter.
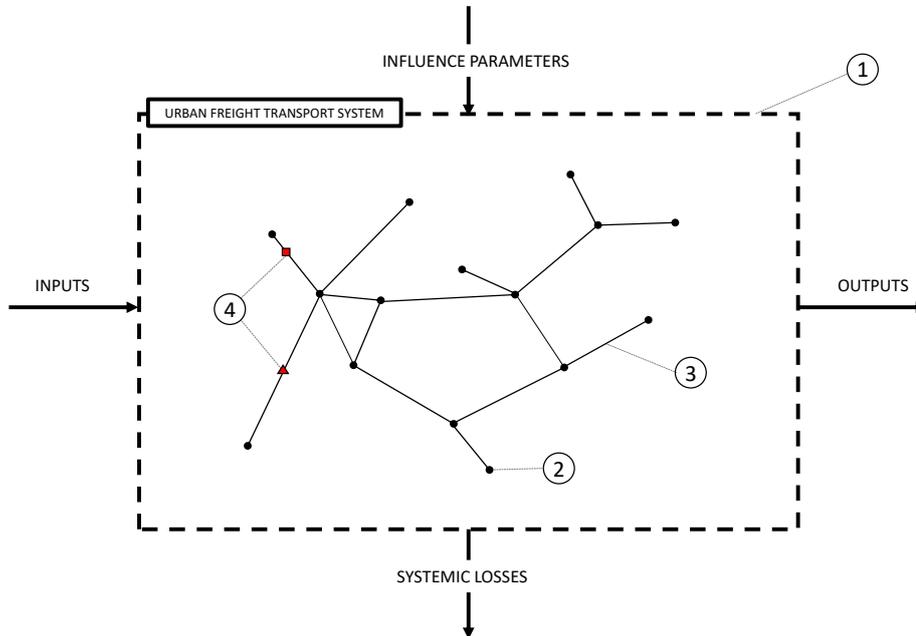

Fig. 1 Urban Freight Transport System – **(1)** system boundaries (e.g. city boundary); **(2)** nodes (e.g.,intersections, hubs); **(3)** edges (e.g., streets); **(4)** entities (e.g., shipments, vehicles)

3.1. Components

In our approach, the urban freight transport system consists of the following key elements inside the system boundaries (e.g., the external border of a central urban area with a comparatively high traffic volume):
- intersections (as nodes)
- roads (as edges and links between the nodes)
- traffic control devices (e.g., traffic lights, traffic signs)
- traffic information devices (e.g., dynamic traffic management signs)
- freight transport related components (e.g., shipments, vehicles, hubs, pick-up points for deliveries, zones for loading and unloading)

3.2. Inputs, Influence Parameters and Outputs

Inputs
When performing the transportation task, the system processes different input parameters. For our approach, we consider public and freight transport as the most important inputs.

As the extent of *public transport* services usually follows fix schedules with regular changes (e.g., from day to night or on a seasonal basis), we consider it as an input parameter in the form of a calculable noise floor for the urban freight transport system.

Another essential input parameter for the urban freight transport system is the *freight transport arising from the demand inside the urban area*. The extent of this transport can be quantified through the shipments (e.g., amount, dimension) into, within as well as out of the urban area. In Chapter 4, we will describe the data and information involved as well as their systemic relationship in detail.

Influence Parameters

From our perspective, the following three influence parameters are of special importance for the urban freight transport system:

- individual passenger transport
- behavior of actors and stakeholders
- municipal decision making

In comparison with the public transport, the *individual passenger transport* (e.g., with cars) is not a periodic input variable for the urban freight transport system. It can as well be assessed as time-dependent, but due to its sensitivity to events (e.g., peak hours after work, events in the city) or the prevailing weather conditions, the individual passenger transport should be handled as a measurable influence parameter that affects the traffic quality (e.g., traffic flow, double parking through parking demand) inside the urban area.

One further influence parameter is the *behavior of actors and stakeholders*. Based on the work of Letnik et al., actors are identified through the fact that they affect issues in urban freight directly (e.g., planners and regulaters from local authorities), while stakeholders are identified through their direct interest in urban freight (e.g., individuals, companies, interest groups) (Letnik et al. 2018). Based on the gathering work of Gatta et al., the main actors respectively stakeholders from the private and public sector can be categorised in *shippers*, *freight carriers, receivers, residents* as well as *planners and regulators* (Gatta et al. 2017).

Another parameter influencing the procedures within the urban freight transport system are the *municipal decision making* respectively the applied logistics policies and measures. Based on the systematic overview created by Letnik et al., these policy measures can be structured into *regulatory*, *land use planning*, *infrastructure*, *management* as well as *policy measures related to new technologies* (Letnik et al. 2018).

Outputs and Systemic Losses

While processing the input parameters under effect of the above-mentioned influence parameters, the transport system produces both wanted outputs and unwanted outputs (systemic losses). These outcomes of the system can be measured in a qualitative (e.g., increase of processed number of shipments) as well as in a quantitative way (e.g., 12% increase of processed number of shipments). In a next step, these measurements serve the following four purposes for municipal decision makers:

- assessing the current situation of the urban freight transport system
- observing the time-dependent development of the system
- providing foundations for actions
- evaluating the impact of undertaken actions as well as existing influence factors

As described by Gatta et al., typical *indicators for the outputs* related to urban freight transport are vehicle movements and load factors as well as financial, social and process indicators (e.g., cost-benefit relations, number of generated jobs or customer satisfaction, flow of goods and traffic) (Gatta et al. 2017).

Furthermore, urban freight transport is also accompanied by negative side effects on the system (e.g., congestion, emission of noise and pollutants), that can be expressed in monetary terms (e.g., time costs of delays, health costs through air pollution, productivity losses due to time spent in congestion). From an economic perspective, these side effects on society are called *external costs* (European Commission 2014). As these negative side effects do not have a positive contribution regarding the transportation task, we consider them as unwanted outputs of the transport system and classify them as *systemic losses*.

4. Operative Steering Approach

In this chapter, we describe the data-related fundament for our operative steering approach based on the model of the urban freight transport system that has been explained in Chapter 3. As a first step, we isolate potential data sources. Afterwards, we take a closer look at the data related to shipments, vehicles and the overall transportation network as well as their interrelations. Finally, in order to form the fundament for the observation and the target-oriented operative steering of the urban freight transport system, we deduce key performance indicators from these data and their interrelations.

4.1. Data Sources

For our approach, we identified the following three categories of data sources:
- *data measured by the city* (e.g., sensors which count the amount of incoming and outgoing traffic)
- *data generated by other actors* (e.g., schedules and movement data from public transport companies or number of shipments and their distribution to different types of delivery vehicles from freight carriers)
- *data from other sources* that allow concluding an effect on the urban freight transport system (e.g., event calendars, weather forecast)

4.2. Data and Interrelations

One key purpose of urban freight transport is to transport shipments inside the urban transportation network using delivery vehicles. As a first step, we therefore focus on data related to the following three key elements of the urban freight transport system: shipments, vehicles and the transportation network itself. As shipments are assigned to vehicles and vehicles are deployed into the urban transportation network, we state that there is a direct relation between these three elements and the associated data (cf. Fig. 2).


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┌──────────────┐  assigned to  ┌──────────┐  deployed into  ┌──────────────────┐
│  SHIPMENTS   │──────────────▶│ VEHICLES │────────────────▶│  TRANSPORTATION  │
└──────────────┘               └──────────┘                 │     NETWORK      │
                                                            └──────────────────┘
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Fig. 2 Systemic relationship between shipments, vehicles and the urban transportation network

In the following table, we take a closer look at the data associated to these three elements and indicate potential sources for the data acquisition. The table is structured into three columns:
- *data:* numbered collection of data related to each element
- *interrelations:* indication of data which the considered data can be deduced from (if applicable)
- *source:* potential source for the data acquisition

Table 1. Data related to shipments, vehicles and the transportation network.
C: "data measured by the city"; A: "data generated by other actors"; O: "data from other sources"

		DATA	INTER-RELATIONS	SOURCE
SHIPMENT	1	origin	-	
	2	dimensions	-	
	3	volume	2	A (shipper)
	4	weight	-	
	5	destination	-	
	6	shipper	-	
	7	job number	-	
	8	type (individual / cumulative)	-	A (freight carrier)
	9	receiver type (e.g., hub)	-	
	10	quantity	-	
VEHICLE	11	freight carrier	-	
	12	type	-	
	13	dimensions	12	
	14	position	-	
	15	load capacity	12	A (freight carrier)
	16	load factor	2, 15	
	17	route	14, 18	
	18	destination	-	
	19	emission (pollutant, noise)	12	
	20	quantity	-	

	21	street segment length	-	O (e.g., Open Street Maps)
	22	street segment capacity	13, 21	C
	23	intersections	-	O (e.g., Open Street Maps)
TRANSPORTATION NETWORK	24	hub position	-	
	25	hub capacity	-	A (freight carrier)
	26	hub load factor	2, 25	
	27	individual transport	-	C (e.g., ground-sensors, cameras)
	28	public transport	-	O (e.g., public transport provider)

The data collected in Table 1 build the fundament for the deduction (e.g., resulting from a combination of different data) respectively the calculation of various key performance indicators of the urban freight transport system that will be presented in Table 2. The table is structured into three columns:

- *key performance indicator:* collection of key performance indicators
- *data:* indication of data, from which each key performance indicator can be deduced (cf. Table 1)
- *variation:* variation of each key performance indicator with regard to different temporal or spatial reference values

Table 2. Key performance indicators of the urban freight transport system.

	KEY PERFORMANCE INDICATOR	DATA	VARIATION
A	shipments (planned)	1, 5, 10	sum overall; per district / time / freight carrier
B	bundling potential	A, 11, 16	sum overall; per district / time / freight carrier
C	shipments (processed)	1, 5, 10, 11	sum overall; per district / time / freight carrier
D	vehicles involved	C, 20	sum overall; per district / time / freight carrier
E	load factor	C, 2, 12, 15	per vehicle; average per vehicle type / freight carrier / overall
F	share of freight traffic	17, 20, 27, 28	overall; per district / time / street segment
G	share of successful deliveries	E	overall; per district / time / freight carrier
H	share of deliveries to hubs	C, 9, 24	overall; per district / time / freight carrier
I	share of indiv./cumul. deliveries	C, 8	overall; per district / time / freight carrier
J	traffic flow	13, 17, 20, 21, 22	overall; per district / time / street segment
K	shipment flow	C, 21, 22	overall; per district / time / street segment / freight carrier
L	speed	14	per vehicle; average per vehicle type / freight carrier / overall
M	congestion (length, duration)	14	overall; per district / time / street segment
N	CO_2 emission	11, 12, 14, 17, 19, 20, 21	overall; per vehicle / vehicle type / freight carrier / area / street segment / district
O	noise emission		
P	acceptance (e.g., of residents)	-	overall; per district / time / freight carrier

5. Conclusion and Outlook

Worldwide efforts for the sustainable development (e.g., *Sustainable Development Goals*) and related binding legal requirements can already be found, for example, in Europe on both national as well as supranational level. In addition, people and their related mobility needs for persons and freight accumulate in urban areas, which is why urban freight transport plays a central role towards these goals. This importance also implies increasing responsibilities and shaping potentials for municipal decision makers.

In order to exploit these potentials, we suggest empowering cities towards an efficient, operative steering of the urban freight transport. This demands supporting tools (e.g., decision support systems) based on reliable in-time information, which will enable an efficient handling of the urban transport from a system perspective on the one hand and a proactive management of the potential negative side effects on the other hand. In this context, we think that the quality and the benefit of decisions for the overall urban transportation network is higher from the system perspective rather than from the perspective of an individual actor (e.g., one freight carrier) with its individual interests. However, the achievable quality of decisions depends highly on the information available at the time of the decision. In our view, a fundamental prerequisite is therefore a high degree of data availability. Thus, it should

be aimed at maximizing the availability of data and information as well as their efficient handling. Instead of isolated data-exchanges, centralized high-quality data flows from different actors (e.g., several freight carriers operating inside the city) are of interest to form a fundament for a sustainable urban development in the context of urban freight transport. However, the fact that the proposed exchange of data has not yet taken place, can be attributed to missing quantification and communication of the potential benefits. Recognizing these benefits would serve as a strong incentive and leverage the involved actors to cooperate.

Another impeding effect regarding cooperation potentials is the fact that competition in the logistics sector is dominated by intense competition for information advantages (e.g., due to the high similarity between business models of freight carriers). This results in increased barriers to enter into cooperation between different market participants, which calls for an impartial and fair mediator (i.e. without giving preference to individual market participants) between them. That mediator should use the available, bundled information for the benefit of increasing the efficiency of the overall system, which at the end benefits again each individual market participant. Due to its interests, we believe that the city is a suitable carrier of this fundamental task, which has not been solved so far. In this context, particular importance should be given to ensuring a high level of security for corporate-individual information (e.g. through anonymization) on the one hand, and to creating binding, plannable incentives and benefits (e.g. cost savings through the bundling of freight traffic) on the other.

From our perspective, further research needs to be undertaken in order to pave the way for the integration of this operative steering approach for the urban freight transport system. Our future research will concentrate on different related aspects: first, the suggested data fundament should be exploited, collected and consolidated centrally for an exemplary city (pilot project) in the course of a data-oriented cooperation between that city and different actors inside the system (e.g., freight carriers). Besides the quantification of single parameters, this enables the identification of qualitative and quantitative interrelations between them. In order to gain further insights from the data, visualisation (e.g., average and peak values, development over time or per district) will play a central role and support municipal decision makers with observing and evaluating the performance of the urban freight transport system. In a next step, these insights lay a data-based fundament to explore a wide range of actions that could be initiated by the city (e.g., central bundling of planned deliveries, temporal or spatial restrictions and priorities, dynamic routing of freight traffic, positioning of consolidation centres or pick-up points).

Based on the changed circumstances regarding the availability of data, the foundation is laid for an expansion of our approach with up-to-date data science methodologies in the environment of machine learning. These methodologies could empower decision support systems to deduce recommendations for the steering of the urban freight transport system through municipal decision makers based on knowledge acquired from effective demands and the observed effects of actions that had been initiated in the past.

Due to the versatility of local conditions (e.g., economy, geography, structure and quality of transport infrastructure), the approach should be applied to other cities and regions in order to assess its transferability. The findings during this process should be used for the further concretisation of the municipal role inside the approach, the definition of accompanying responsibilities and scope of actions for the city.

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