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# Guidelines for transferring sustainable urban logistics concepts



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# Guidelines for transferring sustainable urban logistics concepts

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***Purpose:*** *Inner-city freight transports are characterized by numerous deficits, such as congested infrastructure and increasing emission and noise levels. Sustainable urban logistics is a field with many concepts to improve the efficiency and sustainability of these transports. However, guidelines how to transfer and implement successful concepts in other cities are missing.*

***Methodology:*** *We follow a multi-method approach using a systematic literature review, a multi case study analysis and expert interviews.*

***Findings:*** *First, we identify and characterize 16 concepts of urban logistics. Additionally, seven profiles for typical urban areas are developed based on important factors influencing urban logistics. Second, 137 projects in 70 cities are analyzed. The concepts of urban logistics are aggregated to three urban logistics systems. Their fit with typical urban areas is evaluated. Finally, the findings are assessed with expert interviews and a framework for transferring sustainable urban logistics concepts to other cities is proposed.*

***Originality:*** *The adaptation of urban logistics concepts to specific local environments receives little attention in the literature. By proposing a framework for the transfer of sustainable urban logistics systems, this paper integrates the knowledge gained in urban logistics projects in many cities. Future projects may benefit from a faster and more efficient successful implementation.*

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# 1 Introduction

Increasing urbanization, along with constantly growing online retail and demographic changes, are the main drivers for the increasing demand and intensity of urban freight transport. Supply, distribution and disposal are essential to maintain the functionality of cities. The implementation of these logistics activities serves to satisfy the needs of citizens, commerce and industry in urban areas. But due to resulting negative effects, it conflicts with the ambition of creating livable cities (Straube, Reipert and Schöder, 2017).

In the past, network planning of logistics service providers was focused on supplying a small number of customers or markets with high volumes per stop. For example, freight forwarders' transshipment and consolidation centers were often located outside the city, and deliveries to customers were made by vehicles with large load volumes with an optimized vehicle capacity utilization. Dedicated logistics space in city centers was rarely considered advantageous due to high land prices and additional handling costs. More recently, the growth of online retail, among other things, has led to an increase in B2C deliveries to private households, characterized by low delivery volumes and a high number of stops per tour. This results in a reduced vehicle capacity utilization in existing freight transport concepts and at the same time an increasing number of vehicles required for supply and disposal. Therefore, a growing need for sustainable urban logistics concepts emerged and both academia and practitioners face the challenge of developing, testing and implementing scalable and transferable concepts.

So far, concept development and testing in urban logistics has focused almost exclusively on individual cities and their local characteristics. Each project is initially launched as a pilot project, developed from scratch and afterwards adapted to the specific circumstances of the focal city (Iwan, 2014). Hence, one of the biggest problems of urban logistics is not a lack of opportunities to optimize inner-city flows of goods, but a lack of concepts for successful transfer and implementation (Stoelzle and Preindl, 2019).

Initial approaches in the context of transferring urban logistics can be found in Baindur and Macário (2013). They analyze the basic requirements and transferability to other cities based on a case study of a lunch box delivery system in Mumbai. Macário (2013) considers urban zones based on three dimensions: City characteristics, stakeholder needs, and product characteristics. By analyzing the similarities and differences of the zones, a best practices approach for transferability of city logistics can be derived (Alho and Abreu e Silva, 2015). Ducret, Lemarié and Roset (2016) develop a spatial clustering of urban zones based on local geographic characteristics with the aim to support logistics service providers and public administration in location planning and development. Based on the clustering, transferability of logistics systems can be tested to a limited extent (Ducret, Lemarié and Roset, 2016). Still, it is limited by only considering geographic influencing factors and by missing adaptation strategies across unequal clusters.

The adaptation of urban logistics concepts to specific circumstances receives little attention in literature. Tadić, Zečević and Krstić (2014) develop a general procedure for the structured selection of the most suitable components of urban logistics concepts based on local characteristics. Specific influencing factors must be determined individually for each city by expert groups. However, possibilities for the design of the components are not considered in detail.

There is a lack of practice-relevant models for transferability strategies of successful urban logistics concepts (Stoelzle and Preindl, 2019). Future projects can be implemented faster and more successfully by systematically considering factors that influence the optimal design of urban logistics concepts (Bienzeisler, et al., 2018). Considering the large number of projects currently ongoing and in planning, this can lead to significant time savings, efficiency gains and a higher success rate of implementation.

Addressing this research gap, the subject of this article is the transfer of sustainable city logistics concepts to representative city profiles. Decision makers and logistics companies shall be supported in the development of a specific city logistics system and practice-relevant guidelines for a successful transfer of already established logistics concepts.

## 2 Theoretical background

The literature on urban logistics is highly fragmented and no universal definition of urban logistics exists in academic literature. An overview of different definitions of urban logistics can be found in Rose, et al. (2017) and Wolpert (2013), among others. Following Gonzalez-Feliu, Semet and Routhier (2014), the authors of this article view urban logistics as a multidisciplinary field that aims to understand, analyze and link the different stakeholders, logistics concepts and planning actions related to the improvement of supply chains, logistics systems and freight transport in urban areas, emphasizing their synergies and decreasing related negative externalities.

One of the main characteristics of urban logistics is that it operates in a complex and highly condensed environment with a large number of different stakeholders (Nesterova and Quak, 2016). As some of these stakeholders pursue very different objectives it becomes important to consider the individual interests and interactions with each other when planning and designing urban freight transport. Taniguchi (2014) identifies shippers, transportation companies, public administrations, and residents as relevant stakeholders of urban logistics. Similar approaches can be found in Nathanail, Gogas and Adamos (2016), Wolpert (2013), Bozzo, Conca and Marangon (2014), and Russo and Comi (2010). The objectives of these stakeholders overlap only in parts and are highly divergent in several aspects, something which should be considered in urban logistics design.

Individual measures that support achieving the sustainability goals of urban logistics are called urban logistics concepts. Each of these different concepts affects only a part of the overall urban logistics objectives. One example of this is the substitution of vehicles with conventional drives by battery-electric vehicles or cargo bikes on the first and last mile (Sinn, 2020). Among other things, this substitution enables a reduction in local emissions, but may not be economically advantageous for the transport companies (Taniguchi, 2014). In order to compensate for the disadvantages of individual concepts and/ or to realize synergy effects, several concepts can be combined, such as the subsidization of electric vehicles by local and national governments. The resulting construct is described as an urban logistics system. A successful urban logistics system addresses the interests of all stakeholders involved, i.e., economic, environmental, and social goals (cf. Figure 1). To achieve this, individual urban logistics concepts must be tailored to the local conditions of the city (concept-level) as well as to each other (system-level).

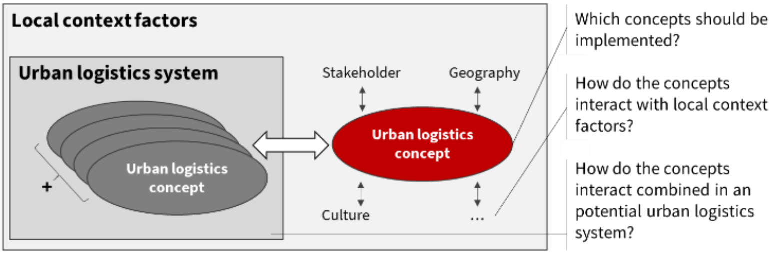


Figure 1: Context factors of urban concepts and systems

So far, interactions between urban logistics concepts and urban spaces on the one hand and between the different concepts themselves on the other hand have only been examined to a limited extent. Therefore, it is necessary to identify successful concepts and their local influencing factors. To enable the transfer of sustainable urban logistics concepts to other cities, it is also necessary to identify possibilities to adapt each concept to the specific circumstances of the focal city.

## 3 Research design

The topic is addressed using a multi-method approach. First, a systematic literature review is conducted to gain insight into urban logistics concepts as well as factors influencing urban logistics and possibilities to customize the identified concepts. Second, a case study analysis is performed and data on urban logistics projects in European cities is collected. Profiles for typical urban areas are derived and best practices for each profile are identified. Third, semi-structured interviews with urban logistics experts are used to validate and complement the results and to form a framework for transferring sustainable urban logistics concepts to other urban areas. In the following, the different methods are described in more detail.

### 3.1 Systematic literature review

The systematic literature review is employed using the approach by Durach, Kembro and Wieland (2017). It is chosen because it is a framework specifically designed for the research area of logistics and supply chain management. In addition, the Subject Pearl Growing method is used. This method describes the process of successively deriving keywords from a small number of relevant works and defining exclusion criteria. The terms and criteria identified from these are used in subsequent searches to achieve a higher quality of search results. (Zwakman, et al., 2018)

Three search iterations are performed. At first, relevant publications are found by means of an internet search on common search portals (Google, Bing, Ecosia) and the involvement of experts. Resulting keywords are used in a second iteration to identify additional works via the Web of Science and Ebsco portals. The following search strings are used:

(i) urban logistics AND concept

(ii) urban logistics AND sustainable

(ii) (urban OR city OR last mile) AND (Logistics OR freight transport OR freight distribution) AND (concept OR system OR approach OR characteristics OR measures OR models OR typology).

In addition, in a third iteration, the bibliographies of particularly promising works were examined for further publications and included in the pool of literature. A total of 260 search results were identified. The results were consolidated, and duplicates were removed which led to the exclusion of 29 works. This was followed by the elimination of publications based on the developed exclusion criteria given in Table 1 by screening abstracts and conclusions. On this basis another 92 search results were excluded. Finally, after examining the full text, another 47 works were excluded. The final literature sample comprised 92 works.

Table 1: Exclusion criteria for literature review

| Exclusion criterion | Reason for exclusion |
| --- | --- |
| **Language not English or German** | Limited by language skills of the authors |
| **Not last mile logistics** | Research focus on urban logistics |

| Exclusion criterion | Reason for exclusion |
|---|---|
| **General descriptions, no focus on urban logistics concepts** | Low probability of identifying concrete influencing factors and design options |
| **No freight transport** | Pure passenger transport is outside the scope of work |
| **No focus on sustainability** | Traditional urban logistics only relevant for basic understanding |
| **Pure mathematical optimization and/or software integration** | Low probability of identifying concrete influencing factors and design options |

## 3.2 Case study analysis

The objects of analysis are existing and past urban logistics projects in Europe. The focus on Europe was chosen to allow a higher comparability of the projects. Europe was identified in the systematic literature review as the epicenter of research on urban logistics. In addition, due to the major changes that have occurred in urban logistics as a result of digitalization, only projects completed in the year 2000 or onwards are considered.

The cases were identified via online search based on projects already identified through the systematic literature review and an additional selection of European cities. A diverse selection of cities emerged in terms of population size and the related country.

Table 2: Project-specific success factors

| Area of success | Success factors |
|---|---|
| **Economic** | Duration of the project; continuance of the project; extensions of the project; successful collaborations; sales increases; cost reductions; image improvements |
| **Ecologic** | Reduction of emissions (CO2, NOX, particulate matter, etc.); reduction of fuel consumption; reduction of driven (ton) kilometers; higher utilization rates of vehicles |
| **Social** | Reduction of noise; reduction of congestion; reduction of driven (ton) kilometers; access to new services; creation of jobs |

On the one hand, data specific to the project was gathered to be able to evaluate the success of the project. Namely information on economic, ecologic, and social factors were collected (cf. Table 2). The lack of public access to information about the projects makes a clear assessment difficult for some factors. In this case, an estimation had to be made.

On the other hand, project-independent information on the city was gathered to analyze the context in which the projects operate successfully (cf. Table 3). The success factors are based on the results of the literature analysis. The lack of (public) availability of information on some factors poses a major challenge.

Table 3: Project-independent, city-specific context factors

| Area of context | Context factors |
|---|---|
| **Shipment structure** | Population; population density; GDP; GDP (growth); GDP per person; GDP per person (growth); e-commerce share (based on De Marco, Mangano, and Zenezini, 2018; Rose, et al., 2017) |
| **City prosperity** | GDP; GDP per person |

| Area of context | Context factors |
|---|---|
| **Land availability** | Number of inhabitants; area; population density; prices of inner-city areas |
| **Urban infrastructure** | Infrastructure quality according to European Regional Competitiveness Index; congestion levels; smart city ranking; |
| **City clustering** | Number of epicenters of daily life in the city (Senate Department for Urban Development and Housing (2017)) |

## 3.3 Expert interviews

To validate the findings and to fill the gaps that could not yet be answered via the systematic literature review or the case study analysis, semi-structured interviews are conducted. The interview guideline consists of three sections: section 1 gives statements on assumptions and customizing of urban logistics concepts; section 2 focuses on urban logistics on a system level; and section 3 is dedicated to the implementation and applicability. Three experts from (academic) research in logistics and supply chain management from German and Swiss universities were interviewed. The experts were given statements, such as “Do you agree with the most important influencing factors in the category "infrastructure approaches"? Which factor do you rate as particularly relevant?”. They were asked to rate the statements on a five-level Likert scale and to comment. The interviews were subsequently transcribed and send to the experts. They validated the transcripts. If they gave any comments, those were incorporated accordingly.

# 4 Review results

The literature review is conducted with the aim to (i) identify concepts of urban logistics, (ii) identify local context factors influencing the urban logistics concepts and (iii) identify possibilities for adapting the concepts in different environments.

The formal analysis of literature characterizes the authors, year of publication, country of publication, methodology (theoretical/ empirical), point of view (descriptive/ normative), and research area. Classification based on these criteria is a common procedure for literature analysis in logistics and supply chain management (Croom, Romano and Giannakis, 2000; Olsen and Ellram, 1997).

The final literature selection consists of 92 unique works , which are listed in detail with a brief summary in the appendix. Urban logistics has seen a clear increase in scientific publications over the last decade. There is a global interest in urban logistics, with Europe identified as the epicenter of urban logistics research. Descriptive and normative research is about equally present in the literature on urban logistics.

Regarding the content of the identified literature, four research areas within urban logistics are identified: (i) theoretical foundations, (ii) enablers/ basic technologies, (iii) urban logistics concepts and systems, and (iv) evaluation and assessment.

A total of 16 urban logistics concepts are found and assigned to five categories. Table 4 lists the concepts to each category and gives a brief description. In addition, local context factors for each category of concepts are compiled and shown in Table 5.

Table 4: Concepts of urban logistics

| **Concept** | **Description** |
|---|---|
| **Category 1: Approaches to land use** | |
| **Loading bays** | Dedicated handling areas in public spaces that act as pick-up/ drop-off stations for fine distribution in the city (Wolpert, 2013). |
| **Multiple use lanes** | Road lanes that, on the basis of certain characteristics, may only be used by a subset of all vehicles (Russo and Comi, 2010). |
| **Category 2: Infrastructure approaches** | |

| Concept | Description |
|---|---|
| **Urban Consolidation Center (UCC)** | Urban Consolidation Centers are decentralized logistics sites in the periphery of urban areas where freight flows are consolidated and distributed with fewer and/ or smaller delivery vehicles (Morfoulaki, et al., 2016; Souza, et al., 2014). |
| **Micro Consolidation Center (MCC)** | Micro Consolidation Centers are decentralized logistics sites in urban areas where freight flows are consolidated and delivered with fewer and/ or smaller delivery vehicles to their point of destination (Crainic, et al., 2009). |
| **Pick-up/ drop-off stations** | Similar in function to UCC/MCC but connecting carriers and shippers/ recipients. The carrier delivers the goods to the station, which later are picked up by the recipient. Returns can be handed over to the carriers (Quak, Balm and Posthumus, 2014). |
| **Modal split concepts** | Shifting freight traffic from road to other modes of transport, e.g., rail/ public transport, water, air (Liu, et al., 2008; Mazzarino and Rubini, 2019). |
| **Category 3: Technological approaches, traffic management** | |
| **Environmentally friendly drives** | Use of emission-free/ low-emission means of transport for freight transport on the road (Taefi, et al., 2016). |
| **Cargo bikes** | (Electric) bikes with transport capacities between 50-500 kg, that are often used for last mile deliveries in urban areas (Nürnberg, 2019). |
| **Intelligent transportation system (ITS)** | Collecting, transmitting and processing of traffic-related data with information and communication technologies with the aim to optimize and shape inner-city traffic (Moerke, 2007). |

| Concept | Description |
| --- | --- |
| **Category 4: Access restrictions** | |
| **Access restriction** | Access restriction based on physical attributes (e.g., weight, length/ width, load factor, emission levels) or time limits (e.g., delivery window) (Russo and Comi, 2010). |
| **Toll/ road pricing** | Fee for the use of transport infrastructure, e.g., roads (Marco, et al., 2018). |
| **Category 5: Other approaches** | |
| **Overnight logistics** | Shifting transports for delivery or pick-up to the nighttime (Kirsch, et al., 2017). |
| **Crowd logistics** | Transferring the concept of the sharing economy to logistics, specifically outsourcing of transport contracts to private operators (Buldeo Rai, et al., 2017). |
| **Logistics pooling** | Transferring the concept of the sharing economy to logistics, specifically sharing logistical resources between companies (Gonzalez-Feliu, and Salanova Grau, 2012). |
| **Use of future technologies** | Significant support for urban logistics by maturing technologies, e.g., 3D printing, robotics technology, autonomous driving (Savolainen and Collan, 2020; Graham, Mehmood and Coles, 2015). |
| **Logistics outsourcing** | (Mandatory) outsourcing of logistics activities to external companies |

Table 5: Local context factors

| Category | Urban logistics concepts | Local context factors |
|---|---|---|
| **Approaches to land use** | Loading bays; multiple use lanes | Land availability, freight traffic volume, enforceability |
| **Infrastructure approaches** | UCC; MCC; Pick-up/ drop-off stations; modal split concepts | City prosperity, land prices, land availability, shipment structure |
| **Technological approaches, traffic management** | Environmentally friendly drives; cargo bikes; ITS | City prosperity, technology availability, infrastructure quality, consignment structure |
| **Access restrictions** | Time limits; restrictions based on physical attributes; toll/ road pricing | Structure of the local economy, congestion, acceptance of the measures |
| **Other approaches** | Overnight logistics; crowd logistics/ logistics pooling; use of future technologies; logistics outsourcing | n/a (concepts are too different) |

Based on the case study analysis, seven types of city profiles are identified. The decisive criteria for subdividing the profiles are the number of inhabitants and the average GDP per person, which is intended to reflect the prosperity of the city (cf. Table 6). The respective city profiles contain internally homogeneous characteristics of relevant factors for urban logistics, such as land availability, land prices, congestion levels, infrastructure qualities and e-commerce levels.

Table 6: Classification of typical city profiles and examples

| Type | Description | Population | Average GDP per person | Example |
|---|---|---|---|---|
| **1** | Large metropolis with high GDP per capita | > 500.000 | > 65.000 € p.a. | Paris, Munich |
| **2** | Large metropolis with medium GDP per capita | > 500.000 | > 35.000 € p.a. < 65.000 € p.a. | London, Berlin |
| **3** | Large metropolis with low GDP per capita | > 500.000 | < 35.000 € p.a. | Barcelona, Lisbon |
| **4** | Small metropolis with high/ medium GDP per capita | < 500.000 > 100.000 | > 35.000 € p.a. | Zurich, Bologna |
| **5** | Small metropolis with low GDP per capita | < 500.000 > 100.000 | < 35.000 € p.a. | Porto, Bergen |
| **6** | Medium-sized city with medium/ high GDP per capita | < 100.000 > 10.000 | > 35.000 € p.a. | St. Gallen |
| **7** | Medium-sized city with low GDP per capita | < 100.000 > 10.000 | < 35.000 € p.a. | Lucca |

The location of the analyzed 137 urban logistics projects is shown in Figure 2. The highest number of projects was identified for city type 2, large metropolis with medium GDP per capita (39%), followed bay city type 4, small metropolis with high/ medium GDP per capita (16%) and city type 1, large metropolis with high GDP per capita (13%).

Only 30% of the reviewed projects focus on one single logistics concept was implemented whereas 70% of projects are combining multiple logistics concepts. This highlights the relevance of researching urban logistics systems in practical implementation. The most common urban logistics concepts identified in the analyzed projects were the usage of environmentally friendly drive technologies (39%) and access restrictions, including tolls (26%). 20% of the projects distribute via micro consolidation centers and another 20% follow a modal split concept by handling at least part of their inner-city transports by rail or passenger transport. The usage of cargo bikes for urban distribution was seen in 19% of the projects. Approaches to land use are only considered in 7% (loading bays) resp. 4% (multiple lane use) of the projects.


Figure 2: Locations of analyzed urban logistics projects in Europe

Also based on the case study analysis, three types of successful urban logistics systems could be identified. Each of these types is to be understood as a "basic framework" that can be adapted to local contextual factors and expanded on a case-by-case basis with other urban logistics concepts. In addition to these "basic types" of urban logistics systems, there are also intermediate stages with parallel use of two types of urban logistics systems, particularly in problematic areas.

### Type A: Single-stage UCC-based urban logistics systems

Type A urban logistics systems are primarily used in medium sized cities (city types 6 and 7), as well as in isolated cases in city type 5. They consist of a provider independent UCC on the outskirts of the city from which the supply to the city center is ensured by a neutral last mile service provider (cf. Figure 3). In most cases, the focus lies on a problem area (esp. downtown) or a problem customer (e.g., trade fairs, construction projects). A major hurdle in implementation and operation is the low freight traffic volumes in cities of this type. The adoption of UCC services is therefore usually supported by the implementation of accompanying regulatory instruments, e.g., access restrictions in the inner-city area. In this case, the vehicles of the UCC can access the inner-city area either exclusively or with discounted access. The access-restricted zone contains loading bays for carrying out necessary handling processes. In addition, access to the zone is protected with conventional ITS, e.g., by means of a barrier and access control based on an electronic identification procedure. As an additional regulatory instrument, the use of the UCC can also be made obligatory for deliveries into the city center.

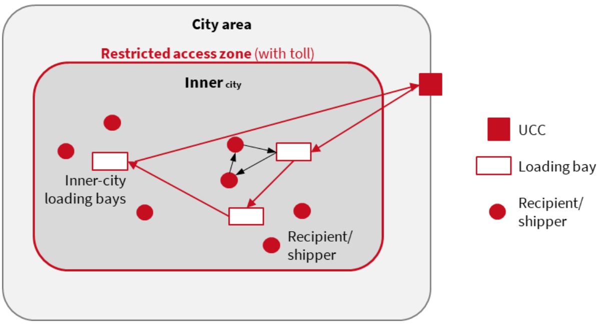


Figure 3: Urban logistics system – Type A

### Type B: Single-stage complex UCC-based urban logistics systems

Urban logistics systems of type B show a high prevalence in cities of types 3 and 4, and in somewhat lower proportions in types 2 and 5. Cities of these types are characterized by intensive freight movements for supply and disposal. The volumes are high enough to allow UCCs to operate profitably even without regulatory instruments apart from environmental taxes. For this reason, concepts such as private dedicated UCCs of a single logistics service provider are enabled. This simplifies the transition to UCC-based systems and reduces administrative expenses, but is accompanied by lower bundling effects. The urban logistics system here usually focuses on entire urban areas or large areas within the city.

Compared to Type A, Type B systems are characterized by a higher degree of complexity, i.e., in addition to the pure bundling of goods flows, further urban logistics concepts are implemented. These include pick-up/ drop-off stations, access restrictions based on vehicle emission levels, ITS (automatic toll controls, traffic telematics) loading bays, multiple use lanes, and multimodal approaches (water, rail).

**Type C: Multi-stage complex UCC-based urban logistics systems**

Type C urban logistics systems are predominantly used in type 1 cities and partially in Type 2 cities. The high level of e-commerce shipments in these cities requires the use of a two-tier urban logistics transport system with a UCC on the outskirts of the city and a multitude of micro hubs within the city. Environmentally friendly drive technologies and modal split concepts are applied in the transportation relation from UCC to micro hubs. Furthermore, between micro hubs and the end customer and/ or pick-up/ drop-off stations, cargo bikes and hand trucks are used. The city's supply and disposal can be parallel single-stage or also use the micro depot network. Stakeholders of the UCC are connected via a digital platform and advanced ITS (e.g. dynamic toll systems, intelligent traffic control, parking sensors) are implemented.

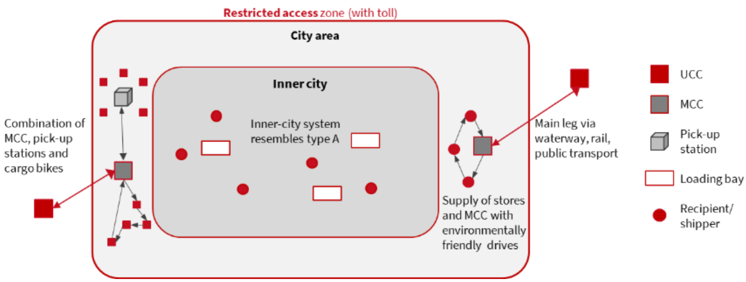


Figure 4: Urban logistics system – Type C

Due to the large number of urban logistics concepts, some of which are implemented in parallel, type C systems are the most complex of the three successful types of urban logistics systems.

Based on the previous findings, the identified urban logistics concepts can be classified into four categories based on their advantageousness in different city types (cf. Figure 5). The most beneficial combination, shown in black, represents the “basic” type of urban logistics system. Red indicates urban logistics concepts that are not absolutely necessary for the implementation of the core system but are still advantageous. The third level - shown in grey - marks urban logistics concepts that can eliminate or reduce deficiencies of the urban logistics system in certain situations in a particular city type. In addition, white entries mark urban logistics concepts that have little/ no advantage or even disadvantage in the respective city type.

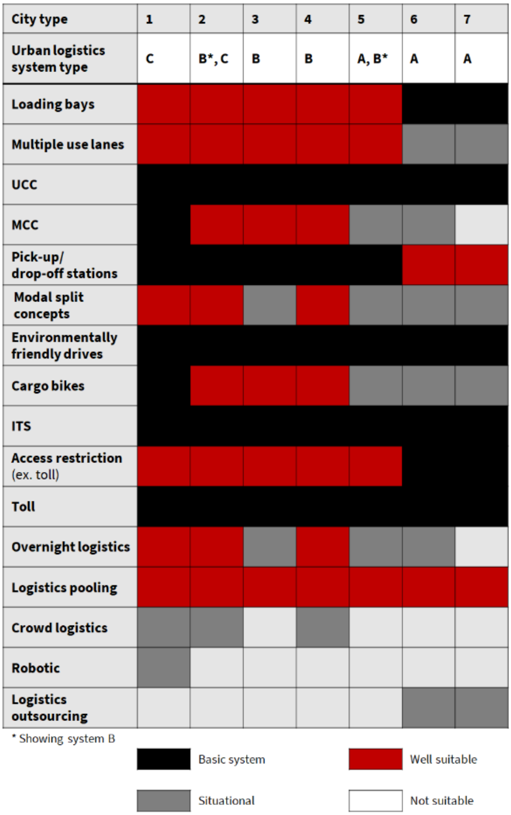


Figure 5: Suitability of city logistics concepts per city type

Three types of urban logistics systems (A, B and C) emerge, each of which can be assigned to specific city profiles. In addition to the "basic framework" of these types, urban logistics concepts can be found, which are well suited or at least situationally well suited for implementation in this system. In a next step, the possibility of adapting the urban logistics concepts within the system will be explained.

# 5 Framework and guideline

To develop a framework, the process of implementing urban logistics systems is divided into three phases: (i) design and assessment phase, (ii) implementation phase and (iii) evaluation phase (Taniguchi, 2014). This paper focuses primarily on the design phase. However, downstream factors of the implementation phase must also be considered in the design of an urban logistics system, as it reduces the susceptibility to error during implementation.

Three approaches can be distinguished in the design phase: (i) Complete redesign, (ii) transfer and adaptation of best practices and (iii) direct copying of best practices (Iwan, 2014). A complete redesign has the greatest degree of freedom and thus the greatest adaptability of the system to local contextual factors but is associated with the greatest expenditure. Direct copying of best practices, on the other hand, is the easiest option and gives the advantage of relying on proven solutions. Without an adaptation of the transferred best practices, this again has the disadvantage of not integrating local factors into the design.

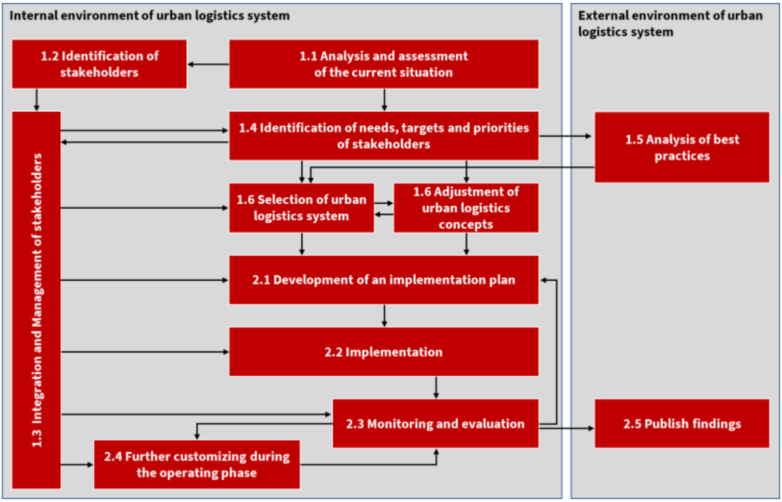


Figure 6: Framework for transferring urban logistics systems

The advantages of both approaches are combined by approach (ii), the transfer and adaptation of best practices, thus mitigating the mentioned disadvantages. The methodological guide by Iwan (2014) serves as an underlying framework for transferring and customizing best practices and is further developed. Figure 6 gives an overview of the resulting framework.

**1. Design and assessment**

The urban logistics project starts with the design of the urban logistics system. For this, the existing situation must be analyzed, and a suitable system must be identified. Important factors in the design of urban logistics systems are the integration of all stakeholders, an accurate and realistic analysis of the potential of the urban logistics system and the integration of the individual measures into a system.

**1.1 Analysis and evaluation of the current situation**

The first block involves recording the current inner-city flows of goods and analyzing them with regard to possible weaknesses/ efficiency losses in the existing freight transport system. Primary and secondary data (concrete flows of goods, general customs statistics, etc.) can serve as a data basis, but it should be noted that little information on intra-urban flows of goods is (publicly) available (Ibeas, et al., 2012). A realistic estimation regarding the volume of goods traffic has a high relevance, because incorrect estimation was one of the main reasons for the failure of urban logistics systems in the past (Faure, et al., 2013). This step can be initiated by a private sector company or group of companies, or by a public sector actor (Stoelzle, et al., 2020). In both cases, it is recommended that a neutral public last mile coordinator is identified early on to take the lead on the project (Ninnemann, et al., 2017).

### 1.2 Identification of Stakeholders

Parallel to the analysis of the current situation, the identification of the (most important) stakeholders should be carried out. This forms the basis for the subsequent integration of the stakeholders into the process and enables the direction of the urban logistics project to be set at an early stage.

### 1.3 Stakeholder integration and management

Involving stakeholders as early as possible and proactively managing them is one of the factors for the success of urban logistics. The neutral public last mile coordinator has the task of bringing all stakeholders together and to ensure their commitment throughout the entire process (Iwan, 2014). It is also important to communicate (interim) results to stakeholders who are not actively involved (e.g., a large part of the population) and to address their concerns. This will increase the acceptance rate of urban logistics systems (Morfoulaki, et al., 2016).

### 1.4 Identification of stakeholder needs, goals and problems

Successful integration of stakeholders into the process requires that the individual needs, goals and problems of the stakeholders are taken into consideration. These can be presented by the stakeholders themselves, (e.g., at citizens' meetings) or generalized listing of objectives of individual stakeholder groups can be used, as given in Taniguchi (2014), Nathanail, Gogas and Adamos (2016) or Russo and Comi (2010).

### 1.5 Analysis of best practices

The next step is to develop a catalog of urban logistics concepts. This should contain the most important information on the modes of action, sustainability, influencing factors and adaptation possibilities of the concept components.

### 1.6 Choice und Customizing

Based on the collected data and interviews, the urban logistics system is selected and designed. This includes the selection of the urban logistics concepts that will be integrated in the urban logistics system, their specific design and the underlying business plan. The business plan must be based on realistic estimates of freight traffic volumes (Faure, et al., 2013) and to rely on fair, economically sustainable profit distribution, possibly with recourse to compensation payments (Stoelzle, et al., 2020). Furthermore, the extent to which the project is publicly funded should be decided, as urban logistics systems without public funding and/ or legislative support are characterized by low success rates (Gonzalez-Feliu; Salanova Grau, 2012).

The selection of urban logistics concepts should also consider the extent to which the concepts are adaptable to local factors that are not covered by city profiles, e.g., topography or the "shape" of the city (e.g., long/ stretched or circular). Furthermore, concepts should not only adapt to local context factors, but also to other concepts used in the system.

## 2. Implementation and evaluation

The design and assessment phase is followed by the implementation and evaluation of the previously designed urban logistics system. The measures with the highest priority should be implemented first and successes should be communicated. Implementation of the urban logistics system should be fast and iterative, and detailed adjustments to the concepts should be made during operation. The publication of findings serves as a global exchange of experience and best practices.

### 2.1 Developing an implementation plan

As a first step, an implementation plan should be developed. This includes, among others, the distribution of tasks, the required resources and time schedules and is the basis for the subsequent implementation step. A well-planned implementation process is an important factor in the success of urban logistics (Quak, et al., 2016). At this point, the focus should already be on embedding the individual urban logistics concepts in the overall context of the urban logistics system.

### 2.2 Implementation

In the context of this research, various success factors for the implementation of urban logistics systems were identified: One of the key components of successful implementation is proactive stakeholder management. In addition, policy participation and enforcement of urban logistics measures by law enforcement agencies are also relevant. Implementation should be incremental and prioritize the most important or effective measures. Successes achieved in the process should be clearly communicated to the population. Parallel advertising of the urban logistics system in the delivery area can help to attract customers and thus increase its overall efficiency even further.

**2.3 Monitoring and evaluation**

Urban logistics is a complex and dynamic subject area. No implemented urban logistics system will be able to unfold its full potential initially or remain static over time. For this reason, constant monitoring of the system and an evaluation of the (interim) results is necessary. Methodologies from the Lean Startup/ Kaizen approach can be used to make systems robust and flexible in the face of internal and external changes (Taniguchi, 2014).

**2.4 Further customizing during operation**

The findings from the previous phase of monitoring and evaluation can be used to adjust the system during operation. This may be the case, for example, if shipment structures change, new technologies bring efficiency benefits, or the legal framework is adapted.

**2.5 Publish findings**

Urban logistics is a globally important issue. Individual, isolated, and scattered projects are a first step toward reducing transportation-related emissions, but in the long term, the goal should be a wide-spread improvement of overall urban logistics. The active exchange of knowledge gains through publications, partnerships or similar measures can contribute to a higher success rate of urban logistics projects worldwide.

To summarize, the developed guideline addresses the need to adapt urban logistics systems to local contextual factors. The active involvement of policy makers, in particular through the appointment of a neutral last mile coordinator as project manager who will ensure stakeholder integration and management, is highly relevant for the success of urban logistics initiatives.

In addition, attention should be paid to a system design that is suitable for implementation. Although adjustments must also be made during operation, the earlier they are implemented, the less effort is required to make the adjustments.

# 6 Conclusion

In this paper, we propose a framework to develop strategies for transferring successful urban logistics concepts from one city to others. Urban logistics systems can draw from a set of 16 different concepts, which are categorized into five groups, namely (1) approaches to land use, (2) infrastructure approaches, (3) access restrictions, (4) technological approaches and traffic management, as well as (5) other approaches, such as overnight and crowd logistics. After analyzing 137 urban logistics projects in 70 cities and extracting context factors from the literature, seven typical city profiles are identified based on number of inhabitants and average GDP per person.

Further the following findings are established:

- Three basic urban logistics systems (A, B, C) are identified and assigned to the typical city profiles.
- Four urban logistics concepts are identified, that can be applied in any type of city and result in positive benefits for the economic, ecologic, and social sustainability. Those are UCC, environmental tolls, environmentally friendly drive technologies and ITS.
- Some urban logistics concepts can be applied situationally to generate sustainable benefits. This includes, for example, delivery to the city center by water when inland routes are not available.

The final framework provides a guideline for decision makers. It comprises the three phases of design and assessment, implementation, and evaluation and addresses the need to adapt urban logistics systems to local contextual factors.

# 7 Limitations

One of the primary goals of this paper is to give impulses for future in-depth research on strategy development for transferring successful city logistics concepts. It is not the ambition of this work to develop a complete guide for the exact design of urban logistics systems. Accordingly, the findings obtained should be critically reflected before applied.

The systematic literature review is undertaken in a way that aims to mitigate the subjectivity of the research, it is characterized by inherent limitations (Durach, Kembro and Wieland, 2017). For example, the sample of literature found may not adequately reflect the total literature available (sampling bias) or the selection of literature may not include relevant works (selection bias). During the formal analysis of the literature, misentries may occur that influence the evaluation (with-in-study bias). In addition, the results expected by the authors may have an effect on the objectivity of the results (expectancy bias). Also, due to the independent execution of the method by several authors, a subjective influence cannot be completely excluded.

The case study analysis is subject to a number of limitations. As with the majority of qualitative studies, the scope of the investigation is restricted. For example, the selection of projects analyzed may not be representative of urban logistics. The limitation to urban logistics projects in Europe may make it difficult to generalize the findings beyond the European region. Also, the conclusions drawn from the case study analysis could be influenced by the authors' expectations or the limited number of case studies.

The expert interviews served to validate the collected findings. Due to the small number of experts interviewed and the concentration of experts in German and Swiss academia, the plurality of opinions may not be sufficiently given. Interviewing additional experts from other regions and industries could result in divergent findings. Expert interviews also have other intrinsic limitations with regard to sample composition, the capture of frames and norms, recall, and the authenticity of response behavior (Sowka, 2016).

Additionally, in the expert interviews, the lack of political context factors was pointed out. Thus, there is a need for further research, in the dimension of political context factors. In addition, the findings may change over time. The use of new technologies or other changing framework conditions can change the advantages of the urban logistics concepts. The emergence of new urban logistics concepts is also likely.

## Acknowledgements

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# Appendix

Table 7: Final literature selection of systematic literature review

| ID | Reference | Summary |
|---|---|---|
| **1** | Akyol, D. E.; De Koster, R. B. M. (2018): Determining time windows in urban freight transport: A city cooperative approach | **Interactions between delivery windows of neighboring cities.** |
| **2** | Alho, A. R.; de Abreu e Silva, J. (2015): Utilizing urban form characteristics in urban logistics analysis: a case study in Lisbon, Portugal | **Empirical verification of the logistics profiles from Macário (2013) using a case study in Lisbon, Portugal.** |
| **3** | Alho, A.; Bhavathrathan, B. K.; Stinson, M.; Gopalakrishnan, R.; Le, D.-T.; Ben-Akiva, M. (2017): A multi-scale agent-based modelling framework for urban freight distribution | **A model for urban logistics system planning, considering various concepts and interacting stakeholders.** |
| **4** | Alho, A.; Silva, J. D. E.; Pinho de Sousa, J. (2014): A state-of-the-art modeling framework to improve congestion by changing the configuration/enforcement of urban logistics loading/unloading bays | **A model for location and size planning of transshipment areas in parking lots.** |
| **5** | Allen, J.; Browne, M.; Cherret, T. (2012): Investigating relationships between road freight transport, facility location, logistics management and urban form | **Analyzing the relationships between the shape of a city and intra-urban freight transport.** |

| ID | Reference | Summary |
|---|---|---|
| **6** | Awasthi, A.; Chauhan, S. S. (2012): A hybrid approach integrating Affinity Diagram, AHP and fuzzy TOPSIS for sustainable city logistics planning | **A framework for choosing the most appropriate urban logistics concept for a specific city.** |
| **7** | Baindur, D.; Macario, R. (2013): Mumbai lunch box delivery system: A transferable benchmark in urban logistics? | **Description and evaluation of a lunch box delivery service in Mumbai using urban logistics systems.** |
| **8** | Bienzeisler, B.; Bauer, M.; Mauch, L. (2018): Screening City-Logistik | **Aggregation and analysis of different urban logistics projects.** |
| **9** | Boudoin, D.; Morel, C.; Gardat, M. (2013): Supply Chains and Urban Logistics Platforms | **Identification of stakeholders and concepts of urban logistics and providing recommendations for future urban logistics systems.** |
| **10** | Bozzo, R.; Conca, A.; Marangon, F. (2014): Decision support system for city logistics: literature review, and guidelines for an ex-ante model | **Development of an ex-ante model for the evaluation of urban logistics efforts.** |
| **11** | Buldeo Rai, H.; Verlinde, S.; Merckx, J.; Macharis, C. (2017): Crowd logistics: an opportunity for more sustainable urban freight transport? | **Analyzing the concept of crowd logistics and its relevant characteristics.** |
| **12** | Cao, C. (2018): Measuring Sustainable Development Efficiency of Urban Logistics Industry | **Ex-ante evaluation of the urban logistics efficiency of cities.** |

| ID | Reference | Summary |
|---|---|---|
| **13** | Cirovic, G.; Pamucar, D.; Bozanic, D. (2014): Green logistic vehicle routing problem: Routing light delivery vehicles in urban areas using a neuro-fuzzy model | **Route planning of green vehicles assuming limited resources of vehicles.** |
| **14** | Crainic, T. G.; Ricciardi, N.; Storchi, G. (2009): Models for Evaluating and Planning Logistics Systems | **A model for operational planning of routes and resources in urban logistics systems.** |
| **15** | Crainic, T. G.; Sgalambro, A. (2014): Service network design models for two-tier city logistics | **A model for route planning in two-tier intra-urban distribution networks.** |
| **16** | Dablanc, L.; Patier, E.; Gonzalez-Feliu, J.; Augereau, V.; Leonardi, J.; Simmeone, T.; Cerda, L. (2011): SUGAR. Sustainable Urban Goods Logistics Achieved by Regional and Local Policies. City Logistics Best Practices: a Handbook for Authorities | **Description and evaluation of different urban logistics initiatives in Europe.** |
| **17** | De Marco, A.; Cagliano, A. C.; Mangano, G.; Perfetti, F. (2014): Factor influencing Logistics Service Providers Efficiency' in Urban Distribution Systems | **Analyzing the influence of operational variables in urban delivery on the resulting number of stops and overall efficiency of last-mile deliveries.** |
| **18** | De Marco, A.; Mangano, G.; Zenezini, G. (2018): Classification and benchmark of City Logistics measures: an empirical analysis | **Evaluating the dissemination of urban logistics measures in cities in correlation with different local characteristics.** |

| ID | Reference | Summary |
|---|---|---|
| **19** | de Souza, R.; Goh, M.; Lau, H.-C.; Ng, W.-S.; Tan, P.-S. (2014): Collaborative Urban Logistics – Synchronizing the Last Mile a Singapore Research Perspective | **Description of collaborative urban logistics concepts.** |
| **20** | Dell'Amico, M.; Hadjidimitriou, S. (2012): Innovative logistics model and containers solution for efficient last mile delivery | **Analyzing the combined use of standardized load carrier and BentoBox on delivery vans.** |
| **21** | Dong, J. J.; Xu, Y. X.; Hwang, B. G.; Ren, R.; Chen, Z. L. (2019): The Impact of Underground Logistics System on Urban Sustainable Development: A System Dynamics Approach | **Analysis of strengths, weaknesses, opportunities and threats of urban logistics systems in China. Derivation of Recommendations for policy makers.** |
| **22** | Donnelly, R.; Thompson, R. G.; Wigan, M. (2012): Process validation of urban freight and logistics models | **Analyzing ways to improve traffic flow data quality.** |
| **23** | Duarte, G.; Rolim, C.; Baptista, P. (2016): How battery electric vehicles can contribute to sustainable urban logistics: A real-world application in Lisbon, Portugal | **Evaluation of the sustainability of an electric vehicle deployment in Lisbon.** |
| **24** | Ducret, R.; Lemarie, B.; Roset, A. (2016): Cluster analysis and spatial modeling for urban freight. Identifying homogeneous urban zones based on urban form and logistics characteristics | **Analyzing the influence of local characteristics on the selection and design of urban logistics systems.** |

| ID | Reference | Summary |
|---|---|---|
| **25** | Eitzen, H. (2017): A Multi-Objective Two-Echelon Vehicle Routing Problem. An Urban Goods Movement Approach for Smart City Logistics | **Development of a routing and scheduling system in two-tier urban distribution networks.** |
| **26** | Faure, L., Battaia, G.; Marques, G.; Guillaume, R.; Vega-Mejia, C. A.; Montova-Torres, J. R.; Munoz-Villamizar, A.; Quintero-Araujo, C. L. (2013): How to anticipate the level of activity of a sustainable collaborative network: The case of urban freight delivery through logistics platforms | **Ex-ante evaluation of profitability of UCC depending on the number of stakeholder and location of the UCC.** |
| **27** | Ferreira, J. C.; Martins, A. L.; Pereira, R. (2017): GoodsPooling: An Intelligent Approach for Urban Logistics | **Developing a concept for transferring the "Uber" concept on urban logistics.** |
| **28** | Ferreira, J. C.; Monteiro, V.; Afonso, J. L.; Martins, A. L.; Afonso, J. A. (2017): Mobile Device Sensing System for Urban Goods Distribution Logistics | **Analyzing mobile devices for improved connectivity and effectiveness of urban logistics systems.** |
| **29** | Fossheim, K.; Andersen, J. (2017): Plan for sustainable urban logistics – comparing between Scandinavian and UK practices | **Comparison of the prevalence of urban logistics measures in the United Kingdom and the Scandinavian countries.** |
| **30** | Fraile, A.; Larrode, E.; Magrenan, A.; Sicilia, J. A. (2016): Decision model for siting transport and logistic facilities in urban environments: A methodological approach | **A tool for locating UCC sites.** |

| ID | Reference | Summary |
|---|---|---|
| **31** | Gonzalez-Feliu, J. (2018): Sustainable Urban Logistics: Planning and Evaluation | **Development of planning and evaluation tools for urban logistics systems.** |
| **32** | Gonzalez-Feliu, J.; Pronello, C.; Salanova Grau, J. M. (2018): Multi-stakeholder Collaboration in Urban Transport: State-of-the-Art and Research Opportunities | **Analyzing sharing models in the urban logistics.** |
| **33** | Gonzalez-Feliu, J.; Salanova, J.-M. (2011): Defining and Evaluating Collaborative Urban Freight Transportation Systems | **Comparison of different levels of collaboration and their effect on relevant KPIs.** |
| **34** | Gonzalez-Feliu, J.; Salanova, J.-M. (2012): Is urban logistics pooling viable? A multistakeholder multicriteria analysis | **Multi-actor multi-criteria analysis for the design of UCCs.** |
| **35** | Graham, G.; Mehmood, R.; Coles, E. (2015): Exploring future cityscapes through urban logistics prototyping: a technical viewpoint | **Description of possible future developments in urban logistics.** |
| **36** | Gupta, A.; Heng, C. K.; Ong, Y. S.; Tan, P. S.; Zhang, A. N. (2017): A generic framework for multi-criteria decision support in eco-friendly urban logistics systems | **Development of a routing and scheduling system while incorporating sustainability dimensions.** |
| **37** | Guyon, O.; Absi, N.; Feillet, D.; Garaix, T. (2012): A modeling approach for locating logistics platforms for fast parcels delivery in urban areas | **A model for site planning od UCC (i.g. location, number, size).** |

| ID | Reference | Summary |
|---|---|---|
| **38** | Ibeas, A.; Moura, J. L.; Nuzzolo, A.; Comi, A. (2012): Urban freight transport demand: transferability of survey results analysis and models | **Estimation of the flow of goods in Rome and Santander and considerations on transferability to other cities.** |
| **39** | Iwan, S. (2014): Adaptative approach to implementing good practices to support environmentally friendly urban freight transport management | **A framework for implementing urban logistics solutions.** |
| **40** | Iwan, S.; Kijewska, K. (2014): The Integrated Approach to Adaptation of Good Practices in Urban Logistics Based on the Szczecin Example | **A framework for representing interactions between urban logistics concepts in the implementation of urban logistics systems.** |
| **41** | Janjevic, M.; Winkenbach, M. (2020): Characterizing urban last-mile distribution strategies in mature and emerging e-commerce markets | **Local influencing factors and differences in the design of last mile distribution networks for eCommerce in developed and developing countries.** |
| **42** | Kauf, S. (2016): City logistics – A Strategic Element of Sustainable Urban Development | **Categorizing urban logistics concepts into joint delivery systems and innovative technologies.** |
| **43** | Kelly, J.; Marinov, M. (2017): Innovative Interior Designs for Urban Freight Distribution Using Light Rail Systems | **Re-design of streetcars for integrating public transport and urban freight transportation.** |

| ID | Reference | Summary |
|---|---|---|
| **44** | Kijewska, K.; Johansen, B. G. (2014): Comparative analysis of activities for more environmental friendly urban freight transport systems in Norway and Poland | **Comparison of the prevalence of urban logistics measures in Norway and Poland.** |
| **45** | Kikuta, J.; Tomiyama, I.; Yamamoto, S.; Yamada, T. (2012): New Subway-Integrated City Logistics System | **Pilot testing of urban logistics systems in Sapporo (JAP) and evaluation of resulting effects.** |
| **46** | Kin, B.; Verlinde, S.; Mommens, K.; Macharis, C. (2017): A stakeholder-based methodology to enhance the success of urban freight transport measures in a multi-level governance context | **Multi-actor multi-criteria analysis for the selection of urban logistics concepts for a specific city.** |
| **47** | Kirsch, D.; Bernsmann, A.; Moll, C.; Stockmann, M. (2017): Potenziale einer geräuscharmen Nachtlogistik | **Analysis of technical and local potentials to implement silent overnight logistics in German cities.** |
| **48** | Kordnejad, B. (2014): Intermodal Transport Cost Model and Intermodal Distribution in Urban Freight | **Analyzing the advantageousness of intermodal urban logistics concepts depending on local characteristics.** |
| **49** | Kunze, O. (2016): Replicators, Ground Drones and Crowd Logistics A Vision of Urban Logistics in the Year 2030 | **Opportunities to deploy future technologies in urban logistics.** |
| **50** | Lagorio, A.; Pinto, R.; Golini, R. (2017): Urban Logistics Ecosystem: a system of system framework for stakeholders in urban freight transport projects | **Transferring the biological concept of ecosystems to urban logistics.** |

| ID | Reference | Summary |
|---|---|---|
| **51** | Le Pira, M.; Marcucci, E.; Gatta, V.; Inturri, G.; Ignaccolo, M.; Pluchino, A. (2017): Integrating discrete choice models and agent-based models for ex-ante evaluation of stakeholder policy acceptability in urban freight transport | **Stakeholder decision model for ex-ante selection of urban logistics regulations.** |
| **52** | Liu, Y.; He, K.; Liu, J.; Xu, Y. (2008): Analysis of the Concept of Urban Rail Transit Based City Logistics System | **Description of a system for designing urban logistics based on combined public transport use of the subway.** |
| **53** | Maes, J. (2017): The potential of cargo bicycle transport as a sustainable solution for urban logistics | **Evaluation of the cargo bike usage in Belgium and derivation of recommendations for policy makers and logistics service providers.** |
| **54** | Malecki, K.; Iwan, S.; Kijweska, K. (2014): Influence of Intelligent Transportation Systems on Reduction of the Environmental Negative Impact of Urban Freight Trnasport based on Szczecin Example | **Evaluation of the use of ITS in urban logistics in Szczecin.** |
| **55** | Masson, R.; Trentini, A.; Lehuede, F.; Malhene, N.; Peton, O.; Tlahig, H. (2017): Optimization of a city logistics transportation system with mixed passengers and goods | **Solving the two-echelon routing problem with a combined use of buses for urban logistics.** |

| ID | Reference | Summary |
|---|---|---|
| **56** | Matusiewicz, M. (2019): Towards Sustainable Urban Logistics: Creating Sustainable Urban Freight Transport on the Example of a Limited Accessibility Zone in Gdansk | **Evaluation of the effects and basic requirements of establishing limited accessibility zones in Gdansk.** |
| **57** | Mazzarino, M.; Rubini, L. (2019): Smart Urban Planning: Evaluating Urban Logistics Performance of Innovative Solutions and Sustainable Policies in the Venice Lagoon—the Results of a Case Study | **Analyzing the use of small boats in the Venice area for freight transportation.** |
| **58** | Montwill, A. (2014): The Role of Seaports as Logistics Centers in the Modelling of the Sustainable System for Distribution of Goods in Urban Areas | **Possibilities and existing projects for using seaports as logistics centers.** |
| **59** | Morfoulaki, M.; Kotoula, K.; Stathacopoulous, A.; Mikiki, F.; Aifadopoulou, G. (2016): Evaluation of Specific Policy Measures to Promote Sustainable Urban Logistics in Small-medium Sized Cities: The Case of Serres, Greece | **Analysis of the advantageousness of different urban logistics concepts.** |
| **60** | Murat, Y. S. ; Uludag, N. (2008): Route choice modelling in urban transportation networks using fuzzy logic and logistic regression methods | **A model for route planning considering uncertainties on the operational level (e.g., congestion, driver willingness to follow the route).** |

| ID | Reference | Summary |
|---|---|---|
| **61** | Nathanail, E.; Adamos, G.; Gogas, M. (2017): A Novel Approach for Assessing Sustainable City Logistics | **Evaluation of urban logistics measures from the perspective of the city and logistics service providers.** |
| **62** | Nathanail, E.; Gogas, M.; Adomos, G. (2016): Smart Interconnections of Interurban and Urban Freight Transport towards Achieving Sustainable City Logistics | **A framework for evaluating urban logistics measures based on a multi-actor multi-criteria approach.** |
| **63** | Nesterova, N.; Quak, H. (2016): A city logistics living lab: a methodological approach | **Description and evaluation initial "City Logistics Living Labs" based on a public-private partnership.** |
| **64** | Pamucar, D.; Gigovic, L.; Cirovic, G.; Regodic, M. (2016): Transport spatial model for the definition of green routes for city logistics centers | **Routing and scheduling for sustainable urban logistics based on a Dijkstra algorithm.** |
| **65** | Papoutsis, K.; Nathanail, E. (2016): Facilitating the selection of city logistics measures through a concrete measures package: A generic approach | **Evaluation of different urban logistics measures and their effect on sustainability goals.** |
| **66** | Perboli, G.; Rosano, M. (2018): A Decision Support System for Optimizing the Last-Mile by Mixing Traditional and Green Logistics | **Development of a routing and scheduling system for a combination of traditional and cargo bike delivery.** |

| ID | Reference | Summary |
|---|---|---|
| **67** | Quak, H.; Balm, S.; Posthumus, B. (2014): Evaluation of City Logistics Solutions with business Model Analysis | **Analyzing the "BentoBox" business model in Berlin, Turin and Lyon.** |
| **68** | Quak, H.; Lindholm, M.; Tavasszy, L.; Browne, M. (2016): From freight partnerships to city logistics living labs - Giving meaning to the elusive concept of living labs | **Deduction of success factors of urban logistics projects and description of an urban logistics living lab.** |
| **69** | Quak, H.; Nesterova, N. (2014): Towards zero emission urban logistics: Challenges and issues for implementation of electric freight vehicles in city logistics | **Summary of opportunities to promote the adoption of electric vehicles in urban logistics.** |
| **70** | Roca-Riu, M.; Estrada, M. (2012): An evaluation of urban consolidation centers through logistics systems analysis in circumstances where companies have equal market shares | **Analysis of the advantageousness of UCC assuming equal market shares of logistics service providers.** |
| **71** | Rodseth, K. L. (2017): Productivity growth in urban freight transport: An index number approach | **Calculation of efficiency gains from urban logistics systems.** |
| **72** | Rose, W.; Bell, J.; Autry, C.; Cherry, C. (2017): Urban Logistics: Establishing Key Concepts and Building a Conceptual Framework for Future Research | **Description of theoretical foundations of urban logistics and providing directions for future research.** |
| **73** | Russo, F.; Comi, A. (2010): A classification of city logistics measures and connected impacts | **Categorization and description of various urban logistics concepts.** |

| ID | Reference | Summary |
|---|---|---|
| **74** | Russo, F.; Comi, A. (2013): A model for simulating urban goods transport and logistics: the integrated choice of ho.re.ca. activity decision-making and final business consumers | **Simulation of the level of activity in urban logistics networks in the hotel, restaurant, and catering sector.** |
| **75** | Santos, R.; Silva, J. (2012): Technical and economic feasibility of the use of airships within two Portuguese market niches: the tourism and the urban logistic case studies | **Evaluation of shifting the mode of transport to airships for the main run.** |
| **76** | Schroder, S.; Liedtke, G. T. (2017): Towards an integrated multi-agent urban transport model of passenger and freight | **Analyzing the impact of urban logistics systems and its interactions with existing passenger transportation networks.** |
| **77** | Semanjski, I.; Gautama, S. (2019): A collaborative stakeholder decision-making approach for sustainable urban logistics | **Development of a routing and scheduling system incorporating sustainability dimensions.** |
| **78** | Serna, M. D. A.; Uran, C. A. S.; Uribe, K. C. A. (2012): Collaborative Autonomous Systems in Models of Urban Logistics | **Analyzing the current state of research and advantages of collaborative logistics concepts.** |
| **79** | Sheu, J. B. (2006): A novel dynamic resource allocation model for demand-responsive city logistics distribution operations | **A model for resource allocation in urban logistics systems based on clustering customer groups.** |

| ID | Reference | Summary |
|---|---|---|
| **80** | Sxolnaraki, E.; Panou, K. (2016): Innovative business models for exploiting green vehicle potential in urban logistics | **Evaluation of the profitability of using biodiesel as an alternative drive for urban logistics vehicles.** |
| **81** | Tadic, S.; Zecevic, S.; Krstic, M. (2014): A novel hybrid MCDM model based on fuzzy DEMATEL, fuzzy ANP and fuzzy VIKOR for city logistics concept selection | **Framework for choosing the most appropriate urban logistics concept for a specific city.** |
| **82** | Taefi, T. T.; Kreutzfeld, J.; Held, T.; Fink, A. (2016): Supporting the adoption of electric vehicles in urban road freight transport - A multi-criteria analysis of policy measures in Germany | **Evaluation of policy tools to promote electric mobility in urban logistics.** |
| **83** | Taniguchi, E. (2014): Concepts of city logistics for sustainable and liveable cities | **Description and evaluation of joint delivery systems including examples from Japan.** |
| **84** | Taniguchi, E.; Thompson, R. G.; Yamada, T. (2014): Recent Trends and Innovations in Modelling City Logistics | **Systematic literature review on modeling and evaluating urban logistics measures.** |
| **85** | Teoh, T.; Kunze, O.; Teo, C. C. (2016): Methodology to evaluate the operational suitability of electromobility systems for urban logistics operations | **A model for determining the deployment feasibility of electric vehicles.** |
| **86** | Visser, J.; van Binsbergen, A.; Nemoto, T. (1999): Urban freight transport policy and planning | **Describing theoretical foundations of urban logistics and providing directions for future research.** |

| ID | Reference | Summary |
|---|---|---|
| **87** | Wang, J.; Lim, M. K.; Tseng, M. L.; Yang, Y. (2019): Promoting low carbon agenda in the urban logistics network distribution system | **Development of a framework for minimizing carbon footprint and cost of goods sold in urban logistics.** |
| **88** | Wesolowska, J. (2016): Urban Infrastructure Facilities as an Essential Public Investment for Sustainable Cities – Indispensable but Unwelcome Objects of Social Conflicts. Case Study of Warsaw, Poland | **Problem analysis in the siting of inner-city infrastructure buildings.** |
| **89** | Wolpert, S. (2013): City-Logistik | **Quantitative and qualitative Analysis of selected urban logistics projects in Central Europe.** |
| **90** | Wolpert, S.; Reuter, C. (2012): Status Quo of City Logistics in Scientific Literature | **Systematic literature review on actors, challenges and concepts of urban logistics.** |
| **91** | Yang, K. D.; Roca-Riu, M.; Menendez, M. (2019): An auction-based approach for prebooked urban logistics facilities | **Analyzing auction-based booking of loading/unloading bays.** |
| **92** | Zhao, L.; Li, H.; Li, M.; Sun, Y.; Hu, Q.; Mao, S.; Li, J.; Xue, J. (2018): Location selection of intra-city distribution hubs in the metro-integrated logistics system | **Development of a model for locating UCCs in urban logistics systems that use public transport networks (subway).** |

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