

Implementation of urban logistics systems

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St. Gallen, October 29, 2021

The President:

Prof. Dr. Bernhard Ehrenzeller

Vorwort

Die vorliegende Dissertation ist das Ergebnis meiner dreijährigen Forschungstätigkeit am Institut für Supply Chain Management der Universität St. Gallen (ISCM-HSG). Während meiner Zeit am Institut durfte ich das Projekt "Implementierung urbaner Logistik am Beispiel von Zürich" begleiten, welches von der Innosuisse (Schweizerische Agentur für Innovationsförderung) finanziell unterstützt wurde und gemeinsam mit Praxispartnern unterschiedlicher Branchen durchgeführt wurde. Insofern stand eine enge Verzahnung aus Praxisorientierung und wissenschaftlicher Fundierung des Themas "Implementation of urban logistics systems" im Mittelpunkt.

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List of abbreviations

AT	<u>A</u> gency <u>t</u> heory
B2C	<u>B</u> usiness-to- <u>c</u> onsumer
CAS	<u>C</u> omplex <u>a</u> ddaptive <u>s</u> ystem
CAST	<u>C</u> omplex <u>a</u> ddaptive <u>s</u> ystems <u>t</u> heory
CEP	<u>C</u> ourier, <u>e</u> xpress, <u>p</u> arcel
CL	<u>C</u> ity <u>l</u> ogistics
CT	<u>C</u> ontingency <u>t</u> heory
DSR	<u>D</u> esign <u>s</u> cience <u>r</u> esearch
GAS	<u>G</u> ermany, <u>A</u> ustria, <u>S</u> witzerland
ICT	<u>I</u> nformation and <u>c</u> ommunications <u>t</u> echnology
KB	<u>K</u> nowledge <u>b</u> ase
KPIs	<u>K</u> ey <u>p</u> erformance <u>i</u> ndicators
LSP	<u>L</u> ogistics <u>s</u> ervice <u>p</u> rovider
MC	<u>M</u> anagerial <u>c</u> hallenge
PM	<u>P</u> roject <u>m</u> anagement
RO	<u>R</u> esearch <u>o</u> bjective
RQ	<u>R</u> esearch <u>q</u> uestion
SCM	<u>S</u> upply <u>c</u> hain <u>m</u> anagement
SET	<u>S</u> ocial <u>e</u> xchange <u>t</u> heory
ST	<u>S</u> takeholder <u>t</u> heory
TOC	<u>T</u> heory of <u>c</u> onstraints
TS	<u>T</u> heoretical <u>s</u> hortcoming
UL	<u>U</u> rban <u>l</u> ogistics
ULS	<u>U</u> rban <u>l</u> ogistics <u>s</u> ystem(s)
VRP	<u>V</u> ehicle <u>r</u> outing <u>p</u> roblem

Summary

Concept components, summarized under the umbrella term ‘urban logistics’ has become a strategic priority for many public and private players in recent years due to the emergence of challenges in urban areas around the globe, including factors such as urbanization, the rise of e-commerce, changing customer demands, and the consequential growth of traffic and emissions. These challenges tend to continue growing in the future. As a result, countermeasures such as urban logistics systems are in high demand. However, many urban logistics undertakings fail to be put into practice and are eventually terminated for various reasons, which can be considered implementation barriers that exist in practice. While research on urban logistics is proliferating, the implementation of urban logistics systems has been insufficiently addressed. Thus, there can be determined a research gap on this topic.

The present dissertation addresses the issue of implementing urban logistics systems and investigates the implementation process from a holistic perspective. For this investigation, which follows the design science research methodology, an eclectic theoretical approach based on contingency theory, stakeholder theory, theory of constraints, and theory of complex adaptive systems is applied. The research comprises (1) a contingency analysis of the conceptual design of urban logistics systems, (2) a qualitative assessment of urban logistics concept components, (3) success factors for urban logistics systems implementation, (4) recommendations for implementation management, and finally, culminates in (5) an adaptable implementation concept for urban logistics systems. With a concentration on these, this dissertation aims to establish a foundation for successfully implemented urban logistics systems.

The results indicate that the application of a broad implementation understanding of the particular case of urban logistics systems implementation is recommended. This way, the classical separation of planning and realization can be overcome in an iterative manner based on a hybrid project management philosophy that combines profound urban logistics system designs with an agile approach to their application. These particular findings not only help to achieve a theoretical foundation from the perspective of the scientific community but also allow for conclusions for practitioners and their specific urban logistics-related projects. Thereby, this dissertation contributes to overcoming the implementation barriers in practice. Thus, it calls for the transfer of this dissertation’s findings into practice.

Zusammenfassung

Das Aufkommen von Herausforderungen in städtischen Räumen rund um den Globus, darunter die Urbanisierung, steigender E-Commerce, veränderte Kundenwünsche mit der Folge von wachsendem Verkehr und Emissionen, haben in den letzten Jahren Konzeptkomponenten, die unter dem Begriff ‘urbane Logistik’ zusammengefasst werden, zu einer strategischen Priorität für viele öffentliche und private Akteure gemacht. Diese Herausforderungen werden in Zukunft weiter wachsen. Folglich sind Gegenmassnahmen wie urbane Logistik-Systeme sehr gefragt. Viele Projekte im Bereich urbaner Logistik scheitern jedoch aus unterschiedlichen Gründen, welche als Umsetzungsbarrieren bezeichnet werden können. Während die Forschung im Bereich der urbanen Logistik wächst, ist die Umsetzung von urbanen Logistik-Systemen bislang unzureichend untersucht worden. Somit kann eine Forschungslücke festgestellt werden.

Die Dissertation befasst sich mit der Implementierung von urbanen Logistik-Systemen und untersucht den Implementierungsprozess aus einer ganzheitlichen Perspektive. Für diese Untersuchung, die der Design Science Research Methodik folgt, wird ein eklektischer theoretischer Ansatz angewandt, der auf der Kontingenztheorie, der Stakeholder-Theorie, der Engpasstheorie und der Theorie komplexer adaptiver Systeme basiert. Die Untersuchung umfasst (1) eine Kontingenzanalyse der Konzeption von urbanen Logistik-Systemen, (2) eine qualitative Bewertung der Konzeptkomponenten, (3) Erfolgsfaktoren für die Implementierung urbaner Logistik-Systeme, (4) Empfehlungen für das Umsetzungsmanagement und mündet in (5) ein adaptierfähiges Umsetzungskonzept für urbane Logistik-Systeme. Somit zielt diese Dissertation auf die Schaffung einer Grundlage für erfolgreich implementierte urbane Logistik-Systeme.

Die Ergebnisse zeigen, dass es empfehlenswert ist, ein breites Implementierungsverständnis auf den speziellen Fall der urbanen Logistik-Systeme anzuwenden. Auf diese Weise kann die klassische Trennung von Planung und Realisierung in einem iterativen Vorgehen überwunden werden, das auf einer hybriden Projektmanagement-Philosophie basiert und eine fundierte Gestaltung urbaner Logistik-Systeme mit einer agilen Vorgehensweise bei deren Anwendung verbindet. Diese Erkenntnisse tragen nicht nur zu einer theoretischen Fundierung aus Sicht der Wissenschaft bei, sondern lassen auch Rückschlüsse für Praktiker und deren konkrete stadtlogistische Projekte zu. Damit trägt diese Arbeit dazu bei, die Umsetzungsbarrieren in der Praxis zu überwinden. So wird der Transfer der Erkenntnisse dieser Dissertation in die Praxis vorgeschlagen.

1 Introduction to the research on urban logistics and its implementation

The present research examines the implementation of urban logistics systems in practice. This first chapter outlines the common general challenges in urban areas around the globe and the connection to the concept of urban logistics for counteracting these challenges. While Section 1.1 adopts a managerial perspective, Section 1.2 characterizes this topic's relevance from a theoretical perspective. Based on the summarized managerial challenges and theoretical shortcomings, the derived research objectives are presented in Section 1.3. An outline of the structure of this dissertation is provided in Section 1.4.

1.1 Managerial relevance

Urban freight transport deals with *«all journeys into, out of, and within a designated urban area by road vehicles specifically engaged in pick-up or delivery of goods (whether the vehicle be empty or not), with the exception of shipping trips»*, according to Hicks (1977, p. 101). According to the Bundesamt für Statistik (Federal Office for Statistics), BFS (2019), over 63% of transport services in Switzerland were provided by road vehicles in the year 2018, and in Swiss agglomerations, about 85% (Ruesch *et al.*, 2013, p. 30) of transport services are provided by road vehicles. This means that road freight transport is disproportionately present and of the utmost importance for the supply of goods to cities. Beyond Switzerland, this is also true for urban areas worldwide, albeit with differing – but usually also very high – proportionate shares of road vehicles.

However, various developments have an impact on the process of supplying goods to urban areas:

- All around the world, more and more people live in urban areas due to not only population growth (7.63 billion in 2018; expected to be 9.77 billion in 2050) but also due to growing urbanization (55.3% in 2018; expected to be 68.4% of the population living in urban areas by 2050), both according to the United Nations (2018). For the Germany, Austria, and Switzerland (GAS) area, the degree of urbanization is already relatively high, with 77.4% of the population in Germany living in urban areas in

2019. The figure for Austria was 58.5%, and for Switzerland, 73.8% (The World Bank, 2020). For urban transport, this development leads to a rising number of goods to transport and more and more complex transportation systems.

- Furthermore, online sales, so-called ‘e-commerce’ have risen heavily in recent years. While e-commerce turnover was EUR 1,700,390 million in 2019, that figure is expected to rise over the short term to EUR 2,922,095 million worldwide in 2024, adjusted for the political impacts of COVID-19 (Statista, 2020a). For instance, in Switzerland, e-commerce rose from CHF 7.2 billion in 2015 to CHF 10.3 billion in 2019 (Statista, 2020b). While not only e-commerce booms in general, especially the business-to-consumer (B2C) share of consignments has also increased sharply. Therefore, instead of delivering goods to retail stores, more and more consignments need to be delivered directly to end consumers, creating another challenge for urban transport. However, because individuals are often not waiting around at home, delivery attempts might not be successful, leading to a second, or sometimes even third, delivery attempt for a single shipment.
- While B2C and other areas are booming, there are also changes in observable consumer behaviors. For example, end consumers have recently begun to expect services such as same-day deliveries (Savelsbergh and van Woensel, 2016), deliveries to their workplace instead of their home, and deliveries within a particular window of time, among other demands (Die Schweizerische Post AG, 2020). Additionally, people are shopping online more often and placing smaller orders, leading to smaller consignments at higher frequencies. This again leads to more freight transport-related trips in urban areas.

These three developments – rising urbanization, the boom of e-commerce, and changes in consumer behaviors – all lead, among other challenges for urban transport, to more traffic in urban areas. This growing traffic volume leads to other challenges:

- More vehicles on the same roads in urban areas create more congestion. For example, in Zurich, 50 hours are lost, on average, per year (INRIX, 2020a). This also leads to financial considerations related to congestion. It is estimated that the 87 hours lost in Munich annually costs EUR 774 per driver or EUR 405 million for the whole city (INRIX, 2020b). Furthermore, a higher density of vehicles may lead to more accidents.

- More than 70% of CO₂ emissions come from urban areas (C40 Group, 2020). A large proportion of those emissions are caused by urban freight transport because larger vehicles account for a higher density of emissions. However, there are other emissions as well, such as NO_x, caused. Due to more and more transport vehicles on the road, which are often not being fully utilized (e.g., 26% without any load in Switzerland, according to the BFS (2019)), more and more pollution is being created by urban freight transport.
- The growing volume of traffic causes higher noise levels (e.g., noise levels greater than 60 dB in large parts of Zurich, according to the BAFU (2020)). In combination with the other mentioned challenges, this ultimately leads to a lower quality of life for urban populations.

While there is a range of managerial challenges related to urban freight transport in urban areas, as outlined above, there are concepts presented under the umbrella term ‘urban logistics’ (UL) that promise to remedy the challenges of growing traffic volume, more congestion, and higher emissions. These concepts are further discussed in Section 2.3.3. In theory, these concepts are well researched and have been proved to help counteract the outlined problems. However, while this is proven in theory, these UL-related concepts miss successful and lasting implementations in practice.

Looking at the history of UL pilot projects since the early 1990s, various barriers to successful implementation can be observed. The barriers are always individually pronounced, depending on the specific UL concept. However, they can be clustered into three project phases, pre-pilot, during the pilot, and post-pilot, and in four topics – funding, stakeholder involvement, concept, and implementation planning and execution, according to Stölzle and Preindl (2019). These classifications are depicted in Figure 1 and described in the following paragraphs.

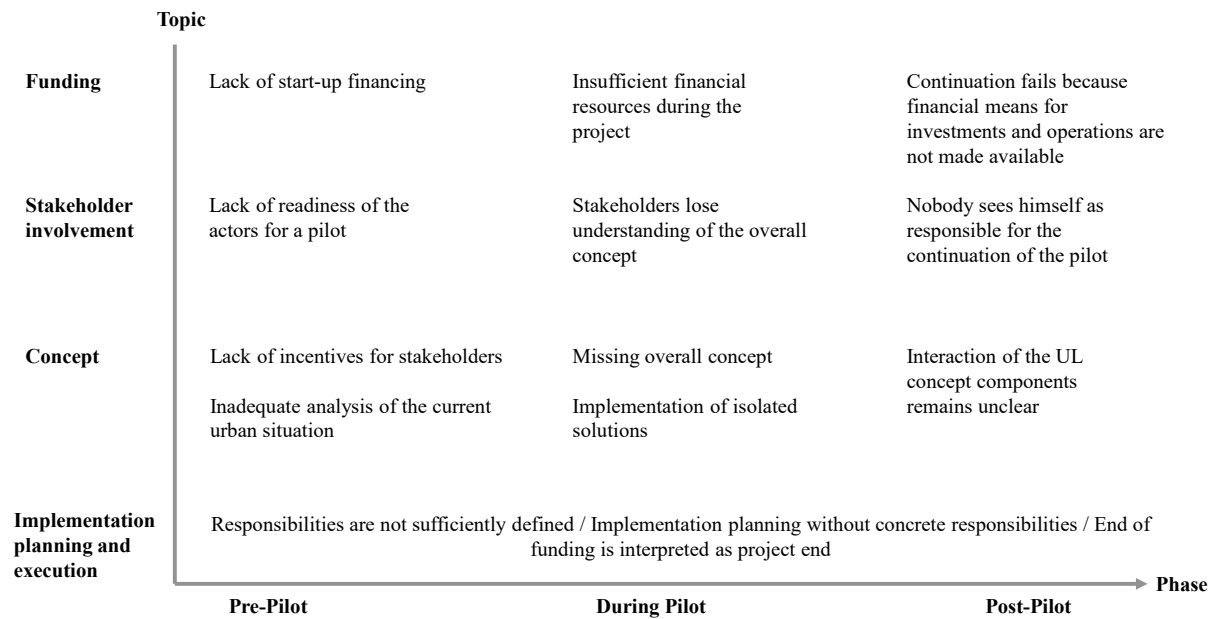


Figure 1. Barriers to the implementation of UL projects¹

Funding

When it comes to funding, some pilot projects are halted before they begin. They do not get startup funding, so they cannot begin operational measures. Other projects start; however, the costs turn out higher than expected, and they find a sudden end in the middle of the process due to insufficient financial resources. There are other examples where the pilot is successful, but when the ramp-up funding expires, there is no continuation, culminating in an end as well. Hence, continued and secured funding is essential to overcoming this barrier.

Stakeholder involvement

Regarding stakeholder involvement, some pilots do not begin because actors question the necessity of UL projects in general or are unwilling to get involved. Where stakeholders actively engage in pilots, it is possible that some actors lose their understanding of the overall concept during the pilot and consequently stop their engagement. It is also hard to achieve a reconciliation of interests regarding the overall concept because different stakeholder groups often have divergent interests. When pilots are successfully completed, these initiatives often run aground because nobody regards

¹ Adapted with changes from Stölzle and Preindl (2019, p. 92).

himself as responsible for the project's continuation. Therefore, intense stakeholder involvement during implementation is an essential factor for successful projects.

Concept

Concerning the UL concept, stakeholders may not be given sufficient incentives to participate in the pre-pilot phase. Furthermore, there is often an inadequate analysis of the local context, culminating in a deficient concept that does not live up to its surroundings. During pilot projects, it may turn out that a fitting overall concept connecting various concept components is missing or that isolated solutions are implemented. Usually, these do not achieve a breakthrough in terms of their impact on the overall urban freight transport situation within an urban area. With such implemented isolated solutions, also, in the post-pilot phase, the interaction of the UL concept components that were implemented frequently remains unclear.

Implementation planning and execution

Last but not least, implementation planning and execution are often not prudently handled. This is true for all phases of pilot projects. Where responsibilities are not sufficiently defined in advance, some tasks are pushed back and forth between participating parties or are not performed at all. Furthermore, detailed planning of the implementation is lacking and is not extensive enough. Consequently, some activities may be missed or miss prepared without anyone noticing until the project is on the brink of collapse. Other examples show that the implementation's execution is ended when the funding comes to an end and there are no plans for how the solution can be continued by integrating an economically lasting business model.

It can be concluded that the main finding is that the classical separation of the conceptualization and realization of UL has thus far failed. To overcome these barriers, research in the field of UL implementation is necessary. Hence, this dissertation aims to mainly give recommendations about the implementation of urban logistics systems (ULS), which consists of various UL concept components, as further explained in Section 2.3.1. This research, therefore, primarily addresses the already discussed existing barriers as 'concept' and 'implementation planning and execution'. The barrier of 'funding' is not explicitly addressed because it typically is the basis for any activity related to UL and is highly individual. The barrier of 'stakeholder involvement' is touched upon, noting that extensive research has been done in this area (e.g., Kiba-

Janiak, (2016)) – those findings were taken into consideration during this research the present study for the development of the implementation concept. By developing a suitable ULS implementation concept combining the conceptualization and realization in an iterative way, it should be possible to overcome these barriers with the aim of a successful implementation. Consequently, the successful implementation of ULS counteracts the mentioned challenges.

To overcome the ‘implementation gap’, an overview of managerial challenges related to the implementation of ULS shows that, in practice, the greatest struggle is with conceptualizing and realizing solutions, which is explained as follows:

- *Managerial challenge 1 (MC1) – Searching and customizing UL concept components:* Due to the increasing number of available UL concept components, practitioners need a better understanding of which solutions are available and how these can be customized to the individual situation on-site.
- *Managerial challenge 2 (MC2) – Designing ULS with adequate consideration of their implementation:* Many UL plans can be characterized as visions. However, a large number never get put into practice. Hence, practitioners need guidance on how to design ULS while taking feasibility into account.
- *Managerial challenge 3 (MC3) – Implementing ULS with a tailored concept:* Practitioners have thus far struggled with successfully implementing ULS. Therefore, a tailored concept that specifically considers the individual UL project’s peculiarities is necessary to guide future projects to fruitful implementations.

1.2 Theoretical relevance

To examine the implementation of ULS, this dissertation is based on various research streams and can be perceived cross-sectional. The predominant anchoring can be found in operations management. General and logistics-related findings from service management, innovation management, and especially strategic management are also considered (see Section 2.2).

In general, according to Porter (1980), a strategy can be defined as a comprehensive formula that corporations use to express the way they plan to compete, which goals should be pursued, and what is necessary to reach those goals. In other words, strategies

can be seen as a general plan to achieve goals when there is uncertainty involved. Companies usually formulate these visions and then try to put them into practice through an extensive implementation.

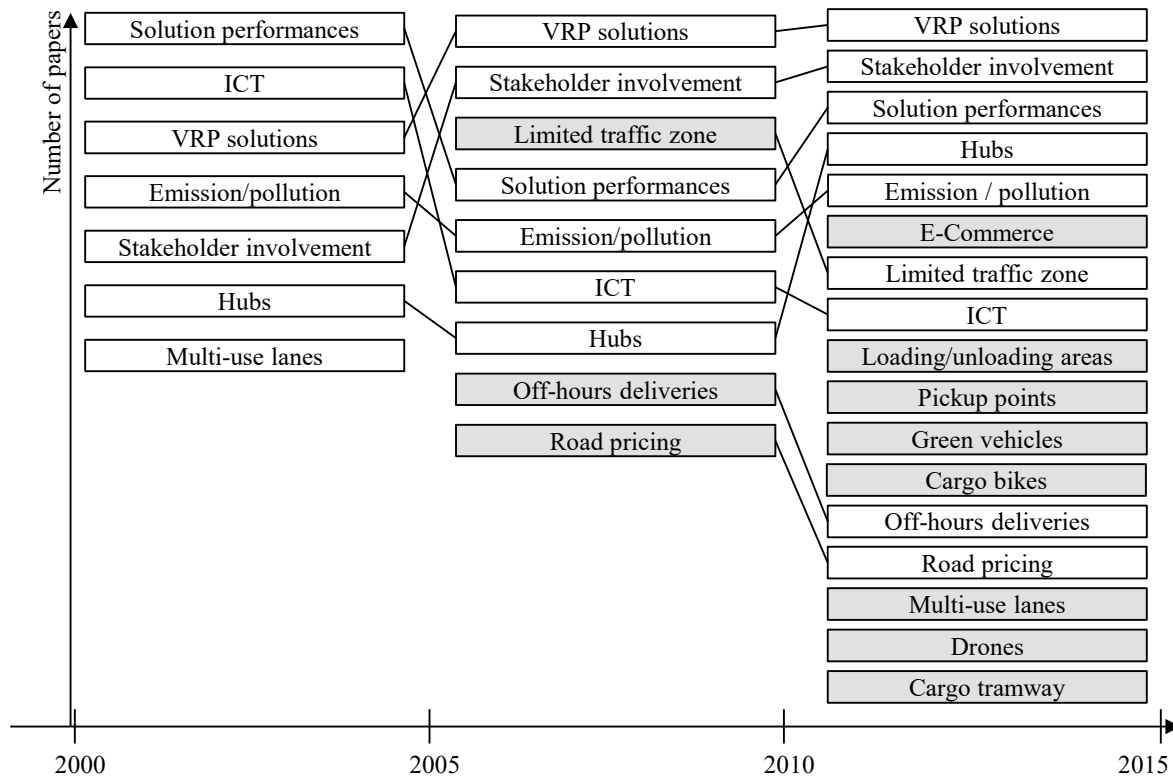
Hence, generally speaking, if implementation undertakings have profound impacts on, for example, the business model or the positioning of a company in its competitive landscape, they can usually be considered strategy implementation projects. Nevertheless, *«[w]ithin the strategic management literature, implementation is now seen as the most difficult phase of the strategy process because implementation activities take a longer time frame than formulation, involve more people and greater task complexity»*, as noted by Andrews *et al.* (2017, p. 3). Therefore, it is not surprising that *«strategy formulation hogs most of the attention of management and strategy thinkers while strategy implementation is sidelined»*, according to Kazmi (2008, p. 1564). In line with that, some scholars report *«that less than 50% of the strategies that organizations formulate ever get implemented. One important reason for this ‘implementation gap’ is that strategy formulation and implementation are often seen as completely separate processes»* (Andrews *et al.*, 2017, p. 3).

Obstacles to successful strategy implementation are manifold and can originate from a wide range of categories, including leadership, available time, communication and perceptions, reluctance to change, behavioral diagnoses, structure, resources, and external events (Cândido and Santos, 2019, p. 41). These obstacles apply to a multitude of implementation undertakings but can also be observed in the area of UL. This ‘implementation gap’ is common in not only the broader management literature but is also true for the specific area of UL where, for example, it has been identified as an area for future research by Rose *et al.* (2017).

To give a brief introduction to UL and its implementation, it must be started with a glimpse into the past. Activity around urban freight issues began arising in the 1970s, but declined in the 1980s. However, research interest increased again in the 1990s due to increased traffic-related problems, primarily concentrated in Europe and Japan. In general, the critical issues of low average capacity utilization of vehicles and many empty trips in commercial traffic are central for the idea of UL, according to Crainic, Ricciardi and Storchi (2009).

Following these universal issues found in many urban areas worldwide, the general idea of UL is to achieve «*significant gains [...] through a streamlining of distribution activities resulting in less freight vehicles traveling within the city and a better use of these vehicles*», according to Crainic, Ricciardi and Storchi (2009, p. 434). Consequently, a form of operations coordination by the consolidation of various shippers and carriers can be understood as the fundamental concept component of UL. According to Bretzke (2010), in the 1990s, UL mainly focused on collaborations between freight forwarders (e.g., in the case of general cargo).

Following less activity up to 1996, the number of scientific publications has risen, with a particular concentration of research in North America, Europe, and Japan (Wolpert and Reuter, 2012). Starting from simple freight forwarder collaborations in the 1990s, UL concepts have broadened from a content perspective in the 2000s, according to Lagorio *et al.* (2016). Research interest grew between 2000 and 2005, at first on specific topics such as solutions to vehicle routing problems (VRP), information communication technology (ICT), reductions of emissions, and comparisons of solution performance. In a second phase between 2005 and 2010, interest grew on topics such as stakeholder involvement, limited traffic zones, hubs, and VRP solutions on a more complex level. From 2010 to 2015, a wide range of new topics arose, such as loading and unloading areas, pickup points, bike delivery, and the use of drones. Also, the connection of e-commerce growth to UL was investigated more thoroughly. However, lasting research interest still lies in VRP solutions and stakeholder management. Hence, generally, UL research has broadened, particularly with the developments of new technological possibilities. This development of the relevant UL research topics over a 20-year time period is displayed in Figure 2.



Notes: Grey background = newly addressed topics during that time period.

Figure 2. Relevance of UL topics over time²

Therefore, while at first UL was rather narrowly concerned with collaborations, more and more so-called concept components arise today. In recent years, a further widening of topics under the term UL can be noted: For instance, alternative and environmentally friendly vehicles such as e-trucks or hydrogen trucks and the introduction of off-hours delivery concepts became more and more popular. It is noteworthy that not only utterly new concept components are raised but also specialized and interconnected concepts, such as the delivery of goods behind a customer's front door when they are not at home. For this reason, the diverse body of UL concept components is discussed in further detail in Section 2.3.3.

While most of these UL concept components are theoretically proven to counteract the managerial challenges in urban areas worldwide (as outlined in Section 1.1), their realization is always highly individual. There is no 'one fits all' UL concept component mixture, but rather, each urban area and its situational challenges must be judged on its own, as pointed out by Nathanail *et al.* (2016). Hence, depending on an individual target

² Adapted with changes from Lagorio *et al.* (2016, p. 916).

matrix where, for example, one urban area might most need a reduction of emissions while another needs a reduction of congestion, individual assessment and customization must take place in order to choose the most fitting concept components and form a ULS. However, if a suitable overall concept is envisioned, the collaboration of various stakeholder groups to successfully conduct UL is usually considered a central topic. When it comes to UL, there is a range of stakeholder groups directly or indirectly involved: According to Taniguchi and Tamagawa (2005), logistics service providers (LSPs), shippers and receivers, residents, and the public authority are connected to UL to differing degrees. Furthermore, site owners of logistics properties are of high importance. Each of these stakeholder groups behaves differently in the dependence of their objectives. Following Oexler (2002), each group has differing partial interests regarding UL: For instance, among other objectives, LSPs want to minimize transportation costs and maximize capacity utilization. Shippers and receivers often want to generate storage space savings and general optimization of their daily supply. Residents aim for an increase in service quality and less traffic with fewer emissions. The latter is also true for public authorities. However, they also pursue the cities' general attractiveness. Site owners aim primarily for the high utilization of their properties. Overall, these aims can be categorized into economic, ecological, or societal goals. While always perceived as highly individual, the different stakeholder groups generally target various objectives, which is a significant cause of conflict and shows the area of tension in which UL measures and the implementation of associated UL concept components need to be justified. Hence, unsurprisingly, stakeholders and their differing interests are often seen as a severe 'showstopper' of successful implementation of UL (Rose *et al.*, 2017).

Thus, it is not surprising that UL projects putting UL concepts into practice face various challenges concerning their implementation. This situation was observable not only in the 1990s but is still valid up to now. Because the problem pressure related to the managerial challenges noted in Section 1.1 was relatively low in the 1990s, as Bretzke (2010) pointed out, all the measures were usually discontinued in the mid-term. However, primarily due to the rising problem pressure being faced today with more urban areas growing worldwide, the concept of UL undergoes a 'renaissance' (Bretzke, 2010). Furthermore, technological progress expands UL to new concept components, as briefly mentioned above and more thoroughly described in Section 2.3.3. Nonetheless,

the challenges keep getting bigger, and barriers to implementation continue to be seen with the implementation of UL, as outlined in Section 1.1. Moreover, while the visioning and theoretical proving of UL concept components are widely popular, its implementation is mostly neglected in management research; in fact, Rose *et al.* (2017) identified implementation as one possible area for scientific extension.

Not unexpectedly, the initial analysis of the literature on the implementation of UL concept components and especially ULS shows that the managerial challenges have remained largely unaddressed. In addition, it is still unclear how the implementation gap of ULS in practice can be solved. Therefore, there is a clear necessity to address the subsequent theoretical shortcomings (TS):

- *Theoretical shortcoming 1 (TS1) – Assessment and customization of UL concept components:* Little is known about the implementation of UL concept components. Existing findings only make a limited contribution to the managerial challenges, and it remains unclear how to assess and customize the concept components depending on the varying circumstances in various urban areas.
- *Theoretical shortcoming 2 (TS2) – Combination of UL concept components to form a ULS:* Previous studies have mainly focused on single, or occasionally a combination of two UL concept components. Hence, so far, it remains unclear how ULS can be designed with regard to their implementation into practice.
- *Theoretical shortcoming 3 (TS3) – Undifferentiated treatment of implementation in UL projects:* To date, there are no empirically confirmed analyses that systematically investigate the implementation of ULS. Considering the complexity of UL in practice, more theoretically guided and empirically based research is required.

1.3 Research objectives

Based on the outlined relevance of this research (see Sections 1.1 and 1.2), the overarching research objective (RO_0) that can be derived is as follows:

RO₀: An examination of how to successfully implement ULS into practice.

To approach RO_0 , three partial research objectives (RO_1 - RO_3) are pursued that loosely build on each other. This procedure allows for examining the detailed shortcomings of

existing research on the implementation of ULS and for making contributions to the examined phenomenon.

A manifold and growing body of UL concept components is available to practitioners wanting to develop solutions to the previously outlined managerial challenges. As the technological developments are still ongoing, more and more concept components will arise, similar to the development of the field during past decades (Lagorio *et al.*, 2016). The existing body of research provides a general discussion about various influences on these concept components, such as antecedents, possible applications, their feasibility, advantages and disadvantages, and necessary investments, but has not yet investigated them holistically and how these can be customized to individual on-site situations in an urban area because there is no general fitting solution (Nathanail *et al.*, 2016). Therefore, the following first partial research objective can be formulated:

RO₁: An examination of the UL components and their customization.

Against the background of many unsuccessful UL implementation undertakings in the last few decades (see, e.g., Gammelgaard (2015)), and mostly only concentrated on one or two isolated UL concept components, guidance is necessary regarding how to design ULS with a consideration of their implementation. The existing research agrees on this necessity, for example, Stölzle *et al.* (2020), noting that this circumstance has not yet been sufficiently addressed in science. Because it is tremendously important to better understand the link of UL concept components in order to form a ULS and also to consider its implementation upfront when envisioning the ULS, from both a managerial and theoretical point of view, the second partial research objective is derived:

RO₂: An examination of the ULS design phase taking into consideration its implementation.

Given that ULS are embedded in complex environments, shaped by individual managerial challenges, such as increasing congestion, high emissions levels, individual sets of stakeholders, and specific interests that are involved, successful ULS implementations have not yet been achieved. While implementation research is considered highly important (Linton, 2002), in reality, research is scarce and mostly concentrated on the formulation of plans (Kazmi, 2008). Due to the highly individual situation in urban areas and, hence, also highly individual ULS implementations, a tailored and adaptable implementation concept for this context is necessary (Marchau *et*

al., 2008). Therefore, more differentiated research on the implementation of ULS is required that is theoretically guided and empirically confirmed to ultimately culminate in a tailored implementation concept for the case of ULS. Hence, the subsequent third partial research objective is derived:

*RO*₃: An examination of the implementation of ULS to identify practical guidelines.

For a further illustration, Figure 3 provides an overview of the managerial relevance, associated theoretical relevance, and this thesis's derived research objectives.

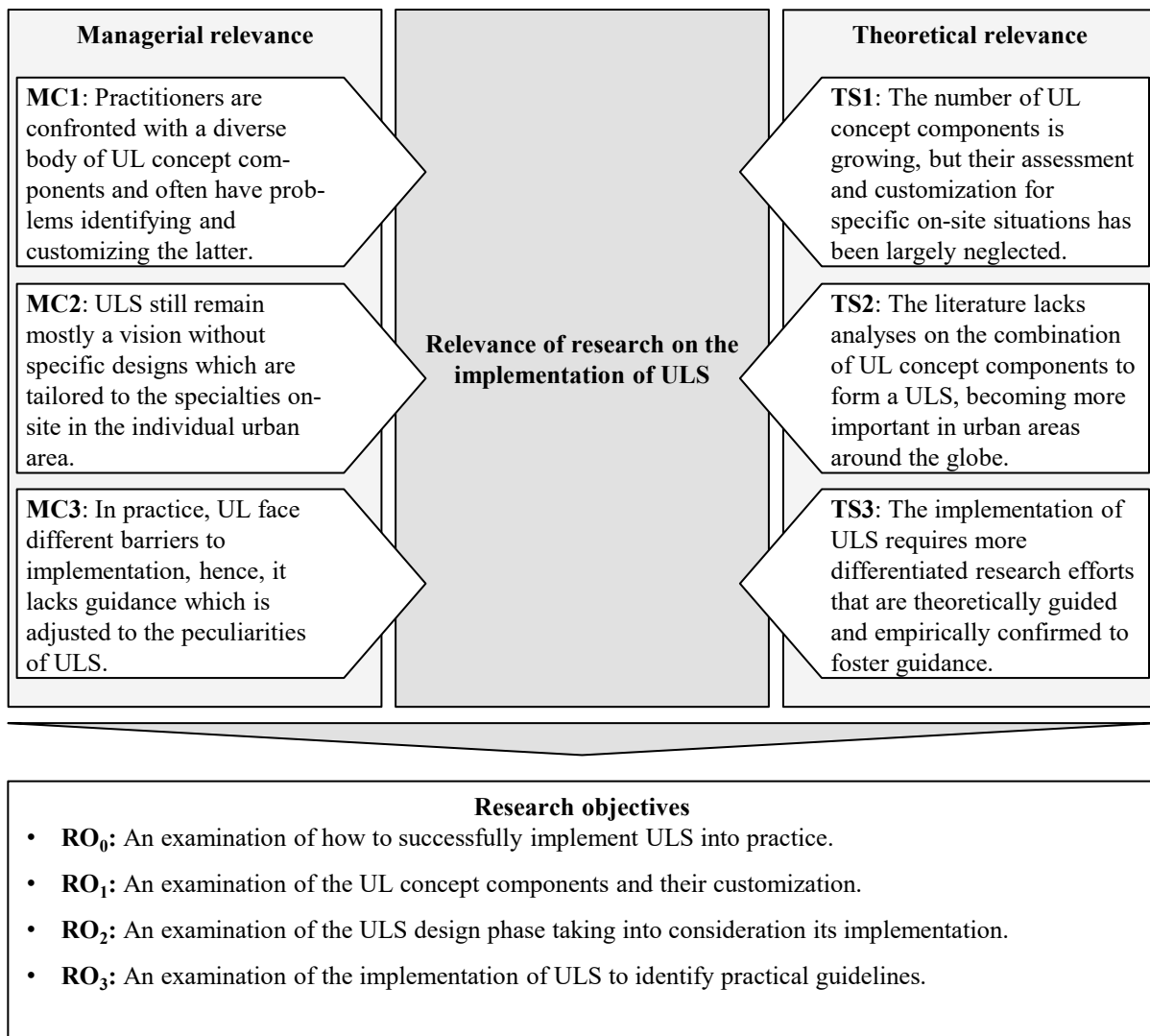


Figure 3. Managerial and theoretical relevance leading to the research objectives

1.4 Thesis structure

This dissertation is organized in five chapters. The structure is outlined graphically in Figure 4.

Chapter 2 sets out the theoretical fundamentals of this thesis. First, Section 2.1 describes the literature review approach. Second, a broad research map is sketched in Section 2.2 to explain the research setting. Then, in Section 2.3, the state-of-the-art research about UL is detailed to characterize the implementation's objective. Section 2.4 looks into the implementation itself and connects implementation to the context of ULS. Next, Section 2.5 outlines the research gaps. Finally, Section 2.6 deals with the research questions.

Chapter 3 is concerned with the research approach to the research phenomenon at hand. First, the theoretical access to it is described in Section 3.1, and, second, Section 3.2 presents the derived theoretical framework for this research. The chapter ends with an overview of the research design and methodology in Section 3.3.

Chapter 4 describes the research results with regard to the research questions. First, a contingency analysis of the ULS conceptual design is given in Section 4.1. Second, a qualitative assessment of the identified UL concept components is explained in Section 4.2. Furthermore, success factors for the ULS implementation are discussed in Section 4.3. Based on that, Section 4.4 introduces recommendations about the implementation management setup in a ULS implementation undertaking. Finally, Section 4.5 introduces an adaptable implementation concept for ULS. It is further categorized in various subsections that focus on different phases of ULS implementation, and an illustrative example for the application of the suggested implementation concept for ULS is provided.

Chapter 5 is concerned with the contributions of this dissertation, which are outlined in Section 5.1. Section 5.2 presents the managerial implications. Finally, limitations and suggestions for further research are discussed in Section 5.3.

The *Appendix* contains the interview guideline for the interviews conducted during the research process for this dissertation along with the qualitative assessment for the identified UL concept components.

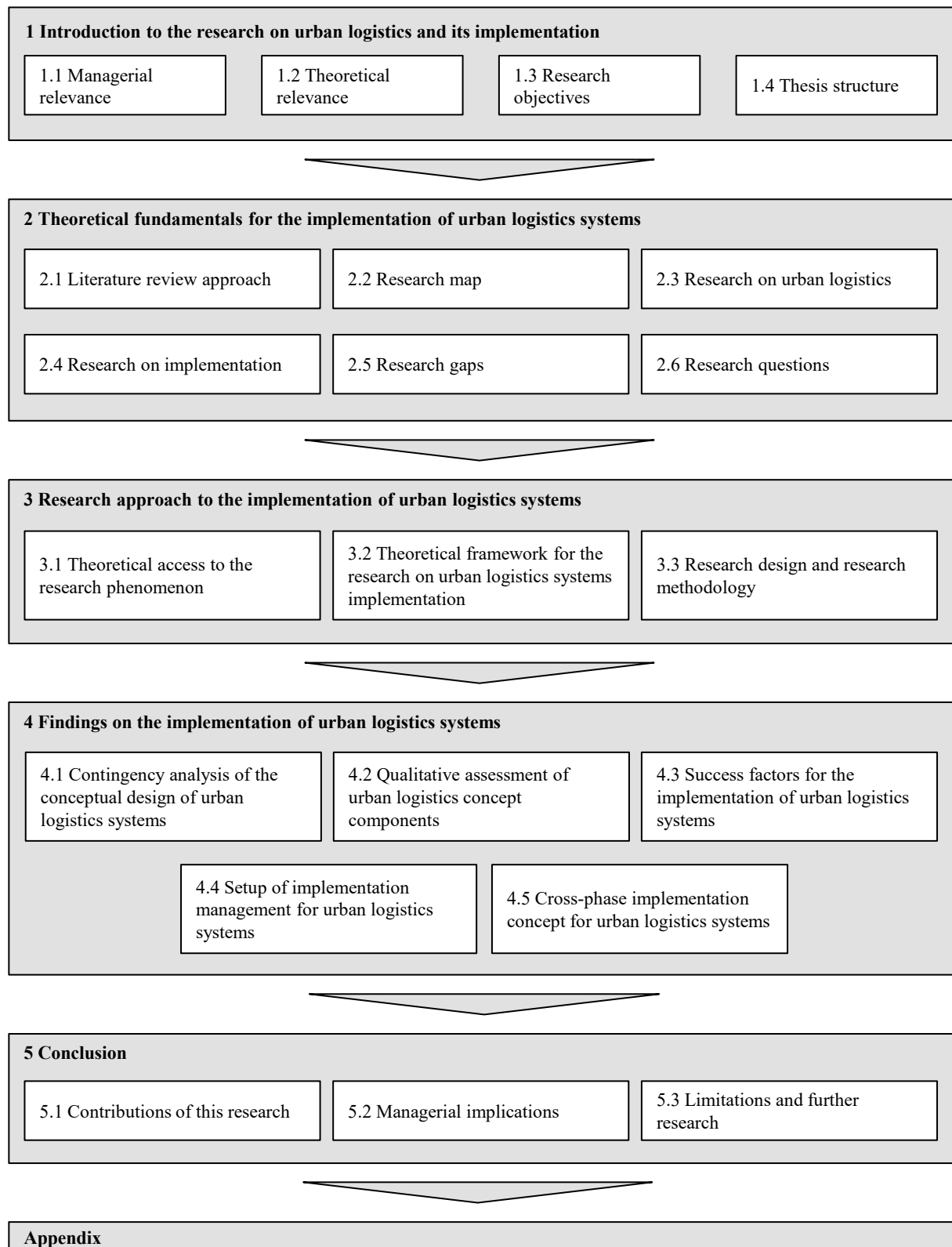


Figure 4. Outline of the thesis structure

2 Theoretical fundamentals for the implementation of urban logistics systems

This chapter introduces the theoretical groundwork for the investigations of the implementation of ULS. First, the literature review approach is briefly described in Section 2.1. Then the research map is outlined in Section 2.2 to understand where the research is located in the broader scientific knowledge base. After that, research on UL (Section 2.3) and on implementation as well as the connection of implementation to UL research (Section 2.4) are discussed in detail. In Section 2.5, the research gaps are described. Finally, Section 2.6 is dedicated to the research questions.

2.1 Literature review approach

To introduce the theoretical fundamentals of the knowledge base (KB) about UL, implementation in general, and its particular application to the object of ULS, separate but significantly connected literature reviews were conducted. A literature review is typically the first step in scientific management research, according to Denyer and Tranfield (2009), with the goal of providing an overview of state-of-the-art knowledge (Hart, 1998). Because this process is associated with various challenges, such as fragmentation and transdisciplinarity, it calls for a systematic approach, following Denyer and Tranfield (2009). While a literature review is always a subjective task because the screening of publications for relevance is biased by the individual's perspective (vom Brocke *et al.*, 2015), the process that is applied must guarantee rigor and validity in order to ensure reproducible results.

Generally, the research scope can be defined in various dimensions, namely in the dimensions of *process*, *source*, *coverage*, and *techniques*, as vom Brocke *et al.* (2015) pointed out. Hence, a serial search *process* in three databases that covers a broad range of business, management, and innovation literature was used as a source. While the process was mainly sequential, iterations regarding the keywords were applied with the aim of reaching a satisfactory and fitting set of keywords. Furthermore, the literature review intended to reach a representative *coverage* of the knowledge body in the research field of ULS implementation. Hence, a wide-ranging set of search *techniques* – i.e., keyword search, backward search, and forward search – was used. The process followed specially the application of vom Brocke *et al.* (2015) in Engel and Ebel (2019).

This thesis follows the recommendations regarding literature reviews, particularly that of Durach *et al.* (2017), as these are specific to the research field of supply chain management and logistics. Furthermore, the recommendations of vom Brocke *et al.* (2015) were considered in detail, shown in the steps mentioned below.

As pointed out, three separate explorative literature reviews were conducted to fully cover the fundamentals of this dissertation's specific topic. First, it was necessary to scrutinize the fundamentals of UL research. Second, the body of knowledge regarding implementation research was investigated. Third, a search was conducted for the specific part of the literature of interest relating to UL implementation research, bringing the first two aspects together. This is also represented in Figure 5.

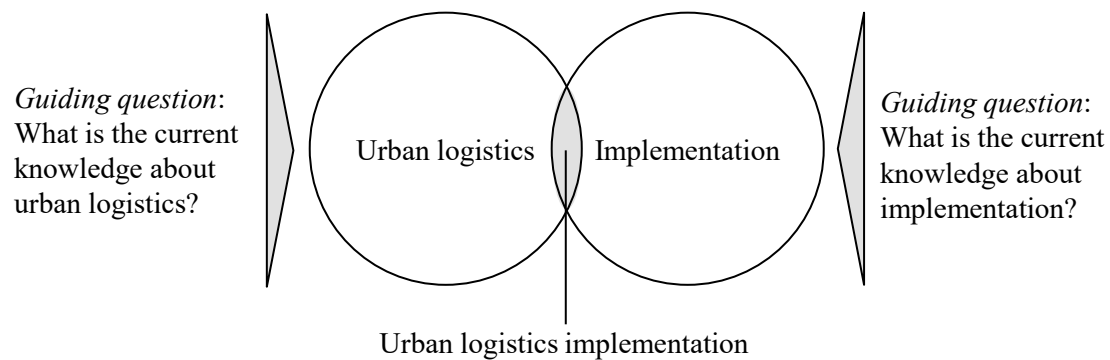


Figure 5. Intersection of the relevant literature

While the main body of literature is of scientific origin, publications from practice, such as reports of consultancies or political agendas, were included to get a complete picture of the current state-of-the-art. Hence, the three literature reviews were each conducted using the following steps:

Step 1 – Keywords selection: To find the relevant publications for each literature review, it was necessary to define specific keywords. As the aim was to cover a wide range of the respective research field literature, keywords were purposefully generic and broad. Thus, for the literature review on ‘urban logistics’, the same generic terms, as well as widely popular synonyms, were used. These keywords were connected using Boolean search strings, and an overview of the selected search strings is given in Table 1. Because it is assumed that the relevant publications use keywords in titles and abstracts, along with keyword lists, these sections were searched during the process.

Step 2 – Database selection: Database selection was done with the aim of determining a representative body of literature regarding the various research perspectives on each topic. To also investigate the latest publications, in addition to journal and book publications, conference proceedings were also considered because, otherwise, an upfront limitation would be the apparent lack of a holistic and integrative investigation of the areas of interest. Hence, three literature databases covering a broad, representative body of publications in business, management, and innovation were selected: EbscoHost, Scopus, and Web of Science.

Step 3 – Iterative refinement: During the search process, the keywords were iteratively refined and extended. For example, with the literature review on ‘urban logistics’ the initial search term would only include «urban logistic*», other related terms, such as «urban freight» or «urban transport*» were also included to ensure an integrated perspective on the topic of interest. Thus, Table 1 shows the final keyword composition. Initially, only the search results were included, and then a forward search and a backward search were conducted to identify further relevant publications.

Step 4 – Selection: Only publications in English and German were selected in all three literature reviews. During the initial scanning process, the results were screened based on titles, abstracts, and keywords. If these were selected as relevant, they were screened in further detail. To be selected, a specific publication needed to deal with the associated literature review’s central topic, and publications that did not cover the respective topic of interest were excluded. Duplications were also removed.

Step 5 – Addition of practice publications: To cover not only scientific results but also the opinions of practitioners, publications from practice were also added to all three literature reviews. Examples of these relevant publications are consultancy reports, company reports, project reports, political plans, and agendas. These were found with the same keywords but using the Google search engine. Publications were first scanned based on titles, and then – if applicable – on the management summary. If selected as relevant, a further detailed screening was carried out, and relevant publications were only those that dealt with the topic of the respective literature review.

Step 6 – Analysis: The relevant body of publications was analyzed from a content-centric perspective. The analysis was carried out in an iterative manner to derive the final summary of relevant knowledge, which is outlined in the next sections. However,

it is important to mention that «*deriving concepts from literature is always an endeavor requiring individual and intellectual human judgement*» (Engel and Ebel, 2019, p. 6), and hence, a subjective bias always remains. The following sections summarize the relevant literature on the respective topics.

Table 1. Literature review parameters

Criteria	Description
Databases	EbscoHost, Scopus, Web of Science
Search options	Search in title, abstract, and keywords; English and German
Keywords for urban logistics research	«urban freight» <OR> «urban transport*» <OR> «urban logistic*» <OR> «city logistic*» <OR> «last mile»
Keywords for implementation research	«implement*» <OR> «execut*» <OR> «realiz*»
Keywords for urban logistics implementation research	(«urban freight» <OR> «urban transport*» <OR> «urban logistic*» <OR> «city logistic*» <OR> «last mile») <AND> («implement*» <OR> «execut*» <OR> «realiz*»)

2.2 Research map

First, to give an overview of the allocation of research on UL and its implementation, it needs to be noted that the topic can be located at the intersection of various major research streams. As Figure 6 shows, the subject can be found in the areas of innovation, service, operations, and strategic management. Hence, the research streams are vaguely connected with a flowing transition. The different streams and their connections, especially to UL, are briefly summarized below.

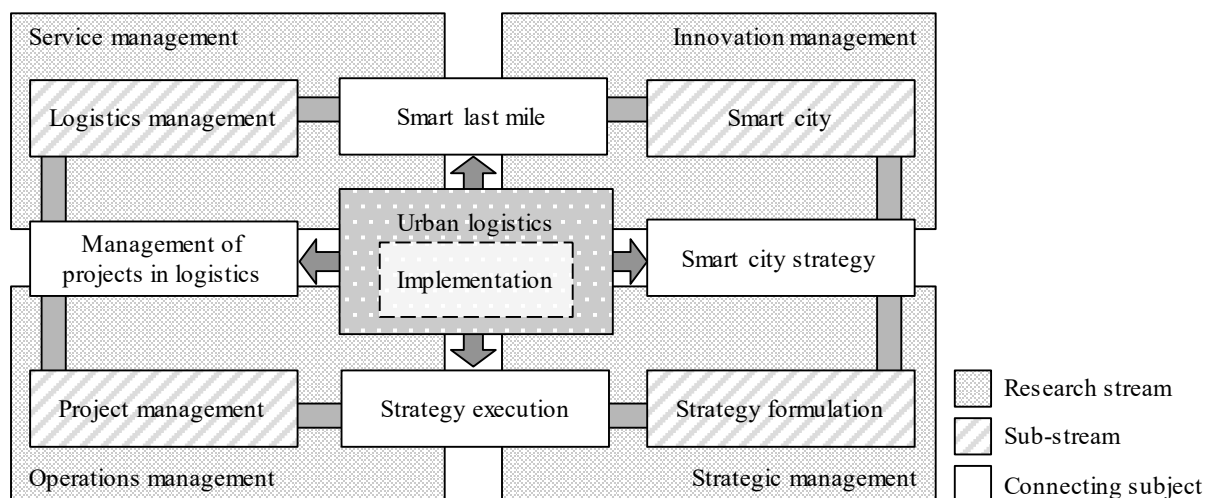


Figure 6. Relevant research streams on the subject of UL

Service management

The research stream of service management deals with all types of services. As Sampson and Froehle (2006, p. 334) point out, generally accepted by scholars, are the following five characteristics of services: «*intangibility, heterogeneity, simultaneity (inseparability), perishability and customer participation*». These characteristics are also valid for the sub-stream of logistics management, which is described as the activities of planning, coordination, and optimization along a supply chain (Lambert and Cooper, 2000) and which is considered important for this dissertation. While logistics management also encompasses the delivery of goods to the end consumer – the so-called ‘last mile’ – in recent years, a range of innovations has been proposed to make this process ‘smart’, culminating in a ‘smart last mile’. The latter can be perceived as the bridge to the research stream of innovation management.

Innovation management

According to Adams *et al.* (2006), the literature about innovation is fragmented and shaped by diverse disciplinary backgrounds. Therefore, unsurprisingly, the term ‘innovation’ and its management lack a single definition. However, it can be described as something new and its successful utilization. Within this wide-ranging research stream, the sub-stream of smart city development is regarded as relevant for this dissertation. While the creation of smart cities is connected to a broad range of subjects, such as their governance, the necessary infrastructure, or connected devices through the internet of things, logistic activities in urban areas can be perceived as one of the pillars of a smart city. The establishment of long-term visions and plans form the bridge to the research stream of strategic management.

Strategic management

Following Nag *et al.* (2007, p. 944), «*the field of strategic management deals with the major intended and emergent initiatives taken by general managers on behalf of owners, involving utilization of resources, to enhance the performance of firms in their external environments*». Hence, the research stream of strategic management is investigating long-term visions and how to achieve them. The sub-stream of strategy formulation is perceived as important for the implementation of UL. It is necessary to formulate a UL strategy to put the relevant stakeholders into the execution position and let the strategy

become reality, and therefore, all activities related to the execution of strategies are related to the research stream of operations management.

Operations management

Slack *et al.* (2011, p. 22) defined operations management as «*the activity of managing the resources which are devoted to the creation and delivery of services and products*». For this dissertation, the sub-stream of project management (PM) is of particular interest (further elaborated in Section 2.1.3). Pich *et al.* (2002, p. 1011) described PM as being comprised of «*planning, executing, and monitoring*» of «*a collection of simultaneous and sequential activities which together produce an identifiable outcome of value*». The management of projects, specifically in a logistics environment, can be perceived as the bridge to the research stream of service management. Logistic projects include changes on an operational level but also the management of long-term strategies, such as participating in UL-related pilots.

To conclude, the subject of UL implementation is inevitably connected to a range of research streams and sub-streams, so the body of literature regarding these streams needs to be considered in this research.

2.3 Research on urban logistics

This section gives an overview of the fundamentals of UL research that are relevant to this dissertation. First, UL and ULS are defined and delaminated in Section 2.3.1. Second, the driving forces, aims, and enablers of UL initiatives are outlined in Section 2.3.2. Third, a systematization and characterization of UL concept components are proposed in Section 2.3.3. Finally, Section 2.3.4 closes with remarks about relevant stakeholders and their involvement in UL initiatives.

2.3.1 Definition and delamination of urban logistics and urban logistics systems

Having described the positioning of UL within the various research streams (Section 2.2), the following paragraphs deal with the differing terms and delaminate them. In addition, relevant terms are distinguished not only between them but also regarding their historical development in terms of UL research over the decades.

According to Mentzer *et al.* (2001, p. 4), ‘supply chains’ are «*a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream*

flows of products, services, finances, and/or information from a source to a customer». Consequently, the management of supply chains is called ‘supply chain management’ (SCM), which can be understood as *«[t]he systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole»* (Mentzer *et al.*, 2001, p. 18). Hence, SCM aims to achieve a competitive advantage for a network of involved actors. Inherently connected to SCM is the term ‘logistics’ which *«entails the process of planning and controlling the flow and storage of goods and services from the point of origin to the customer, conforming to customer requirements»*, according to Lummus *et al.* (2001, p. 429). Hence, in line with that, the term ‘logistics management’ is understood as *«that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers’ requirements»* (Council of Supply Chain Management Professionals, 2021). Thus, the term ‘urban logistics’ is connected mainly to these definitions.

Turning to the focus of UL, it must be noted that there is a rich history in research with an evolving understanding of relevant terms: Early research interests centered around the term ‘intraregional flows’. It was investigated as early as the 1970s, when McDermott (1975, p. 29) defined it as *«shipments having both source and destination within a defined regional area»*. Looking at only transportation-related processes in urban areas, the scholarly discussion went on to define the term ‘urban freight transport’ later, at the end of the 1970s, as pointed out in Section 1.1. These efforts gained interest in closer to UL-related areas, such as the movement of urban goods and transportation management. However, according to Rose *et al.* (2017), in the 1980s, reduced federal funding led to less research related to those considerations.

Nevertheless, starting in the early 1990s, scholars again became more interested in this subject area. The research interests at that time were then centered around the idea of logistics in urban areas. While most of the initiatives were subsumed under the label of ‘city logistics’ also the term ‘urban logistics’ was defined early on as *«the movement of things (as distinct from people) to, from, within, and through urban areas»* (Ogden, 1992, p. 14). The central idea of those initiatives in the 1990s was the consolidation of

groupage with several freight forwarders, leading to fewer trucks being necessary and higher utilization based on a cross-company approach. However, at the time, only limited support was given via information systems. Therefore, a great manual effort was required of participating companies.

The term ‘urban logistics’ is today used very much interchangeably with the mentioned term ‘city logistics’ (CL) even though denoting the same concept, according to Rose *et al.* (2017). Therefore, it seems reasonable that the development of various definitions of both terms can be observed: Muñuzuri *et al.* (2005, p. 15) provided definitions of both terms, where ‘urban logistics’ was defined as *«those movements of goods that are affected by particularities associated to urban traffic and morphology»* and ‘city logistics’ was defined *«as the process for totally optimizing logistics and transport activities by private companies in urban areas while considering the traffic environment, the traffic congestion, and energy consumption within the framework of a market economy»*. Later, complex definitions evolved that reflected a more profound understanding of the subject. Hence, Gammelgaard (2015, p. 334) defined ‘city logistics’ as *«[a]ll coordinated measures comprising logistic collection and delivery activities of logistic service providers in urban areas that aim at the reduction or prevention of commercial traffic and its negative external effects»*. In this research, the terms are also understood similarly, but the abbreviation UL is used consistently to express the aspiration of investigating entire urban areas instead of ‘only’ city centers while researching ULS (further explained in the second next paragraph). Generally, it must be noted that the underlying idea of UL is *«to stop considering each shipment, company, and vehicle in isolation, but rather as components of an integrated logistics system to be optimized. Coordination and consolidation are at the basis of this idea»*, according to Crainic, Gendreau and Potvin (2009, p. 548).

Related to the subject of UL and CL is research focusing on the ‘last mile’. As Souza *et al.* (2014, p. 423) pointed out, the subject deals with *«a common logistics collection/distribution problem in built-up (urban) environments»*. It is also *«the final leg in a business-to-consumer delivery service whereby the consignment is delivered to the recipient, either at the recipient’s home or at a collection point»*, according to Gevaers *et al.* (2011, p. 57). Typical problems associated with the last mile are high costs, failure rates of deliveries, lack of a critical mass of deliveries, environmental impacts, and vehicle routing (Gevaers *et al.*, 2011), and as a result, research interests

usually concentrate on those subjects. Therefore, last mile logistics can be understood as connected to UL. Olsson *et al.* (2019) also pointed out that an overlap exists: While research about the last mile *«aims to increase efficiency to contribute to economic sustainability regard reduced cost and increased profit»* (p. 16), research about UL aims at increasing the effectiveness of logistics processes with the larger goal of reducing externalities. These externalities are mainly caused by road-based transportation (Browne *et al.*, 2012). Furthermore, last mile logistics is also a topic in rural areas, where the problem of critical mass arises, leading to rises in delivery costs. Consequently, the subject of last mile is not focused on in this research since it is understood to be a sub-theme, of course, with implications for UL; yet, it is only treated as a side note within this research.

Turning back to the focus of this research, the development of an understanding of UL is still evolving, as noted by Rose *et al.* (2017). Nowadays, according to Rose *et al.* (2017, p. 362), the term ‘urban logistics’ can be understood *«as that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers’ requirements, as influenced by complex interactions among densely populated social systems and associated infrastructure»*. In the present study, this complex and up-to-date understanding of UL is followed.

However, as Preindl (2020) pointed out, UL is composed of various UL concept components, which are discussed in Section 2.1.2. Nevertheless, these concept components are often seen as ‘silos’ that have limited or no links. Hence, the concept components usually do not live up to their full capabilities. Lagorio *et al.* (2016) and Iwan (2014a) recognized the need for systems in UL, and Crainic, Ricciardi and Storchi (2009) argued that a system can integrate and consist of several sub-systems. Similarly, Preindl (2020) argued that *«only with a highly individualized but structured combination of diverse UL concept components a real relief in terms of social (e.g. too many congestion hours, high noise pollution) and environmental (e.g. emissions of fine dust) problems in urban areas can be achieved»*. Hence, the term ‘urban logistics systems’ is defined as *«a ULS combines diverse urban logistics concept components to one structured system, which is capable dealing efficiently with a large share of deliveries, returns, pickups and disposals, which take place in an urban area. It is a coordinated*

system where private and public work together to reduce traffic and related negative effects on the urban area», according to Preindl (2020). Furthermore, a ULS can be restricted to different dimensions, such as geographically (e.g., by certain postal codes), the logistics submarket (e.g., only express shipments are considered), the shipment's recipients (e.g., only private customers), the means of transportation (e.g., only shipments delivered by economically friendly vehicles), or a combination of characteristics mentioned above.

An important differentiating characteristic of ULS for the common understanding of UL is the interplay of the various concept components introduced in the next section. The focus of ULS is on the establishment of a complex network of customized solutions for individual on-site situations in urban areas. Therefore, to understand the concept of ULS, it is necessary to understand the actor and network levels in SCM. The latter is outlined as the duality inherent in SCM between 'companies in the network' (actor level) and the 'network' (supply chain or network level), according to Eßig *et al.* (2013, p. 9). This can also be transferred to the context of ULS: The idea of ULS is situated on the network level and implies interventions in the autonomy of individual actors in the network for the superordinate network perspective of their aims in the target dimensions of economic efficiency, environmental as well as societal aspects.

Hence, ULS connect various actors along the logistics chain for the greater whole. Next to the basic idea of combining multiple UL concept components, the latter is one of the prominent delimitation marks to UL and former understandings. Furthermore, due to recent technological developments, especially in the last decade, ULS may use a range of concept components that did not exist in the past. Therefore, former understandings and former pilot projects, especially those in the 1990s and early 2000s, fall short of these characteristics. To get a deeper understanding of the concept components out of which ULS consist, a systematization and characterization derived from literature are presented in Section 2.3.3.

While a lot of research has been conducted about UL, it is vital to comprehend where UL can ultimately be applied: namely, in urban areas around the globe. Weeks (2010, p. 34) defined urban places as *«a spatial concentration of people whose lives are organized around nonagricultural activities»*. Furthermore, urbanity is dependent on the population size and density, the space of the city, and its economic and social

organization within it, according to Weeks (2010). Following the definitions introduced by the Bundesministerium für Verkehr und digitale Infrastruktur (2020), urban areas can be divided into metropolitan and non-metropolitan urban areas. Hence, the measure indicating a large city includes having at least 100,000 inhabitants. These cities – or urban areas (the terms are used interchangeably in this thesis) – with many distinguishable traffic movements are considered relevant for UL initiatives in this dissertation.

Because there exist many different traffic movements in urban areas, it must be noted that not all urban goods movements within an urban area are relevant for UL measures. Generally, urban freight transport can be divided into movements by end consumers and logistics-related movements considering multiple decision-makers, according to Russo and Comi (2010). Furthermore, traffic types can be further divided into

- *Destination traffic*: The repository lies outside, but the destination is inside the urban area;
- *Domestic traffic*: The repository and destination lie within the urban area;
- *Repository traffic*: The repository lies within, but the destination is outside the urban area;
- *Transit traffic*: The repository and destination lie outside the urban area,

as stated by Bretzke (2010). Consequently, transit traffic is usually not subject to UL. The remaining three types are relevant for UL because they contribute to the discussed challenges, especially congestion and emissions, as mentioned in Chapter 1. While there are different distinct transport modes, including air, waterway, underground, and road, UL initiatives typically concentrate on road. Again, however, not all road traffic is relevant for UL. For example, Gonzalez-Feliu (2018, p. 51) estimated that, in total, 46% of road traffic is related to traffic between two economic entities and the traffic of so-called urban management flows «*associated with residual or accessory flows*» (p. 50). Dablanc (2007) estimated relevant road traffic for UL measures was more than one-fourth of the total. Hence, it must be individually judged which proportion of all traffic types are dealt with in UL initiatives. Finally, it must be pointed out that UL initiatives must have an impact on a sufficiently large share of urban goods movements to justify them and to sustain the support of local actors (Bretzke, 2010).

2.3.2 Driving forces, aims, and enabler of urban logistics initiatives

Research in UL has gained more and more interest recently. Literature reviews such as those conducted by Dolati Neghabadi *et al.* (2019) and Hu *et al.* (2019) have found a significant rise in interest over the last five years, in particular. As described in Section 1.2, the volume of UL concept components discussed in the literature has broadened over time, especially due to technological advances, see, for instance, Lagorio *et al.* (2016). In terms of the selected methodological approach, most academic research has made use of a qualitative method along with mathematical optimization (Dolati Neghabadi *et al.*, 2019), case study, and respective interview approaches (Lagorio *et al.*, 2016). However, most studies are conceptual, as stated by Wolpert and Reuter (2012) and Hu *et al.* (2019). UL research can be judged as a global phenomenon, with a significant number of studies ranging in the geographic distribution with top ranks of the United States, Italy, the United Kingdom, France, China, Netherlands, and Germany, according to Hu *et al.* (2019). A detailed discussion of the theoretical lenses applied in UL research is provided in Section 3.1. Based on the reviewed literature, the most researched topics of driving forces, aims, and enablers of UL initiatives are discussed in the following. In addition, concept components and stakeholders are the most debated topics in academic literature, and hence, Sections 2.3.3 and 2.3.4 are dedicated to them, respectively. Also, these topics are of primary importance for this thesis.

First of all, it should be noted that driving forces, aims, and enablers for UL initiatives are always highly individual. This is because the situation in each urban area is different in many ways, meaning that they differ significantly in regard to, for example, the existing infrastructure, topography, types of vehicles in use, number of inhabitants, or settlement structure, among other factors.

As discussed earlier, driving forces for UL solutions are generally not new. Even Julius Caesar tried to minimize urban congestion by introducing a ban on commercial deliveries during the daytime (Holguín-Veras, 2008). Nevertheless, the problem pressure in practice has increased recently due to the described factors (see Section 1.1) of urbanization, e-commerce growth, and rising customer demands leading to the effect of growing traffic volume, which in turn has the consequence of increasing hours of traffic congestion, higher levels of emissions of CO₂ and other particles, and more noise. Taken together, these can be summarized as the negative externalities of urban goods

movements (Wolpert and Reuter, 2012). Furthermore, negative externalities of urban goods movements can be generally categorized as having economic, environmental, or societal impacts (Anderson *et al.*, 2005). Moreover, urban goods movements tend to become more complex as urbanization increases (Crainic, Gendreau and Potvin, 2009), and these challenges are not expected to ease in the near future. Additionally, recent years have also seen a rise in the importance of the sustainability of business processes due to concerns about climate change. This development has taken place also in urban freight transport (Lindholm, 2010). Consequently, UL concept components have garnered more interest in urban areas worldwide.

Hence, unsurprisingly, these challenges have thus been addressed with not only a significant increase of academic research but also an increase of practice-related projects of all kinds. UL projects, in practice, deal with the implementation of UL concept components (discussed in Section 2.3.3), and in general, most practice-related initiatives deal specifically with the consolidation of shipments to achieve tour condensation, resulting in less traffic (Bretzke, 2010). However, implementations on a large scale that have a significant impact on the outlined challenges are unknown thus far.

What all of these initiatives have in common are the aims they try to achieve. These goals are primarily connected to the outlined challenges in urban areas. This means there are generally one of three goals that are the reasons for introducing UL-related measures, according to Crainic *et al.* (2004, p. 120):

1. *«Reduce congestion and increase mobility.*
2. *Reduce pollution and noise; Contributing reaching the Kyoto targets;
Improve living conditions of city inhabitants.*
3. *Avoid unduly penalizing the city center commercial activities such as not to
“empty” them.»*

While these are broadly formulated aims, it must be noted that these aims are always individually pronounced based on two factors:

- *The individual situation on-site:* As described, urban areas worldwide differ significantly. For instance, in one urban area, congestion may be the most pressing problem, while for another urban area, the implementation of UL measures might be driven mainly by environmental factors like pollution. Hence, the composition of a project's aims must be judged individually.

- *Involved stakeholders*: Different stakeholder groups (see Section 2.3.4) have different interests in UL initiatives, and those interests are sometimes contradictory (Browne *et al.*, 2007). They are usually driven by the stakeholder's agenda (Anand and Yang *et al.*, 2012), and therefore, depending on which stakeholders are involved in individual UL initiatives, these aims must be aligned individually to achieve a satisfying solution for all involved.

However, while the above aims are perceived as generally true, these high-level aims can be broken down into different dimensions. According to Anand and Yang *et al.* (2012), three different dimensions can be distinguished:

- *Economic aims*: This dimension is mainly concerned with the economic success of UL initiatives. Hence, profitability is the central gauge. However, profitability can have different specifications, which are principally dependent on the actors' perspectives.
- *Environmental aims*: This dimension addresses the need for sustainability, mainly in terms of emissions and noise. Fossil fuel consumption is addressed to introduce ultimately more sustainable and environmentally friendly solutions.
- *Societal aims*: This dimension is primarily concerned with the general public, meaning the inhabitants of an urban area. In general, these aims contribute to a better quality of life in the urban area.

Table 2 provides a non-exhaustive overview of examples of various UL aims in these three different dimensions. It must be noted that these three dimensions are partly interrelated.

Table 2. Structure of UL aims³

Dimension	Aims
Economic	• Congestion reduction • Local prosperity enhancement (e.g., creation of jobs, increased competition) • Profitability raises (e.g., through reductions in logistics cost, product prices, increased product availability, service levels, and logistics quality)

³ Adapted with changes from Anand and Yang *et al.* (2012, p. 11949).

Dimension	Aims
Environmental	• Emission reduction • Fossil fuel consumption reduction • Nuisance reduction • Valuable area protection
Societal	• Livability enhancements • Health betterment • Safety enhancements

Because the aims of different dimensions are general, the measure of their achievement needs to be unique to each UL initiative in order to judge an initiative as successful or unsuccessful. For this purpose, specific so-called ‘key performance indicators’ (KPIs) can be introduced. Usually, in an ex-post analysis, it must be individually judged if a certain KPI lives up to the expectations connected to a UL initiative. Table 3 provides an overview of possible KPIs; however, it must be noted that this list is not exhaustive and can be individualized for distinct UL initiatives.

Table 3. Possible KPIs to measure achievement of UL aims⁴

Dimension	KPI
Economic	• Congestion indicator • Local prosperity indicator • Infrastructure protection indicator • Profitability indicator
Environmental	• Emission indicator • Fossil fuel consumption indicator • Nuisance indicator • Valuable area protection indicator
Societal	• Attractiveness indicator • Happiness indicator

The aims of UL can be widely judged heterogeneously, at least from a high-level perspective. However, while the enablers of UL initiatives are mostly the same, they can be divided into two categories:

⁴ Adapted with changes from Anand and Yang *et al.* (2012, p. 11949).

- *Technology*: Technological advances lead to an increasing scope of UL concept components. This is described for the last decades, for instance, by Lagorio *et al.* (2016), and it is estimated that these concept components will advance in the future. The ongoing process of digitization contributes to UL as well. According to Henke (2020), in particular, the increasing digital infrastructure, advances in the concepts of the Internet of Things and big data, and digital platforms can all be considered enablers of UL. The latter technologies are perceived as promising for UL (Taniguchi *et al.*, 2020).
- *Organization*: Advances in the alignment of the interests of various stakeholders through a systematic organization used in UL initiatives can also be judged to be an enabler of UL. Without a stable and supportive organization, where different stakeholder interests are considered not only upfront but throughout an initiative, UL is usually considered to be doomed to failure. Hence, systematic stakeholder management is crucial for UL (Gammelgaard *et al.*, 2017). This is further outlined in Section 2.3.4.

Based on this discussion about driving forces, aims, and enablers of UL, it is clear that the implementation of UL concept components requires «*planning at the strategic, tactic, and operational levels*», as stated by Crainic, Gendreau and Potvin (2009, p. 549). However, so far, «*there is a lack of studies analysing urban logistics as a whole and comprehensive issue*» (Lagorio *et al.*, 2016, p. 924). This is necessary because any UL «*solution, in fact, does not live in isolation, but rather, it represents a system within a larger system of systems*» (Lagorio *et al.*, 2016, p. 924). Therefore, the following section discusses UL concept components from a holistic perspective to gain an overview of which concept components can be part of ULS.

2.3.3 Systematization and characterization of urban logistics concept components

Generally, studies deal with different UL concept components in detail, discussing, for example, antecedents, possible applications, feasibility, advantages and disadvantages, necessary investments, or impact on the different target dimensions of UL, including economic efficiency and environmental and societal aspects. This is also true for practice-related publications, except that they do not typically go into as much detail as academic sources.

Early studies such as those from Taniguchi and van der Heijden (2000) or Taniguchi and Shimamoto (2004) identified only five types of UL concept components. Since then, the number of UL concept components has grown, primarily due to ongoing technological developments. The basic, underlying ideas can be categorized in the five segments shown in Table 4, and the various concept components are briefly discussed in the following paragraphs.

Table 4. UL concept components⁵

Segment	Concept components
Alternative delivery options	• In-car delivery • In-home delivery • Off-hours delivery • Parcel boxes • Parcel lockers • Parcel shops
Alternative means of transportation	Short-haul • Delivery robots • Drones • (E-)Cargo bikes • E-trucks
	Long-haul • Cargo tramway • Rail freight • Underground transport systems
Consolidation of logistics services	• Crowdsourced delivery • Macro-hub • Micro-hub • Periphery hub • Resource sharing
Information systems	• Intelligent transport system platform
Regulatory measures	• Driving bans • Parking spaces dedicated to loading and unloading • Priority lanes • Mobility pricing • Toll systems

⁵ Adapted with changes from Stölzle and Preindl (2019, p. 90) and Preindl (2020, p. 5).

Alternative delivery options

The concept components categorized in this segment deal with replacing the standard system for delivery of a shipment to the recipient. While timing is addressed with off-hours delivery, as discussed by Holguín-Veras (2008) and others, using non-peak hours to conduct logistic services, the other concept components emphasize the point of delivery. The concept component of in-home delivery suggests that the delivery agent can access private homes with a type of key or smart entry. Similarly, the concept component of in-car delivery is where mail carriers or couriers place a shipment in the trunk of the recipient's car (e.g., further discussed by Reyes *et al.* (2017)). With the concept component of parcel boxes, households can set up private boxes to receive packages (as noted by Punakivi *et al.* (2001) and others). Parcel shops and parcel lockers pursue a target of centralizing shipment reception using newsstands and special central lockers as the point of delivery (see, e.g., respectively, Dell'Amico and Hadjidimitriou (2012) and Iwan *et al.* (2016)).

Alternative means of transportation

All of the concept components in this segment target the replacement of conventional vehicles that run on fossil fuels, but each concept component is suitable for a specific part of the logistics market and can be divided into short-haul and long-haul. Regarding short-haul, electric and hydrogen-powered trucks are mainly constructed for general cargo, respectively, large amounts of packages of the courier, express, parcel services (CEP) market. For example, Davis and Figliozzi (2013) discussed the competitiveness of electric delivery trucks. Also addressed by scholars are cargo bikes (e.g., Melo and Baptista (2017)), drones (e.g., Kunze (2016)), and delivery robots (e.g., Boysen *et al.* (2018)), especially for their use in the CEP market. In terms of long-haul, freight transportation of all types via rail in urban areas was discussed by Diziain *et al.* (2014), among others. Also, for all types of cargo, underground transport systems (e.g., discussed by Hai *et al.* (2020) and others) may be introduced in the future, along with the use of existing tramways (as argued by De Langhe (2017)).

Consolidation of logistics services

At the core of the consolidation of logistics services is the bundling and sharing of all types of resources among various LSPs, letting a cross-company network of usually competing firms emerge. The consolidation takes place in periphery, macro- or micro-

hubs, also known as urban consolidation centers or urban distribution centers, see, for instance, Nordtømme *et al.* (2015) or Ji *et al.* (2020). These hubs can either be at a fixed location, mostly in the case of macro-hubs, or be flexible in terms of location. The latter applies primarily to micro-hubs. Another concept component is resource sharing, such as of trucks or the hub area, as discussed by Li *et al.* (2020) and others. Furthermore, private persons can undertake the delivery of goods, which is described as crowdsourced delivery, as suggested by, among others, Buldeo Rai *et al.* (2017).

Information systems

According to Taniguchi (2014), the segment of information systems is of utmost importance for UL because the physical flow of goods requires digital support in various dimensions. Such a multidimensional support tool is called an ‘Intelligent Transport System’-platform, which cover the following dimensions: (1) route optimization through mathematical models for considering specific delivery restrictions such as time windows; (2) communication systems among operational staff; (3) documentation of relevant processes, such as shipment tracking; and (4) the handling of complex pricing systems between the relevant actors. Intelligent transport system platforms are repeatedly discussed by scholars researching UL (e.g., Małecki *et al.* (2014)) and due to the variety of tasks to be covered, they are generally perceived as complex.

Regulatory measures

The fifth segment deals with the regulatory measures that influence the field of UL, which are typically established by a public authority. Cardenas *et al.* (2017) provided a sound overview of these measures. One such concept component is the introduction of priority lanes, referring to lane facilitation for electric trucks. A stricter measure is the concept component of driving bans. Such a measure can ban any specific group of vehicles based on, for example, their emissions class. Toll systems can also indirectly facilitate the deployment of environmentally friendly solutions. Mobility pricing refers to establishing fares, such as with a ‘pay as you use’ policy, which also intends to reduce externalities. Finally, the public authority can introduce specific parking spaces dedicated to loading and unloading to avoid incorrectly parked vehicles while the delivery takes place.

To conclude, there is a range of different concept components. Due to ever-evolving technological developments, new concepts or aspects will likely arise in the future. So

far, many studies and pilot projects have concentrated only on the examination of one or sometimes two concept components, without thinking in ULS. For example, a ULS can consist of the interplay of the following UL concept components:

- *Periphery hub*: Shipments of all kinds are bundled and distributed in a periphery hub, situated outside of an urban area.
- *Rail freight*: The shipments are then transported from the periphery hub to at least one macro-hub in at least one urban area.
- *Macro-hub*: Shipments, such as CEP shipments, are bundled and distributed in a macro-hub, usually situated at the edge of an urban area.
- *E-trucks*: The shipments are then transported from the macro-hub to several small sites within the urban area.
- *Micro-hub*: The sites called micro-hubs are where shipments are unloaded from e-trucks and bundled by route for delivery.
- *Cargo bikes*: The delivery of the shipments to their final destination point is done through using environmentally friendly cargo bikes.
- *Parcel lockers*: Instead of delivering a shipment to the end consumer's home or office, many shipments can be delivered to parcel lockers situated all over the urban area, where consumers can then pick up their shipments.

The above example is one ULS out of many possibilities and describes a high-level vision of it. However, it remains unclear how many hubs and vehicles are necessary, among other factors. This must be individually tailored according to the situation on-site.

Only through a considerate combination in ULS, taking into account the on-site situation, and prioritizing targets in line with existing challenges, the single UL concept components can unfold fully to counteract the managerial challenges introduced in Section 1.1. All in all, while the various concept components have already been profoundly discussed among scholars around the world, what falls short is the discourse on how to customize and integrate them to form more extensive systems (what is understood as ULS in this dissertation) and – especially – implement ULS.

2.3.4 Stakeholders and their involvement in urban logistics initiatives

UL cannot be put into practice without the engagement of different stakeholder groups. These stakeholders need to mainly cooperate in operational processes to successfully implement either isolated UL concept components or – preferably – a planned and individualized ULS consisting of a combination of concept components. However, it too often seems as if «*all players are expecting initiatives to come from the other side*», as Dablanc (2007, p. 284) pointed out. This is called a ‘status quo bias’ (Le Pira *et al.*, 2017). From this perspective, implementing UL can be considered a so-called ‘chicken-and-egg’ problem.

UL stakeholders have a stake in UL initiatives, which can be either an interest such as a situation where an organization is affected, or a right, as with situations where an organization needs to be treated in a specific way based on their legal claims (Katsela and Pålsson, 2019). To overcome this problem of diverse stakes and achieve large-scale UL implementations, it is necessary to know, engage, and manage stakeholders and their individual stakes (Dolati Neghabadi *et al.*, 2019). The diversity and heterogeneity of UL stakeholders have been acknowledged as being among the most important problems in UL to date (Anand and Yang *et al.*, 2012), underscoring the need for the interaction and cooperation of these stakeholders (Gatta and Marcucci, 2016).

Partly interdependent stakeholder groups relevant for UL initiatives can typically be distinguished. Some scholars identify four groups, including Taniguchi and Thompson (2002), or Taylor (2005), while others identify five groups (e.g., Wolpert and Reuter (2012); Tamagawa *et al.* (2010)), often named and grouped differently, for instance, Anand and Quak *et al.* (2012), or Gonzalez-Feliu (2018) suggest only two, but differing groups. This thesis distinguishes between the following stakeholder groups, based on the identified academic literature:

- *Estate managers and developers*: Estate managers and developers are companies concerned with the development and management of real estate. In this context, primarily business real estate is necessary, such as logistics properties. However, for some UL concept components, including parcel boxes, properties used for private purposes play a role as well.
- *LSPs*: LSPs include all types of companies offering logistics services. According to Mathauer (2020), these can be categorized by carriers, third-party logistics providers,

fourth-party logistics providers, and logistics intermediaries, which differ in the scope of their services and the degree of customization.

- *Public*: The public can be subcategorized as residents or visitors of an urban area. Residents are all the people who live permanently in the respective urban area, while visitors temporarily stay in the urban area for work, travel, or leisure purposes, among other reasons.
- *Public authority*: Public authority is understood as the public administrators responsible for policy making in an urban area. It can be further divided into the local authority responsible for a specific, relatively small area, such as a part of an urban area or the whole city, and the federal authority that is responsible for country-wide policy making.
- *Shippers and receivers*: Shippers and receivers are concerned with all organizations that ship or receive goods. This can be manufacturing companies, as well as retailers. Both types can be of any size, from small companies with only a few employees to multinational blue-chip companies. Shippers and receivers can be positioned anywhere within an urban area.

Three of these stakeholder groups (estate managers and developers, LSPs, shippers and receivers) can be considered private, while the remaining two can be denoted as the public sector. Secondary stakeholder groups can also be identified, such as trade associations, commercial organizations, land owners, public transport operators, and vehicle manufacturers, yet they have only an indirect impact on the above-mentioned ‘key’ stakeholder groups with regard to UL initiatives (Ballantyne *et al.*, 2013).

As determined from the discussion of the UL concept components in the previous section, most components require the engagement of at least two parties from the stakeholder groups. These can be two stakeholders from the same group. For instance, in a relatively simple ULS consisting of the use of e-trucks and central parcel lockers, one LSP needs to deploy e-trucks and possibly another needs to establish parcel lockers. For more advanced ULS, such as the one described at the end of the previous section consisting of periphery hubs, rail freight, macro-hubs, e-trucks, micro-hubs, cargo bikes, and parcel lockers, significantly more actors need to be involved not only in establishing the ULS but also in its daily operations. Therefore, it can become complex relatively quickly. LSPs can be considered the most important stakeholder group for implementing

ULS because they are involved or affected by any or all of the UL concept components. Nevertheless, it must be noted that the different stakeholder groups of UL initiatives are considered highly interdependent (Anand and Yang *et al.*, 2012). In practice, there has been to date a lack of interaction among stakeholder groups (Ballantyne *et al.*, 2013).

For the establishment and operation of complex ULS, which usually aim for a more significant impact on the outlined challenges in urban areas, the acceptance of the private actors, in particular, plays a vital role in UL initiatives, according to Oexler (2002). Objective characteristics such as price/performance ratio do not solely determine acceptance; subjective factors such as the financial possibility for investments in UL, the willingness to create interorganizational cooperation, and general open-mindedness to innovation need to also be considered for deciding how a UL initiative should be developed. Consequently, UL initiatives must be perceived as adding value and be meaningfully approached from the stakeholders' perspectives (Gammelgaard, 2015).

Just as the body of stakeholders is diverse, so are their interests and objectives regarding UL, and they are sometimes conflicting (Gatta and Marcucci, 2016). Table 5 provides a description of some such factors.

Table 5. UL stakeholder interests⁶

Stakeholder group	Interests
Estate managers and developers	• Accessibility • Introduction of new utilization concepts for vacated areas • Profitability
LSPs	• Adequate infrastructure for transport operations • Avoidance of time loss • Cost efficiency • Service-level adherence
Public	• Accessibility and parking space • Good shopping environment • Reduction of traffic and other external effects (emissions and noise) • Timely availability of goods

⁶ Adapted with changes from Macário *et al.* (2008, p. 91) and Oexler (2002, p. 8).

Stakeholder group	Interests
Public authority	• Beautification of the cityscape • Increase of traffic safety • Positive publicity and public relations • Reduction of traffic and other external effects (emissions and noise)
Shippers and receivers	• Accessibility • Cost efficiency • Good shopping environment for customers • Reduction of storage area • Targeted disposal of waste and recyclables

The only shared interest of all stakeholders is typically the transportation of goods in urban areas (Anand and Quak *et al.*, 2012). Nevertheless, due to the manifold of individual interests, Stathopoulos *et al.* (2012, p. 42) pointed out that *«[t]o develop feasible and practical solutions to urban goods transport problems there is a need to investigate the preferences of the various stakeholders in depth»*. Thus, decision problems in UL implementation can be referred to as multi-objective (Marcucci *et al.*, 2017); however, UL initiatives normally strive for the overall aim of efficient and low-cost operations in combination with on-time delivery and minimal impact on traffic conditions (Crainic, Ricciardi and Storchi, 2009).

Nevertheless, there exists the latter overall aim, due to the circumstance that private and public stakeholders typically having different interests in details of UL initiatives, it is generally suggested that partnerships be formed between these stakeholder groups to foster collaboration and put innovations into practice (Crainic, Ricciardi and Storchi, 2009). Alongside the constraints of an existing infrastructure, the reconciliation of stakeholder interests in UL initiatives is pursued as highly important (Russo and Comi, 2020). Scholars argue that better decisions are made in UL initiatives that lead to realizations with less conflict and a greater success rate if the decisions are stakeholder-driven, i.e., based on profound stakeholder engagement (Le Pira *et al.*, 2017). Hence, so-called *«[f]reight quality partnerships [...] are effective means to involve local governments, freight operators, environmental groups and other interested stakeholders when addressing specific freight transport-related problems»* (Marcucci *et al.*, 2017, p. 70). In particular, public authorities have a significant impact on how successful a UL initiative is (Crainic, Ricciardi and Storchi, 2009). In line with that, Taniguchi *et al.*

(2001) suggested that local authorities can facilitate this situation due to their neutral stance and ability to mediate conflicts that arise. However, in practice, local authorities often refuse to assume such a role (Browne and Gonzalez-Feliu, 2017). Therefore, there are few examples of private actors' involvement in UL planning from public authorities thus far (Lindholm and Browne, 2013).

Nevertheless, Lindholm and Browne (2013) argue that partnerships of private and public for purposes of introducing UL initiatives can take place not only on an urban area-specific level but also on a national level. They state that taking the discussion to the national level may also support the creation of partnerships on a local level. Key points to consider when forming UL partnerships, among others, are establishing a strong management and organization, including a variety of stakeholders beyond the relevant ones, fostering a trusting relationship and knowledge exchange between actors, and focusing on a long-term perspective (Lindholm and Browne, 2013).

Ground-laying to achieving successful cooperation between different stakeholders, the establishment of trust is a crucial factor (Dolati Neghabadi *et al.*, 2019). Russo and Comi (2018) suggest that trusting cooperation consists of various stakeholder groups cooperating during the assessment of the as-is state, the planning, and the realization of any UL initiative, as these aspects are highly interconnected. For this purpose, many academics have suggested making use of models such as what-if scenarios and continual profound ex ante analyses of stakeholders' behaviors during the implementation process of any UL concept component (Taniguchi and Thompson, 2014). Gatta and Marcucci (2016) state that for an in-depth ex ante analysis, there exist several data acquisition methodologies, i.e., case study research, multi-criteria analysis, personal critical assessment, simulation, and stated preferences. Consequently, models can be deployed for forecasting ex ante but also for validating the impacts of realized UL initiatives in an ex post manner (Ortúzar and Willumsen, 2011).

As outlined, these UL initiatives usually have an impact on the operational processes of the involved stakeholders. The entirety of operational processes is typically part of a company's business model, which denotes «*a representation of how a company buys and sells goods and services and earns money*» (Macário *et al.*, 2008, p. 87). Therefore, UL initiatives must consider the involved stakeholders' business models and define an appropriate UL business model that is perceived to be foundational (Björklund *et al.*,

2017). Benjelloun *et al.* (2010) stated that any UL business model needs to address four critical factors: infrastructure financing, operations financing, management, and competitive advantage. When considering these critical factors, the interests and roles of the various involved stakeholder groups can be formed in detail, enabling the actors to assess the operational and technical feasibility upfront before realization takes place (Quak *et al.*, 2014). To date, however, business model analysis has only rarely been applied (Zenezini *et al.*, 2019). Specialized tools for UL initiatives, such as the altered business model canvas presented by Katsela and Pålsson (2016) or the methodology designing and assessing business models introduced by Zenezini *et al.* (2019), can help to achieve a reconciliation of interests and a lasting business model.

Aside from all of the research about stakeholder management in UL, Gammelgaard *et al.* (2017, p. 19) pointed out that *«[s]takeholder involvement does not necessarily guarantee actual implementation. One possible explanation for this is that, although consensus is reached, the measure is not necessarily implemented in the end, simply because it does not make sense or add value in the reality of the involved stakeholders' rationality»*. While a general 'sense' is undoubtedly essential for any UL initiative, for this reason, it is especially necessary to investigate implementation research further. Therefore, the next section provides an overview of implementation research in general, as well as the specific context of ULS implementation.

2.4 Research on implementation

This section provides an overview of implementation research. First, Section 2.4.1 defines and delaminates implementation in general. Second, the aims, barriers, and success factors of implementation processes are introduced in Section 2.4.2. Third, aspects of the configuration of the implementation are discussed in Section 2.4.3. After that, Section 2.4.4 gives information about PM as an implementation instrument. Then, Section 2.4.5 discusses ULS as an implementation object before its peculiarities are derived in Section 2.4.6. Finally, Section 2.4.7 outlines the importance of a participatory approach for the implementation of ULS.

2.4.1 Definition and delamination of the implementation

The term 'implement' originates from the Latin word 'implementum', which can be translated as 'fulfillment' (Huber, 1985). Today's use of the term goes hand-in-hand

with the verb ‘to implement’, which can also be substituted with ‘to carry out’ or ‘to execute’ (Daniel, 2001). Consequently, the term implementation is concerned with a process – the action of implementing – and can be understood as the process of realization (Kolks, 1990). Zeyer (1996) referred to this term as the intentional and planned change of an as-is state into a target state by introducing a known implementation object with its own design requirements due to its changeability during the introduction. For this reason, the key critical factor is the implementation context or environment, which is basically understood as the entirety of the conditions concerned (Zeyer, 1996). Hence, in general, implementation refers to embedding a new concept in an existing context (Reiß, 1995).

The term ‘implementation’ originated in engineering, especially in the study of information technology (Engstler, 2009), but found its way to management research (Daniel, 2001). Implementation research is an interdisciplinary research field with offshoots to not only management research but also to sociology and psychology (Heusler, 2004). While scholars in the 1980s and 1990s called for emphasizing implementation research, including Schultz and Slevin (1982), or Cooper and Zmud (1990, p. 124), stating that there are limitations *«in both its perspectives and its progress»*, to date, research about implementation in management science is scarce, and many gaps are still open (Schreyer, 2008). Underscoring this problem, Noble (1999, p. 132) pointed out, *[t]o date, implementation research has been fairly fragmented due to the lack of clear models on which to build. If the area is to advance, more conceptual efforts must be made to enable [...] implementation to achieve an identity of its own as a valid and distinguishable area of study»*. Nevertheless, generic insights into implementation in management are discussed below.

Fundamentally, implementation can be described as the transformation of an initial state to a final state; therefore, it is related to change and change projects, which show considerable differences depending on the characteristics of the respective objective, the scope of change, and the temporal dimension (Grewe, 2012). Hence, implementation needs to be delaminated from change management. Reiß (1995) introduced a positioning of the term implementation, which is displayed in Figure 7: According to him, differentiation can take place along the continuums of the scope of change (global vs. local change) and the time dimension (transformation vs. evolution). These terms are described herein, based on Reiß (1995):

- *Transformation*: This term describes planned and abrupt changes made to achieve the desired aim as soon as possible. These approaches can be designated as radical.
- *Evolution*: This term relates to continuous and not deliberately planned change, which usually should be achieved with little effort and low friction. These approaches can be designated as incremental.
- *Global change*: This term represents situations where the change context is comparatively large and connected to the whole organization or the entirety of the actors. These approaches affect a great number of actors.
- *Local change*: This term describes situations where the change context is small and well can be delimited with a relatively low number of affected actors. This can apply to specific departments or functional areas.

In line with that, implementation can be described as being concerned with limited local changes, whereas change management is concerned with profound changes (Reiß, 1995). Implementation can be further divided into the areas of PM and continuous improvement, according to Reiß (1995). However, it must be noted that the transition between implementation and change management is fluid.

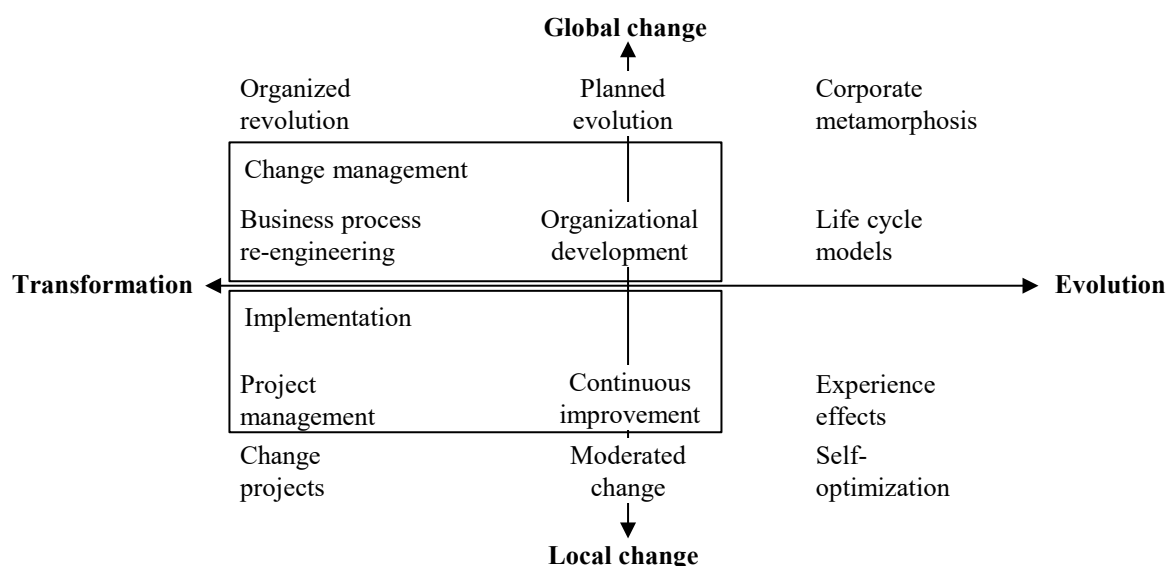


Figure 7. Positioning of the implementation⁷

⁷ Adapted with changes from Reiß (1995, p. 293) and Grewe (2012, p. 29).

Although this transition is fluid, a common characteristic of implementation processes is the change of an existing context by introducing a new concept – the implementation object (Zeyer, 1996). The concept should represent a problem-oriented, optimal solution (Reiß, 1997b). The context can be understood as the entirety of the circumstances affected by the change (Kolks, 1990). The context can be further divided into the following, according to Zeyer (1996):

- *Old context*: Conditions before the beginning of the implementation process.
- *As-is context*: Conditions in the current status of the implementation process.
- *Target context*: Conditions after the end of the implementation process.

Hence, based on the introduction of a concept in a specific context, implementation processes always entail a ‘what component’ (focus on the concept) and a ‘how component’ (focus on the context), according to Grewe (2012): The first type represents the content-related configuration, while the latter represents the possibilities of the required circumstances. Consequently, implementation can be characterized as an iterative reconciliation and coordination process to achieve a problem-oriented and contextually appropriate solution, as outlined by Reiß (1997b). The flow of this process is also depicted in Figure 8. The iterative process is especially important for incorporating the affected parties’ perceptions and wishes into the implementation to achieve stakeholder acceptance and commitment.

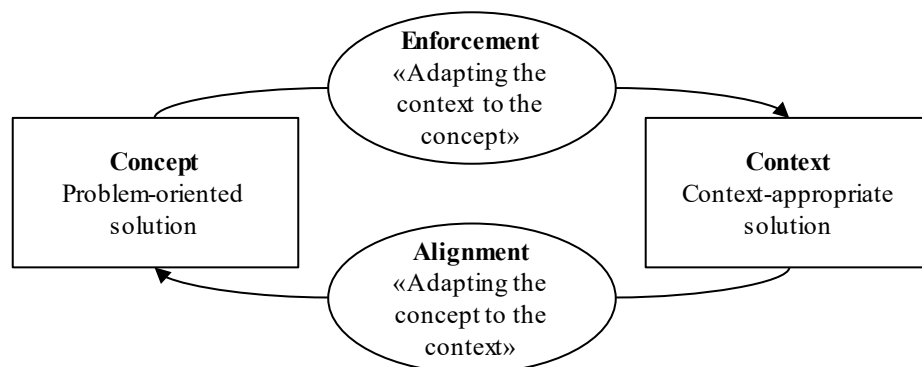


Figure 8. Implementation as iterative adjustment of concept and context⁸

At its core, this iterative implementation process consists of different actions that need to be fulfilled in order to achieve successful implementation. While Tarlatt (2001)

⁸ Adapted with changes from Reiß (1997b, p. 25).

enumerates a list of activities, such as establishing an operational planning system or establishing an organizational structure, these actions are normally interconnected. Hence, actions in an implementation process with a high degree of homogeneity or that are directly sequentially related can be grouped into phases (Grewe, 2012). Therefore, following a narrow interpretation of the term, implementation is a phase within a more extensive change process that starts with a planning phase and ends with a control phase (Grewe, 2012). These phases and implementation's role therein are graphically displayed in Figure 9.

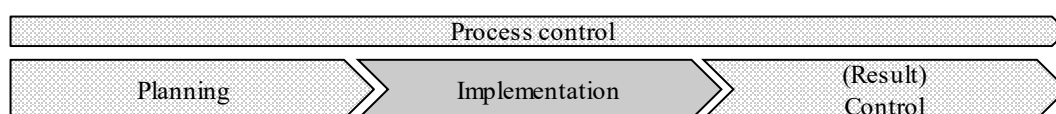


Figure 9. Traditional understanding of 'implementation' in a phase-based process⁹

However, following a broader understanding of the term 'implementation', it can be understood as the entire change process that begins with the formulation of plans and includes actions such as selecting alternatives and the design and conception of the implementation object (Grewe, 2012). This broader understanding also includes all tasks, methods, and techniques necessary to reach specific project aims, regardless of which point in time or in which phase of the process corresponding activities occur (Grewe, 2012). Hence, the classical separation of planning, execution, and control is not existent, but there is the goal of interlocking these phases. This is illustrated in Figure 10. In this way, a certain change is always visible during the process. The implementation is successful if the desired degree of application is achieved after the completion of all necessary measures, according to Raps (2017).

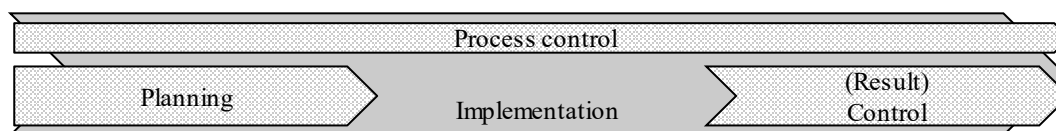


Figure 10. Broad understanding of 'implementation' as interlocking phases¹⁰

In this dissertation, implementation is understood following the broader understanding with an interlocking of all of the named phases. This is because, in the specific context of ULS, the classical separation of phases has so far failed, as further discussed in

⁹ Adapted with changes from Daniel (2001, p. 16).

¹⁰ Adapted with changes from Daniel (2001, p. 18).

Section 2.5. Implementation is understood as interactive – including a dialogue between the various UL stakeholder groups – and integrative, which includes all types of steering tasks, starting from the first idea and ending with the success control after the realization. This understanding of the term ‘implementation’ can extend over a longer period of time but is always of a temporary nature, and thus, this kind of initiative must be understood as a delimitable project.

Based on the interlocking understanding of the implementation and necessary steering tasks, it is implied that the implementation needs to be prepared thoroughly, and for the achievement of the desired success, an implementation management is necessary (Daniel, 2001). In a functional way, this can be designated as all activities to help the implementation succeed, and in an institutional setting, implementation management can be designated as the total of all those who are concerned with implementation tasks (Zeyer, 1996). Against that backdrop, successful implementations are characterized by a high-level fit between (object) optimality and (context) compatibility (Huber, 1985).

This implementation success is highly dependent on the specific context of the implementation. Hence, while academic research about implementation is scarce, research about the implementation of specific objects is manifold, although the latter hardly provides any gain in general knowledge. For example, in regard to the logistic and interorganizational setting of ULS (see subject ‘logistics management’ in Figure 6), certain contributions loosely stimulate the dissertation, including those from Audy *et al.* (2012), which discussed a framework for the efficient implementation of logistics collaborations; Basso *et al.* (2019), who debated the obstacles and difficulties faced in the implementation of horizontal collaborations; Dameri (2017), which considered the implementation of smart cities; and Boddy *et al.* (2000), which viewed the implementation of collaboration through supply chain partnering.

While prior papers are examples for specific implementation objects, generally, research about the object of implementation processes is usually concerned with implementing strategies or innovations. These areas are considered vital when it comes to the implementation of ULS (see also the research streams of ‘strategic management’ and ‘innovation management’ in Figure 6). Hence, a brief summary is given below.

Regarding strategy implementation, it has been stated that different strategies call for different competencies to achieve a successful implementation (Gupta and

Govindarajan, 1984). For that reason, *«general management [...] designs an organization structure and set of management processes to elicit organizational behavior required to implement [...], using rational procedures»*, according to Guth and Macmillan (1986, p. 313). Due to a high level of uncertainty, which is perceived as a fundamental problem for successful strategy implementation, the consideration of contingencies is of great importance (Govindarajan, 1988). While the environment is highly individual, specific barriers to successful strategy implementation, such as *«poor coordination across functions, businesses or borders»* or *«conflicting priorities»* can generally apply, according to Beer and Eisenstat (2000, p. 37). In line with that, Noble (1999) pointed to the eclectic roots of strategy implementation research. However, to date, the effectiveness of strategy implementation is still not well understood (Huber, 2011), and systematic research on strategy implementation is still scarce (Hitt, 2017).

In the field of innovation implementation, the need for research on this subject was identified in the 1980s by Tornatzky and Klein (1982) and others. According to Leonard-Barton (1988), the implementation of innovations must be considered thoroughly because it greatly influences acceptance. Klein and Sorra (1996, p. 1055) pointed out the importance of implementation research in innovation management, stating, *«[a]n organization's failure to achieve the intended benefits of an innovation it has adopted may thus reflect either a failure of implementation or a failure of the innovation itself»*. However, research on the topic is cumbersome and rarely found (Klein and Knight, 2005). Nevertheless, only through an appropriate implementation, innovation can unfold its full effectiveness (Sung *et al.*, 2011). Yet, the implementation of innovations is difficult to achieve for many corporations, although it is one of the main drivers of developing and nurturing competitive advantages (Kuratko *et al.*, 2014).

For these reasons, implementation research, in general, is further discussed in the following sections before investigating the specific context of ULS implementation.

2.4.2 Aims, barriers, and success factors of implementation processes

Implementations are usually undertaken to achieve specific aims, which need to be measured to define the project's success (Grewe, 2012). It is necessary to specifically define these implementation aims upfront in order to ensure that ambiguities are avoided throughout the process (Daniel, 2001).

The main aim of implementation undertakings is the realization of a sufficient application of the implementation object in the implementation context (Kolks, 1990). To achieve this, there are two dimensions of aims to be fulfilled (Daniel, 2001):

- *People-related aims*: Achieving acceptance and avoiding reactance.
- *Factual-related aims*: Achieving quality, cost, and time aims.

Regarding people-related aims, it is especially crucial to achieving acceptance for the concept to be implemented with the affected entities and interconnected to achieve a fit with the affected structures, resources, and programs (Grimmeisen, 1998). Acceptance is expressed when the affected stakeholders have a positive attitude stemming from an inner conviction regarding the implementation undertaking and, consequently, they act accordingly (Daniel, 2001). The avoidance of reactance, which can also be called resistance, can be perceived as the counterpart to acceptance, and it must take place if acceptance cannot be fully achieved (Daniel, 2001). Scholars also emphasize the importance of the psychological components of achievement of consensus and active participation of the affected parties during the implementation undertaking, which is often neglected in practice despite being expected to have a significant impact on the implementation's success (Tarlatt, 2001).

Turning to factual-related aims, these are situated within the strategic triangle of quality-cost-time (Krüger, 1997). Hence, conflicts usually arise between these three aims because the respective implementation undertakings can only cover a part of the triangle (Krüger, 1997). The quality of the implementation can be understood as the degree of achievement of the concept aims (Grimmeisen, 1998), which is the most complete possible and error-free fitting of the implementation object in the implementation context (Zeyer, 1996). The implementation cost is usually aimed at the lowest possible total cost and the greatest possible transparency about the costs incurred (Grimmeisen, 1998). In terms of time, preferences are typically for an early start of the implementation undertaking, a completion as early as possible, and a short implementation time period (Zeyer, 1996). Consequently, the interrelation of time and cost in an implementation can also be expressed in the implementation efficiency (Grimmeisen, 1998).

All in all, implementation aims can be designated as situated in an area of high tension between societal and economic aims, which usually find expression in a highly individual coordination problem (Grewe, 2012). Therefore, aim setting is dependent on

diverging interests, as Grewe (2012) pointed out, which need to be weighed individually (Grimmeisen, 1998). Thus, a specific aim matrix has a significant impact on the configuration of the implementation undertaking (Tarlatt, 2001) (Section 2.4.3).

Nevertheless, the achievement of the specific aims of implementation undertakings needs to be measured. For this reason, performance measurement indicators are available in different dimensions, as outlined in Table 6. These need to be understood as examples, where each implementation undertaking needs to define performance indicators individually. Scholars argue that the confirmation of the factual implementation aims can be achieved through validation (Riemenschneider, 2001). Zeyer (1996) suggested introducing performance indicators according to the strategic triangle discussed above. However, Reiß (1993) claimed that ‘hard’ controlling instruments, which are frequently deployed in routine business, cannot be simply transferred to implementation undertakings because they imply constant change. Hence, he points out that there is a typical ‘success curve’ visible in implementation undertakings: Implementation success indicators do under no circumstances follow a constant upward trend, but at first, there is usually so-called implementation damage, given that profound restructuring as a consequence of implementation undertakings creates considerable unrest and uncertainty. Hence, implementation success measurement should be based on life-cycle models because a multi-period evaluation perspective must be adopted (Grimmeisen, 1998). In the center of such life-cycle models stands the object of analysis – the performance development of the concept to be implemented, as Grimmeisen (1998) suggests.

Table 6. Examples of implementation success measures¹¹

Dimension	Variable	Examples
Economic performance	Cost indices	Inventory costs, costs per part, savings
	Return on investment	Simple payback, rate of return
Human partnership dynamics	Altering management structure	Changes in role relationships and decision-making
	Attitudes	Well-being, satisfaction, motivation, boredom
	Redistribution of responsibility	Elimination of management layers
Implementation, integration, and institutionalization	Degree of implementation	Extent of use
	Fidelity of implementation	Innovation employed to meet original objectives
	Utilization	Operating system
	Workflow integration	Interconnectedness of equipment

¹¹ Adapted with changes from Linton (2002, p. 68), based on O'Connor *et al.* (1990, p. 74f.).

Dimension	Variable	Examples
Operational effectiveness	Flexibility	Tolerance, time for changeover, materials
	Retention	Turnover, absenteeism, displacement
	Work measures	Cycle time, setup time, bottlenecks

However, to achieve implementation success throughout an implementation undertaking, it is necessary to analyze the factors impeding and promoting the implementation process. For instance, Tarlatt (2001) named four central barriers to implementation processes: (1) the habits and anxieties of affected parties as a general problem; (2) the existing organization, which is, for example, confusing and unclear; (3) social factors such as the company culture and negative experiences with change; and (4) deficits in the implementation undertaking itself, such as those caused by insufficient knowledge of appropriate methods. Zeyer (1996) primarily attended to the social factors and affected parties because the research posited, those stakeholders can act as opponents, indifferentists, or promoters of an implementation undertaking. This is supported by Krüger (1997), who also focused solely on people-related barriers using the same segmentation but with more detail. In contrast, Daniel (2001) argued that it is necessary to analyze external factors (micro and macro environments) as well as internal factors (factual resources, structures, culture). According to him, if such an analysis shows impeding factors in the external dimension, they should be observed and – if possible – developed. Internal impeding factors should be changed, if necessary. Promoting factors in both dimensions should be used in the implementation process for the good.

Based on the factors that are impeding and promoting the implementation process, specific implementation success factors can be derived individually for each undertaking. Generally speaking, there is a manifold of success factors described by scholars, often based on specific cases. From the broad spectrum of the findings, selected, predominantly named success factors in two dimensions – method and psychology – can be derived. These are given in Table 7.

Table 7. Success factors of implementation undertakings¹²

Dimension	Success factors
Method	• Availability of adequate resources • Definition of limited key figures • Incremental approaches and usage of pilots • No striving for perfection • Stringent project management
Psychology	• Acceptance and participation of affected parties • Active communication and training for affected parties • Clarity of the concept to be implemented • Management involvement • Supportive company culture

While these are the most common success factors for implementation undertaking, it becomes clear that the affected parties have a significant impact on the outcome of any undertaking. Hence, acceptance of the ability to change (awareness, proficiency) and the willingness to change (desire, permission) is very crucial (Reiß, 1997c) and is a particular emphasis in the body of literature. Consequently, any configuration of an implementation undertaking must take these factors into account. Thus, general aspects of implementation configuration are further outlined in Section 2.4.7.

2.4.3 Configuration of the implementation

An implementation undertaking usually pursues specific aims, as outlined above. If these aims are clear initially, the configuration of the implementation can be considered, which should take into account the manifold levers that must be adjusted. The various adjusting levers can be grouped in subdomains of the implementation configuration. There exist usually the following three subdomains¹³:

- *Preparation (Pre)*: This subdomain is concerned with all decisions that are part of laying the foundation and are universally valid for the implementation undertaking.
- *Effectuation (During)*: This subdomain relates to all decisions regarding how the actual realization of the implementation undertaking should be configured.

¹² Based on Scharfenberg (1997), Riemenschneider (2001), Linton (2002), and Schreyer (2008).

¹³ Mainly following Daniel (2001), who outlined the phases of ‘implementation strategy generation’ and ‘implementation measure design’.

- *Examination (Post)*: This subdomain focuses on all decisions regarding the control and monitoring of the implementation undertaking.

These three subdomains are further outlined in the following paragraphs.

Implementation preparation

To prepare the implementation, an implementation strategy needs to be determined (Daniel, 2001). Within the latter, there are usually the following dimensions to consider:

- *Implementation object composition*: This dimension asks the question of ‘what’ to implement, as an implementation object can be subdivided into modules or components and their integral parts (Daniel, 2001). Hence, there exists a need for coordination and reconciliation, which can be divided into four factors, according to Reiß (1995): (1) width, (2) wideness, (3) depth, (4) rigidity, and (5) speed. It is suggested that a development strategy consisting of ‘customizing’ and ‘prototyping’ should be applied to achieve an object composition suitable for the context (Reiß, 1995). This is always highly individually composed. Implementation objects can be configured very complex; therefore, if that is the case, complexity management strategies need to be deployed for successful implementation (Zeyer, 1996). According to Reiß (1995), this includes measures such as modularization, focus, approximation, reformatting, standardization, and individualization, as well as opportunistic procedures. The concept can also be split for reasons such as size or ease of handling or in order to achieve a staggered schedule.
- *Implementation context composition*: This dimension is concerned with the question of ‘where’ to implement, as the implementation object needs to fit with the implementation context (Daniel, 2001). The context can cover only one or more subsegments of an organization or the whole organization, or it can extend beyond the organization’s boundaries, according to Daniel (2001). Tarlatt (2001) suggests analyzing the implementation context and its changes with regard to the change width and depth. According to him, aspects that should be considered include the context’s complexity, the feasibility of the concept to be implemented, the surrounding market, and the affected parties and their attitudes. Due to the usually complex implementation context, it is recommended to apply systems thinking and to think from the rough to the detail, or from the outside to the inside, to identify the influencing factors and their dependences (Daniel, 2001). Hence, complexity

management strategies, such as the division of the implementation context along individual functions, business areas, or hierarchical levels, for example, can be applied (Zeyer, 1996).

- *Implementation timing*: This dimension focuses on the question of ‘when’ to implement and therefore relates to the determination of the optimal point in time to begin the implementation (Daniel, 2001). To avoid early starts, false starts, or takings by surprise (Engstler, 2009), it is recommended to start when the concept is ready to use or else wait for opportunities to arise (Daniel, 2001). Additionally, Zeyer (1996) suggested analyzing factors such as competitive pressure, competitor behavior, or the utilization rate of existing and the availability of additional resources in order to determine the implementation timing. However, framework conditions may change over time due to a variety of factors, including upcoming trends or a crisis (Reiß, 1993). Hence, measures like implementation acceleration through intensified resource deployment or an implementation limitation on a specific part of the implementation can be deployed (Reiß, 1993).
- *Implementation style, tactic, and direction*: The implementation style asks the question of ‘how to implement’, which can be situated on the continuum between a directive (authoritarian) and participatory behavior and which is considered to be on a meta level (Daniel, 2001). Hence, the implementation style is closely related to the degree of participation (Kolks, 1990). In particular, four degrees of participation can be distinguished, according to Zeyer (1996): (1) a ‘bomb-throwing strategy’ with zero participation from affected parties, (2) a partial involvement with low levels of participation, (3) a total involvement with high levels of participation, and (4) a ‘partisan strategy’ with a personal initiative of the affected parties. These implementation styles are also called implementation tactics and centrally distinguish the level of participation (Nutt, 1986). The implementation style or tactic is also connected with the implementation direction differentiated as a top-down strategy (i) for (1) and (2), a from the middle strategy (ii) for (3), and a bottom-up strategy (iii) for (4), according to Tarlatt (2001). These implementation directions have different advantages and drawbacks, which are not further discussed here (Heusler, 2004).

Consequently, the decisions in the implementation preparation subdomain create the preconditions for the implementation effectuation. If the questions arising in the

abovementioned dimensions are answered thoroughly, the implementation effectuation can be prepared.

Implementation effectuation

The implementation effectuation domain can be further divided into factual management, competence management, and behavior management.

Factual management

Factual management is concerned with introducing the implementation object to the implementation context, as outlined in Section 2.4.1. To achieve a successful implementation, it is necessary to plan the so-called context transition in detail (Daniel, 2001) and maintain sufficient flexibility to adapt to unforeseen problems (Zeyer, 1996). According to the latter, there are four different *implementation context transition strategies*: (1) a direct strategy where the ‘new’ follows the ‘old’, (2) a stretch strategy where the ‘old’ and the ‘new’ overlap, (3) a parallel strategy where the ‘old’ operates next to the ‘new’ for a specific time period, and (4) a distance strategy where there is a decoupling of the ‘old’ and the ‘new’. These different strategies have different advantages and disadvantages, including regarding their costs, implementation complexity, risk, and duration (Heusler, 2004). Engstler (2009) also described a successive transition where the ‘new’ is divided into several modules that are implemented step-by-step to replace the ‘old’. Roughly, different context transition strategies can be summarized with phases of ‘unfreezing’, ‘moving’, and ‘refreezing’, according to Krüger (1997), or ‘planning’, ‘realization’, and ‘control’, as described by Heusler (2004). The decision about which strategy to choose is also interrelated with the *implementation object scope*, whether a complete concept is planned to be implemented at once or in parts, and whether a ‘perfect’ solution is desired or a proximity solution (Engstler, 2009). Nevertheless, the strategy selection also serves to specify the implementation steps, their chronological order, capacity planning, and budgeting of the necessary resources (Daniel, 2001).

However, it must be noted that these decisions need to be scrutinized regularly, since the implementation emphasizes change over time, according to Raps (2017): While the initial focus is on enforcement – the achievement of acceptance and avoidance of reactance – the actual realization gains more and more interest over time. Hence, this change needs to be reflected in the context transition.

Based on these context transition strategies and object scope, it must be iteratively decided about the *implementation pace* (Tarlatt, 2001). It is recommended to avoid time pressure, which usually leads to insufficiently prepared decisions (Tarlatt, 2001). The implementation pace is largely interrelated with the *implementation intensity*, which denotes the measure of intensity deployed within a specific time period (Tarlatt, 2001). Generally, the following implementation intensities can be distinguished, according to Tarlatt (2001): Incremental implementation, where small steps are made to avoid reactance; radical implementation, where an object is implemented at once to avoid time loss; stepwise implementation, which denotes a compromise between the latter with segmentation and implementation of specific parts of an implementation object; progressive implementation, where small steps with a large scope of change are preferred initially; and degressive implementation, where many measures are applied initially with a degressive intensity over time. Besides, Zeyer (1996) only differentiates the implementation intensity into revolutionary, stepwise, and evolutionary courses.

Competence management

Competence management is concerned with deploying the implementation object on a personal level (Daniel, 2001). Usually, an implementation undertaking occurs on different hierarchical levels, for instance, on a company level, business area level, functional area level, and operational level, because this is a company's typical organization (Tarlatt, 2001). Hence, it is necessary to decide on the *personnel anchoring* of the implementation activities. The personnel carrier performs implementation-related tasks, and in particular, makes relevant implementation decisions (Tarlatt, 2001). These personnel can be appointed based on an evaluation of their level of ability in areas such as the expertise necessary for the position, their power, or their political competence, according to Daniel (2001).

Because an implementation undertaking can typically be denoted as a project, given that it is a temporary task with specific levels of complexity and novelty (Tarlatt, 2001), it is necessary to set up a specific *implementation organization* consisting of operational and organizational structures (Engstler, 2009). This organization is highly dependent on the respective undertaking, and thus the determination of individual requirements, and it can be changed to different variants over the course of the undertaking (Engstler, 2009). Generally, an implementation organization should ensure cross-departmental

coordination and integration (Engstler, 2009). Furthermore, the specific organization needs to be matched with the favored implementation style (Kolks, 1990) and also be connected to the primary organizations of the respective implementing company (Daniel, 2001).

Based on the implementation organization, specific *implementation roles* should be determined. Daniel (2001) distinguished the roles of ‘decision-maker’, ‘planner’, ‘realizer’, and ‘consultant’ but emphasized that the various roles do not always have to be performed by different people; instead, a person can be both a ‘planner’ and ‘realizer’. However, Marr and Kötting (1992) differentiate the roles of ‘initiator’, ‘creator’, ‘realizer’, ‘steerer’, and ‘monitorer’. As the crucial roles in an implementation undertaking are also individual, it must be judged individually which person occupies which role.

The aforementioned implementation role models should be reflected in the *implementation leadership style*, which is largely connected to the implementation style, as Zeyer (1996) distinguished four interconnected types:

- *Extensive participation*: Implementation style is participatory; leadership style is authoritarian.
- *Limited participation*: Implementation style is authoritarian; leadership style is participatory.
- *Standardized octroyation*: Implementation style is authoritarian; leadership style is authoritarian.
- *Standardized participation*: Implementation style is participatory; leadership style is participatory.

Hence, based on the individual situation, a fitting leadership style needs to be chosen, and executives need to be placed into the various roles (Reiß, 1997a) outlined above.

For successful implementation executives, it is necessary to acquire specific *implementation competencies* that are not typically included in executives’ standard repertoire (Reiß, 1993). Because enforcement, as part of the implementation, is primarily connected to working with the affected people and groups, instruments from conflict management, in particular, can be deployed to reiterate factual management (Reiß, 1997c). There exist four instrument packages, according to Reiß (1997c), which

loosely correlate with the ability and willingness to change, as introduced in Section 2.4.2: (1) communication instruments, such as press releases; (2) qualification instruments, such as training; (3) motivation instruments, such as awards; and (4) organization instruments, such as specific implementation organization.

Behavior management

Behavior management is concerned with ensuring the willingness of the affected parties to adapt to an implementation undertaking (Daniel, 2001). According to him, it deals with the achievement of behaviors that welcome the implementation of an undertaking and the avoidance of behaviors that hinder it. Consequently, it is achieving a change in awareness that the implementation undertaking is beneficial in general.

Hence, it is necessary to deal appropriately with *implementation relevant psychological aspects*. According to Tarlatt (2001), the following aspects are relevant to implementation undertakings:

- *Perception*: The process of organizing and interpreting information.
- *Reactance and resistance*: Rejection of a perceived threat or limitation.
- *Conflicts*: Intra- and interpersonal situations with incompatible action tendencies.

These aspects can be managed positively by establishing various effects, as Tarlatt (2001) pointed out: First, that the implementation appears necessary in order to settle a persistent problem pressure. Second, that the implementation undertaking can be used to ease the problem pressure. Third, the support of the implementation undertaking by promoters. Fourth, there is good information available to affected parties sharing the purpose and content of the implementation undertaking. Fifth, the introduction of the statement that the implementation undertaking does not pose a threat to any affected party.

Decisions about behavior management during the implementation effectuation are, of course, also interrelated with ground-laying decisions during the implementation preparation, especially with the implementation style, as this goes along with the *degree of participation* of affected parties, which has a direct influence on the above-mentioned psychological aspects (Zeyer, 1996).

Furthermore, the *organization's culture* needs to be considered. Organizational culture relevant to implementation undertakings exist at three levels, according to Raps (2017):

A symbolic system at the top, which is visible through measures such as specific rituals; a system of norms and values that is partly visible through leadership principles, for example; and a system of basic premises, which is invisible but imparted through circumstances such as the company environment. Hence, the organization's culture is ubiquitous in any implementation undertaking. While it is necessary to let affected parties participate to some extent in the implementation in order to achieve motivation and get their contribution, full acceptance of the 'new' is only achieved if the 'new' is lived throughout the organization (Riemenschneider, 2001). Hence, because openness to change and willingness to learn are considered the basis for successful implementations, it is necessary to establish an organizational culture that embraces those traits (Riemenschneider, 2001). Regardless, the new implementation objects must be compatible with the organization's culture, generally speaking (Schreyer, 2008). Hence, it is necessary to gather information about the cultural basis of the organization (Tarlatt, 2001) in order to perform a concept-culture-compatibility check, as outlined by Raps (2017).

To achieve such compatibility, there are different *implementation adjusting screws* available for the management of an implementation undertaking, following Gaßner (1999), who set forth that management should undertake certain behaviors. For example, he advised avoiding evoking uncertainty among affected parties, ensuring a good working atmosphere, taking care to achieve fairness across hierarchical levels, and minimizing any extra burdens placed on affected parties.

Implementation examination

The implementation examination is concerned with monitoring the implementation outcomes and carrying out a target-performance comparison (Heusler, 2004). By doing so, the implementation's efficiency can be ensured and the erosion caused by, for example, fallback to old patterns, can be counteracted (Grimmeisen, 1998).

To carry this out, it is necessary to define the people who should be entrusted to perform the implementation examination, who are called *implementation monitoring organs*. In principle, this monitoring can be differentiated from self- or third-party monitoring and from centralized or decentralized monitoring (Tarlatt, 2001). Centralized monitoring can be deployed to make use of factors such as economies of scale, whereas decentralized monitoring has the advantage of being on-site so there is faster

information access. Each approach has specific pros and cons, so which one to choose must be individually judged (Tarlatt, 2001).

Entrusted organs need to decide on specific *implementation monitoring criteria*, as Tarlatt (2001) pointed out. However, there often exists a problem with measuring the success of an implementation because it is often not possible to prove a connection between the implementation and a certain variable change (Marr and Kötting, 1992). While Tarlatt (2001) suggested relatively quantifiable criteria, such as segmented in the monitoring of costs, outcomes, target dates, or motivations, Kolks (1990) pointed to qualitative criteria, including the measurement of the acceptance level, the degree of application, and the implementation adequacy. Consequently, the measures to apply to the specific implementation undertaking must be reflected upon individually.

If, based on the application of the implementation monitoring criteria, certain deviations from the original plan are identified, specific implementation adjustments need to occur. Hence, an *implementation adjustment analysis* must be carried out with the aim of finding the reasons for any deviations, as Tarlatt (2001) discussed. According to him, the causes of a need for adjustments can be divided into organization-induced or environment-induced – and therefore, these must be subject to further analysis. If organization-induced causes are identified, the implementation concept can be modified; if environmentally-induced causes are identified, the implementation concept can be modified or eliminated (Tarlatt, 2001). If elimination is chosen, the alternatives of replacement or dissolution are available for selection (Engstler, 2009).

It is noteworthy that a pure outcome examination at the end of an implementation undertaking can lead to a time-consuming and costly phase of revision (Heusler, 2004). In extreme cases, it can lead to a re-run of the entire implementation process (Raps, 2017). Consequently, an implementation examination on a regular basis – a *continuous implementation examination* – that is based on specific intermediate goals is recommended (Heusler, 2004). In that way, if deviations are identified, countermeasures can be embraced as early as possible (Tarlatt, 2001).

Finally, the *implementation knowledge* that is gathered must be stored for use in future implementation undertakings. Various approaches are available to process and secure implementation knowledge, all with different pros and cons, which must be discussed individually based on the specific implementation undertaking (Daniel, 2001): These

approaches are situated on a continuum from individual solutions to group solutions to structured solutions. For instance, an individual solution would be using experts, a group solution could be an organized experience exchange, and a structured solution might be a database (Daniel, 2001).

To conclude, based on the discussion above, it is clear how complex the implementation configuration is. Consequently, it is unsurprising that scholars describe the implementation context as an iceberg, where only factual management related to costs, quality, and time are visible at first, and although questions about competence and behavior are closely related – they are invisible underwater (Krüger, 1997). Given this broad understanding, it must be noted that there is no ‘one fits all’ solution, as every implementation undertaking vastly differ in a number of areas (Scharfenberg, 1997), such as in terms of the implementation object, the implementation context, the implementation timing, and style.

2.4.4 Project management as an implementation instrument

Alongside these general findings, many scholars suggest that implementation undertakings are realized through the application of PM, noting that implementation can not only be interpreted as a project, but also reconstructed as a project (Schreyer, 2008). Based on the delamination of the term ‘implementation’ given by Reiß (1995), as discussed in Section 2.4.1, it is clear that PM can be understood as an implementation concept (Grewe, 2012). According to Engstler (2009), PM provides guiding principles for the execution of implementation projects.

Grewe (2012) described a project with the following characteristics derived from the body of literature: they are (1) risky, (2) limited in time and cost, (3) often extensive and complex, (4) working on a defined or to-be-defined aim, (5) relatively new, and (6) a cross-functional collaboration. These characteristics can be fully transferred to the ULS implementation context.

In this dissertation, the implementation of ULS can be understood as a project and which can also be categorized as a change project that can be handled with the help of the systematic use of PM concepts. Following Riemenschneider (2001, p. 74), when looking at the PM dimension of implementation, the questions about ‘who’ should ‘what’ ‘how’ ‘where’ to implement arise. These questions have to be answered through an appropriate

implementation concept in conjunction with the findings described in the previous section.

Furthermore, the PM dimension, in particular, is central for this dissertation because it aims at ultimately developing an adaptable implementation concept for the specific area of ULS, answering the questions proposed by Riemenschneider (2001). Adaptability in this context means the deployment of the implementation concept in different urban areas with different ULS (for further elaboration, see Section 2.2). After the questions of ‘who’ and ‘how’, the PM domain of implementation research is the most promising to investigate and is, therefore, discussed in further detail. Hence, this dissertation brings the context dimension of the implementation and the content-specific concept of ULS together.

While general implementation research is scarce, as already noted, and there was only minimal progress over especially the last two decades, in that same time period, PM research evolved. In order to discuss PM in further detail, it must first be noted that it can generally be divided into three dimensions (Grewe, 2012):

- *Institutional*: This dimension deals with the ‘who’ during the project.
- *Functional*: This dimension focuses on the ‘what’, i.e., the steering, control, and information aspects.
- *Instrumental*: This dimension concentrates on the ‘how’, i.e., using adequate concepts.

For the instrumental dimension, there are certain PM concepts that can be used throughout the implementation process, as mentioned above, following Grewe (2012). These concepts can be thought of as the ‘heart’ of an implementation concept and are thus described in more detail. These concepts can be hierarchically arranged within the three segments of ‘philosophy’, ‘approach’, and ‘method or tool’. This is illustrated in Figure 11. The following paragraphs describe what is understood for these terms in this dissertation, which is focused primarily on the instrumental dimension of the PM domain in the implementation process. Selected examples are given and briefly described. The different levels can be differently interconnected to each other, depending based on the individual implementation setting, and each dimension has a significant impact on the other two. Hence, the instrumental dimension acts as a ‘starting

point’ with consequences for the composition of the other two dimensions in the implementation of ULS. Choosing the best aspects from the right levels and ideas provided below can result in an implementation concept tailored to the specifics of the implementation’s setting. As this is the dissertation’s focus because there is currently no implementation concept for ULS, selected examples within the hierarchy are described briefly below.

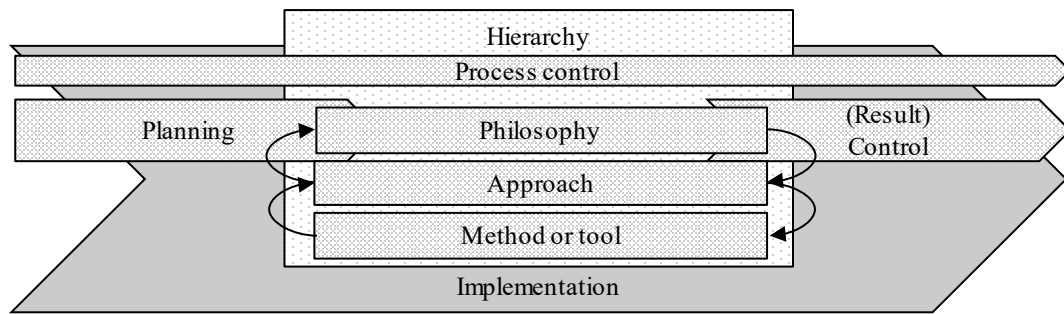


Figure 11. Hierarchy of project management concepts as part of the implementation process

Philosophy

A ‘philosophy’ in the context of an implementation process is understood as a primary school of thought that sits at the top of the just-introduced hierarchy and is applicable to PM (Wischniewski, 2002). The literature on PM is extensive and has proved that PM philosophy influences project success (Mir and Pinnington, 2014). As a result, choosing the right PM philosophy is essential.

Generally, depending on the environment, a choice can be made from various schools of thought (Pich *et al.*, 2002): The traditional school of thought, or classical PM, is a linear phase- and stage-based process (Mulder, 1997). This ordinarily implies phases such as scoping, planning, testing and validation, and the final launch (Karlstrom and Runeson, 2005). This is reminiscent of the classical management process described by Pfohl and Stölzle (1997) and others. Traditional PM can be understood as a very rigid process, where one step follows another and which has a long planning time frame. This is also expressed in ‘waterfall’ PM, where each step is preplanned in a linear sequence.

While this was wildly popular up to the early 2000s, another school of thought has arisen since then: agile PM. ‘The Agile Manifesto’ by Beck *et al.* (2001) is seen as a seminal contribution to this school of thought. They introduced 12 principles to follow, specifically in software development. Generally, the agile philosophy refers to fast-

paced development in incremental, iterative steps. An upfront planning of all steps, such as in traditional PM, is perceived as too time-consuming and unnecessary; instead, the quick correction of further development is central. This iterative and adaptive approach diffused into areas other than software development (Fernandez and Fernandez, 2008) to deal with rapid and ever-changing environments (Conforto *et al.*, 2014).

Next to it, lean PM was introduced (Ballard and Howell, 2003), trying to transfer the principles of lean production to the PM environment. This approach begins with a planning process, such as in traditional PM, but is with iterative loops similar to agile PM and thoughts of lean in the background (e.g., the elimination of waste, which refers to, among other things, too many time buffers in traditional PM). This also finds its expression in the ‘lean start-up’ principles introduced by Ries (2014). Hence, these developments, along with others, can be considered ‘hybrid’ or ‘mixed’ PM, combining elements of traditional PM with the more contemporary elements of ‘agile’ PM, such as was discussed by Baird and Riggins (2012) or Špundak (2014).

Approach

‘Approach’ represents the second level of the hierarchy. In line with the word’s meaning, it is understood in the implementation context as the manner of doing something, such as the specific steps taken. Two examples are introduced in further detail to show procedural models based on the traditional school of thought and the agile school of thought, as explained above.

The term ‘systems engineering’ originated at Bell Labs in the 1940s and emerged since then in the same called approach (Haberfellner *et al.*, 2019). The approach structures complex problems, such as socio-technical systems (Baxter and Sommerville, 2011), and helps find specific solutions. It sets out a structured process for development and integrates stakeholders’ business and technical needs (Caillaud *et al.*, 2016). Hence, it offers a step-by-step plan to follow. While this can be seen as part of the traditional PM school of thought, systems engineering can also be combined with agile elements (Douglass, 2016). Consequently, the systems engineering approach is continuously evolving (Sheard and Mostashari, 2009). Another example of a traditional PM-style approach is the business engineering approach, discussed by Winter (2008a) and others.

An example of an approach shaped by the agile school of thought is the well-known ‘design thinking’ approach, which is based on an iterative process model and is applied

to find user-oriented solutions to complex problems (Uebernicket *et al.*, 2015). Design thinking can lead to innovation through the imagination of the user. However, it can also feel chaotic due to its iterative approach (Brown, 2008). Despite this, design thinking employs quite deliberate and specific ways of dealing with complex problems during the creative process (Dorst, 2011). Generally, design thinking is more solution focused than problem focused, according to Razzouk and Shute (2012). A further example of an agile PM-type of approach is the collaboration engineering approach, discussed by Leimeister (2014), among others.

Method or tool

‘Methods’ and ‘tools’ are understood as systematic procedures for solving concrete problems or gaining insight into specific issues. ‘Methods’ can be carried out with pen and paper, and ‘tools’ are understood as those that are computer aided. Both can be considered the third and ground level of the hierarchy and can be used at particular stages, such as during a design thinking session. Given the multitude of business-related problems, there is a multitude of methods and tools that can be applied for their solution. A suitable choice of method or tool depends, as with other elements, on the individual problem and must be considered individually. Hence, no exhaustive list of methods and tools can be presented in this dissertation. Selected examples include well-known methods such as strengths-weaknesses-opportunities-threats (SWOT) analysis; the political, economic, sociocultural, and technological (PEST) analysis; and the cost-utility analysis. Also included are methods such as Porter’s four corners, Porter’s six forces, and six thinking hats from de Bono. Tool examples include simulations like the Monte Carlo simulation and forecasting models.

To conclude, while implementation research in management science cannot be considered a separate research stream and generally adaptable findings are still relatively scarce, the findings discussed above show how broad the subject is, with offshoots in research on strategy, innovation, psychology, and PM.

2.4.5 Urban logistics systems as an object of implementation

As pointed out in Section 2.4.1, while there are few implementation research studies with the aim of general findings, implementation research investigating specific implementation objects is manifold. An implementation object can be further broken into diverse implementation object parts, including modules or components, as

suggested by Zeyer (1996). Hence, it is routinely recommended to achieve clarity on the question of ‘what’ should be implemented to formulate a specific implementation mission (Daniel, 2001). Consequently, implementation objects are highly distinct. Nevertheless, investigations into specific implementation objects can be sorted into three categories, according to Nutt (1986) and Grewe (2012):

- *Case studies*: Scholars investigate specific implementation undertakings in various operational areas.
- *Factor-oriented studies*: The conditions surrounding successful implementation undertakings are studied.
- *Process-models*: A dynamic treatment of the respective implementation undertaking is usually employed.

Referring to the specific context of this dissertation, the implementation of ULS, there are also a limited number of studies that can be seen as fitting in one of the three categories. For example, Kiba-Janiak (2016) deals with success factors of the public authority stakeholder group. Other examples, such as studies mainly (co)authored by Iwan, are further discussed in Section 2.5.

To understand the specifics of ULS implementation, in general, ULS, as an implementation object have different characteristics, which can be derived from the body of literature:

- *Positioning between strategy and innovation*: While the implementation of ULS is normally a strategic, long-term undertaking, ULS are also built on innovative UL concept components that further develop due to technological advancements.
- *Interorganizational positioning*: There are ordinarily several stakeholders or stakeholder groups involved in realizing and operationalizing ULS over a longer period of time. These stakeholders need to collaborate intensively.
- *Complex undertaking*: ULS usually touch upon operational processes, such as those of LSPs or shippers and receivers. Physical flows and information flows are mainly affected. These processes may often be restructured in a far-reaching manner.
- *Composition based on different components*: ULS are composed of various UL concept components that need to be compatible. The implementation of these

components can be broken into several steps to achieve the best possible overall solution.

- *Dynamic, ever-evolving environment*: ULS are never static objects; they need to evolve constantly because the environment, and consequently the problem statement, is highly dynamic. An iterative procedure is necessary for constant evaluation.
- *High levels of interdependence with the implementation context*: The implementation context highly influences a ULS since a ULS tries to contribute to solving the challenges arising in a specific urban area. Hence, when the implementation context changes, a ULS must take this into account.

Based on these characteristics, it becomes clear that in order to achieve general findings applicable to different ULS implementation undertakings, a holistic perspective needs to be occupied. This can culminate in an implementation concept tailored to the implementation object of ULS. However, these recommendations always need to be specified in order to generate a clear implementation mission, as suggested by Daniel (2001).

2.4.6 Peculiarities of the implementation of urban logistics systems

While the previous section described the implementation object of ULS in general, this section turns to the peculiarities of this implementation context in order to give further detail.

UL initiatives, especially larger ones with the aim of implementing a ULS consisting of several UL concept components, exhibit several peculiarities, as suggested, for instance, in Le Pira *et al.* (2017) and similar studies. These components collectively have a significant impact on the management of the implementation process. These peculiarities, presented in Table 8, contribute to the justification of ULS-specific research and its implementation.

Table 8. Peculiarities of ULS initiatives and their implications for ULS implementation

Peculiarity	Description	Implications for ULS implementation	Selected literature
Broad range of UL concept components	UL concept components are still evolving, especially through technological advances.	Guidance is necessary to fit and customize UL concept components to the individual situation on-site.	Lagorio <i>et al.</i> (2016); Russo and Comi (2018); Taylor (2005).

Peculiarity	Description	Implications for ULS implementation	Selected literature
Capital intensity for implementing UL concept components	The implementation of UL concept components is relatively capital intensive due to required specific resources like new trucks.	Operational processes need to be assessed and are expensive to change; therefore, this major obstacle for ULS implementation needs to be overcome.	Björklund <i>et al.</i> (2017); Davis and Figliozi (2013); Wolpert and Reuter (2012).
Involvement of many stakeholders	Many UL concept components can only be implemented by an interorganizational collaboration with many different stakeholders.	Collaboration of various stakeholders needs to be fostered and moderated in order to achieve a lasting and successful implementation.	Anand and Yang <i>et al.</i> (2012); Gatta and Marcucci (2016); Stathopoulos <i>et al.</i> (2012).
Long time horizon of implementation	UL initiatives usually have a long time horizon until first realizations, and their impacts are recognizable.	It is necessary to engage with stakeholders regularly and actively align interests and certain isolated solutions.	Dolati Neghabadi <i>et al.</i> (2019); Nuzzolo <i>et al.</i> (2014).
Multitude of different, partly opposing interests	Stakeholder groups engaging in UL initiatives are often competitors and have differing interests.	Specialized methods need to be deployed in order to find the lowest common denominator, especially during the planning phase.	Dablanc (2007); Macário <i>et al.</i> (2008); Oexler (2002); Taniguchi and Thompson (2002).
Partnership of private and public sector	For the implementation of many UL concept components, it is necessary to form private-public partnerships.	Private and public stakeholders need to work together in a moderated process to ensure lasting success and acceptance.	Crainic, Ricciardi and Storchi (2009); Le Pira <i>et al.</i> (2017); Lindholm and Browne (2013).
Short-term disadvantages to generate long-term benefits	Certain UL concept components disadvantage specific stakeholders; however, they receive benefits in the long run.	Stakeholders need to be convinced to participate and invest in ULS to achieve positive long-term returns.	Dampier and Marinov (2015); De Langhe (2017); Russo and Comi (2020).

As stated in Section 2.3.4, LSPs can be perceived as most important for implementing ULS because they either need to get engaged in a multitude or are affected by each of the UL concept components. Consequently, it is important to investigate LSPs further.

LSPs can be simply defined as «*companies which perform logistics services on behalf of others*» (Delfmann *et al.*, 2002, p. 204). Generally, the logistics service industry can also be characterized by a range of peculiarities. These LSPs-related peculiarities have

implications for the implementation of ULS as well, and consequently, need to be considered. Therefore, these characteristics and their implications for this research are presented in Table 9 hereafter.

Table 9. Peculiarities of LSPs and their implications for ULS implementation¹⁴

Peculiarity	Description	Implications for ULS implementation
Capital intensity of services	Logistics services require specific resources for production and are, therefore, capital intensive.	ULS implementation often affects processes of all kinds, including technical requirements, and are, thus, expensive for LSPs to realize.
Firefighting mentality	Companies usually are operations-driven with a focus on daily operations and less on strategic processes.	LSPs are often hard to persuade to get engaged in ULS implementation as these are usually long-term projects with a strategic focus.
Function of covering distances	Logistics services are decentralized, geographic spread, and mobile entities contribute to that.	The interorganizational collaboration and information exchange is key to ULS implementation; however, still very challenging.
Heterogeneity of customer demands	LSPs serve a broad range of customers, each with individual requirements leading to robust relationships.	LSPs usually implement customer-specific solutions; hence, ULS need to integrate specialized requirements.
Heterogeneity of offered services	Logistics services are often customized to individual requirements due to the usual customer diversity.	ULS need to be able to integrate multi-user solutions; this is usually hard to achieve as services of LSPs differ in a range of characteristics.
Restrictive outsourcing contracts	Strict service-level agreements regulate the services in an outsourcing contract.	A reactive approach to counter problems is usually widespread, and innovations such as ULS need to be adjusted to contractual conditions.
Special position within the supply chain	LSPs are situated between their customers and their customers' customers and take up a network function.	ULS need to adapt to the requirements of a range of customers of LSPs without a drop concerning the service-level agreements.
Use of sub-contractors	LSPs often use sub- and sub-subcontractors to live up to the specialized customer requirements.	ULS need to take into account that a rising complexity in terms of the service-level constellations exists.

The peculiarities mentioned above of the ULS implementation, in general, and LSP-related peculiarities, in particular, can be considered to be constituent characteristics, which need to be taken into account for the present research. Due to these circumstances,

¹⁴ The peculiarities of LSP are adopted from Mathauer (2020, p. 17f).

ULS implementation can be denoted as complex. Consequently, ULS as an object of implementation needs further investigation. An outline is given in the next section.

2.4.7 A participatory approach for the implementation of urban logistics systems

As noted in Section 2.4.2, the success of implementation undertakings is highly dependent on the psychological factors of achieving acceptance and avoiding reactance. Hence, these factors hold a high priority in any implementation undertaking and are considered a central factor to be considered.

Section 2.4.3 discussed how achieving acceptance and avoiding reactance are primarily connected to the topic of the configuration of implementation, especially concerning aspects such as different levels of participation from affected parties, the style of leadership, and the level of scope supervisors have for decision-making compared to the scope of subordinates.

These findings of the implementation process can be transferred to the ULS implementation setting. Due to the instrumental characteristic of ULS of achieving aims in various segments, as noted in Section 2.3.2, a high level of acceptance from the affected parties can lead to positive impacts on their identification with the operational processes. The affected parties of ULS are usually various stakeholder groups, introduced in Section 2.3.4. This circumstance particularly suggests far-reaching participation from the various stakeholder groups throughout the entire ULS implementation process. This is also supported by a broad and profound body of research about stakeholder management in UL. Scholars researching UL agree, for instance, that «*[t]he importance of adopting a participatory decision-making process is, nowadays, widely recognized*» (Marcucci *et al.*, 2017, p. 70). Hence, the collaboration of stakeholders in a participatory manner is necessary to implement ULS.

While a participatory approach for the implementation of ULS is advisable for not only pragmatic reasons – ULS stakeholders can be expected to get engaged in the implementation with higher motivation if they can help to shape the ULS – scholars have argued for stakeholder involvement to implement UL for some time (e.g., Taniguchi *et al.* (2001), Crainic, Ricciardi and Storchi (2009), and Lindholm and Browne (2013). Le Pira *et al.* (2017, p. 2) further argued that «*for a successful participatory decision making process, it is important not only to forecast stakeholders' reaction [...], but also to predict the outcome of an interaction process aimed at*

consensus building». They also suggest using focus groups throughout a multi-step process consisting of the phases of problem definition, preliminary analysis, survey, modeling phase, scenario simulations, presentations, and consensus building (Le Pira *et al.*, 2017). In comparison, Russo and Comi (2018) suggested a three-step process of development, planning, and theory building in a highly interconnected, iterative process. Nevertheless, the common ground of academic literature on UL implementation suggests that to successfully realize a UL concept, a participatory manner is needed. This understanding can be transferred to the setting of ULS implementation as well.

To conclude, it is of great importance to put profound thought into how and when which ULS stakeholder group needs to participate throughout the ULS implementation process in order to achieve acceptance for the concept to be implemented and to avoid reactance towards the latter.

2.5 Research gaps

Having briefly summarized the literature on UL concept components and the literature on implementation research, the missing connection between them is further outlined in the following paragraphs to specify the research gaps.

While there is a range of literature on both topics, the connection between them has not yet been sufficiently shown. From academic literature, few publications deal with the implementation of UL in general. There are some papers dealing with specific topics such as challenges and issues for implementation of e-trucks (see, e.g., Quak and Nesterova (2014)), the implementation of metro-based UL (see, e.g., Dampier and Marinov (2015)), or the implementation of low emission zones (see, e.g., Cruz and Montenon (2016)). The literature has in common that the implementation is normally researched using a specific case study or a specific UL concept component. However, transferable insights on implementing UL are scarce. The results of the literature review on the intersection of implementation research and UL-related research are displayed in Table 10.

Table 10. Literature on UL implementation

No.	Author(s)	Year	Type	Methodology	Theory	Contribution
1	Marchau <i>et al.</i>	2008	Journal paper	Conceptual	–	Development of a framework to implement UL policies

No.	Author(s)	Year	Type	Methodology	Theory	Contribution
2	Iwan	2014 a	Conference paper	Conceptual	–	Development of an adaptive approach to implementation
3	Iwan	2014 b	Conference paper	Conceptual	–	Development of an adaptability index for evaluation of various cities
4	Iwan	2016	Journal paper	Conceptual	–	Application of adaptability index for telematics-based UL measures
5	Kijewska and Iwan	2019 a	Chapter of a book	Conceptual	–	Methodological assumptions for the implementation of UL measures
6	Kijewska and Iwan	2019 b	Chapter of a book	Case study	–	Implementation of UL in the case of south Baltic region cities

To date, only a few papers have dealt with the topic of implementation of UL in general. Aside from one early study conducted before 2010, all of the other identified papers were (co)authored by one researcher, Stanisław Iwan, from the University of Szczecin, Poland. The main contributions are the following:

- Marchau *et al.* (2008) developed a framework to deal with uncertainties during the implementation of UL. A policy making procedure is introduced and applied in three cases of various UL concept components, based on an integrative perspective.
- Iwan (2014a) proposed a methodology for the efficient implementation of UL measures. He introduced a framework with specific tasks to be performed significantly ahead of the realization, resulting primarily in statements about factors such as the identification and involvement of stakeholders and the identification of needs and goals, among others. Hence, the conceptualization of UL measures is mainly concentrated on, while the realization falls short.
- Iwan (2014b) developed an adaptability index meant to evaluate a city's level of adaptability to UL measures. He proposed a quantitative method based on 15 questions asked cyclically throughout the implementation process to several stakeholders. The answers result in an index score that can be used as a measurement of the adaptability of a city. The higher the score, the better a city is adaptable to UL measures.

- The latter's adaptability index is applied by Iwan (2016) in the case of telematics-based UL measures. While the index can measure a city's capability in adapting to UL measures, it does not provide any information about the implementation of those measures.
- Kijewska and Iwan (2019a) further developed the framework, but the paper focuses on problem identification and choice of UL measures. Consequently, findings about the realization of UL measures are once again not included.
- Another paper by Kijewska and Iwan (2019b) discussed UL measures in locations in Germany, Lithuania, Poland, and Sweden. This paper is also focused on the challenges and potential visions rather than the realization of the measures.

All of the mentioned papers have the following characteristics in common: The authors propose their findings based on their own study; therefore, they follow a conceptual approach. They do not follow a specific literature review methodology nor explain sufficiently how the introduced findings were developed and validated. Furthermore, they do not apply any theoretical lenses, and empirical data are scarce. Additionally, the findings of implementation research are widely neglected. These are significant shortcomings. Hence, knowledge is available only in a rudimentary form. However, it is not only not empirically verified but also especially not brought together with common findings in implementation research (see Section 2.1.3) or connected to the setting of an integrative ULS.

However, philosophies such as traditional, agile, or hybrid PM, interlocking and underlined with specific recommendations about which elements to consider and how to approach them, may contribute to the body of knowledge and aid in structuring the implementation process. These conclusions can be adapted to the ULS setting and culminate in particular recommendations for the ULS implementation process, which is the subject of this dissertation.

To conclude, as already briefly outlined at the end of Section 2.1.2, a research gap has been identified regarding the implementation of ULS. While there is a vast body of in-depth research available about UL concept components, their implementation in a holistic setting in which they play together – referred to as ULS – in combination with known findings from implementation research can be considered a gap. Therefore, investigating how to transfer insights from implementation research to the specific

setting of a ULS is the focus of this dissertation. To further break it down with the classical implementation understanding in mind, the theoretical shortcomings concerning the implementation of ULS can be further divided into two research gaps:

- (1) How to design ULS conceptually taking into consideration their implementation?
- (2) How to realize ULS accordingly?

These two questions can be answered together as part of a broad understanding of the general ULS implementation process (in line with the broad understanding introduced in Section 2.4.1). As outlined, this broad understanding of implementation is the basis for the present dissertation. From a participant-observer perspective (see Section 3.3), an investigation of the implementation in the ULS environment is missing. Hence, this dissertation is ultimately aimed at developing recommendations for ULS, contributing to closing the above-mentioned research gaps, in particular, but also contributing to easing the MC introduced in Chapter 1. These recommendations can find their entry in an adaptable implementation concept for the particular environment of ULS. In this context, ‘adaptable’ is understood in line with Iwan (2014a, p. 73): *«transferring practically proven solutions while making changes that mainly depend on the implementation environment»*. With the term ‘concept’, guidelines and principles are meant on a meta level, while the term itself can be considered a blueprint, unfolding its value in its application. Hence, the adaptable implementation concept for ULS should be deployable in various urban areas.

To narrow the scope of this research, a distinction is necessary between the ‘*unit of analysis*’ and the ‘*unit of observation*’: In this dissertation, the *unit of analysis* refers to ULS as a whole. This can be considered a holistic perspective of ULS, which is justified by the variety of UL concept components, involved stakeholder groups, and an always unique situation in urban areas. Furthermore, scholars call for a holistic understanding of the UL environment, denoted as ULS in this dissertation, as research into just one UL concept component is typically considered too narrow. Besides, the *unit of observation* as used in this dissertation refers to urban areas usually found in the GAS area. Urban areas worldwide differ significantly in a broad range of characteristics, including their existing infrastructure, topography, types of vehicles in use, number of inhabitants, and settlement structure. However, urban areas in the GAS area are perceived to a certain extent very similar, because the same types of vehicles are typically used, the settlement structure can be primarily compared, and the existing infrastructure is relatively similar.

Urban areas outside the GAS area differ profoundly concerning the number of inhabitants. For instance, megacities with more than 10 million inhabitants and several major city centers do not exist in the GAS area. Hence, cities in the GAS area are chosen as the *unit of observation*.

2.6 Research questions

As outlined above, a holistic perspective on the implementation of ULS is a major theoretical shortcoming. To address the research gaps that have been identified, the following guiding research question (RQ_x) places emphasis on the holistic implementation of ULS:

RQ₀: How to implement ULS successfully?

For further structuring the outlined research gaps, the overarching research question RQ₀ can be further divided into secondary research questions. These are primarily structured in chronological order, following the common implementation process introduced in Section 2.4.2.

To address the shortcomings in regard to the ULS conceptual design, the first secondary research question addresses the highly unique environment in urban areas, and therefore, it has to date remained unclear what situational factors and design variables need to be considered during the implementation of ULS. This is expressed through RQ₁:

RQ₁: What situational (contingency) factors and design variables affect the conceptual design of ULS?

For a further deepening of the ULS design process, another secondary research question is asked. As previously noted, there is limited knowledge about how UL concept components can be chosen according to individual conditions in distinct urban areas. This research demand is expressed in RQ₂:

RQ₂: How to choose UL concept components fitted to the individual on-site situation?

To address the shortcomings concerning the realization of ULS in line with the broad implementation understanding, further secondary research questions focus on this part of the shortcomings. So far, no knowledge has been identified concerning success factors that should be considered during the implementation of ULS. The identification

of success factors is a common question when it comes to complex undertakings. Therefore, this need is put into words through RQ₃:

RQ₃: What success factors need to be considered to implement ULS?

While RQ₃ focuses on the overall implementation of ULS, it is specifically necessary to transfer the knowledge from general implementation research to the ULS environment, which has not yet been done. Especially the supporting, not directly operational structures that are necessary for ULS implementation are not yet identified. Thus, it is still unclear how an implementation management tailored to the ULS context can be set up. RQ₄ focuses on that aspect:

RQ₄: How should an implementation management tailored to the context of ULS be set up?

With the findings of the secondary research questions RQ₁ to RQ₄, this dissertation aims at their culmination in an overall adaptable implementation concept for the particular environment of ULS. This adaptable implementation concept claims to act as a guideline for ULS implementation undertakings in various urban environments and encompasses recommendations for the successful ULS implementation. Thus, last but not least, a specific, adaptable implementation concept for ULS is investigated. Consequently, RQ₅ focuses on this circumstance:

RQ₅: How can an adaptable implementation concept for implementing ULS look like in order to achieve a successful implementation?

With the combination of these research questions, a holistic understanding of the process of ULS implementation is the goal of this dissertation, which aims at the closure of the identified research gaps while also contributing to the MC outlined in Chapter 1.

3 Research approach to the implementation of urban logistics systems

This chapter considers the theoretical anchoring and research methodology of the thesis at hand. First, Section 3.1 gives a detailed overview of the theoretical access to the research phenomenon. Furthermore, relevant perspectives that have been employed in UL research are briefly described. In line with the applied theory selection procedure and with all things considered, four theories were selected for this dissertation: complex adaptive systems theory (CAST), contingency theory (CT), stakeholder theory (ST), and the theory of constraints (TOC). These theories are described briefly, along with their connections and possible contributions. The chapter continues with the derivation of the research framework (Section 3.2) and ends with a presentation of the research design and methodology (Section 3.3).

3.1 Theoretical access to the research phenomenon

In studies conducted in the logistics domain, scholars often deploy theories from a range of disciplines, according to Defee *et al.* (2010). The investigation of UL research showed that the following categories are mainly those from which theories are applied:

- *Competitive theories*: Competitive theories focus on explaining how organizations can achieve a competitive advantage in a specific market. Absorptive capacity theory can provide insights to greening logistics activities as part of ULS, such as discussed by Abareshi and Molla (2013). Furthermore, CT can help with gaining an understanding of the factors influencing an individual ULS (e.g., Rose *et al.* (2017)). The theory of dynamic capabilities can help establish certain UL concept components, including urban consolidation centers, as discussed by Harrington and Singh Srai (2012).
- *Innovation theories*: While theories in the domain of innovation are always focused on innovations starting from their invention to their bringing to the market, they can be applied to an individual but also on a company and market level. For instance, in the context of UL research, innovation diffusion theory is applied for studying customers' intentions to use self-collection services (e.g., discussed by Yuen *et al.*

(2018)) or in investigations of automated parcel stations, consumers' initial adoption of the system (e.g., discussed by Wang *et al.* (2018)).

- *Microeconomic theories*: Theories of this provenance investigate how companies and individuals make decisions about limited resources and their allocation against the background of current trends (Defee *et al.*, 2010). Following that, in UL research, agency theory is applied (e.g., Frehe *et al.* (2017)). The theoretical lens of fuzzy theory can evaluate, for example, competitiveness, as discussed by Liu (2011). Game theory can be applied to model urban freight movements, as discussed by Friesz and Holguín-Veras (2005), among others.
- *Social psychology theories*: Theories of this origin can be applied at an individual level to study human behavior within organizations and at a company level to study organizational behavior. In the context of ULS implementation, a social psychology perspective can lead to insights about the various stakeholder groups. Examples include social exchange theory for understanding crowdsourced activities (e.g., Ye and Kankanhalli (2017)), ST for the investigation of stakeholder needs (e.g., Katsela and Pålsson (2019)), social network theory for the assessment of urban parkland (e.g., Campbell *et al.* (2016)), prospect theory for understanding superior UL concept components (e.g., Jiang and Ren (2020)), and actor-network theory for gaining insights to socio-technical innovations in UL (e.g., Fischer (2017)).
- *Systems theories*: Generally, supply chains and logistics chains are perceived as complex systems, as pointed out by Defee *et al.* (2010). Therefore, systems theories are frequently applied. Also, in the UL context, the application of systems theory promises to holistically investigate the complexity of ULS. For example, Serna *et al.* (2012) applied the theory to investigate collaborative autonomous systems in UL, and Crespo de Carvalho (2004) applied it to structure ULS.

With the aim of an appropriate selection of theories and scientific constructs from these categories that offer an explanatory contribution to the implementation of ULS, specific requirements for theory application can be determined. Against the background of the fundamentals for this research outlined in Chapter 2, applicable theories must fulfill the following *context-specific criteria*:

- Potential for structuring and systematizing the examination of ULS implementation in a dynamic, changing, and complex environment.

- Potential for insights into the impact of environmental factors and constraints influencing the ULS implementation process.
- Acknowledgment of various actors involved in the ULS implementation process and potential for insights into how to manage these actors.

Because these criteria are diverse, it cannot be expected that one theory meets all of the mentioned requirements. Therefore, this dissertation pursues an eclectic approach based on various theoretical lenses that are used for description, explanation, or composition of specific phenomena (Friedli, 2006). The primary motivation behind choosing an eclectic approach is to generate a more complete picture of the investigated object than would be possible with only one theoretical view (Friedli, 2006). As the implementation of ULS is perceived as a complex phenomenon with many influencing factors, several theories contribute to this dissertation. Hence, applicable theories must also have the ability to be integrated with other theories. In addition to the context-specific criteria, the theory selection process can be structured in four categories of *general criteria*, according to Stölzle (1999)¹⁵:

- *Theoretical attractiveness*: This criterion is concerned with the existence of a research paradigm and an orientation toward critical rationalism. While the former is supported by a theory's problem-solving potential, its generalizability, and its precision potential, the latter is proved by its exploratory power and its ability to generate hypotheses.
- *Design orientation*: This criterion is focused on the existence of design variables, efficiency criteria, and determinants that are related to a theory. These support the operationalization of the theoretical construct. Furthermore, the application potential, the empirical relevance, and the theory's informativity refer to this criterion's formal aspects.
- *Integrative power*: This criterion is met if a theory has the potential for learning (the chance to enhance another existing theory), systematization (the chance to structure theoretical constructs), and the ability to be integrated with other theories from the theoretical landscape.

¹⁵ The theory selection process is oriented on previous dissertations written at the Institute of Supply Chain Management, University of St. Gallen, for instance, Mathauer (2020), Hänsel (2018), and Lampe (2014).

- *Adaptability*: This criterion refers to the general applicability of a theory to a specific research context. A theory is considered adaptable if it meets at least one of the aforementioned context-specific criteria for further investigations on the respective research topic.

For this dissertation, theories were perceived suitable if they were applied frequently in recent research studies in the research domain and if they are capable of explaining the complex phenomenon of ULS implementation. Hence, the following theories from the five categories previously mentioned were analyzed based on the context-specific criteria in the theory selection process:

- *Agency theory*: The agency theory is concerned with the relationship between two parties in a professional environment, where the principal delegates work through an agent who performs the work, according to Eisenhardt (1989). Agency theory expects different desires and goals from these two parties (Eisenhardt, 1989). The result is an asymmetry of information that can be further divided into hidden action, hidden characteristics, hidden information, and hidden intentions, according to Jensen and Meckling (1976). This theory seems relevant for this dissertation because the thesis is concerned with the implementation of ULS. In addition, principal-agent relationships may occur because different actors must interact when implementing various UL concept components.
- *Complex adaptive systems theory*: The theory of complex adaptive systems is not explicitly related to a certain research domain but is concerned with complex adaptive systems (CAS) in general (Friedli, 2006). For an entity to be a CAS, four characteristics need to be fulfilled, according to Pascale (1996): First, a CAS consists of a variety of actors who act in parallel and are not hierarchically ordered. Second, the elements of a CAS change permanently. Third, a CAS aims for an increase in its entropy. Fourth, a CAS can recognize patterns to adapt to their environment. Because these four characteristics are applicable to ULS, the theory of complex adaptive systems is considered further for this research.
- *Contingency theory*: According to contingency theory, every decision and action is contingent upon its environment and the current situation (Donaldson, 2001). Anderson and Lanen (1999) named two types of contingencies: internal, namely endogenous, and external, namely exogenous contingencies. According to Donaldson

(2006, p. 19), «[i]t holds that the most effective organizational structural design is where the structure fits the contingencies». The theory is widely accepted in the research of different domains and was applied by researchers such as Rose *et al.* (2017) in UL research. Because this dissertation aims to achieve systematic and differentiated insights into ULS implementation, contingency theory may serve as a theoretical lens.

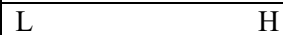
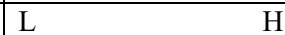
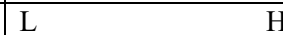
- *Dynamic capabilities theory*: Dynamic capabilities make reference to a «firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. Dynamic capabilities thus reflect an organization's ability to achieve new and innovative forms of competitive advantage given path dependencies and market positions» (Teece *et al.*, 1997, p. 516). Hence, the competitive advantage of an organization is ascribed to its dynamic capabilities, according to Teece *et al.* (1997). Because this dissertation does not seek to explain competitive advantage, such as by using UL concept components or the involvement in ULS, dynamic capabilities theory is not considered further for this thesis.
- *Innovation diffusion theory*: The innovation diffusion theory is concerned with the question of how innovations spread ('diffuse') over time through a social system (Rogers, 1962, 2003). It is frequently applied for investigating innovation phenomena, in general, as well as in the logistics context, see, for example, Holmqvist and Stefansson (2006). While the theory is focused on how technology diffuses, technology may be part of a ULS, it is not considered the center of this dissertation as it turns mainly to the implementation of ULS. Hence, this theory appears less applicable to the research context of ULS implementation and is, therefore, not selected.
- *Social exchange theory*: Social exchange theory links economics with sociology, stating that social behavior is an «exchange of goods, material and non-material», according to Homans (1958, p. 597). Furthermore, the exchange can also be of «symbols of approval or prestige» (Homans, 1958, p. 606). Scholars have identified six resource types for exchange: love, information, goods, money, services, and status (Cropanzano and Mitchell, 2005). Individuals try to maximize their profits in such exchanges; nonetheless, they usually keep an eye on «that no one in his group makes more profit than [they do]» (Homans, 1958, p. 606). While social exchange theory

mainly focuses on individuals in a dyadic relationship, it can also be applied in an environment of organizations. Because that applies to the context of ULS implementation, social exchange theory is considered for this thesis.

- *Stakeholder theory*: Stakeholder theory is concerned with the firm level and states that various internal and external stakeholders, including employees, shareholders, suppliers, customers, and political institutions, are involved in every organization (Mitchell *et al.*, 1997). As a result, decisions of the organization are influenced by the interests and aims of these parties (Freeman, 2010). Regarding the context of ULS implementation, the evaluation and realization of various UL concept components also requires considering the interests of various stakeholder groups (e.g., LSPs, shippers and receivers, the public). Hence, stakeholder theory seems applicable to this research context.
- *Theory of constraints*: The ground-laying ideas of the theory of constraints can be summarized in two points, according to Rahman (1998): First, every system has at least one constraint. Second, constraints represent opportunities for improvement. To achieve a continuous improvement process, there is an iterative procedure that starts with identifying the constraint, then exploiting the constraint, subordinating all resources to a global decision, elevating the constraint, and overcoming inertia, as presented in the seminal contributions of Goldratt and Cox (1984) and Goldratt (1991). The theory of constraints was also applied in implementation investigations, such as by Geri and Ahituv (2008). In the context of ULS implementation, the theory of constraints can contribute to identifying and overcoming constraints in the implementation process. Hence, this theory is further evaluated throughout the theory selection process.

Based on this initial analysis regarding the adaptability of the introduced theories, only six out of eight seem to be applicable to the research context of ULS implementation in general. Next, an evaluation of these six theories regarding the remaining selection criteria by Stölzle (1999) is carried out. This evaluation is presented in Table 11.

Table 11. Evaluation of theoretical attractiveness, design orientation, and integrative power

Theory	Theoretical attractiveness	Design orientation	Integrative power	Applicability
Agency theory (AT)	Occasionally applied in UL research, such as to study crowd logistics business models (Frehe <i>et al.</i> , 2017).	Explains information asymmetries during the establishment of a business model between different parties; can be overcome with governance mechanisms (Eisenhardt, 1989).	Allows for integration with CT (e.g., Kosnik and Bettenhausen, (1992)), SET (e.g., Bottom <i>et al.</i> (2006)) and ST (e.g., Hill and Jones (1992)).	 Medium
	L H	L H	L H	
				
Complex adaptive systems theory (CAST)	Frequently applied in logistics research, e.g., to study supply networks (Cordes and Hülsmann, 2013) or to study factors influencing logistic processes (Nilsson, 2016).	Explains complexity in different systems and their dynamics; can be operationalized in UL settings for purposes such as an approach to urban systems (Ulysses, 2018).	Allows for integration with CT (e.g., McCarthy <i>et al.</i> (2006), with ST as suggested by Phillips and Ritala (2019), as well as with TOC (e.g., Gill (2001)).	 High
	L H	L H	L H	
				
Contingency theory (CT)	Frequently applied in UL research, e.g., for research on crowdsourced logistics (Castillo <i>et al.</i> , 2018) or logistics networks (Wollenburg <i>et al.</i> , 2018).	Proposes that organizations need to adjust to various (i.e., contingent) factors (Donaldson, 2001); can be operationalized by various factors in a UL setting (Rose <i>et al.</i> , 2017).	Allows for integration with AT (e.g., Kosnik and Bettenhausen (1992)), with CAST (e.g., McCarthy <i>et al.</i> (2006)), with ST (e.g., Husted (2000)), and with TOC (e.g., Panizzolo (2016)).	 High
	L H	L H	L H	
				
Social exchange theory (SET)	Infrequently applied in UL research, e.g., investigating the participation of individuals in logistic processes on the last mile based on platforms (Ye and Kankanhalli, 2017).	Provides explanations for exchanges that are predominately between individuals, as well as on an organizational level but underestimates formal mechanisms necessary for ULS (Wynstra <i>et al.</i> , 2015).	Allows for integration with AT (e.g., Bottom <i>et al.</i> (2006) and with CT (e.g., Belaya and Hanf (2009)).	 Medium
	L H	L H	L H	
				

Theory	Theoretical attractiveness	Design orientation	Integrative power	Applicability
Stakeholder theory (ST)	Extensively applied in UL research, for example, to investigate governance mechanisms (Gammelgaard <i>et al.</i> , 2017) or prioritize stakeholder motives (Katsela and Pålsson, 2016).	Differentiation in directly and indirectly involved UL stakeholder groups (Stathopoulos <i>et al.</i> , 2012); operationalization by addressing stakeholder needs (Katsela and Pålsson, 2019).	Allows for integration with AT (e.g., Hill and Jones (1992)), with CAST according to Phillips and Ritala (2019), and with CT (e.g., Husted (2000)).	 High
	L H	L H	L H	
Theory of constraints (TOC)	Widely applied in implementation research, such as to investigate the feasibility of implementing interorganizational systems (Geri and Ahituv, 2008).	Proposes that every system has at least one bottleneck that needs to be overcome, which can be transferred to a logistics setting, e.g., Amin and Rhamn (2019) or a UL setting, e.g., Ewedairo (2019).	Allows for integration with AT (e.g., Chemutai and Nzulwa (2016)), CAST (e.g., Gill, (2001)), and CT (e.g., Panizzolo, (2016)).	 High
	L H	L H	L H	

Notes: L = low, H = high. The black bars visualize the assessment outcomes for the different dimensions.

Based on the above evaluation, the theories chosen for this thesis were CAST, CT, ST, and TOC. While all of them meet the theory selection requirements introduced by Stölzle (1999), together, they fit the specific research context of ULS implementation. These four theories are further discussed separately next. Additionally, their application to the research setting of ULS implementation is explained.

Outline of CAST and its application in ULS implementation

CAST has its roots in the life and physical sciences, as discussed by Prigogine *et al.* (1988) and Kauffman (1993). However, CAST is also applied in engineering science (e.g., Holland (1995)), and particularly in social science research into strategic organizational design (e.g., Anderson, (1999)), innovation management (e.g., Chiva-Gomez (2004)), and logistics and SC management (e.g., Choi *et al.* (2001)). CAST can also be applied to the area of corporate value creation systems (Knecht, 2003). Hence, CAST is a significant part of the discussion concerning complexity science, according to Friedli (2006). Holland (2006, p. 1) argued that, «[CAS] are systems that have a large

numbers of components, often called agents, that interact and adapt or learn». In order to label a particular phenomenon a CAS, Pascale (1996) described four characteristics that must be present: (1) a CAS consists of various agents or actors, (2) elements and relationships change permanently in various ways in a CAS, (3) a CAS strives to increase its entropy, and (4) a CAS has the ability to recognize patterns concerning the appropriate adaptation to environmental changes. In line with that, according to McCarthy *et al.* (2006, p. 442), «[a] CAS is somewhere between a linear and a chaotic system, with partially connected agents whose decision making and interactions produce behavior and outcomes that are neither fully controlled nor arbitrary».

These four characteristics can be transferred to the ULS setting. CAST offers a theoretical lens for the implementation of ULS in a descriptive application by providing a structure for the phenomenon. Hence, CAST contributes to the delamination of ULS as it is a complex, interconnected system with no ‘hard’ borders at the edges. In line with an explanatory application of CAST, a ULS consists of various actors who act in parallel and who are not subject to hierarchical control. Hence, the various actors, such as LSPs, shippers and receivers, or the local authority, can be considered the actors of a ULS. A ULS as a CAS strives to increase its entropy so that the actors need a constant, external supply of resources to keep running their value creation in a ULS. In addition, the actors of a ULS – namely companies of various origins, the public, and the local authority – have the ability to adapt to environmental changes, which is usually expressed through competition in the market. Furthermore, the adaptive aspects incorporated in CAST, the dynamic environment during ever-changing implementation processes, means it can be considered in this dissertation. These aspects make CAST necessary for all introduced research questions given that the background knowledge it can provide is worth its consideration.

Outline of CT and its application in ULS implementation

CT was introduced by Fiedler (1964) as part of behavioral theory. According to CT, organizational structures must consider framework conditions – so-called situational or contingency factors – to come into alignment (Fiedler, 1964). These can be divided into internal and external situational factors, which are usually exogenous to the company, and hence, in most cases, only within the company’s limited or indirect control, according to Mintzberg (1979). Mintzberg (1979) proposed design variables, which are

concerned with the organization's structures and are thus in managerial control and can be changed by decision-makers. To elaborate on organizational structures, CT draws on particular circumstances (Lawrence and Lorsch, 1967). However, a general drawback of CT is that these situational parameters are often difficult to measure and, consequently, also difficult to operationalize (Otley, 1980). Hence, it states that there is no single best way to manage and organize corporations. Drazin and van de Ven (1985, p. 514) noted, «*that context and structure must somehow fit together if the organization is to perform well*». Consequently, an individual management style and organizational structure must be based on situational factors that must crucially be taken into consideration.

CT can also be incorporated in the ULS implementation setting in an explanatory application. Every urban area is highly individual in terms of many factors, as outlined in Chapter 2, so CT fits accordingly. Therefore, urban areas need to be assessed based on contingencies to enable the implementation of ULS. While the consideration of contingencies is necessary to plan ULS, they also need to be considered throughout the realization process. These contingencies can be found in internal surroundings – for instance, the firm size of participating companies – and external surroundings, (e.g., political problem awareness in a specific country). Hence, due to the heterogeneity of urban areas, there may exist a range of factors influencing decisions during the ULS implementation process. These factors can be considered strategic decisions, such as the consideration of which UL concept component should be implemented, and also in operational decisions (e.g., how many cargo bikes to deploy in a specific UL setting). Thus, CT offers theoretical grounding for primarily RQ₁, but also partly for RQ₂ and RQ₃. However, it may be kept in mind during the whole implementation process of ULS as this is always highly individual and must fit the context and structure, as the latter was pointed out in general by Drazin and van de Ven (1985).

Outline of ST and its application in ULS implementation

According to Freeman (1984), regarded as the father of ST, ST lies a focus on all parties – suppliers, employees, customers, among others – involved in a value creation process. Those can be divided into two groups: Narrow stakeholders, which are specifically necessary for the success and survival of organizations, and further stakeholders, which may be affected by the organization (Freeman, 1994). Otherwise, Mitchell *et al.* (1997)

argued that stakeholders could be categorized based on the following three attributes they may have: *power* for influencing company behavior, *legitimacy* of a claim against the company, and *urgency* in terms of the degree to which they have time-sensitive attention from the company. Stakeholders might put pressure on an organization (Delmas, 2001). It is further argued «*that all persons or groups with legitimate interests participating in an enterprise do so to obtain benefits and that there is no prima facie priority of one set of interests or benefits over another*», according to Donaldson and Preston (1995, p. 68). As a result, these stakeholders need to be actively managed, which can create a competitive advantage (Harrison *et al.*, 2010). Furthermore, ST proposes that various stakeholder groups affect the implementation of organizational practices (Sarkis *et al.*, 2011). This can also be transferred to interorganizational settings. In recent years, ST became more and more popular in management research, according to Gassmann *et al.* (2016).

ST has been extensively adapted to the UL setting and contributes in an explanatory manner to this dissertation regarding the implementation of ULS as well. ST offers insight into managing the different stakeholders that are part of ULS during the implementation process. It provides propositions for reasons why and how stakeholders may contribute to a ULS, although there is the need for explicit investments from their side. Furthermore, ST sheds light on the cooperative processes involved and on how to build trust among the various, sometimes even competing stakeholders, to share sensitive data and work together for the greater good in terms of the UL aims, as mentioned in Chapter 2. This theoretical contribution of ST needs to be considered during all phases of the ULS implementation process, from the planning to the realization. Hence, it helps to decide when and especially how to involve which parties from the range of stakeholders involved in ULS, along with how they can contribute to the implementation of ULS and how these parties can be managed. In general, ST contributes to investigating organizational behavior during the implementation process. Thus, ST can be kept in mind for answering all of the research questions, but especially RQ₁, RQ₂, and RQ₅.

Outline of TOC and its application in ULS implementation

TOC was first introduced by Goldratt and Cox (1984) around the idea that at least one bottleneck can be defined in every system, and it inhibits the system, keeping it from

reaching better performance. Hence, TOC was proposed around the saying ‘that a chain is only as strong as its weakest link’. Constraints can have various origins, such as people, information, technology, or financial aspects, which can occur individually in any organization. According to Goldratt (1991), every organization is a system with a specific goal. Hence, every part of a system must be judged against its impact on the greater whole. Consequently, to improve an organization’s global performance, it must be focused on these leverage points. Goldratt (1991) defined a five-step process to overcome those limitations: (1) identify the system’s constraints, (2) decide how to exploit the system’s constraints, (3) subordinate the system to the constraint, (4) elevate the system’s constraint (if a constraint has been broken in the previous steps, go back to step 1), and (5) do not let inertia become the system’s constraint. TOC has been mainly applied to production and service systems, with significant performance improvements (Şimşit *et al.*, 2014). However, TOC can also be applied in other areas, such as interorganizational settings (Geri and Ahituv, 2008).

TOC serves as a leading explanatory theoretical perspective for this dissertation for several reasons. The implementation of ULS is situated in an interorganizational environment. Geri and Ahituv (2008) showed that TOC can be applied in such a surrounding. Hence, the implementation process can be considered a system that has bottlenecks that must be overcome to achieve a successful implementation. From that viewpoint, it becomes clear that a successful ULS implementation may be constrained by different factors that need to be identified and overcome, and examples may originate in the dimensions of economic, technological, or financial infeasibility. These constraints are considered to be highly individual and contingent upon the situation on-site in an urban area, and certain constraints can dynamically arise. This can occur during the planning phase or the realization phase of the implementation process. Consequently, the application of TOC aims to identify the constraints (also called ‘barriers’) that limit the implementation of ULS at any stage of the process. In addition, TOC can contribute to identifying advice for overcoming these constraints. Hence, TOC helps to focus on the essential factors and ultimately leads to overcoming the implementation barriers, enabling the successful implementation of ULS. Consequently, TOC can be applied to all of this dissertation’s research questions but has a particular impact on RQ₅ and partially impacts RQ₃.

3.2 Theoretical framework for the research on urban logistics systems implementation

The thoughts described above can be summarized through a research framework. Figure 12 illustrates the research framework that merges the theoretical and practical perspectives of the research setting. It can be interpreted as a guide for the investigation by linking the applied theories with the overall research context. The research framework roots in the managerial and theoretical relevance for developing an adaptable implementation concept for ULS, outlined in Chapters 1 and 2. Furthermore, the selected theories outlined in Chapter 3 are also depicted.

This research pursues an eclectic approach drawing on four theoretical lenses (i.e., TOC, CAST, CT, and ST). This is considered necessary because a single-theory approach might fall short in the complex implementation setting, as noted in the previous section. The investigation is embedded in CAST because this theoretical lens serves in terms of structuration and guidance for this research. CT helps to develop an understanding of what a ULS implementation process might look like against the background of general situational factors and relevant actors such as LSPs, estate managers, shippers and receivers, the public, and public authority in general. ST contributes to the critical aspect of stakeholder management. These three theories serve as ‘background knowledge’ considered throughout the research process. TOC is applied as the leading theoretical lens for identifying constraints and exploiting them in order to finally overcome them during the whole implementation process.

According to the usage of the different theories, the various research questions are positioned within the research framework. Where research questions touch upon more than one phase or element, they are visually set at an intersection of the relevant topics. The arrows symbolize the imagined iterative and interlocking aspects of the implementation process for ULS.

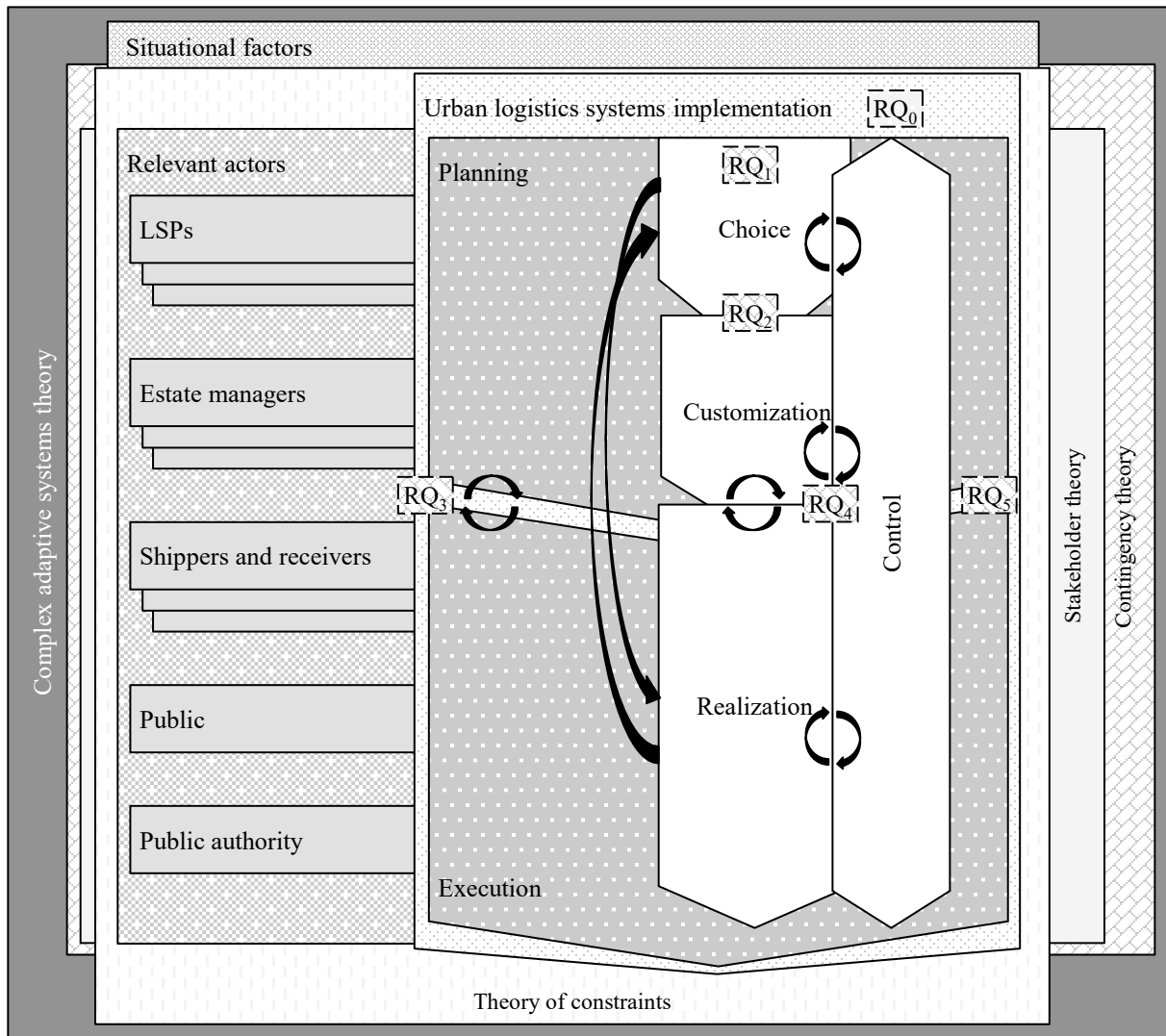


Figure 12. Research framework

3.3 Research design and research methodology

To choose an adequate research design, research methodology, and data collection procedure, first of all, the paradigm positioning this research needs to first be discussed for transparency. An appropriate research paradigm leads to an appropriate research design and methodology, according to Saunders *et al.* (2016).

As already stated, the implementation of ULS has been only minimally researched to date, and thus an understanding of this process is not yet available. Consequently, the general research objective of this dissertation is to gain an understanding of ULS implementation (see also RO₀ in Section 1.3). This means that a research paradigm must be chosen in line with the objective of understanding the research phenomena.

For this reason, the research paradigm of interpretivism was chosen for this research (Gregor, 2006). Interpretivism aims to understand «*the complex world of lived experience from the point of view of those who live it*», as stated by Schwandt (1994, p. 118). The goal of interpretivism is «*to describe and explain in order to diagnose and understand*» (Gioia and Pitre, 1990, p. 591). Following interpretivism, the researcher's view of the nature of reality is socially constructed and subjective, and the researcher is part of the research, according to Saunders *et al.* (2016). Hence, qualitative research designs are most popular to allow for an elaboration of the understanding.

Research design

Due to the fact that specialized insights for the implementation of ULS are barely known in practice yet, this research ultimately aims to develop such a concept with an adaptable aspiration, which calls for an explorative research design.

Exploratory research is mainly conducted to «*to discover new ideas*» (Sreejesh *et al.*, 2014, p. 31) and determine «*what is happening; to seek new insights; to ask questions and to assess phenomena in a new light*» (Robson, 2009, p. 59). This research setting applies to the present dissertation: Because there is no concept tailored to the implementation of ULS nor an in-depth analysis of ULS implementation in general, it remains unclear to what extent knowledge from adjoining fields of investigation, such as implementation of technology or best practices, is transferable to the specific research setting of ULS implementation. Hence, it is necessary to explore this specific research phenomenon – ULS implementation – in an in-depth manner. That, in turn, makes it necessary for impulses from practice to be taken into account to achieve feasible results.

Due to this circumstance, the investigation of the implementation of ULS requires conceptual and empirical cycles, meaning a combination of deductive and inductive approaches to create a triangulated research design. Since science does not provide in-depth explanatory findings regarding why the implementation success of ULS is barely observable in practice, qualitative data collection methods are focused. This is in line with Miles and Huberman (1994), who identified qualitative research as highly appropriate for the early stages of research. Furthermore, as this dissertation aims to facilitate the implementation of ULS ultimately, a pragmatic research approach targeting practical problems should be chosen.

Research methodology

Combining the pre-considerations – namely, an exploratory research setting with deductive and inductive elements with a pragmatic orientation as the basis – the ‘design science research’ (DSR) methodology is selected for this dissertation.

DSR originated in information systems research; however, it is also popular in business innovation research, especially for making «*business innovation happen*» (Winter and Aier, 2016, p. 478). DSR follows a pragmatic philosophy due to its particular emphasis on the relevance of its outcome (Hevner, 2007), and it can be applied in exploratory research settings (Briggs and Schwabe, 2011). It is understood as a structured process for generating knowledge drawn from different streams of information (Hevner *et al.*, 2004). It may also provide innovative solutions to problems from practice (Hevner *et al.*, 2004) with the overall objective of ‘usefulness’. Therefore, useful so-called ‘artifacts’ should be designed to solve relevant problems. These artifacts can be segmented into different types, each with a hierarchical claim, as March and Smith (1995) discussed:

- *Constructs*: These artifacts can be understood as vocabulary and symbols with the aim to define and understand problems or solutions.
- *Models*: Models are perceived as representations of the problem class and of the possible solutions.
- *Methods*: Methods consist of various steps in use to perform a particular task. These can also be understood as recipes with specific instructions.
- *Instantiations*: Instantiations are to be understood as physical realizations in the environment.

The development of the artifacts follows an iterative approach and can follow the definition from Hevner (2007), which is divided into three interdependent cycles shown in Figure 13:

- *Relevance cycle*: The essential motivation is the improvement of the environment through the introduction of useful artifacts. This cycle focuses on the environment and fosters the practically driven process. It usually begins by identifying the relevant problems in practice and serves as initiator. The final output must be returned to the environment and evaluated in the application domain. If necessary, due to

shortcomings of the artifacts, further iterations of the complete DSR approach are recommended.

- *Rigor cycle*: The rigor cycle focuses on existing knowledge found in the ‘knowledge base’ and provides past knowledge to the research project. Hence, it looks for theoretical grounding and the positioning of the artifact based on already existing knowledge, and the designed artifacts can be understood as additions to the KB.
- *Design cycle*: The design cycle concentrates on the artifact building and evaluation process and is perceived as the heart of the DSR approach. This process iteratively goes through the construction of an artifact, its evaluation, and its refinement. It draws on input from both the rigor and relevance cycles. Hence, the design cycle is dependent on the other two cycles. Maintaining an ongoing balance between constructing and evaluating the artifact to achieve relevance and rigor is recommended.

The final artifacts are derived from an iterative process of going through these cycles.

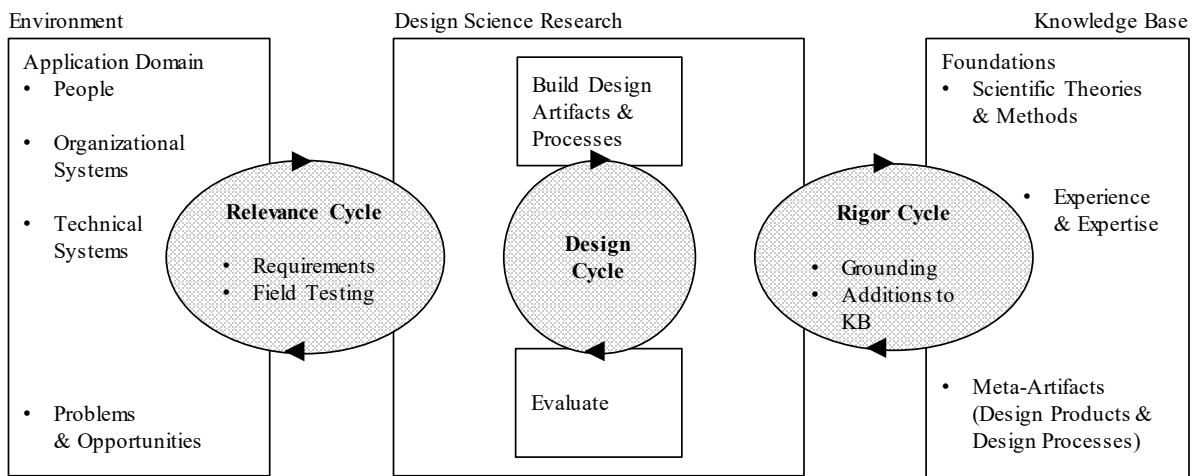


Figure 13. The DSR three-cycle approach¹⁶

One of the advantages of the DSR approach is its ability to be combined with different qualitative or quantitative research methods, according to Winter and Aier (2016). For example, a first conversation with practitioners may initiate the research project (relevance cycle). Then, a systematic literature review can be part of the rigor cycle. Based on these findings from practice and theory, a first artifact can be designed (design cycle). Further empirical validation can be undergone by methods such as semi-

¹⁶ Adapted from Hevner (2007, p. 88).

structured interviews, focus groups, experiments, case studies, or role plays. A further countercheck against the knowledge can also take place. As pointed out, the whole process can be undergone several times in an iterative manner to derive the final artifact. In this way, DSR combines deductive and inductive research. When applying the DSR approach, researchers are occupying a «*participant-observer perspective*», since «*[t]his implies design science researchers are not satisfied with describing field problems and analyzing their causes, but also develop alternative general solution concepts for these field problems*», according to van Aken and Romme (2012, p. 45).

However, DSR also has various limitations and challenges: For example, Winter (2008b) pointed out that DSR may not be rigorous enough and lacks transparent quality control mechanisms. Also, as Hevner *et al.* (2004) stated, researchers construct artifacts based on intuition and experience and, hence, the results are biased by the researcher's knowledge. These criticisms are noted, and the specific application of DSR in this thesis is designed correspondingly. How DSR is specifically applied in this dissertation and how the limitations were considered, are described in the following paragraphs.

The specific application of DSR

The iterative application of DSR in the research process of this dissertation follows the recommendations of Hevner (2007), as outlined below and also displayed in Figure 14:

Problem statement: The application of DSR starts with an initial formulation of a problem statement from practice to outline the research objectives. In the context of this dissertation, the problem statement addresses the unsolved problem of ULS implementation in practice. This was based on informal conversations with practitioners in the field of UL as well as reports from practice. As the problem of ULS implementation is rather large and vague, it was broken down into the RQs outlined in Section 2.6.

Assurance of innovativeness: During the rigor cycle, the innovativeness of the research must be assured. Hevner (2007) suggested reviewing the KB not only for assurance but also as the basis for knowledge contributing to the research project. Hence, a systematic literature review was carried out as described in Section 2.1. Furthermore, the application of appropriate theories and methods was investigated (see Chapter 3). To achieve rigorous results, this was done in an iterative manner.

Design and development process: The design cycle is considered a key activity of the research process. During this process, it was rapidly iterated between the design of the artifacts and their evaluations based on the KB. When a satisfactory design was achieved, further evaluation was performed based on not only the body of literature but also on an empirical investigation that applied semi-structured interviews. The data collection and data analysis process are described in detail next.

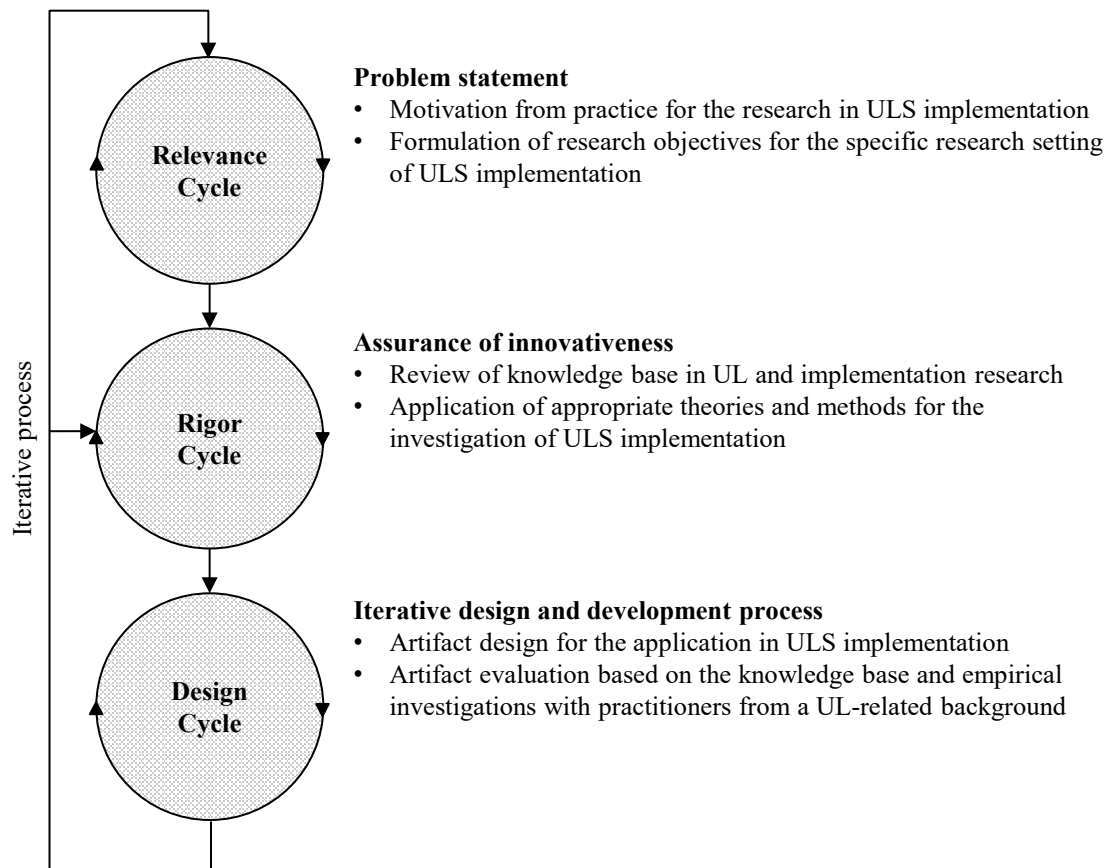


Figure 14. DSR-based research process used in this dissertation¹⁷

Generally, it must be noted that the developed artifacts intentionally were designed to be universally applied. Hence, they do not reflect a particular perspective of the various stakeholders involved in the implementation of ULS but are formulated neutrally. This has the advantage that any single stakeholder and a consortium of stakeholders (as this is typically the case when it comes to implementing ULS) can orient themselves to the various artifacts. Hence, the artifacts are not limited to an application in practice with regard to a specific stakeholder group.

¹⁷ Loosely based on Hevner (2007).

Data collection

The iterative design and evaluation of artifacts are considered a key activity in DSR (March and Smith, 1995). In dependence of the respective artifact, appropriate evaluation criteria and methods must be employed, according to Prat *et al.* (2015). Typical questions in a DSR design evaluation include how well the artifact achieves utility, quality, and efficacy (Venable *et al.*, 2016), and based on the answer, an appropriate evaluation strategy must be employed. Venable *et al.* (2016) distinguished two dimensions: First, ‘*why to evaluate*’ deals with using either a formative approach (during the artifact’s development) or summative one (at the end of the artifact development). Second, ‘*how to evaluate*’ deals within the context of either an artificial setting (e.g., criteria-based) or a naturalistic one. For this dissertation, at the end of the DSR process, a summative and criteria-based evaluation was chosen, oriented on the suggestions of Sonnenberg and vom Brocke (2012), who provided a framework for assigning evaluation methods and criteria to DSR artifacts. Informal conversations with practitioners ensured a formative evaluation throughout the artifact development process. Based on that, a suitable data collection method for evaluation was necessary to determine.

To set the search for a suitable data collection in a broader perspective, as outlined, qualitative research methods are applicable to early-stage research, according to Miles and Huberman (1994). Qualitative methods are also suitable for the in-depth descriptions necessary for understanding the investigated phenomena (Klein and Myers, 1999). Following an interpretive approach, qualitative data collection employing semi-structured interviews was chosen to achieve open-minded in-depth insights into the research phenomenon of ULS implementation. According to King (2012, p. 11), interviews are «*the most common method of data gathering in qualitative research*». Generally, the aim of any interview is «*to see the research topic from the perspective of the interviewee*», according to King (2012, p. 11).

To conduct semi-structured interviews, a list of themes and questions are normally prepared in advance to ensure completeness. However, the specific coverage of these themes and questions typically vary from interview to interview as Saunders *et al.* (2016) pointed out: Encountering, for example, interesting topics throughout an interview, additional questions can be asked to explore the topic more deeply, depending

on the flow of the conversation. Also, the order of the questions can be changed, or some questions can be omitted. This flexibility is an advantage of semi-structured interviews. A further advantage of this data collection method is the possibility to ask open-ended or complex questions, according to Gray (2013). However, subjective interpretation is a disadvantage with semi-structured interviews, so that was taken into account as described in the discussion of data preparation.

The interviewees in qualitative research must be chosen using a purposeful sampling strategy, according to Gerring (2017) and Creswell and Poth (2007): There is a range of various sampling strategies available, including ones that aim for ‘maximum variation of interviewees’, ‘extreme or deviant cases’, and those representing ‘typical cases’. Hence, depending on the research objectives, appropriate interviewees must be chosen. Furthermore, it is not only the type that is important but also the number of interviewees. To achieve well-saturated research results, it is recommended to stop interviewing if saturation is perceivable based on a content-focused analysis.

While there are certain advantages regarding semi-structured interviews, also, certain aspects should be considered in designing credible interviews, as Arksey and Knight (1999) pointed out: To strengthen validity, it is recommended that enough time is allotted to explore the research topic, build trust through appropriate interview techniques and to ask interviewees to elaborate on their responses. To ensure reliability and minimize bias, it is suggested that the same interview protocol is followed to ensure that the questions are asked in the same manner with all interviewees (Gray, 2013). These points were kept in mind during the data collection.

For this dissertation, the semi-structured interviews are situated in the ‘design cycle’ of the DSR approach, as part of the evaluation iteration. Hence, the semi-structured interviews had an evaluative character. All interview partners were asked for their assessment of the derived artifacts with the aim of getting a reflection of their potential use in practice.

A semi-structured interview guideline¹⁸ was prepared before the interviews, which served as the basis for conducting the interviews. To ensure completeness, the interview guideline was structured thematically, following the recommendations of Lillis (1999). Hence, the interview guideline consisted out of 15 questions in 8 sections oriented

¹⁸ An excerpt of the interview guideline is provided in the Appendix.

toward the suggestions for evaluation criteria provided by Sonnenberg and vom Brocke (2012). Based on the available information about the interviewees, not all questions were always asked; instead, a selective adaptation of the interview guideline was applied. The questions regarding the different artifacts were asked separately to avoid overlapping answers. Furthermore, the interview guide was iteratively further developed further through its usage, following the recommendations of Gioia *et al.* (2013) and King (2012).

The sampling of interviewees was accomplished using a multi-step approach based on the recommendations of Saunders *et al.* (2016). First, a homogenous origin (German-speaking) was necessary to ensure a comparable setting in line with the unit of observation (urban areas in the GAS area). Second, because a ULS implementation affects various stakeholder groups, as noted in Section 2.3, a diverse body of interviewees from differing stakeholder groups was deliberately chosen with the aim of understanding the research phenomenon better and in order to achieve triangulation. Interviewees were chosen with a variation strategy, meaning that they differed in terms of their country of residence, the size of their organization, and the service scope. Generally, the interviewee's position was necessary to judge and reflect their experience in the wider UL setting to determine if they qualified for the sample in this study.

Generic information about the interview partners is given in Table 12, in the same order as the interviews were carried out. In total, there were 14 interviews, which lasted between 24 and 70 minutes, with an average of 44 minutes. It was ensured that enough time was available to discuss the questions in detail. The interviews were carried out via video conference calls in June and July 2021.

To achieve triangulation, as outlined, various stakeholder groups were chosen for the semi-structured interviews. In addition to the semi-structured interviews and the review of academic and practice-related literature from different sources, secondary data sources (e.g., webpages, reports, and presentations) were analyzed to apply a triangulation strategy.

Table 12. Interview partners

No.	Description	Stakeholder group	Country	Size	Position of interviewee
1	CEP service provider	LSP	G	L	Group manager, city logistics and sustainability
2	International freight forwarder	LSP	A	S	Chief executive officer
3	Trading company with a focus on food	Shipper and receiver	G	L	Head of logistics services
4	Swiss canton authority; office for mobility	Public authority	S	L	Project manager, commercial traffic and logistics
5	Building and transport department, mobility	Public authority	S	S	Mobility strategy project manager
6	Consultancy with a focus on logistics	Consulting	G	S	Senior consultant
7	CEP service provider	LSP	G	L	Sustainability and new mobility manager
8	Mobility department, research and innovation	Public authority	G	L	Business unit strategy
9	Economic alliance with focus on sustainability	Association	S	S	Expert for climate and mobility
10	Academy of mobility	Research	S	S	Head of research and projects
11	Chamber of commerce	Public authority	A	L	Head of location and infrastructure policy
12	Top municipal association	Umbrella organization	G	S	Press spokesman
13	Trading company	Shipper and receiver	S	L	Head of logistics department
14	Logistics real estate manager and developer	Real estate manager	S	S	Chief executive officer

Notes: Private organization size: L = large (revenue > EUR 250 million); S = small (revenue ≤ EUR 250 million); Public organization size: L = large (urban area inhabitants > 500,000); S = small (urban area inhabitants ≤ 500,000); Country: A = Austria; G = Germany; S = Switzerland.

Data preparation and analysis

As mentioned, DSR is an iterative research methodology. Therefore, the findings from the KB and the interview process were continuously reflected, and, hence, the actually asked interview questions adapted during the research process. Each semi-structured interview was recorded, and extensive notes were taken during the interviews. To ensure accuracy and correctness as well as to achieve content validation and to detect misunderstandings, the recordings were rehearsed after the interviews. Interview data

were triangulated with other data sources such as notes and website information to increase construct validity. Then, all collected data were stored in a database to enhance reliability and enable structured data analysis.

Since the classification and interpretation of qualitative data are typically subjective and depend on the experience of the individual, potential subjectivity is a limitation. Therefore, the bias in the process was minimized, and the internal validity of the research was enhanced through a systematic process of data documentation, preparation, and analysis, following the recommendations from Lillis (1999).

According to Lillis (1999, p. 87), qualitative data analysis «*involves processes of reduction or summarisation, classification and interpretation*». Hence, to ensure an impartial, complete, and reproducible data analysis, a multi-step systematic analytical approach was carried out, mainly based on the suggestions of Miles and Huberman (1994), as follows:

Step 1: Establishment of a connection between the interviews and results based on multiple stages of data summarization and reduction.

Step 2: Usage of all interview recordings for the evaluation and further development of the artifacts.

Step 3: Iterative evaluation of all artifacts via two-way reviews of all interview data and all artifacts.

Besides, Mayring (2010) also emphasized the iterative character of the qualitative data analysis process. Hence, following those suggestions, data were systematically reduced in several steps, including deleting repetitions or irrelevant statements and summarizing key statements for purposes of consolidation.

Finally, it must be noted that the data collection and analysis process related to the DSR evaluation phase carried out in the process of this dissertation was of a simultaneous and continuous character. This is typical for qualitative research, as outlined by Bryman and Burgess ((2002), among others.

4 Findings on the implementation of urban logistics systems

Chapter 4 provides a detailed discussion of this research's findings based on the theoretical access and DSR methodology discussed in the previous chapter. First, in Section 4.1, a contingency analysis of the conceptual design of ULS is carried out. Second, Section 4.2 provides a qualitative assessment for the various UL concept components. Third, success factors for the ULS implementation are discussed in Section 4.3. Fourth, the setup of a profound implementation management for the context of ULS is elucidated in Section 4.4. Finally, the chapter ends with an integrative implementation concept for the context of ULS described in Section 4.5.

4.1 Contingency analysis of the conceptual design of urban logistics systems

This section is concerned with the derived contingency analysis for the conceptual design of ULS. It refers directly to RQ₁ and provides answers. As outlined, UL concept components are primarily piloted individually or in a combination of two different concept components, such as e-cargo bikes with micro-hubs. However, to fully unfold the contributions of the UL concept components, ULS consisting of several UL concept components need to be designed and realized in urban areas around the globe. Hence, a thorough analysis of the situation on-site in the respective urban area is normally the first step of the operations project steering in a ULS implementation undertaking. The operations steering is elaborated on in Section 4.5, where the findings of this section are put into a broader perspective.

To design ULS, it is necessary to thoroughly analyze the individual situation in the specific urban area. Therefore, this dissertation suggests a contingency-based framework consisting of situational factors and design variables, following Mintzberg (1979). Hence, when applying CT to the design of ULS, there exist specific factors that are – in line with CT – mostly not under the control of the respective UL initiative, which are called situational factors. Furthermore, there are also variables that are under the control of the respective UL initiative – the so-called design variables. Drazin and van de Ven (1985) suggested that in a CT environment, context and structure must fit together to perform well. Hence, performance indicators can contribute to evaluating a

specific ULS conceptual design. Based on this differentiation, a contingency analysis for the conceptual design of ULS was carried out for this dissertation.

Prior UL research has thus far only considered situational factors superficially. For example, while Rose *et al.* (2017) referred to specific urban area related characteristics and claim them to be highly individual, there was no thorough analysis for the ULS design conducted. Furthermore, Ducret *et al.* (2016) remarked on the argument made by scholars that urban transport activities are largely affected by geographic and spatial factors. The researchers also identified first criteria to analyze when dealing with urban freight. Hence, this dissertation aims to close the gap in the body of research and by providing a profound analysis of the ULS context.

This dissertation's contingency analysis of the conceptual design of ULS does not aim to be exhaustive due to the wide range of potential situational factors and design variables, as well as their interrelation. This investigation must, however, be understood as an aid to orientation when UL initiatives aim to design ULS. Furthermore, it must be noted that the following sections are broadly based on a further development from Preindl (2020).

The following Section 4.1.1 discusses the derived situational factors, and Section 4.1.2 goes into the derived design variables. Performance indicators are discussed in Section 4.1.3. The respective factors, variables, and indicators are ordered alphabetically; consequently, the order does not make any statement about their respective importance. These elements are considered to be distinctive to each specific urban area. Therefore, the factors, variables, and indicators need to be weighed individually, impacting the goal identification and prioritization that is aimed for with the design of the specific ULS. For example, the weighting can be based on a cost-utility analysis.

4.1.1 Situational factors

In general, it is suggested in the research (e.g., Sila (2007)) to differentiate between internal and external situational factors. While this is usually applied to a specific organization, the differentiation can be adapted to the context of interorganizational ULS as well: ULS are typically designed for one explicit urban area, given that the situations in urban areas may vastly differ. The respective ULS can be designed and realized based on the participation of several organizations or stakeholders. Hence, the concept of internal situational factors adapted to the ULS context is concerned with

stakeholder-wide internal factors impacting the ULS conceptual design. These factors are called endogenous in this dissertation.

Furthermore, the design of ULS is subject to external situational factors as well: While the situation in every urban area differs, external situational factors are embedded in the national context, such as by national political decisions. Hence, such superordinate factors must be considered for the design of ULS. These factors are called exogenous in the following.

While the design of ULS is significantly influenced by endogenous and exogenous factors, in this specific context, there must be a further differentiation: As outlined, urban areas differ significantly in a range of factors, with the consequence that every urban area can be considered highly individual. Hence, the contingency analysis must bear these factors in mind. In this dissertation, these factors are referred to as urban area situational factors. This differentiation is set forth in Table 13.

Table 13. Situational factors affecting the ULS conceptual design

Category	Description
Exogenous	National external situational factors impacting ULS conceptual design in several urban areas due to superordinate spread
Urban area	Urban area specific situational factors impacting ULS conceptual design with highly individual characteristics in the respective urban area
Endogenous	Stakeholder-wide internal situational factors impacting ULS conceptual design with respect to the local branch office in the respective urban area in particular

Based on these findings, Figure 15 displays the derived situational factors impacting the conceptual design of ULS, subdivided into exogenous, urban area, and endogenous situational factors. These factors impact the goal identification and prioritization process for the respective ULS, primarily targeting an individual consideration of economic, environmental, and societal aims (see Table 2). Subsequently, a structured choice and customization of UL concept components is possible when designing a specific ULS. Such design variables are introduced in the next section. These situational factors have an upstream impact on the ULS conceptual design and also on the realization.

Generally speaking, it can be recommended to investigate the situational factors on a rolling, iterative basis, symbolized by the arrows in the following Figure 15. As the environment, in this context, the respective urban area embedded in the national

environment and consisting of individual organizations, changes relatively quickly by, for example, introducing a new regulatory framework, ULS design must fit these new circumstances. Consequently, changes in the ULS conceptual design have to be made. This iterative process of the operations steering in a ULS implementation undertaking is further discussed in Section 4.5.

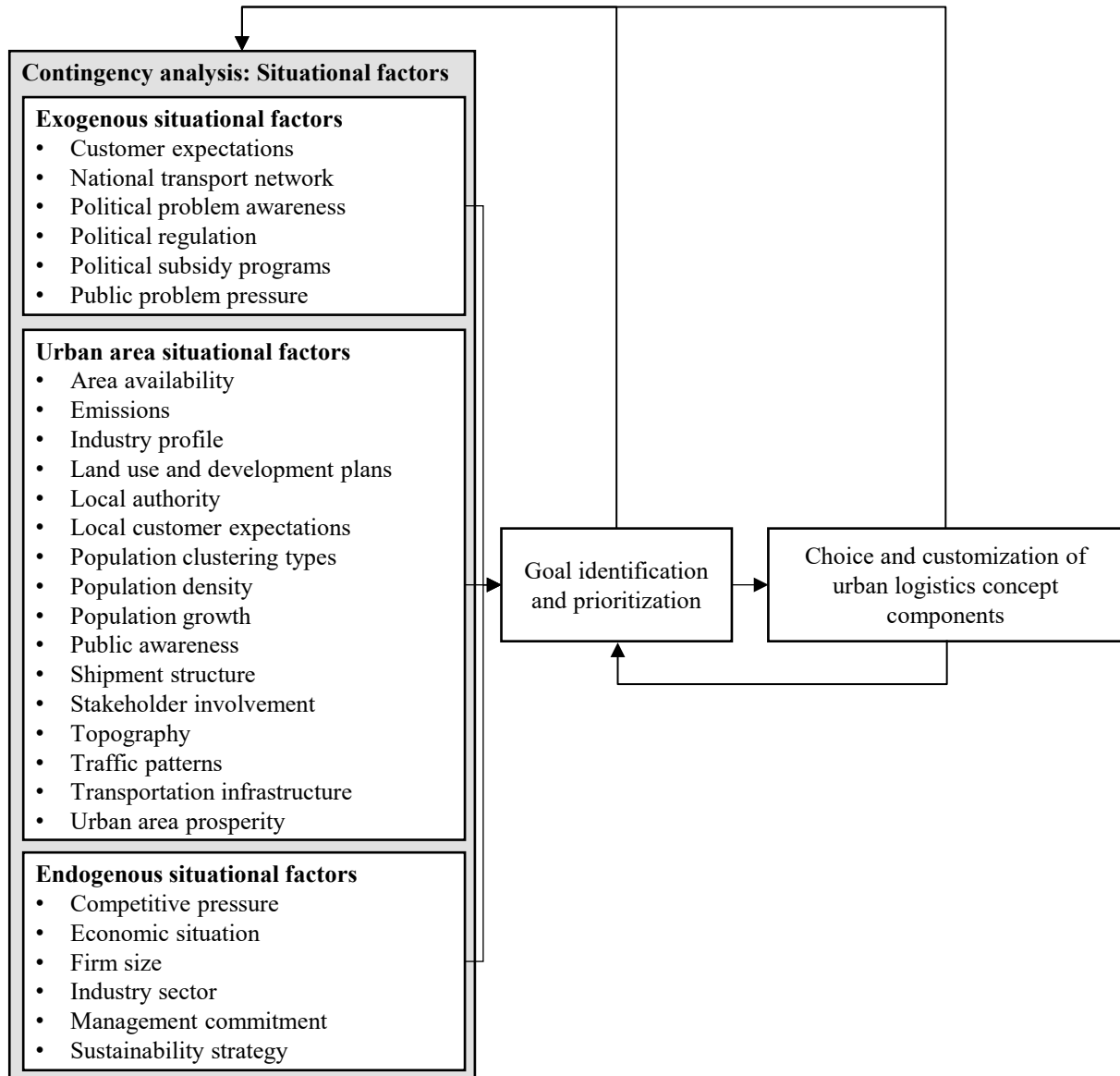


Figure 15. Situational factors

The three categories of situational factors are discussed in the following:

Exogenous situational factors

- *Customer expectations:* In highly developed countries, customer expectations can be observed to rise on a national level. This also applies to the GAS area, where

customers expect specific services such as same-day delivery or delivery to the workplace. In these cases, specialized logistics services are required to fulfill these consumer demands. Consequently, rising customer expectations need to be considered when designing ULS. This must be analyzed with an in-depth survey of customers throughout the country. By doing so, these customer expectations can be met by the respective ULS by establishing suitable solutions, for instance, a dedicated network of parcel lockers.

- *National transport network:* When looking at urban areas on a national level, it can be seen that they can be located either centrally or peripherally, as noted by Rose *et al.* (2017). This has an impact on the conceptual design of ULS due to the connections of the respective urban area to the other ones: If an urban area is located centrally, it frequently acts as an intermediary between other locations on a national level. This has implications for UL services for reasons such as a higher strain on the local infrastructure. For peripheral urban areas, it is the other way around. Consequently, the position of the urban area in the national transportation network needs to be kept in mind.
- *Political problem awareness:* As consciousness of environmental problems is growing nowadays, the political problem awareness is as well with regard to negative externalities of transportation in general, but also specifically about freight transport, getting more and more attention. This applies equally in urban areas of the GAS area. In countries where this is the case, the design and realization of ULS are widely encouraged and often politically supported, such as through funding opportunities. In particular countries, UL is even addressed on the level of federal government and then handed down to local authorities in several steps. Hence, the political problem awareness impacts ULS conceptual design.
- *Political regulation:* National political regulations are ordinarily binding for all federal states, and consequently, they impact the conceptual design of ULS in particular urban areas. If, for example, governments define a specific upper limit for certain emissions or prohibit the use of some truck types in urban areas, the design of ULS must take these circumstances into account and adjust the logistics services to comply with these regulations. This can impact decisions in numerous areas, such as which type of delivery vehicles are used in that urban area. With a rising number of

political regulations, whether restrictive or stimulative, ULS need to be appropriately and adequately designed.

- *Political subsidy programs*: National political authorities often enact subsidy programs applicable to UL initiatives. These subsidy programs can be bound to particular technologies, such as the use of e-trucks, or to specific urban areas, such as the largest urban areas in the country. Regardless of their mode of expression, political subsidy programs heavily impact the design of ULS because they are so often aimed at benefiting from such programs. While this is frequently the case, it must be kept in mind to design ULS conceptually, first and foremost, not to obtain the maximum funding but rather with respect to the particular goals of that specific urban area.
- *Public problem pressure*: This situational factor can influence the conceptual design of ULS in a particular urban area in two ways: First, with greater public problem pressure to take on the negative externalities of urban freight transportation, the public can influence the motivations of local stakeholders to initiate designing of ULS. Second, public problem pressure needs to be considered throughout the ULS design. For example, if a logistics hub is being planned in an area next to residential buildings, resistance from the residents can arise and lead to rearrangements in the ULS design. If this factor is not considered, a successful ULS implementation may be at risk.

Urban area situational factors

- *Area availability*: Numerous UL concept components such as logistics hubs or the establishment of (un)loading places throughout an urban area can only be realized if there is an area available for such dedicated use. Urban areas are invariably densely populated, and consequently, the available area is almost always extremely limited. This must be considered when ULS are conceptually designed. The aforementioned concept components can only be incorporated in ULS design if the critical areas for them are available. If not, it must be discussed in detail whether existing buildings can be suitably repurposed for a ULS use.
- *Emissions*: When designing ULS, the local emissions in the respective areas must be considered. While national regulations apply nationwide, a specific upper limit for NO_x concentrations can differ in different urban areas. This circumstance is typically

dependent on the as-is composition of emissions. Based on those factors, the determination of which UL concept components should be incorporated in the ULS must be prioritized in order to achieve profound relief in respect to the local emissions. Hence, the in-depth investigation of local emissions has an extensive impact on the ULS conceptual design.

- *Industry profile*: This is understood as the composition of locally domiciled stakeholders, especially private companies, in any urban area (Rose *et al.*, 2017). While some urban areas are known to have a particular concentration of companies involved in a certain industry, such as the Wolfsburg area in Germany, which is home to the automobile manufacturer Volkswagen AG and local suppliers to the auto industry, most urban areas have a heterogeneous composition of industries. This can be seen as preferable due to the possibility of incorporating various stakeholder perspectives. Hence, the industry profile also profoundly impacts ULS design.
- *Land use and development plans*: Local authorities regularly develop long-term focused land use and development plans that regulate which area is permitted to use by whom with which type of usage for now and the future. Hence, these plans influence the ULS design greatly. Future plans must not only incorporate UL solutions but current plans must be checked to determine which UL concept component can be deployed where and in what way. For example, the placement of logistics hubs or (un)loading places dedicated to urban freight transportation need to be thought of. Thus, ULS conceptual design needs to be matched with these plans.
- *Local authority*: Generally, the more sensitized a local authority is with respect to urban freight transport, the better it is for the design of ULS, as this circumstance may ease the perceptions of such UL-related initiatives. Besides, local authorities are also important stakeholders in ULS and should be actively engaged in the process to incorporate their perspectives. Usually, the latter is embossed in a long-term way with benefits for the applicability of the respective ULS. Furthermore, local authorities usually have access to locally specific data supporting the ULS design. Consequently, local authorities have a significant impact on the ULS conceptual design.
- *Local customer expectations*: While customer expectations generally arise in developed countries, as outlined above, it must be noted that customer expectations can be distinctly expressed in different urban areas. This is mainly dependent on the

local culture. If local residents are more open to certain innovative solutions, such as alternative delivery options similar to delivery inside their front door (in-home delivery), these attitudes can profoundly influence the design of ULS. Hence, it is necessary to investigate customer expectations on not only a national level but also on a local, urban area specific level in order to design adequate UL solutions.

- *Population clustering types*: Rose *et al.* (2017) stated that there are different population clustering types in urban areas: single clusters with significant activity in a single area; multi-cluster with multiple centers within the urban area; or a ‘sprawl’ type, where an even distribution of activities can be found across the urban area. Consequently, the population clustering types shape an urban area in a fundamental way, leading to implications for the ULS conceptual design as well. For example, where activities occur in a single area, the ULS can concentrate on only that area with a focused ULS design. Having this in mind, it must be decided how a ULS should be formed.
- *Population density*: The population density measures the number of inhabitants in a specific area. This can be calculated for an entire urban area, or more interestingly, just for particular parts of an urban area. This factor should be taken into account when conceptually designing a respective ULS, because the number of people living in a certain area, influence decisions on factors such as the number of pickup points or parcel lockers incorporated in a ULS, which is dependent on the number of shipments flowing in and out of the respective area. Hence, the population density sets up requirements for UL solutions that must be accounted for in the ULS design.
- *Population growth*: Alongside population density, the growth of a population influences the ULS conceptual design. Population growth must be measured not only historically but also forecast for the coming decades. These measures influence ULS designs for fitting not just the current situation the best way possible but also, through the forecast, accounting in an adaptive manner for future developments. This circumstance needs to be incorporated from the beginning to achieve a suitable UL solution. The influence of population growth must therefore be measured on an urban area specific level.
- *Public awareness*: The situational factor of public awareness takes the local inhabitants of an urban area into account. While the problem pressure and public

awareness for environmental topics tend to rise in general, the specific public awareness about UL initiatives in the respective urban area must also be determined. The public's awareness can motivate not only local stakeholders to get engaged in a ULS but also profoundly influence the specific composition of a ULS. For instance, where logistics hubs are rejected by the public due to concerns about noise levels, this local attitude can foster a ULS conceptual design that incorporates suitable alternative UL concept components.

- *Shipment structure*: The shipment structure of urban areas can differ significantly due to differences in the preferences of private consumers and local companies. Where private consumers rely heavily on e-commerce solutions, shipments from the CEP segment may have a greater share of the local shipments, and hence, the shipment structure profoundly influences the ULS design by shaping what UL concept components must be focused on. For example, if the CEP segment plays a vital role in the respective urban area, a ULS must be conceptually designed with respect to that circumstance.
- *Stakeholder involvement*: This situational factor is concerned with the initial stakeholder involvement. Looking at the initiation of a ULS, it is not under control which stakeholders get involved upfront. Stakeholders can be found, for example, in local companies, residents, and the public authority. Due to the initial signal of interest, the initial ULS design must incorporate the possibilities and interests of all initial stakeholders. Generally, it is preferable to include at least one stakeholder from each stakeholder group (see Chapter 2). Later, when the ULS design gets specific, stakeholder-related variables can be controlled and are therefore discussed in Section 4.1.2.
- *Topography*: Topography is concerned with the form of the land surface in an urban area. Urban areas are usually not sited on the top of a mountain; rather they routinely are sited on relatively flat and sometimes hilly surfaces. Depending on the local topography, ULS must be designed to fit the natural circumstances. For example, cargo bikes without an (electric) engine may not be suitable in a very hilly environment where riders manage to go uphill only with great difficulty due to the weights they need to move. Hence, a flat environment is generally preferable. Besides

this example, the topography of an urban area particularly influences the UL concept component composition of a ULS.

- *Traffic patterns*: The traffic patterns of an urban area depend not solely on urban freight transport but also on passenger transport. Hence, the traffic composition in any urban area is highly individual. For the ULS conceptual design, especially the urban freight transport traffic pattern is interesting. If, for example, urban freight transport is comprised primarily of small trucks for the CEP segment, an adequate ULS design can focus on deploying emission-free small trucks. Hence, the traffic pattern must be understood before deciding on the respective composition of the ULS design. Usually, local authorities collect data about the local traffic.
- *Transportation infrastructure*: The transportation infrastructure also differs from one urban area to the next (Rose *et al.*, 2017). While in many larger urban areas, there are airports, tramways, underground systems, and rivers available to transport goods, most urban areas rely primarily on roads and railways. Hence, the current and planned future transportation infrastructure must be taken into account given that the ULS design relies on the deployment of means of transportation based on the available infrastructure. It is generally preferable to draw from the full range of possible transportation infrastructure types in general. However, ULS design must be oriented primarily to the as-is state of the local infrastructure.
- *Urban area prosperity*: The prosperity of an urban area can be divided into public and private prosperity. Generally, greater prosperity is preferable due to expected higher investments in the ULS conceptual design. While public prosperity may influence the financial support for the ULS, private prosperity influences the ULS design because prosperity is directly related to private consumer behavior. With greater private prosperity, people tend to consume more goods, resulting in more shipments. Hence, the design of ULS needs to take this circumstance into account and also investigate how the prosperity in the respective urban area will develop moving into the future.

Endogenous situational factors

- *Competitive pressure*: Private stakeholders in the respective urban area, such as local companies, usually compete with other market participants in their industry where they are located. Called competitive pressure, this factor can vary within various

industries and develops differently over time. This needs to be taken into account for the ULS conceptual design because competitive pressure has a considerable influence on a company's measures, such as getting involved in innovative solutions like ULS. This is usually done to stand out from their competitors. Hence, competitive pressure can influence the respective ULS design.

- *Economic situation:* The macroeconomic situation normally has implications for the economic situation of companies. If private companies are suffering from a negative economic situation, they tend to be less innovative and less open to getting involved in sustainable solutions such as the ULS design. Consequently, companies in good economic condition, with high profit margins, and where economic security is seen for near future tend to become more actively engaged in the ULS conceptual design. Hence, the economic situation has a profound impact on the ULS design by influencing the probability that private stakeholders in an urban area will get involved.
- *Firm size:* Companies vary in size, such as with regard to the number of employees or their turnover rates. This also has implications for the ULS conceptual design because, first, the process of ULS design involves company representatives, and larger companies tend to be more flexible than smaller ones about placing relevant resources and internal experts at the disposal of complex initiatives. However, second, the ULS design needs to also take into account the smaller companies in order to avoid omission of their interests. Starting with the involvement of larger companies, the ULS design process can be expanded in a step-by-step manner to also incorporate smaller companies.
- *Industry sector:* Depending on the products or services a company provides, the exchange of goods is either a core activity for the company or it is not. For instance, software companies do not manufacture tangible products; therefore, they do not cause as much traffic as an automotive manufacturer. Consequently, exchange-oriented companies tend to carry the responsibility for their caused negative traffic externalities and tend to get more actively engaged in the ULS conceptual design. Hence, these companies must be engaged in order for the ULS design to include their interests in the pursuit of a suitable ULS design.

- *Management commitment*: This situational factor refers to the direct participation of a company's top local management. It is essential and preferable that top-level management such as boards of directors get actively involved or promote the participation of company representatives in the ULS conceptual design process so that their interests are considered. If this commitment of top management is missing, companies tend to get excluded from the ULS design process and potentially end up feeling disregarded. Hence, it is vital that the particular ULS design can be altered to ensure a company's commitment in the form of top management.
- *Sustainability strategy*: As awareness of environmental issues has risen in recent years, more and more companies have developed sustainable business activities that culminate in a sustainability strategy. Such initiatives typically include a road map to more sustainable processes. Having a sustainability strategy also has a significant impact on the ULS conceptual design: First, if there is a clear goal to become more sustainable, companies are more open to involvement in the ULS design. Second, dedicated investment in sustainable solutions such as ULS are often more likely to be authorized if companies have a sustainability strategy.

4.1.2 Design variables

In CT, the design variables are under the control of the respective organization (Mintzberg, 1979), as outlined above. Because a ULS is normally not designed by one organization, it can be described as an interorganizational setting where several stakeholders (organizations) work together, as outlined in Chapter 2. This collaboration can constitute a consortium in the respective urban area, and consequently, the design variables are under the managerial control of the consortium as an interorganizational collaboration. Generally speaking, the design variables can be changed by the consortium to make them fit with the particular specification of the situational factors on-site in the respective urban area.

Research in the UL domain has thus far neglected design variables in line with CT. While Rose *et al.* (2017), as mentioned above, recommended situational factors, design variables were not delineated. Therefore, this research aims to close this gap by deriving a comprehensive list of general design variables applicable to any ULS conceptual design process.

It is suggested that the design variables be differentiated into four main categories: fundamentals, stakeholder, technical configuration, and operational processes. In the following discussion, these categories are ordered by the level of detail, starting with the highest-level strategically influenced variables and going down to the operational level. The variables in each category are provided alphabetically, without regard for their importance, as described above. This differentiation is also provided in Table 14 with a description of each category.

Table 14. Design variables affecting the ULS conceptual design

Category	Description
Fundamentals	Decisions in this category are fundamental to the way ULS are designed and are, therefore, situated at a high level.
Stakeholder	This category is about the questions of which stakeholders should be involved and where and how intensely they are tangentially affected.
Technical configuration	The technical configuration affects the ULS design due to the interplay of the design and how the individual UL concept components are configured.
Operational processes	Operational processes determine the way the ULS design is put into practice and how the day-to-day business processes work.

Based on these findings, the derived design variables impacting the conceptual design of ULS are given in Figure 16 and discussed below. The figure also shows the iterative process of the ULS conceptual design development. While the situational factors are sited upstream, mostly ahead of the goal identification and prioritization process, the design variables come into play when the choice and customization process of UL concept components need to be carried out. Thus, the design variables are part of the iterative process and may also impact prior decisions (not displayed in the figure). Consequently, the situational factors and design variables provided here work closely together with the overall aim of achieving a fit of the respective ULS conceptual design to the specific urban area.

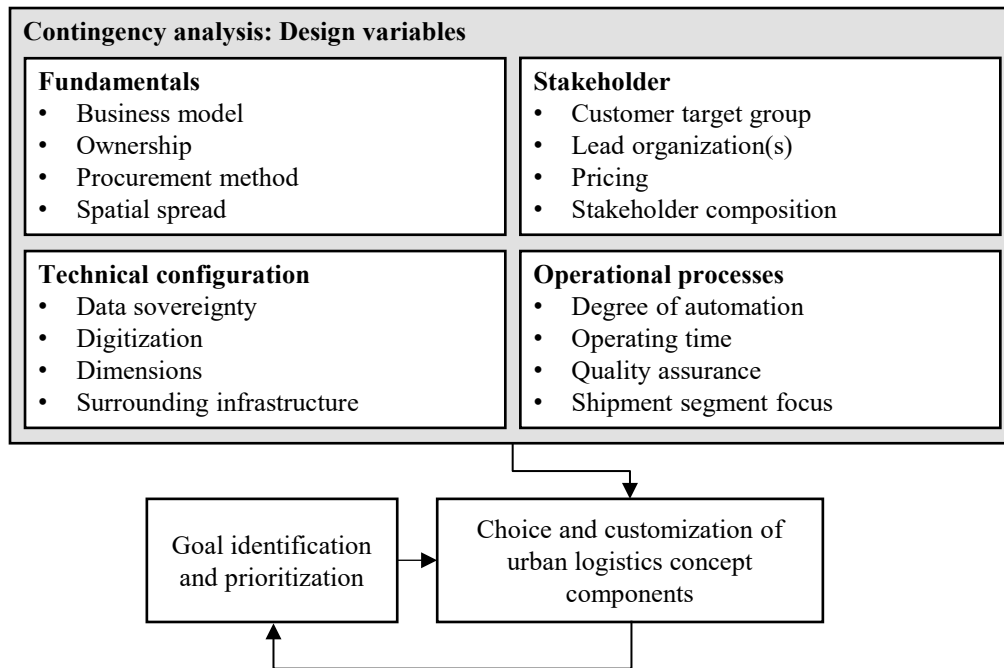


Figure 16. Design variables

Fundamentals

- Business model:** The business model of a ULS is a central component of the ULS conceptual design. It makes statements about the functionality of the ULS and how a road map for generating profits is laid out. The well-known concept of the business model canvas was adapted to a UL context by Katsela and Pålsson (2016). Thus, it is necessary to thoroughly discuss the key elements of designing a ULS according to the above-mentioned situational factors. In particular, the key activities, necessary key resources, and the value proposition of the ULS need to be discussed in detail in order to design a suitable ULS.
- Ownership:** The ownership structure of ULS is a crucial element for the ULS conceptual design. First, it must be decided who initiates the ULS design process. Second, when a high-level ULS design is recognizable, it must be determined who invests and owns specific essential resources. For example, if logistics hubs are included as cornerstones of ULS, the ownership of these resources is initially open. Because there are various potential ownership structures, for instance, that an LSP or the public authority owns the hub, the design of the ownership structure must suit the individual on-site situation based on the above-mentioned situational factors.

- *Procurement method*: The ULS conceptual design consists, at its core, of a combination of various UL concept components. This often requires the procurement of specific resources, such as specialized e-trucks. Hence, a central variable in the ULS design is the procurement method. As there are various methods, such as a total upfront purchase, leasing, or performance-based contracts, so the most suitable method must be decided on a case-by-case basis, and it varies depending on the ULS design and particularly the financial possibilities of the participants. Especially for pilot projects, it may be necessary to discuss the procurement method with the local authority.
- *Spatial spread*: Usually, ULS do not cover the entirety of an urban area up to the last buildings in the suburbs. ULS may, for example, initially cover only the inner city or only the area of the city with the most industrial activity. Later, ULS might be expanded in a step-by-step manner to cover more and more parts of the respective urban area. Hence, the spatial spread of the ULS is a crucial design variable. Which parts of the area to cover must be decided based on these situational factors. The latter may be influenced by the problem pressure, such as specific parts of an urban area being constantly affected by traffic jams or excessively high emissions.

Stakeholder

- *Customer target group*: ULS can be designed to cover an urban area and its B2C or business-to-business stakeholder customers in general or with a focus on a specific customer target group. If a particular customer target group is the focus of a ULS conceptual design, two different strategies are available to choose from: First, a ULS can be designed to focus on a specific industry. Second, it can be designed to focus on fulfilling certain customer expectations (e.g., same-day deliveries). Hence, the discussion of a choice in customer target group must be elaborated on during the ULS design process to achieve a suitable solution in the specific urban area.
- *Lead organization(s)*: As outlined earlier, the conceptual ULS design is normally a process undertaken with the collaboration of several organizations local to the respective urban area. Each organization (stakeholder) can contribute to the design by bringing in their specific knowledge and resources. Based on the UL concept components that the particular ULS should encompass, a decision must be made about which participating organization leads this specific work stream. For example,

it might be decided that one stakeholder mainly operates e-cargo bikes, but the logistics hubs where the bike deliveries with the aforementioned means of transportation starts, are operated by another organization.

- *Pricing*: ULS design is heavily dependent on the underlying pricing system. Usually, since the day-to-day processes of the involved stakeholders are touched upon deeply during the ULS design process, there are often changes in their respective profitability and financial KPIs. Hence, it must be discussed which stakeholders should participate and which costs are caused by the newly arranged process. For example, if a logistics hub is part of the ULS design, the pricing system, including the costs of rent and operating the hub, must be arranged by agreement between the hub owner and the stakeholders, for example, LSPs, using the hub. Hence, pricing is a key variable in ULS design.
- *Stakeholder composition*: As outlined above, stakeholder involvement is initially a situational factor. However, as an initial ULS conceptual design is created, it becomes more and more transparent which stakeholders need to be continuously involved in the design and, afterward, the realization of the respective ULS. Hence, the stakeholder composition becomes a design variable in the ULS design process, as the ULS design is heavily dependent on the composition of the involved stakeholders. Thus, it must be decided which part of the ULS design is expedited by whom and who is responsible for each part.

Technical configuration

- *Data sovereignty*: Many UL concept components as part of the ULS design can generate particular data, such as how many shipments per day can be delivered with a particular model of e-cargo bikes. Due to the manifold of data that can be generated, it must be determined in the respective ULS design which stakeholder should have access to the various available data. Generally, to ensure smooth running of ULS, the necessary data for operational processes must be usable by the stakeholders responsible for that process. However, data that are beyond the scope of this criterion but would be interesting to share must be discussed to ensure standardized handling of the ULS data sovereignty.
- *Digitization*: Concerning the technical configuration of the ULS design, it must be decided how the respective UL concept components, out of which the particular ULS

should exist, should be digitized. Next to its technical core, for instance, a constant data interchange via the internet of the various means of transportation for overall coordination, also implies the technical adjustments for flawless interoperability. For example, if the ULS design includes logistics hubs being connected with e-cargo bikes, specific loading boxes can be used at the hubs for a fast exchange from the e-cargo bikes. Hence, the digitization of the UL concept components must be determined.

- *Dimensions:* As mentioned, any ULS consists of diverse UL concept components. Most UL concept components require a tangible asset such as e-trucks, e-cargo bikes, or logistics hubs. These UL concept components can be dimensioned differently, depending on the local situation and, for example, the shipment segment focus. If logistics hubs should only be deployed for the CEP segment, they can be dimensioned smaller than when they should be used for groupage. Hence, it must be discussed how the ULS design regarding its dimension needs to be formed to achieve a suitable solution.
- *Surrounding infrastructure:* The ULS design is also affected by the surrounding infrastructure. For example, a logistics hub needs specific surrounding infrastructure such as a large enough shunting area or rail access, especially for periphery hubs. Hence, the ULS design must consider the surrounding infrastructure when customizing it for the specific urban area. Consequently, it is not only the general infrastructure of an urban area that needs to be analyzed but also the specific surrounding infrastructure near the areas where parts of the tangible ULS should be realized.

Operational processes

- *Degree of automation:* Operational processes of ULS can be automated to a certain degree. For instance, the intelligent transport system platform can automate the disposition of shipments on specific means of transportation. This is not a strict requirement, however, because the disposition can also be handled manually. Hence, it must be decided which parts of a ULS design should be automated and to what degree. Therefore, stakeholders need to discuss the operational processes to ensure a reasonable level of automation. Furthermore, it can begin with manual processes that are then automated step-by-step during the realization of the ULS design.

- *Operating time*: The ULS design is also affected by the planned operating time for the ULS. While there are specific UL concept components that operate primarily at night (e.g., off-hours deliveries), others operate during the whole day. Furthermore, not only the time of the operation during the day but also the days of the week that must be discussed. While particular deliveries may be able to take place seven days a week, others can only be successful during the week, such as those that require employees on-site. Hence, the operating times and days for each specific UL concept component must be included as part of the ULS conceptual design.
- *Quality assurance*: The operational processes of any ULS conceptual design must be qualitatively measured. Hence, a decision is required about how a ULS design can support the quality assurance of operational processes to ensure an appropriate design. Therefore, quality control measures should be discussed to get a quantitative feeling for the ULS processes. For example, the quota of shipments delivered on time can be deployed as a central quality measure. To ensure a high quota of punctual deliveries, the ULS design must be suited to the on-site situation. To track performance, quality assurance must be considered in the ULS conceptual design.
- *Shipment segment focus*: As previously outlined, urban freight transport consists of a variety of different shipment segments, such as CEP and larger groupage shipments. However, the operational processes of a ULS do not typically cover every shipment segment but, rather, concentrate on a particular segment. For example, micro-hubs, in particular, can be deployed for CEP shipments, whereas rail freight makes more sense for larger goods. Hence, the ULS conceptual design must take this into account to ensure operational processes are tailored for not just the particular situation in that urban area but also for the shipment segment focus.

4.1.3 Performance indicators

In their seminal paper, Drazin and van de Ven (1985) argued that there are three different concepts of fit between situational factors and design variables in CT-based research, indicating performance in the particular context: According to the researchers, the ‘selection’ approach assumes congruence between the situational factors and the design variables. The ‘interaction’ approach interprets fit as pairs of interactions between situational and design variables. The ‘systems’ approach follows a holistic understanding of where multiple situational factors and multiple design variables

interplay to create a fit and, ultimately, better performance. In other words, as Sousa and Voss (2008, p. 706) put it, «*there are multiple, equally effective ways in which an organization can achieve fit*», when following the systems approach. Adapted for the ULS context, the systems approach is chosen to evaluate fit and suggest performance indicators as there are manifold various ULS conceptual designs that may fit and perform in each context. Consequently, the situational factors and design variables introduced in this research should be evaluated holistically and iteratively, depending on the specific urban area, when shaping a ULS conceptual design. The evaluation of performance indicators can help with understanding if a fit between a ULS conceptual design and the specific context can be expected.

In UL research, performance indicators in line with CT have not yet been identified for ULS conceptual design. Scholars have thus far concentrated on situational factors, as already noted. Nevertheless, also they are only superficially researched. Hence, this research contributes to a CT analysis of the ULS conceptual design by not only introducing situational factors and design variables but also by providing the following performance indicators. These performance indicators are of a qualitative nature and do not depict hard measures. They must be individually judged and weighed, and it should be noted that this is not an exhaustive list as the unique ULS conceptual design can be subject to a different composition of performance indicators.

Based on the derived situational factors and design variables, several performance indicators as part of the contingency analysis for the conceptual design of ULS are differentiated. These are alphabetically ordered without ranking and described in the following discussion:

- *Acceptance of the public in the specific urban area*: A well-fitting ULS conceptual design must be accepted by the general public residing in the specific urban area. Hence, it can be recommended to involve the public in the ULS design process to ensure that their interests, fears, and wishes are sufficiently taken into account by the ULS. To achieve an in-depth involvement of the local public, there are various ways to activate them: For example, articles about the current situation in the respective urban area, about UL in general, as well as the upcoming plans of local stakeholders to conceptually design a ULS can be published. This can be accompanied by a call to action for the general public to attend public gatherings discussing possible UL

initiatives, culminating in the ULS conceptual design. Such measures can be repeated in an iterative way to ensure an active discussion that leads to public acceptance of the ULS.

- *Aim contribution for the specific urban area:* The aim composition, which is based on the economic, environmental, and societal aims (see Table 2), is always highly individual based on the situation in the respective urban area. Consequently, it must be ensured that the ULS conceptual design fits the aims of the respective stakeholders. For example, if environmental aims are most important in a specific urban area due to the exceeding of emissions limits, the UL concept components the ULS is made of, must be evaluated in terms of their contribution to lowering emissions levels. Here again, an iterative evaluation and adjustment of the conceptual ULS design can be recommended. If the expected aim contribution of the ULS reaches the required level, the ULS conceptual design can be expected to perform well against the on-site situation.
- *Availability of financing in the specific urban area:* The ULS conceptual design must be financeable in the respective urban area to achieve a good fit. Therefore, it can be recommended that the funding of specific UL concept components be considered during the ULS design process. This can be checked iteratively during each workshop of the participants involved in the design process. For example, if logistics hubs are to be a part of the respective ULS, the participants can first check their financial resources and their commitment to invest in such an innovative solution, and second, check the availability of external funding. Examples of external funding include publicly available grants, where a specific application is required. Consequently, it must be clarified if an application for external funding is strived for. Only by making sure that the ULS is financeable, the ULS can be realized.
- *Integration into the larger political agenda:* Although some countries provide a national agenda related to UL initiatives, urban areas may also be engaged in the topic of UL with their own political programs. To ensure that a ULS conceptual design performs well in a particular urban area, it can be recommended that an evaluation be made about the ability to integrate the ULS with the local political agenda. This should not pose a barrier for the ULS conceptual design, but it should nonetheless be coordinated to ensure a good fit. For example, it can be recommended that public

representatives are actively involved in the ULS design process for an early adjustment to the plans of the local public authority. For this process, especially land use and development plans are of particular interest and should be evaluated during the ULS design process to ensure the compatibility of the plans.

- *Compatibility with the existing regulatory framework:* In addition to a political agenda relating to UL initiatives, some countries and local public authorities issue specific regulatory frameworks that can also influence potential ULS. For instance, there can be regulatory measures to noise in urban areas, which can limit the positioning and operation of logistics hubs in the respective area. Regulatory measures concerning the registration of particular specifications of e-cargo bikes are another example. Consequently, the ULS design process must be in agreement with the specific local regulatory framework. This helps ensure a good fit between the ULS design and local regulations, leading to better performance of the ULS design. Therefore, it can be recommended to iteratively evaluate the compatibility of the ULS conceptual design with the existing regulatory framework.

Looking at the performance indicators as a whole, their entirety is centered around the question of implementability. Implementability can be understood as the key aim of the conceptual design of any ULS. Only if the context, meaning the specific urban area embedded in national and local factors, fits with the ULS conceptual design, the requirements are fulfilled to ensure a successful realization. This ‘fit’ may not be achieved right away, and there may be a need for iterative development going back and forth to arrive at a suitable conceptual design for the respective ULS. However, practice misses this significant fact many times so far. UL initiatives often envision a specific ULS design without a thorough contingency analysis, ultimately leading to a good-sounding vision with little chance of being realized. Hence, to turn back to the introduction to this research, this is the barrier called ‘concept’, where the concept of a ULS does not fit the reality of the specific urban area. Consequently, it is essential that an adequate effort is put into the contingency analysis and that the performance indicators are investigated to overcome this barrier and plan a ULS design under consideration of its implementation.

4.2 Qualitative assessment of urban logistics concept components

ULS consist of the composition of different UL concept components, as primarily outlined in Section 2.3. As part of the ULS design process, the manifold of existing UL concept components in the different identified segments (see Table 4) must be assessed to ensure the most promising ones are chosen for the ULS conceptual design. Therefore, this section directly refers to RQ₂ by answering it.

Thus far, UL research has neglected the process of choosing appropriate UL concept components when designing ULS. For example, scholars have noted that there is insufficient knowledge about possible UL concept components (Ballantyne *et al.*, 2013). Instead of focusing on the process of choosing UL concept components, most studies to date have simply taken for granted that the choice of UL concept component(s) was the most promising. Consequently, it is usually only a single UL concept component that is discussed in detail (e.g., Boysen *et al.* (2018) or Hai *et al.* (2020)) and no significant effort was put into ensuring a fit between the UL concept component and the respective urban area. This also means that prior studies have not built a larger ULS out of a variety of UL concept components.

However, this dissertation aims to close this research gap with guidance on the qualitative assessment of UL concept components. This guidance contributes to the ULS conceptual design process by recommending how to choose UL concept components fitting to the individual on-site situation in the respective urban area from the various existing ones to form an individual ULS. Due to the fact that the situation in every urban area is highly individual, the guidelines seek to be adaptable for any urban area.

Therefore, this dissertation develops a two-step procedure for the qualitative assessment of UL concept components in order to choose the fitting ones to the individual situation. This is in line with the insights of implementation research that state that any implementation object (here, the respective ULS) needs to be fitted to the respective context (here, the specific urban area). Hence, the two-step procedure suggests as a first step a general qualitative assessment of the UL concept components derived from literature (see Table 4), creating a short list of possible components for the respective ULS. However, regulatory measures are excluded for two reasons: First, the character of regulatory measures is different from other UL concept components because their operationalization and realization depend mainly on legal considerations. Second, the

guidance on choosing UL concept components is mostly intended for consortia made up of private stakeholders with the support of the respective local authority. If the particular local authority investigates regulatory measures as part of the ULS, it is expected to be an individual procedure due to highly differing larger political agendas for the future and the existing regulatory framework at the specific moment. For these two reasons, regulatory measures are excluded from the qualitative assessment developed in this dissertation. It must be noted that the first step – the general qualitative assessment – is carried out based on the current state of information when this dissertation is finalized in mid-2021. With ongoing UL research and changing information about the respective UL concept components, the general qualitative assessment suggested in this dissertation may require updating in the future.

After the first general qualitative assessment of the UL concept components, a specific assessment of the remaining UL concept components on the short list is suggested by this research. This specific assessment is subject to the individual on-site situation in that urban area, and therefore, it is primarily connected to the contingency analysis for the conceptual design of ULS as discussed in Section 4.1.

The two steps are discussed in the following two sections in detail.

4.2.1 General qualitative assessment

The present research suggests a general qualitative assessment of the identified UL concept components based on a systematic assessment framework. Based on the DSR methodology, this framework is derived. It includes various dimensions for the assessment of UL concept components that are subject to different requirements:

- First, for the purpose of consistency, the dimensions must be applicable to each of the identified UL concept components without any changes to details.
- Second, the dimensions must be updatable to ensure that new knowledge can be incorporated into the individual assessment in the future.
- Third, the dimensions must include the most important cornerstones to give a sense of how generally suitable the particular UL concept component is for the respective ULS conceptual design.
- Fourth, the dimensions must be situated at a high conceptual level to give ideas about further consideration that are at a more precise level of detail.

Consequently, the suggested assessment framework must ensure a particular balance between a general claim and the level of detail. Against this backdrop, the qualitative assessment needs to be understood as a first hint that a specific UL concept component is suitable for the respective ULS conceptual design. However, its outcome, the specific short list of UL concept components, needs to be thoroughly discussed by the participating actors of the particular consortia. Having this in mind, the derived dimensions for the qualitative assessment are described below. Following that, exemplary discussions of two selected example UL concept components are provided. The qualitative assessment of all identified UL concept components can be found in the Appendix.

Dimensions for qualitative assessment

- *Importance for a ULS:* Generally, a ULS consists of UL concept components that are oriented around the logistics chain, starting with the shipper and ending with the receiver of the goods. In the logistics chain, the different UL concept components are positioned either on the various nodes (turnover of goods; e.g., logistics hubs; or receipt of goods; e.g., alternative delivery options), on the different edges (transport of goods; e.g., alternative means of transportation), or on a meta level, influencing the whole chain (e.g., regulatory measures). While there is a manifold of UL concept components available for the different edges, with the consequence that the components can be replaced more easily, the UL concept components for the nodes are harder to replace. Hence, the relative importance of a UL concept component for the ULS conceptual design needs to be assessed from a low level to a high level, which achieves a sense of whether replacements are available, without jeopardizing the respective ULS.
- *Maturity level:* This dimension is concerned with the development status of the respective UL concept component. While specific components were initially developed several decades ago (e.g., the use of logistics hubs), other components developed more recently (e.g., usage of e-cargo bikes). Further components are primarily at the initiation phase and not yet deployable in practice but only in limited pilots. An example of this is the use of drones in UL. Consequently, it is necessary to assess the development status, which is denoted as the maturity level in the assessment framework and is visualized via a continuum from a comparatively low

maturity level to a high one. Assessing the maturity level of a UL concept component eases the estimation of whether it is applicable for the usage as a part of the respective ULS. It can generally be recommended that UL concept components with a low maturity level be excluded from a larger ULS conceptual design, and conversely, UL concept components with high maturity levels should be included in the ULS conceptual design.

- *Duration of implementation:* This further dimension covers the question of how quickly the respective UL concept components can be implemented. As previously outlined, the implementation includes not only the realization but also particularly the planning of any undertaking. Hence, in the context of UL concept components, the time for the implementation can be considered important because there will likely be specific aims to achieve within a particular time frame. For example, logistics hubs take a comparatively long time to implement because considerable effort is required just to find a suitable area and to design the operational processes. If this is achieved with a sufficient level of detail, the realization can take place, and that also takes time. In comparison, the deployment of, for example, e-cargo bikes can be implemented much more quickly. Hence, the implementation duration of the respective UL concept component can be considered an important dimension for consideration of inclusion in the respective ULS and is depicted from short to long.
- *Costs:* Decisions about the inclusion of any UL concept component in the ULS conceptual design are always connected to investments in terms of costs. These costs include not only the procurement of physical resources such as e-trucks but also their operation in the day-to-day business. Consequently, it can be recommended that a total cost of ownership approach is deployed in the ULS conceptual design context. However, possible subsidies and external funding opportunities, such as those from local or national authorities, can lower the respective UL concept component costs. For example, the deployment of environmentally friendly means of transportation such as e-trucks is often supported by governments, and this can have a considerable impact on decisions related to the ULS conceptual design. Hence, this dimension of costs is presented from low to high and always represents an estimation compared to the other UL concept components.

- *Leading stakeholder group*: Every UL concept component needs to be realized by particular actors, namely the specific stakeholder groups. As outlined in Section 2.3.4, there are several stakeholder groups associated with UL initiatives. Consequently, it needs to be assessed on a UL concept component level who leads the respective realization as part of the ULS conceptual design. This must be thought of as it is central to decide who is responsible for what. In doing this, the various directly involved stakeholder groups (LSPs, shippers and receivers, and public authorities) in the realization of ULS are part of the assessment framework. In this context, a filled black bar in the assessment framework suggests that the respective stakeholder group should be considered the leader for that specific UL concept component. Against this background, it must be judged if the individual UL concept component should be included in the ULS conceptual design.
- *Involvement of stakeholders*: While a leading stakeholder group is often necessary, most UL concept components are usually not realizable with only one stakeholder group involved. Therefore, it is often necessary to form strategic alliances based on, for example, a long-term oriented consortium or a joint venture to successfully realize particular UL concept components as part of the ULS implementation process. Thus, an assessment must be made about which stakeholder group needs to be involved during this process to support the various stages. For example, while LSPs can operate underground transportation systems, and can therefore be considered the lead for that UL concept component, the public authority must first lay the foundations in terms of a supportive regulatory framework. Hence, the public authority needs to be involved in the process. This circumstance is part of the assessment framework where the black bars visualize the involvement of the respective stakeholder groups.
- *Legal considerations*: The different UL concept components are often subject to legal considerations, primarily due to their innovative character. For example, the usage of drones in the context of UL has not yet been sufficiently defined in the regulatory framework. This depicts a barrier to the implementation of drones to date. Hence, legal considerations are of high importance for this specific UL concept component. While that can be considered an extreme case, other UL concept components also need to fit within the regulatory framework. Therefore, this dimension provides an estimation of the importance of the required attention to legal considerations. This is depicted on a continuum ranging from unimportant to important and always gives a

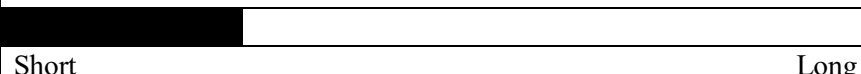
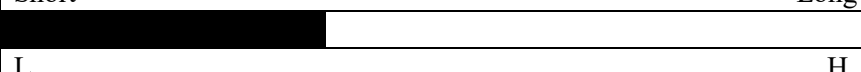
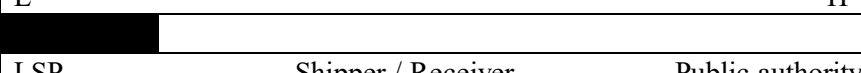
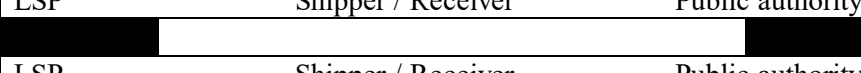
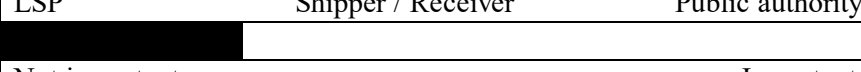
comparison with the UL concept components. This information can also have a considerable impact on the decision to include the respective UL concept component in the particular ULS conceptual design.

Exemplary discussion

Based on the characterization of the different dimensions, it is suggested that they be put together in the qualitative assessment framework. This framework is displayed in Table 15, along with the example of the assessment of e-trucks. Due to the limited scope of this dissertation, in the following, only two selected UL concept components are discussed, following the suggested assessment framework.

E-trucks

Table 15. Filled assessment framework for the UL concept component e-trucks

UL concept component	Dimension	Qualitative assessment		
E-Trucks	Importance for a ULS			
	Maturity level			
	Duration of implementation			
	Costs			
	Leading stakeholder			
	Involvement of stakeholders			
	Legal considerations			

Notes: L = low, H = high. The black bars visualize the assessment outcomes for the different dimensions.

- *Importance for a ULS:* E-trucks are situated on the edges of a ULS and can be used especially for the transport of goods within the boundaries of the urban area. They contribute particularly to the environmentally related aims of ULS because their deployment contributes to zero emissions. Furthermore, they are comparatively silent, which means they can be deployed for off-hours deliveries at night, for example. Similarly, as a large part of urban goods, groupage shipments, need to be transported by larger means of transportation, a comparatively high degree of importance for a ULS can be assigned to the UL concept component of e-trucks. E-trucks are relatively hard to replace in ULS and are easy to combine with other UL

concept components, such as logistics hubs. Both circumstances add to the importance of this particular concept component.

- *Maturity level:* E-trucks are being deployed more and more from LSPs in their day-to-day business. While in past years, a number of pilot projects arose around e-trucks for special purposes, such as deliveries in city centers, e-trucks have more recently been deployed in a broader range of applications, including for longer distances due to better battery ranges. Consequently, the maturity level of e-trucks can be estimated to be relatively high and they are more usable in the context of ULS. Processes in the day-to-day business need to be arranged around the loading time of e-trucks to ensure their application not only for one tour but at least for a second one as well. Due to comparatively low distances in the UL context, e-trucks can be considered mature to be deployed widely as part of any ULS.
- *Duration of implementation:* E-trucks can be implemented as part of a ULS comparatively rapidly. The time until an e-truck can be used in a ULS depends mainly on the need for special equipment, such as specialized building structures for a particular shipment segment. This has implications for its delivery time from the manufacturer. However, once the respective e-truck is delivered to the LSP deploying it, it can be used almost immediately in the ULS. Drivers may need a short introduction to the new vehicle, but the general handling is similar to conventional trucks. Depending on the decision about where, when, and for which shipment segment e-trucks should be used in a ULS, their implementation duration can be relatively short.
- *Costs:* The costs of deploying e-trucks in ULS are considered to be in the middle range compared to other UL concept components. As e-trucks represent a physical resource, their procurement cost should first be taken into account. So far, e-trucks are considerably more expensive than conventional trucks in terms of purchase price. In addition, the costs for day-to-day operations of e-trucks need to be considered. This depends on local electricity rates, which can vary significantly. Furthermore, it is possible that direct or indirect subsidies from the government for use in acquiring e-trucks should be evaluated and included in calculations. The bottom line is that the costs for deployment of e-trucks as part of ULS differ depending on the individual on-site situation in an urban area.

- *Leading stakeholder group:* LSPs can be considered the leading stakeholder group for deploying e-trucks in ULS. While some shippers may also deploy e-trucks for their own transportation needs, such as self-organized branch deliveries, logistics operations transporting goods in urban areas are usually carried out by LSPs. Hence, it is primarily LSPs that need to deploy e-trucks as a UL concept component in a ULS. Against this backdrop, LSPs can appear as initiators of replacing conventional trucks with e-trucks in consortia that are conceptualizing a ULS design. While the deployment of e-trucks has implications for other stakeholders, the day-to-day business processes of LSPs need to be rearranged to suit the new means of transportation. Hence, the critical path to deploying e-trucks in ULS can be assigned to LSPs.
- *Involvement of stakeholders:* While the deployment of e-trucks as part of ULS can be considered to be led by LSPs, the other identified stakeholders involved in UL initiatives can contribute as well. Specifically, the public authority can be involved in close consultation to determine, for example, if there are subsidies available for deploying e-trucks. This can help to achieve the breakthrough of alternative means of transportation such as e-trucks, given that their costs are higher than conventional transportation means to date. Hence, public authorities can considerably enhance the development of using e-trucks through the decree of appropriate regulatory measures. While such measures can be issued on a national level, local authorities need to be consulted to find a feasible way of deploying e-trucks in ULS.
- *Legal considerations:* Legal considerations for the UL concept component of e-trucks can be considered to be rather unimportant. The current models on the market are on essentially equal terms with conventional trucks. However, there can be privileges granted for using e-trucks, such as specialized access times or deployment at night. These privileges are of special interest when it comes to combining e-trucks with other UL concept components such as off-hours deliveries. The latter is typically not allowed with conventional trucks due to noise, but such forward-thinking plans can be implemented with a fitting regulatory framework. Hence, it is necessary to consider legal considerations, especially on a local level.

Periphery hub

Table 16. Filled assessment framework for the concept UL component periphery-hub

UL concept component	Dimension	Qualitative assessment		
Periphery-hub	Importance for a ULS			
		L		H
	Maturity level			
		L		H
	Duration of implementation			
		Short		Long
	Costs			
		L		H
	Leading stakeholder			
		LSP	Shipper / Receiver	Public authority
	Involvement of stakeholders			
		LSP	Shipper / Receiver	Public authority
	Legal considerations			
		Not important		Important

Notes: L = low, H = high. The black bars visualize the assessment outcomes for the different dimensions.

- *Importance for a ULS:* Logistics hubs, such as the UL concept component of periphery hubs, enjoy a high-level status in the composition of ULS. Hubs are normally a central part of ULS and are thus considered to be of comparatively high importance for ULS. Periphery hubs are situated on a particular node within the logistics chain that is typically upstream in the logistics chain as the next node after the shipper of the goods. Therefore, they are perceived as important for the handling, sorting, and distribution of goods throughout the respective urban area. Consequently, periphery hubs usually stand for the first part of the ULS with a high impact on the successive parts as the foundation, meaning that functioning ULS can be improved by deploying dedicated periphery hubs.
- *Maturity level:* The maturity level of periphery hubs can be estimated to be relatively high. The concept of freight distribution centers is not new in logistics operations, but their dedicated deployment in the context of ULS is rather innovative and still being piloted in some urban areas. Nevertheless, the basic functioning of a periphery hub – mostly the sorting and handling of goods – is typically the same as general freight distribution centers. Consequently, the overall maturity level is perceived to be high, but the detailed processes involving factors such as the question of who initiates and operates a periphery hub are still thoroughly debated. Thus, the know-how for

deploying periphery hubs is given so far but needs to be further tested in different compositions.

- *Duration of implementation:* As with every logistics hub, the usual problem is to find an appropriate area to site the hub. As the concept of periphery hubs requires a large amount of space, because large goods of all kinds are usually handled through them, finding an appropriate area is often hard to achieve. Hence, while the decision for a periphery hub in a ULS can be made relatively quickly, the duration of implementation is usually relatively long. Furthermore, questions such as who owns the hub, who operates it, and who is directly involved with the hub need to be discussed in detail. Consequently, this also takes additional time, and the planning horizon is rather long. However, once these questions are solved, the operational processes can begin swiftly.
- *Costs:* As previously outlined, appropriate areas for establishing periphery hubs are crucial. This represents the greatest part of the costs for this UL concept component. The usual costs for a greenfield or brownfield development situated in or nearby urban areas are relatively high. The large size of periphery hubs means that even larger areas are necessary because trucks need to shunt on the site. If there are residential areas nearby, noise reduction measures need to be established. All of these circumstances drive the costs of periphery hubs upward. In comparison to the development of a periphery hub, the operational costs for its day-to-day business are rather low. However, when all things are taken into consideration, the costs for implementing periphery hubs are relatively high.
- *Leading stakeholder group:* LSPs can be viewed as the leading stakeholder group for establishing periphery hubs. Some large industrial companies, such as supermarket chains, may also establish periphery hubs for their exclusive use. However, while these may contribute to efficient urban freight transport, periphery hubs are normally used by several LSPs together to ensure efficiency gains in comparison to exclusive company solutions. Consequently, the aim of periphery hubs as a UL concept component is not that every LSP deploys its own hub but, rather, that the focus is on a collaborative daily business. Accordingly, the daily operational processes of stakeholders need to be rearranged for such collaborative work. Hence, the

collaboration of LSPs as the leading stakeholder group is crucial for establishing periphery hubs.

- *Involvement of stakeholders:* While the establishment of periphery hubs in ULS can be perceived as being led by LSPs, other identified UL stakeholders can contribute, too. As outlined, shippers can establish their own periphery hubs. However, instead of exclusive usage, they can open their hubs for third parties to gain efficiencies in truck utilization. Furthermore, shippers can contribute to handling goods in shared periphery hubs by delivering their goods there instead of delivering directly to receivers such as supermarkets. The public authority can also contribute to establishing periphery hubs by, for instance, negotiating with landowners or by offering specific subsidies to incentivize LSPs and shippers. Consequently, a collaborative manner for the involvement of the various stakeholders must be ensured to achieve solutions that suit every party.
- *Legal considerations:* Regarding legal considerations, the UL concept component of periphery hubs is relatively simple. Because freight consolidation centers have been used for years, there is not a substantial difference between these conventional hubs and periphery hubs. Consequently, legal considerations are rather unimportant for periphery hubs. However, while the external regulatory framework is less important, internal government measures dealing with collaboration among the involved parties are critically important. These government measures can be unique to each periphery hub. In general, these deal with factors such as the internal pricing model for arranging day-to-day costs, which can be based on a pay-per-use model. Aside from the pricing model, decisions must also be made regarding who gets access to the periphery hub.

4.2.2 Specific qualitative assessment

After the consideration of the general assessment of the UL concept components with the aim of generating a short list for the respective urban area, a specific qualitative assessment of the UL concept components must take place.

This specific assessment needs to be carried out against the backdrop of the specific urban area's characteristics. As already outlined, urban areas differ from each other in a manifold of characteristics. To achieve a thorough analysis of urban areas, the contingency analysis (see Section 4.1) should be applied, where especially the

situational factors need to be considered. Therefore, the following specific qualitative assessment must be carried out in an iterative manner and in conjunction with the contingency analysis.

Based on the situational factors, as well as the goal prioritization and the specific qualitative assessment, the process of choosing and customizing the respective UL concept components takes place with the aim of creating a suitable ULS conceptual design. Choice refers to the process of choosing the generic UL concept components for the specific urban area. For example, a decision to integrate parcel lockers into the ULS conceptual design as a general UL concept component is made in conjunction with investigating the situational factors in the respective urban area. However, the decision to deploy parcel lockers as part of the ULS conceptual design does not imply anything about how the UL concept component parcel locker should be designed and realized. For instance, it remains unclear who plans the functionalities of the parcel lockers, where and how many of them are to be built, or who participates in the realization and permanent operation over the long term. While numerous questions may arise such as this, all such questions are part of the customization process. This is where the design variables of the contingency analysis described earlier come into play: With the design variables, the generic UL concept component can be customized to fit the respective urban area. The different dimensions of design variables need to be discussed in detail to find the optimal customization of each UL concept component. At least when this is finalized for each UL concept component that is part of the ULS, or better yet, during the customization of each UL concept component, their interplay needs to also be customized as well in conjunction with the contingency analysis. For example, if e-trucks and macro-hubs are part of a ULS conceptual design, their interplay needs to be customized, for instance, with loading stations at the macro-hubs to ensure the running of e-trucks throughout the day. This is only one example, and the reality is that with numerous combinations of the various UL concept components, it is actually complex. Due to the limited scope of this thesis, not every combination of UL concept components for forming a ULS can be discussed. Hence, this dissertation does not aim to give recommendations for the detailed customization of a ULS conceptual design. Generally, as Daniel (2001) points out, it is not possible to give optimal recommendations for any implementation undertaking without knowing the specific framework conditions in detail. As each urban area, and thus, every ULS conceptual design, is different, this

thesis only aims to give general recommendations for achieving fit and, therefore, a ULS conceptual design that promises success. However, the principle of achieving a fitting ULS conceptual design in accordance with the situation on-site is perceived as central to the ULS implementation process. As the concept is one of the main barriers to successful ULS implementations in practice (see Section 1.1), this dissertation suggests the aforementioned iterative procedure to overcome this barrier. In general, this procedure can be referred to as fitting the implementation object (here, the ULS conceptual design) to the implementation context (here, the respective urban area). With the help of this procedure, fitting ULS conceptual designs can be expected to be implemented in practice.

4.3 Success factors for the implementation of urban logistics systems

While the previous two sections were concerned with the conceptual design of ULS, because it is one of the identified barriers to successful UL implementation in practice (see Section 1.1), this section turns to the broader implementation process of ULS. It refers directly to RQ₃ by answering it in the following remarks.

As outlined, this dissertation follows a broad implementation understanding, where the planning (here the ULS conceptual design, in particular) is also part of the implementation process as the plan needs to be implementable, meaning that there is no ULS vision detached from reality created but a ULS that can be realized in practice. However, as already discussed, this understanding has fallen short in practice and research thus far. Bearing this in mind, the two previous sections are also subject to the success factor identification process. Against this broad understanding of a ULS implementation, this section identifies success factors for the specific case of ULS implementation.

Generally, the search for the reasons for success as the underlying idea of success factor research is clear as success is a natural aim of any business action (Schmalen *et al.*, 2006). According to Schmalen *et al.* (2006), this kind of research into success factors has existed since the 1960s. It dates back to Daniel (1961) and gained wider popularity with Rockart (1979), who described success factors as «*the limited number of areas in which satisfactory results will ensure successful competitive performance for the individual, department, or organization*» (Rockart, 1979, p. 85). Although the concept

of success factors was originally applied only at the level of business segments, it can also be applied in a broader context, such as at the company or industry level (Schmalen *et al.*, 2006). Nevertheless, a central characteristic of success factor research is that despite the multidimensionality and multicausality of different situations, success is supposed to be traced back to a few central factors that must be identified and exploited (Schmalen *et al.*, 2006).

While the concept of success factors is widely adopted from scholars in different research areas as outlined, there have been few studies conducted looking at success factors in the UL context (Kiba-Janiak, 2016). However, the following findings are drawn from the limited body of literature: A significant difference from existing research to the contribution of this research is that success factors in the UL context that were identified in prior studies all were determined from a specific perspective. For example, Kiba-Janiak (2016) adopted the perspective of local authorities and developed a set of 27 success factors that are only applicable to this stakeholder group. Conversely, Quak *et al.* (2016) identified fewer than 10 success factors, which are also primarily connected to the specific case under investigation. Other practical initiatives such as SUGAR or BESTUFS have also identified success factors, but these findings are mostly related to the specific initiatives. Therefore, these conclusions are not universally applicable. Furthermore, the findings from research have thus far fallen short because the implementation of ULS is a complex topic that depends on different stakeholder groups (see Section 2.3.4). Consequently, research conducted thus far has missed the identified «*social and organizational change process*» (Gammelgaard, 2015, p. 349) of UL implementation and, hence, success factors for this overall process are necessary. With a concentration on general success factors, as already outlined, it can be expected that ULS implementation undertakings will perform better and lead to successful implementation examples in practice.

With this knowledge from UL success factor research in mind, it must first be noted that the contingency analysis carried out in Section 4.1 lays the basis for the conceptual design of ULS and, therefore, also for the implementation of ULS. In conjunction with this contingency analysis, the perspective of the ULS as a CAS is especially relevant. As outlined in Section 3.2, ULS can be considered a CAS, which are of a particularly high dynamic and depend on different actors in the system. This dynamic is rooted in an ever-evolving environment, such as the individual urban area and its conditions.

While the contingency analysis covers this specific aspect of an in-depth analysis of the environment based on the identified situational factors, it must be noted that the specifications of the situational factors can change over time, which is in line with the CAST applied to the ULS implementation. Hence, this dynamic of ULS and its implementation should be taken into account when suggesting and applying success factors for the specific context. Furthermore, the aspect of ULS implementation, being dependent on several actors, as CAST suggests, also needs to be considered. Therefore, success factors must reflect these circumstances of different actors and their interdependence.

Based on these pre-considerations, several success factors for the implementation of ULS are suggested by this research. In contrast to the findings outlined thus far by scholars, there is no specific perspective taken when it comes to the success factors; rather, the aim of this research is to suggest success factors that are adaptable to any ULS implementation undertaking that is pursued by a consortium of UL stakeholders. These stakeholders are described in Section 2.3.4. Consequently, the perspective of the suggested success factors needs to be viewed as neutral, without any notable concentration on any of the identified stakeholders. Moreover, these success factors are perceived to be generally important for the entire ULS implementation process in any urban area, and consequently, the general success factors are perceived to be adaptable. With this in mind, six central success factors are identified and are listed in the following paragraphs. The order of the success factors is oriented around the expected implementation process:

- Formation of a consortium with representatives from all relevant local stakeholder groups and particularly the local public authority, with a central person or department in charge, with the aim of considering all interests for the ULS.
- Establishment of a neutral coordinator to guide the ULS implementation undertaking, such as by founding a joint venture, to ensure successful partnerships.
- Creation of a ULS conceptual design fitting to the local context, with a focus on realistic solutions to ensure implementability.
- Prioritization of ULS measures with a step-by-step breakdown into several pilots and a merging plan to eventually create a ULS.

- Pursuit of an iterative manner for the ULS implementation, such as based on a hybrid PM philosophy, with constant evaluation and adjustment to account for the highly dynamic environment.
- Pursuit of a long-term perspective of the ULS-related measures to ensure transition to day-to-day business after implementation.

However, while the above-mentioned success factors are perceived to be important for the respective overall ULS implementation undertaking, there are further detailed success factors suggested that are segmented into several phases and dimensions. This is aimed at giving more detailed recommendations to contribute to successful ULS implementation undertakings. Consequently, these detailed success factors are situated a level below – more precise – than the general success factors. For this, a segmentation is suggested by this dissertation that is described in detail in the following.

The segmentation in phases is close to the general course of an implementation undertaking, which is usually perceived as a project (see Section 2.4.4). A key characteristic of projects is normally their attribute to be limited in time. The time required for a project can be further divided into different phases. This is also true for implementation projects, as outlined in Section 2.4.3. The literature review in the aforementioned section revealed several phases that can be widely adapted to the specific context of ULS implementation. This adaptation, is described below and forms the basis for the segmentation of the suggested success factors:

Phases

- *Initiation*: The first phase of the respective ULS implementation undertaking is the initiation phase, where UL measures come up first to engage with a given situation in the respective urban area. Usually, based on specific measures such as lowering emissions, UL measures are discussed on a high level as part of counteractions to improve the current circumstances. Consequently, this phase is subject to great uncertainty if a ULS implementation takes place based on only these first considerations. However, the initiation phase has various implications for the basis of any ULS implementation because it influences the basic strategic, organizational, and operational alignments in the respective urban area. Hence, it must be ensured that it is clear to some extent that a ULS implementation undertaking is planned to be induced at the end of the initiation phase.

- *Preparation*: The second phase is concerned with the preparation of the respective ULS implementation, where the implementation management, in particular, needs to deal with strategic questions such as the ULS object and context composition. Typically, based on further detailed discussions about possible UL measures, preliminary decisions need to be made regarding the strategic direction of the implementation undertaking. This has consequences for the setup of necessary structures such as the organization, the formulation of possible operational processes at a high level, and communication with the local stakeholders and their willingness to participate. Hence, this preparation phase is perceived to be essential for the success of the entire ULS implementation process because it sets up the broad and high-level basis.
- *Effectuation*: The third phase of the ULS implementation process is concerned with the effectuation of the ULS implementation. This phase is especially about planning and realizing the respective UL measures that are prepared for in the previous phases. This phase is usually expected to go into the details of the ULS conceptual design. This has implications for all levels of the ULS implementation undertaking, starting with a high-level strategic perspective and going down to an operational perspective. Based on the setup structures, the effectuation needs to continue until the ULS is fully realized. Therefore, the effectuation phase can be seen as the core phase of the implementation undertaking, because it is when the concept is put into practice with the aim of creating operational processes.
- *Examination*: The fourth phase in the ULS implementation process is named the examination phase, which is concerned with all activities relating to the review of the implementation undertaking. For example, KPIs of the respective ULS need to be constantly evaluated, and the operational processes need to be examined and further adjusted when necessary. Generally, this phase is also concerned with terminating the project structures and transferring the ULS undertaking into daily processes. Consequently, this has implications on various levels and is primarily connected with the involved stakeholders. Further initiatives can be started from this point to enlarge and enhance the respective ULS. In summary, the examination phase ensures the continued success of the ULS.

Based on the identified phases of the implementation process in any ULS undertaking, there are various dimensions for the suggested success factors that are applicable for each phase. These dimensions are oriented on the most significant elements that must be taken into account in an implementation undertaking and are based on the eclectic theoretical underpinning of this research. The named aspects of the theories serve as the perspective of the different dimensions. This reflects general success factors that are noteworthy within the overarching phases of the more extensive implementation process. For a further detailed understanding, the five dimensions are discussed in the following.

Dimensions

- *Strategy*: In the ULS implementation process, strategy is one of the key dimensions to be considered. The dimension of strategy refers to all long-term decisions that influence the particular phase and potentially beyond. Consequently, the success factors in this dimension need to reflect this ground-laying positioning and need to be taken into account in basic considerations for the complete ULS implementation process.
- *Organization*: This further dimension is concerned with all questions relating to organizing the ULS implementation undertaking. Therefore, this dimension is also applicable to all identified phases because the organization has vast implications for the complete implementation undertaking. Against this backdrop, the suggested success factors deal primarily with essential remarks about the personnel structure of the implementation undertaking.
- *Operation*: The dimension of operation deals with the operational questions that arise in the different identified implementation phases. While the strategy dimension is aimed at long-term questions, this dimension deals with day-to-day business-related processes and recommendations for carrying them out. Therefore, the suggested success factors in this dimension concentrate on daily tasks and their organization during the respective ULS implementation undertaking.
- *Communication*: The communication dimension is about all aspects of the dialogue between the ULS implementation participants and beyond. This communication can deal with stakeholder group-internal, cross stakeholder group, and external measures that involve dialogue. As the interests of the various stakeholder groups need to be

addressed during a ULS implementation, the communication dimension is perceived as essential and applicable at every phase.

- *Finance*: The assurance of adequate financial capacities is crucial for all of the identified phases as this can be considered the basis for any steps done in the various phases. Consequently, the dimension of finance needs to be taken into account. The identified success factors deal with ensuring the financial ability to act within the ULS implementation undertaking. In other words, the success factors aim at achieving and maintaining this ability. As there are different challenges in each phase, these actions need to be differentiated.

Following this structuration in phases and dimensions, the success factors are described in detail in Table 17. The success factors for the different dimensions are ordered by the expected sequence of necessary actions within the larger implementation process. This ordering does not reflect any relative importance of the success factors.

Table 17. Success factors for the implementation of ULS

Phase	Dimension	Success factors
Initiation	Strategy	• Analysis of the external impulse for the ULS implementation, such as national regulations and their operationalization • Discussion of the need for ULS implementation in the specific context with key stakeholders • Primal discussion about the willingness to have a ULS implementation with key stakeholders
	Organization	• Setup of an initial project group consisting of key stakeholders and particularly the local authority • Creation of a central contact point for all UL activities at the local authority to achieve tractive power • Appointments of spokespersons at key stakeholders for the bundling of activities
	Operation	• Setup of initial open tables for the discussion of possible UL initiatives with local stakeholders • Appointment of an initial leader organizing the open tables for the respective urban area • Initial analysis of best practices in the UL domain for idea generation concerning the specific urban area
	Communication	• Active marketing of the UL initiative through local newspapers or relevant online resources • Addressing of local associations, such as trade associations, to reach out to key stakeholders

Phase	Dimension	Success factors
Preparation	Finance	• Setting up exchanges with actors from best practices to ensure learning from experiences
		• Assurance of a pro bono arrangement with key stakeholders in the early initiation phase • Assurance of the initial funding of possible UL initiatives, such as those based on public funds • Search for possible public grants to apply for with the aim of advancing the potential initiative
	Strategy	• Involvement of the broadest possible range of stakeholders, including the local authority, through regular round tables • Gathering, formulating, and prioritizing of general goals for the ULS to ensure an appropriate concept • Reconciliation of stakeholder interests through in-depth discussions and workshops
		• Setup of implementation management organization and initial project structure with key stakeholders • Creation of a central neutral coordinator at the local authority dedicated to UL initiatives in the urban area • Establishment of a system thinking within the organization to aim for a ULS consisting of several UL concept components
	Operation	• Formulation of an implementable ULS concept that is divided into several pilots and independent work streams • Creation of an initial high-level business model that takes into consideration the key stakeholders • Reflection on the implementation timing, style, and direction to ensure a successful ULS effectuation
		• Address possible local partners for the ULS implementation in the specific urban area • Communication of a high-level ULS conceptual design that is implementable in the specific urban area • Achievement of acceptance from various local stakeholders to ensure their support for the ULS
Effectuation	Finance	• Achievement of the acceptance of participating actors for short-term investments • Promotion for financial support but not complete reliance on subsidies to get the ULS implemented • Application for public grants, such as for the support of innovative ideas, ensuring ramp-up funding
	Strategy	• Assurance of stringent prioritization of the single measures and breakdown into specific pilots • Performance of a detailed situation analysis in the specific urban area, with sufficient documentation

Phase	Dimension	Success factors
		Assurance of the continued willingness of participating actors to cooperate
	Organization	- Setup of a factual management entity within the implementation management organization - Setup of a competence management entity within the implementation management organization - Assurance of ongoing evaluation throughout the operations steering of the ULS implementation undertaking
	Operation	- Detailed search for appropriate resources, such as the areas that are necessary for the effectuation of the ULS - Mapping of a clear plan to achieve economic sustainability within a defined time frame - Frequent improvement of the implemented measures in small but robust steps, starting with a minimum viable product
	Communication	- Promotion of cooperation beyond the circle of already participating actors to enlarge the ULS - Involvement of the local population to ensure their acceptance and gather new ideas - Continued regular involvement of the top management of participating actors
	Finance	- Prioritization of comparatively small investments with a significant impact on the ULS implementation - Step-by-step establishment of an adequate pricing model to ensure a transfer model for the participating actors - Assurance of economic benefits for stakeholders with a long-term road map for the ULS
Examination	Strategy	- Regular check of key performance figures that are influenced by the ULS implementation in the respective urban area - Iterative refinement of the ULS business model to ensure lasting economic sustainability - No striving for perfection of the ULS, but continuous refinement and extension of the single measures
	Organization	- Establishment of a regular review by the participating actors through the shutdown of implementation management - Formulation of the key insights about the ULS implementation in a publicly available knowledge storage site - Transfer of the ULS to day-to-day business as the ‘new normal’ in the respective urban area
	Operation	- Final implementation control regarding the implementation’s performance factors - Deviation analysis of the goals pursued by the ULS implementation undertaking

Phase	Dimension	Success factors
		• Reaction to deviations in the implementation in the form of the establishment of day-to-day business
	Communication	• Public promotion of the ULS implementation with the start of possible further UL initiatives that can be integrated • Monitoring of arising and future UL trends to communicate ULS problems that have been rectified • Encouragement of in-depth knowledge exchange with ULS implementation undertakings in other urban areas
	Finance	• Assurance of long-term economic benefits for the participating actors in the ULS • Securing the ULS's financial ability to survive without external grants • Final overpass of ULS funding to the day-to-day business, employing cost cutting measures where necessary

To operationalize success factors, measures normally must be introduced to indicate success and make progress comparable. The characteristics of a measure can be either qualitative or quantitative (Schmalen *et al.*, 2006). The number of success measures is variable, dependent on the respective context, and can, for instance, also only comprise a single measure, as outlined by Schmalen *et al.* (2006). Hence, it must be individually judged which and how many success measures are necessary to estimate the success of the particular undertaking. While a complex success measure system can be considered far-reaching in terms of its level of detail, it can be challenging to measure all the defined variables at predefined points in time. However, a more straightforward success measurement system with only a few measures can miss the required detail and can be considered too aggregated. Consequently, a success measurement system needs in-depth thought based on the respective context.

Against that background, with transfer to the ULS implementation context, the following recommendations can be given by this dissertation: First of all, a differentiation needs to be made between two types of measures that aim to make statements about the success of the respective ULS implementation undertaking:

- *Implementation-related measures*: These measures aim to indicate if the respective implementation object is successfully put into practice in the specific context. In the context of ULS implementation, this is the case if the ULS works in practice, where 'working' is dependent on the particular ULS conceptual design. Hence, while this

individual design usually calls for individual measures, there are specific, mainly qualitative measures that can be universally applied. Following Kolks (1990), there are three main implementation-related success measures: The so-called degree of application, the level of application, and the adequate realization. These can be transferred to the ULS implementation context. The measures are further discussed in detail in Section 4.5.4; however, it must be noted that these measures should be judged at predefined points in time, especially during the operations steering of the respective ULS implementation undertaking.

- *Output-related measures:* These measures can be applied to the output dimension of the respective ULS implementation undertaking. The output dimension is concerned with the impact of the respective ULS on the specific urban area. Based on the goal prioritization of a ULS, it can be measured how well the ULS influence KPIs related to the defined goals. For example, if one of the main goals of a specific ULS implementation undertaking is to minimize congestion, it needs to be determined how the hours of congestion that are measured in the respective urban area are reduced. If a certain threshold is met, the ULS can be designated a success. While this is a quantitative example, there can also be qualitative measures in the output dimensions, for instance, the perceived quality of life for the general public in that urban area. If the quality of life increased by a certain level, the ULS implementation undertaking can be assumed to be a success.

While there exist these two types of success measures, it must be noted that the specific composition of necessary success measures should always be determined in a highly individual manner pertinent to the specific urban area and ULS context. This is because the composition of a ULS implementation is also highly individual and always dependent on the contingencies identified in the particular urban area, as outlined by the contingency analysis in Section 4.1. Examples of measures relating to the implementation type can be found in Table 6. Bearing this in mind, this dissertation recommends the setup of an individual success measurement system based on the particular ULS implementation undertaking. The respective success measurement system for this context can be composed by considering the following aspects:

- *Fit of the success measures to the specific ULS conceptual design:* The decision of how the measurement system should look needs to be based on the specific ULS

conceptual design because that largely impacts the implementation undertaking as a whole. Hence, a fit between the success measures and the ULS conceptual design needs to be reached to ensure adequacy.

- *Concentration on key barriers in the particular urban area:* The measurement system needs to consider key barriers that exist in that urban area. For instance, if stakeholders are hard to motivate, measures can be implemented to indicate how stakeholder management is proceeding. Further barriers are discussed in the following two sections and can be taken into account individually.
- *Rooting in existing measures in the particular urban area:* Every urban area collects different data, such as data regarding congestion. While the database can in some urban areas be judged to be well developed, others may fall short with existing data. Hence, it is recommended to ‘use what is already there’ and root the measure system in it. For measures that are not yet collected, a particular collection method needs to be established.
- *Balanced differentiation of measures:* As outlined, there exist implementation-related measures and output-related measures. Both types of measures are necessary to consider for the indication of success of the respective ULS implementation undertaking. Hence, a balanced differentiation between these two types can be recommended for the judgment of success.

With these recommendations in mind, every ULS implementation undertaking must prioritize and define particular measurements to indicate its success. These success measures need to be judged throughout the implementation process at predefined points in time as part of the operational evaluation process that is further discussed in Section 4.5.

4.4 Setup of implementation management for urban logistics systems

This section directly refers to RQ₄ and aims to answer it by providing recommendations about the management setup for ULS implementation undertakings. Thus, the following needs to be understood as recommendations and non-binding ideals for a typical setup of any ULS implementation undertaking. These recommendations sit at a relatively high level, and as a consequence, they need to be broken down and reviewed in detail for any

specific ULS implementation undertaking. In other words, these statements need to be understood to be guidelines only.

First of all, the term ‘implementation management’ needs to be transferred into the ULS implementation context. This dissertation understands the term implementation management in line with Daniel (2001): It encompasses *functional* aspects, which denote all activities that help the implementation, leading to success, and *institutional* aspects, which refer to a specific circle of people who are entrusted with implementation-related tasks as well as their organizational anchoring within the implementation undertaking. Thus, the implementation management needs to be understood as a cross-phase domain that encompasses functional and institutional aspects that cannot be unified in phases but act on the entire implementation undertaking. In the particular context of ULS implementation, this understanding contributes to a wide range of matters that need to be considered. These matters are structured in so-called elements for the ULS implementation undertaking and are suggested by this dissertation and subsequently discussed.

Generally, the implementation management needs to be set up in an early phase of the ULS implementation undertaking, before any operational activity related to the implementation. An implementation management is typically necessary after the initial phase of an implementation undertaking which can be called the preparation phase. This phase is concerned with all decisions that are ground-laying and universally valid for the respective implementation undertaking. This is discussed in further detail in Section 4.5.

With this in mind, following the eclectic approach used for this dissertation and is based on the conjunction of CAST, CT, ST, and TOC, a fitting PM philosophy is particularly necessary for the specific context of ULS implementation. This is due to the dynamic and ever-changing environment of urban areas, which influences the respective ULS implementation undertakings. However, a purely agile philosophy would be too far-reaching, given that an in-depth analysis phase, such as the contingency analysis reviewed in Section 4.1, is undoubtedly necessary to achieve a fitting ULS conceptual design. Hence, it is suggested that a hybrid PM philosophy should be followed for any ULS implementation undertaking; this also directly influences the setup of the implementation management. While the hybrid PM philosophy is discussed in further

detail in Section 4.5, it needs to be noted that it particularly influences the ULS implementation management in its iterative aspects: All identified elements need to be revisited and adjusted regularly to ensure a constant fit of the implementation management setup and the current requirements from the respective ULS implementation undertaking due to the highly dynamic nature of the project which requires a highly responsive philosophy to manage it.

Based on these pre-considerations, several crucial elements are identified by this dissertation. These are considered to be parts of any ULS implementation undertaking and are discussed in Sections 4.4.1 through 4.4.6. These elements are picked up by the cross-phase adaptable implementation concept for ULS that is introduced in Section 4.5. Hence, this puts implementation management into a larger perspective and integrates its element into an overall concept. The statements in the following sections make reference to the cross-phase adaptable implementation concept when necessary.

4.4.1 General setup

The general setup of ULS implementation management is concerned with ground-laying decisions that form and impact the entire ULS implementation undertaking over the life of the project. While these decisions need to be made upfront, in the preparation phase of the project, they need to be reconsidered regularly and – if necessary – adjusted to enhance the project's success in the best possible way.

The initial project members can make decisions about the general setup that crystalize after the initiation phase described in further detail in Section 4.5. Without preempting too many details of Section 4.5, however, it is expected that the initial project members come from different organizations, both private and public, to form the ULS initiative in an elemental way. Hence, these members normally decide on the initial ULS implementation management setup.

This dissertation suggests that these decisions in the preparation phase of a ULS implementation undertaking can be structured with several elements that are discussed in the next paragraphs. While each element is necessary to form a ULS implementation management general setup, they are not siloed and instead are interconnected. Hence, a decision on one element can influence another element's characteristics, and these interactions need to be investigated in the respective ULS implementation undertaking

with the aim of achieving a coherent and proficient setup that is able to steer the subsequent decisions that must be made.

These subsequent decisions can be assigned to the effectuation phase of the ULS implementation undertaking, which is also further described in Section 4.5. Again, there are elements of the ULS implementation management suggested by this dissertation that need to be decided on for the respective undertaking. These elements are further discussed in Sections 4.4.2 through 4.4.6.

Object composition

As outlined in the literature review, object composition refers to clarifying the question of ‘what’ to implement. In the context of this dissertation, it refers to the conceptual design of the respective ULS.

The object composition always starts with a formulation of the problems in an urban area or (voluntary) willingness to improve the situation in the urban area for the greater good. This can be viewed as one of the outcomes of the initiation phase, which the object composition builds on. However, in the early phase of preparation, this is usually a high-level vision for a specific ULS. This means that there is a foggy vision for a potential ULS but no clear image of how it looks in terms of the operational processes and their impact on the situation in that urban area. Nevertheless, the ULS vision must ensure justice for the definition of ULS, as outlined in Section 2.3. Consequently, it has to claim that it deals with a significant part of the logistic flow in and out of the respective urban area and ensure that it has a great enough measurable impact on specific KPIs during and especially after its full implementation.

The ULS vision can include existing UL initiatives since, in many urban areas, there are already ongoing UL-related activities, but it does not necessarily have to (‘bottom-up’). When existing initiatives are considered, the high-level vision should include a rough plan for how these initiatives can complemented and be brought together to fit within a larger ULS. If existing initiatives are not considered, the ULS vision should include a plan for modularization, meaning that it can be broken down into several pilot projects that are brought together afterward to form the larger ULS (‘top-down’). However, both types of ULS visions can be driven by opportunistic behavior upfront to contribute to its initial implementability. Furthermore, both types need to be customized to the

respective situation in the urban area, taking its high-level characteristics into account to ensure a fit.

This high-level ULS vision can be considered necessary for this early object composition phase that aims to achieve high-level clarity of the ULS vision. Later, this is analyzed in detail in the effectuation phase (see Section 4.5), with an iterative further development to result in a detailed ULS object composition in the form of a conceptual ULS design. It is suggested that the contingency analysis in Section 4.1 and the assessment procedure introduced in Section 4.2 can help in this process.

Context composition

This element of the implementation management setup refers to the answer of the ‘where’ the respective implementation object should be implemented. Because this dissertation aims for the implementation of ULS as an object, the context refers to a specific urban area.

During the preparation phase of a ULS implementation undertaking, it is necessary to analyze the respective urban area at a high level to form the basis for further decisions. This means that during this phase, publicly available data, in particular, can be roughly analyzed to achieve an understanding of the situation on-site at the respective urban area. While the context analysis in most implementation undertakings is usually concerned with either subsegments of an organization or the organization as a whole, the rough context analysis needs to incorporate data from the urban area and is, thus, situated on an interorganizational and environmental level.

Hence, the context composition for ULS implementation undertakings can be regarded as a very complex topic in most cases. While this is obviously connected to the size of the urban area, there are other characteristics, such as the local public authority and environmental factors such as local emissions, to be incorporated in this rough analysis in order to understand the context in terms of its width and depth.

Based on this preliminary context composition analysis of the respective urban area, the object composition in terms of the high-level ULS vision needs to be further developed in close conjunction. This can be denoted as an iterative manner where the high-level ULS vision is incorporated in the respective urban area context to achieve a preliminary fit. This ensures its preliminary feasibility by taking into consideration the affected surrounding market and possible barriers that can arise in practice. To achieve this, it is

recommended to apply systems thinking, particularly with regard to identifying preliminary influencing factors and their interdependencies.

To manage this complexity, this dissertation suggests applying complexity management strategies, such as the divide of the urban area in terms of various aspects (e.g., in logistic streams of various goods, in different spatial regions or in different stakeholder groups) that are affected by the potential ULS vision. This may lead to several ‘sub-visions’ in aspects of the respective urban area (context), with specific borders that can be incorporated in the preliminary ULS vision.

Timing

The element of timing is concerned with the question of ‘when’ to implement, which relates in the context of this dissertation to finding the best possible point in time to implement the respective ULS.

Generally, also in the context of ULS, early or false starts of the implementation need to be avoided. Hence, it is necessary to achieve the object and context fit of the preliminary ULS vision first to ensure that it is ready in terms of its contours. Later, the ULS vision is turned into the ULS conceptual design, which gives a more detailed understanding, which, in consequence, has implications for the implementation timing again.

During the preparation phase, given where this element is situated, it is necessary to roughly analyze factors such as the competitive pressure in the respective urban area and the behavior of the different stakeholder groups. This has implications for the availability of the resources required to move the ULS vision further in terms of its practicality and, therefore, also for determining the implementation timing in the respective urban area. While such aspects are also analyzed for the element of ‘context’, as already outlined, the decisions about the ULS implementation timing need to be made in close conjunction with the findings of the context analysis. These conditions may change over time, such as by trends or crises that arise, which need to be roughly tracked to ensure the best possible timing.

Managerial challenges like urbanization or e-commerce growth tend to get more and more provoking in urban areas, as outlined in the introduction; generally, it can be recommended to set the timing of a ULS implementation as early as possible if the discussed aspects are sufficiently analyzed. The implementation timing is recommended

to be held to an overall rough timeline rather than that is no more detailed than, for instance, a yearly milestone report. This does not have to aim for perfection, but it is recommended to give a feeling for the overall ULS implementation.

However, the ULS implementation needs to possess high levels of flexibility to ensure the ability to have necessary reactions to changing conditions. Necessary accelerations, for instance, those prompted by the identification of opportunities such as new external funding possibilities, need to be deployed when required. This can lead to intensified resource deployment by implementation management.

Style

This particular element of style regarding implementation management asks the question of ‘how’ the implementation should take place. In the context of this dissertation, answers are suggested on how the ULS implementation management should act to ensure a respective successful implementation in practice.

As outlined, certain peculiarities are inherent in the context of ULS implementation. This dissertation’s literature review therefore suggests participatory implementation management behavior. This is mainly connected to the psychological aspects involved in any implementation process, namely achieving the acceptance and avoiding the reactance of the affected parties and groups. As any ULS implementation management needs to deal with interorganizational aspects due to the range of stakeholder groups involved in the process, a participatory implementation style is strongly recommended by this research.

This participatory implementation style requires a high degree of participation of the affected stakeholder groups. In the preparation phase of the respective ULS implementation undertaking, it is necessary to organize the process openly, with the aim that anyone – be it private citizens, local businesses, or the public authority – is welcome to participate. This can be classified as a total involvement, according to the literature review. However, during the progress of the implementation, it can move over to what is called partial involvement, with less involvement from anyone, but with specific representatives from each stakeholder group staying involved to streamline the process of the ULS implementation. Nevertheless, particular key stakeholders need to participate heavily throughout the entire implementation process, and consequently, a

core project group needs to steadily form to promote the ULS implementation undertaking.

This core group must be thoroughly organized to ensure the implementation's success. This is further discussed in the following two sections. In addition, this core group needs to be open to existing UL-related initiatives to ensure their inclusion where possible and meaningful. With a participatory implementation style, it is recommended that the core group listen to and incorporate the interests of the various stakeholder groups. Ultimately, this can have implications for the implementation object, namely the ULS vision and, later, the ULS conceptual design. This is part of the iterative further development of the ULS for fitting in the context of the specific urban area.

Direction

The outlined implementation style is primarily connected with the implementation direction, which denotes different strategies for effecting measures of an implementation undertaking. In the context of this dissertation, this denotes 'from where' the different ULS-related measures are carried out.

Thus, the previously suggested participatory implementation style has implications for the ULS implementation direction. As there are two different general scenarios for the ULS implementation – namely the top-down approach with one general ULS vision or the bottom-up approach with the identification of UL-related initiatives that are combined into one ULS vision – this dissertation provides suggestions for both types:

- *Top-down ULS vision:* The top-down ULS vision suggests that the implementation direction is also top-down in the sense that the ULS implementation management lets relevant stakeholder groups participate, but certain ULS-related measures are introduced in a 'top-down' manner. Certainly, this requires a particular engagement of a local authority that regulates the urban area in such a manner that the ULS vision is supported by local stakeholders.
- *Bottom-up ULS vision:* The bottom-up ULS vision suggests a bottom-up implementation direction based on the specific intensive participation of relevant stakeholders. The independent UL-related initiatives need to be coordinated to ensure a larger ULS vision that is coherent and implementable. Hence, based on a

participatory style, the bottom-up ULS vision needs to be directed primarily from the independent stakeholders.

Both types have in common that the participatory ULS implementation style suggested previously does implicate that relevant stakeholders are intensively incorporated in the relevant decision-making processes. However, the bottom-up variant may change over time to a top-down implementation direction when a greater ULS vision based on the bottom-up initiatives is supported by all now ‘internal’ participants, namely the project members. If this is the case, a top-down direction is suggested to ensure momentum.

These five elements – object composition, context composition, timing, style, and direction – are denoted as the general setup of ULS implementation management in this dissertation. They are situated in the preparation phase and influence the later phases of a ULS implementation in a ground-laying manner. While this general setup is subject to this early phase of the implementation process, the various elements need to be checked regularly and, if necessary, adjustments need to be made to take the respective current state into account. It is recommended to revisit these elements every four to six months during the implementation process.

4.4.2 Factual management

With the element of factual management, the suggested ULS implementation management passes into the phase of effectuation. This phase is further outlined in Section 4.5.3. Generally, factual management deals with introducing the respective implementation object to the implementation context, as outlined in the literature review of this dissertation. Consequently, further detailed management of the preliminary ULS vision is subject to factual management. Thus, this element is primarily content-related in terms of the implementation object of ULS.

Factual management relates to all activities that manage the introduction of the ULS to the urban area, but on a management level, not an operational level. This level is subject to operations steering, where specialists need to be deployed, which is further discussed in Section 4.5.3. Consequently, this element of factual management is at its core about the steering of factual changes, especially with communication measures.

For this purpose, it is recommended that implementation management introduce specific project objectives. These objectives can mainly be divided into quality, cost, and time objectives. In the context of ULS, the quality of the introduced measures needs to be

sustainable in terms of a lasting impact on the respective content-related goals, such as an improvement of emissions. Objectives in the cost dimensions can be situated either on an overall implementation project level, determining overall costs for the ULS implementation, or they can be further detailed, such as by the introduction of ULS implementation modules, as previously outlined. Time objectives set boundaries on the time frame when certain ULS – or to be more detailed, the respective ULS modules – should be fully implemented. Such objectives need to be set by implementation management to ensure management by objectives.

In addition to these measures, there are further elements of factual management outlined in the following paragraphs.

Context transition

The element of context transition refers to the way the implementation object is introduced to the respective implementation context. Generally, it has to do with the process of unfreezing, moving, and refreezing, as already discussed. Thus, a so-called context transition strategy needs to be applied.

Turning to the ULS implementation, it is recommended that the context transition strategy occurs in two stages: First, the ULS vision needs to be developed to a level of detail where modularization can take place. This means that from the overall ULS, several independent pilots or work streams can be effectuated without any interdependencies. With this modularization strategy, the implementation management considers the high level of complexity in ULS implementations and mitigate the risks for the overall project ahead of bringing the different streams together to achieve the ULS vision. Second, it can be recommended to introduce the different modules in a way that overlaps the ‘old’ (the existing context) with the ‘new’ (the new ULS context). This step-by-step process ensures a robust strategy where adjustments can be made in a timely manner if problems arise. These two steps are considered by this research to be a fitting context transition strategy for ULS implementation undertakings in terms of complexity, risk mitigation, and duration by this dissertation.

Object scope

While the implementation object is also discussed in previous sections, it changes with the entrance in the effectuation phase of the implementation undertaking. Generally,

while a high-level vision is outlined during the preparation phase, that vision gets more detailed in the effectuation phase.

In the context of the ULS implementation undertaking, factual management needs to be concerned with achieving a more detailed level of the prior ULS vision. One way of doing this is modularizing to achieve a deeper understanding. For this process, this dissertation suggests an analysis of good practices from other urban areas, as well as from academia, and insights taken from those good practices can flow into the more detailed ULS vision. This detailed vision does not have to strive for perfection but it does need to be detailed enough to introduce it to the general public. With this, it is recommended that a first feasibility study be conducted with the aim of evaluating the vision and developing it further. This early feasibility study can also have implications for a first rough specification of the necessary resources and needs for implementing the ULS in practice. In this way, external stakeholders can be satisfied, which ensures their acceptance. In the operations steering element, the object scope gets picked up (see Section 4.5.3).

Implementation pace

Another element of factual management is the implementation pace which refers to the speed with which the several steps of the implementation take place.

The context of ULS is highly complex, with a diversity of factors to investigate and consider, be it the manifold of the UL concept components or the external, non-controllable factors outlined in the contingency analysis. These factors all have implications for the implementation pace, which is highly dependent on the specific ULS implementation undertaking. Consequently, it is difficult to give general recommendations for the ULS context. However, the aforementioned early feasibility study in the element ‘object scope’ can provide ideas for the implementation pace, especially when the ULS is modularized. In that case, each module can be implemented at its own pace, with independent operations steering, steps to be taken, and implications for capacity planning and budgeting. Thus, the implementation pace needs to be determined individually. Generally, time pressures should be avoided to ensure the flexibility and adjustability of the ULS implementation measures.

Implementation intensity

The implementation pace is closely associated with the element of implementation intensity. This denotes the intensity of the embraced measures that culminate in the achievement of the ULS.

Due to the close association with the implementation pace, it is also difficult to give general recommendations here that are applicable to any ULS implementation. However, the following proposals are suggested by this dissertation: In general, the greater the intensity of the measures, the earlier the results are perceivable. Hence, if the circumstances allow it, a greater implementation intensity is recommended for ULS implementation as long as the acceptance of the affected stakeholder groups continues to be sufficient. The acceptance of stakeholder groups is of vital importance and should not be jeopardized. This acceptance can thus be thought of as a boundary. Up to that boundary, ULS-related measures should get realized as quickly as possible and in incremental steps to avoid reactance.

4.4.3 Competence management

The element of competence management as part of implementation management deals with deploying the implementation object on the personnel level, as outlined in the literature review. Hence, competence management includes all personnel-related decisions and activities.

In the context of ULS implementation, competence management has a special role due to the peculiarities of the ULS implementation process: First, all ULS implementation undertakings have an interorganizational character due to the necessary interplay of various stakeholder groups that is required to put a ULS into practice. Second, this interplay is also an interplay of private and public actors, which needs particular attention in terms of competence management. Third, the interests of these different stakeholder groups need to be reconciled, which is especially achieved based on the personal connections of the personnel chosen for the respective ULS implementation undertaking. Fourth, this may be connected to the acceptance of short-term disadvantages for some stakeholders in order to generate long-term benefits for the respective urban area, which is also managed by personnel's relationships and competence. Fifth, a ULS implementation undertaking is always related to a long time frame because a ULS cannot be put into practice overnight. Consequently, competence

management as a part of ULS implementation management needs to be carefully thought of to ensure the project's success.

Generally, competence management can be subdivided into several elements, which are discussed in the following sections, with specific reference to the ULS implementation context.

Personnel anchoring

Due to the complexity and sheer number of activities being steered in a ULS implementation, it is necessary to entrust this process to a group of people rather than a single person. Thus, the various activities culminate in the personnel anchoring of the respective undertaking.

First, those to be included in the ULS implementation should be qualitatively evaluated in terms of, for example, their expertise in the UL context or their political competence and power. Second, these individuals typically originate from the various stakeholder groups. Consequently, with the entrance of implementation management into the effectuation phase, and based on the participating stakeholders up to that point, it is recommended that decisions be made about which people are worth considering to be seconded into the ULS implementation. If their expertise and connections to stakeholders are adequate, this group of people can join the project. Further external parties, such as permanent consultants, can also be included in the ULS implementation if necessary, such as for reasons of their knowledge. The operational processes and activities can subsequently be assigned to this circle of people.

Implementation organization

The selected personnel entrusted with the ULS implementation need to be structured in a consistent implementation organization, which contributes to a successful project. For this purpose, this dissertation suggests the following implementation organization, using the different hierarchical levels that are shown in Figure 17 and discussed in the subsequent. This organization is based on the Cargo Sous Terrain project.

Generally, it is recommended that the ULS implementation be steered via the founding of a joint venture of all participating stakeholders to ensure high levels of commitment to the project. The participating stakeholders need to appoint an internal person to be in charge of the ULS-related measures, thereby ensuring the anchoring of the project in the

respective organization. These people can come from the top management of the respective stakeholder, can be organized in a supervisory board for the respective ULS implementation undertaking, and represent an interface of the ULS project and the stakeholder organizations. This supervisory board steers the executive committee, which is made up of senior management that has expertise in UL-related activities. The executive committee appoints an operations president to steer the operational level. In addition, there can be supporting bar positions, such as for public affairs or accounting-related activities. At this point, the related parties can be considered implementation management for the project. Below the operations president, different functional experts lead various teams that are in charge of the operations steering and represent the operational level of the organization. Internal parties from stakeholder organizations can contribute on the operational level through, for example, being put in charge of logistics activities. However, it is recommended that these persons are recommended to be seconded in full-time.

If the public authority participates in the project, it is recommended that a full-time position in charge of all UL activities be created and also included in the supervisory board. Operations experts from the public authority can further enhance the implementation.

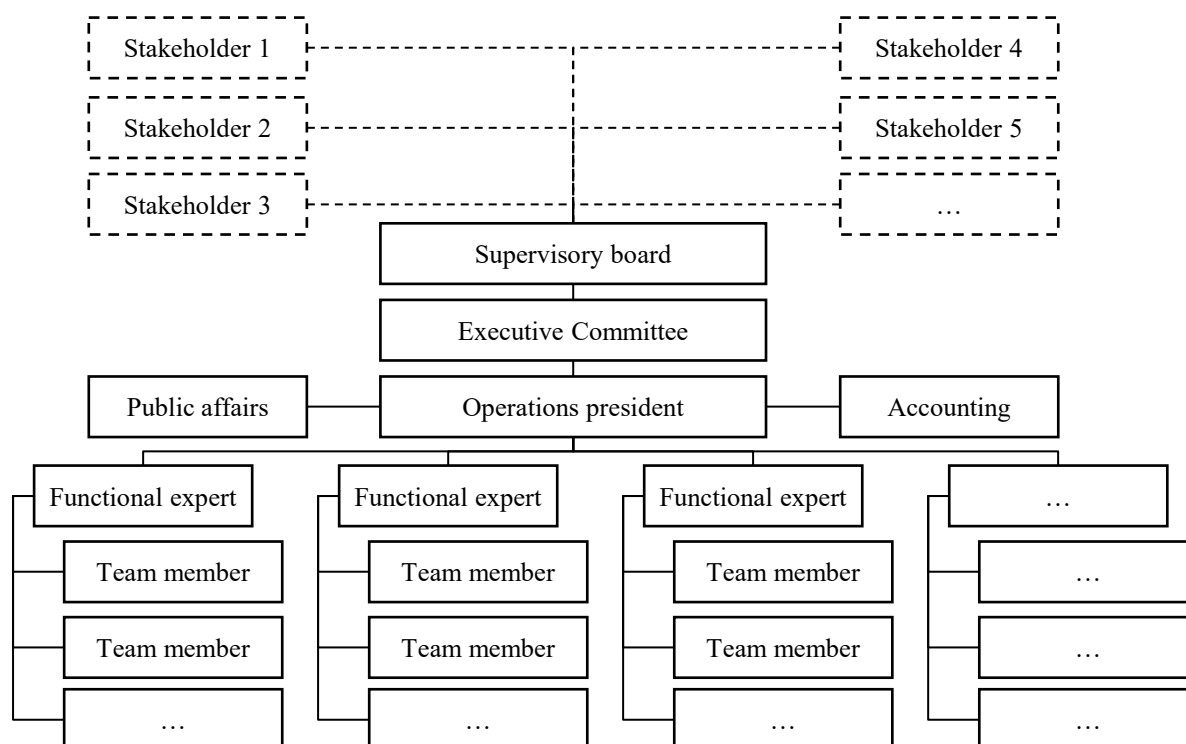


Figure 17. Suggested ULS implementation organization

Implementation roles

Based on the implementation organization, different implementation roles can be assigned to the seconded personnel. Following the literature, differentiated roles such as ‘decision-maker’, ‘planner’, ‘realizer’, and ‘consultant’ can be created. A brief overview is given in Table 18, including a short description of each type of role and an assignment with regard to the implementation organization just explained.

Table 18. ULS implementation roles

Roles	Description	Implementation organization
Decision-maker	The decision-makers are mostly senior professionals who make decisions about strategic and operational tasks.	• Supervisory board • Executive committee • Operations president
Planner	Planners go into detail regarding all planning-related tasks on the management and operational levels.	• Functional experts • Team members
Realizer	Realizers are mainly situated on the operational level and realize the plans and decisions of management.	• Functional experts • Team members
Consultant	Consultants are external experts that are included but are not members of the permanent organization.	• External personnel, so not displayed

Implementation leadership style

As outlined in the literature review, these implementation roles need to be modeled on the implementation leadership style as a further element of competence management. This is integrally connected to the implementation style discussed as part of the general setup of implementation management. However, while this is situated in the preparation phase, the implementation leadership style is part of the effectuation phase.

With the transition to the effectuation phase, the leadership style needs to be consolidated because it especially tangents the internal ULS implementation organization. Hence, this dissertation suggests matching the participatory implementation style, in accordance with the literature review, which refers to it as ‘standardized participation’: Here, it is not only the implementation style but also the leadership style that is participatory. While participation always leads to greater complexity, it is necessary, especially in the ULS context, due to the high importance of achieving acceptance. This ultimately leads to a simplified effectuation of the entire

ULS implementation. In line with this, the present research suggests management by objectives of implementation management in regard to operations personnel. In that way, high levels of flexibility and purposefulness are ensured, which both contribute to the ULS.

Implementation competencies

Finally, competence management as an element of implementation management also encompasses the implementation competencies that are necessary to effectuate any implementation undertaking.

As outlined, the ULS implementation must handle certain peculiarities, and the implementation competencies of the chosen personnel have to reflect these circumstances. In particular, the interorganizational setting requires highly skilled communication capabilities to ensure maximum transparency from the involved parties. Due to the complexity of any ULS implementation, transparency is especially important so that no stakeholder feels left out or excluded. Furthermore, it contributes to confidence building and the avoidance of rumors among ULS stakeholders. It is recommended that these implementation competencies be expressed through appropriate communication instruments, such as meetings with stakeholders, workshops for involved parties, or information pages. Where these implementation competencies are not sufficient on the personnel level, these people must be qualified through measures such as on-the-job training.

4.4.4 Stakeholder management

The element of stakeholder management as part of implementation management is concerned with all stakeholder-related activities. In the context of this dissertation, this element is understood to be on a par with the behavior management element of an implementation as described in the literature. The following statements build on ST from the perspective of implementation management of a consortium of organizations that want to implement a ULS.

Generally, stakeholder management has offshoots that range from the early beginnings of a ULS implementation (denoted as the preparation phase in the suggested cross-phase implementation concept for ULS; further discussed in Section 4.5.2) to the closing of the implementation (denoted as the examination phase; further discussed in Section 4.5.4). However, the main task of this element is the effectuation of the ULS

implementation. With this in mind, the following concentrates on ST-related suggestions tailored for a ULS implementation, with an additional focus on possible barriers and strategies for overcoming them.

Transferring the ST view to the ULS implementation context, stakeholders can also be divided into two groups: (1) LSPs, shippers and receivers, estate managers and developers, and the public authority as narrow stakeholders, which are of high importance for the success and survival of the ULS, and (2) those affected by the ULS, which are predominantly the public in the specific urban area. These are general stakeholder groups, and the particular organizations and parties must be specifically identified for each ULS implementation.

After these stakeholders have been identified, they need to be analyzed with respect to their drivers, potential reservations regarding UL measures, and the primal origin of their interests, such as economic, ecological, or societal aims. Furthermore, it is necessary to assess their level of power and UL-related knowledge to achieve a deeper understanding of them. Subsequently, they must be actively managed, following the recommendations from ST and implementation insights, with the ultimate aim of achieving acceptance and avoiding reactance. In line with the findings of Section 2.4.7, a participatory approach is suggested by this dissertation for stakeholder management throughout the ULS implementation. Depending on the particular situation in the respective urban area, the ULS implementation management must decide when, how, and which stakeholders should be included to ensure the project's success. Generally, it is recommended that stakeholder participation be ensured through the implementation organization, as described above, by consolidating their interests in the supervisory board. This body needs to ensure reconciliation of interests to achieve acceptance and living partnerships, which are of great importance, as emphasized in the literature (see e.g., Quak *et al.* (2016), Le Pira *et al.* (2017), or Gammelgaard *et al.* (2017)). This dissertation underscores this importance, especially from the perspective of the implementation. For this, it is necessary that the local public authority, in particular, is engaged in the creation of a central position responsible for all UL-related measures. This way, actions are bundled and transparent for local stakeholders.

Thus, it is recommended that a consistent strategy be developed for engaging with stakeholders throughout the implementation process. This strategy can encompass ways

to involve stakeholders, the time to involve them, discussions of their possible responsibilities and roles, and financial aspects to take into account before, during, and after their engagement in the ULS implementation. These aspects need to be communicated transparently to ensure that no one is left out. The stakeholder management strategy can be rooted in a stakeholder map, including their interests, responsibilities, and interconnections, with a regular, anticipatory assessment that caters to unforeseen events in a flexible way.

Barriers to stakeholder management in ULS implementations typically come down to two issues: conflicts between the stakeholders and reactance to the ULS. To overcome these barriers, it is recommended that the above suggestions be followed. However, for the special management of these barriers, some further techniques that can be employed based on an individual assessment are suggested: To ensure informed stakeholders and guarantee a high level of transparency, newsletters, fact sheets, and a central website for the ULS implementation are suggested. Initial reactance can be eased with their application. Furthermore, stakeholders can be included with surveys, questionnaires, or interviews that are applied with the aim of a better understanding of the stakeholders' motives. For further involvement, workshops and information sessions, potentially open ones conducted by a neutral coordinator, can be carried out to show stakeholders how they can participate in the ULS implementation. In addition, focus groups can be organized to thoroughly involve stakeholders and ensure high levels of engagement. There, to overcome conflicts, advanced measures can be used, such as the analytical hierarchy process suggested by Katsela and Pålsson (2016). With these activities, the great importance of stakeholder management throughout the ULS implementation must be taken into account.

4.4.5 Project controlling

Following the understanding of an implementation undertaking as a project with an aperiodic character, the element of project controlling as a support function of the PM can be seen as an indispensable steering instrument (Grewe, 2012). Thus, because this dissertation regards ULS implementation as a project, project controlling is perceived as necessary for the planning, steering, and control of any project in this context.

Project controlling aims can be considered factual-related aims that are situated within the triangle of quality, cost, and time. This typically leads to conflicts among these three

aims due to the fact that the respective implementation undertaking cannot simultaneously cover all parts of the triangle (see Section 2.4.2). This, in turn, leads to the inference that project controlling needs to ensure an integrative consideration of this triangle with the aim of provisioning results-oriented information for the respective implementation management. Thus, the general task of project controlling measures can be perceived as the support of the PM as a coordination of the project-related planning, control, and information system. Because this task needs to be carried out throughout the entire project effectuation, this dissertation suggests that the element of project controlling be part of the implementation management of a ULS.

In the context of ULS implementation, while project controlling, generally must take care of adherence with planning premises, related aims, and particular economic requirements of the specific ULS implementation, it also takes on the tasks of support, coordination, and especially moderation.

For support and coordination, particular project controlling instruments are suggested, including a project structure plan, which should be established in every ULS implementation: A project structure plan can be built upon the previously suggested feasibility study and it transfers those findings into specific tasks and work streams that are also finding their way into the modularization of the ULS. Whereas the project structure plan is relatively rough at the start of the ULS implementation, it is one of the main tasks of project controlling to achieve more and more detail. If necessary, project-external information from good practices, for example, should be obtained and analyzed. External information processed by project controlling may originate from external sources such as public databases, consultancies, project reports, or associations. This information needs to be processed to allow for their further application in ULS implementations, particularly on the operational level. In addition, instruments such as cost tables, cost-utility analyses, checklists, and individually set KPIs can be useful for respective ULS implementations. These are individual in nature due to the highly individual objectives of any ULS implementation. It is further suggested that reports be introduced on capacity and resource planning and utilization, which are situated at the modular level of the ULS. However, due to the hybrid PM philosophy, which is further discussed in Section 4.5, there must be a constant reconciliation between the iterative procedure and the classical detailed planning. The latter must not constrict the iterative manner of a ULS implementation. Nevertheless, based on these instruments, project

controlling is, at its core, a comparison of the respective target status with the as-is status on a regular basis. To achieve a constant flow of information and enable these support functions, implementation management, which is responsible for project controlling, needs to work in close conjunction with the operations steering for the project. Consequently, the aforementioned recommendations for the implementation organization need to be revisited to ensure close collaboration between these two entities.

For the purpose of moderation and based on the instruments just reviewed, project controlling contributes to a permanently revised judgment of the ongoing ULS implementation. Due to the highly individual interests of various stakeholder groups involved in any ULS, great importance should be attached to this moderating task of the project controlling element, and thus, project controlling contributes to the motivation of relevant stakeholder groups as well as the achievement of acceptance by provisioning the appropriate controlling instruments.

The tasks associated with project controlling need to be carried out throughout the effectuation phase of a ULS implementation. It is suggested that the information collected be used as input in the element of project information (see Section 4.4.6) in a limited way, as well as the examination phase, which is further discussed in Section 4.5.4. Consequently, project controlling is perceived as essential for the success of any ULS implementation and beyond in the form of knowledge exchange during the examination phase.

4.4.6 Project information

Any implementation undertaking needs to achieve acceptance from affected parties and stakeholders, along with the avoidance of their reactance, as a central aim. This is outlined in Section 2.4. It is only with this acceptance for the particular implementation and its associated measures and changes that an implementation undertaking is perceived to being able to succeed. Achieving acceptance is closely related to reducing the anxieties of affected parties and stakeholder groups, and it centrally builds on necessary project information, including the reasons for, aims of, and impacts to the respective implementation undertaking. Consequently, the element of project information is discussed in further detail next. In this dissertation, there is a distinction

made between project controlling and project information to emphasize that, while these elements are closely related, the latter's success is crucial for a ULS implementation.

Turning to the context of ULS implementation, project information-related tasks are assigned to implementation management, as this is the level that interacts especially with a project-external circle of parties. These tasks must be handled throughout the ULS implementation effectuation due to the importance of achieving acceptance. Thus, the related tasks of the project information element stimulate the stakeholder management element (see Section 4.4.4).

The target group of the project information element in a ULS implementation can be thought to be all relevant stakeholders that are affected by the ULS. This encompasses not only the participants that are active in the ULS implementation but also those not actively participating, which are therefore external. Examples of stakeholder groups are given in Section 2.3.4 and do not require further detailing because the aim of the project information element for each of them is the same: achieving acceptance and avoiding reactance by providing adequate information. This requires enlightenment and transparency about the ULS implementation, its structure, its mode of operation, the project status, and the participants. Ultimately, the provision of sufficient project information to externals contributes to building trust between the parties, which is perceived beneficial for any ULS implementation. If adequate transparency about the ULS implementation is not provided, it can lead to insecurity and anxieties among the external affected parties. For this reason, the element of project information should make use of the various instruments discussed in the following paragraphs. All of them contribute to the above-mentioned aims.

With the entrance of the effectuation phase in a ULS implementation, it can generally be beneficial to have decided on a particular project name upfront. This enables an unambiguous way to communicate with potential external partners, such as through media or a specialized website.

Furthermore, it is suggested that a particular ULS implementation information system be set up to provide extensive information for externally affected parties. The required information from the project should be sourced from the element of project controlling. The information system is suggested to be based on two pillars:

- *Oral communication of project information:* This pillar encompasses all activities that are carried out orally. This includes, for example, informal talks with implementation management and external parties, such as meetings and workshops on-site with stakeholders or presentations at public events. It also includes information exchanges at events such as special exhibitions.
- *Written communication of project information:* That pillar is concerned with all written communication regarding the project. This includes reports on project planning or the project's status, which it is suggested should be updated regularly. In addition, this pillar includes meeting minutes of the most important meetings and workshops that can be made available.

It has to be decided on a case-by-case basis which pillar of the information system best suits the situation for each specific ULS implementation. The decision is closely related to a particular target group and should be aligned with specific aims. Principally, project information should be made available in a timely manner, especially when it comes to large-scale decisions. However, in general, written communication can be made accessible on a ULS implementation project website, which can also include contact details to signify an approachable undertaking. Nevertheless, written communication, in particular, must be regularly evaluated to ensure up-to-date information is shared. Finally, this synthesized project information should be placed in knowledge storage, which is discussed further in Section 4.5.4.

4.5 Cross-phase implementation concept for urban logistics systems

This section makes direct reference to RQ₅ and aims to answer it by suggesting a cross-phase implementation concept for the context of ULS. This section also refers closely to the TOC, discussing which constraints in the form of burdens can occur in the various phases and suggesting possibilities for overcoming them.

Beginning with the introduction of the suggested implementation concept for ULS, it is necessary to provide the following annotations, which need to be considered for an appropriate interpretation:

- In the context of this dissertation, the suggested implementation concept picks up the findings of Sections 4.1 through 4.4 and puts these findings in the larger perspective of the concept. Hence, this section refers punctually to, for instance, the contingency

analysis, the qualitative assessment of UL concept components, the identified success factors, and the suggested elements of the implementation management.

- As outlined, this concept aims to be adaptable, meaning that it can be understood as a general framework that is applicable to ULS implementation undertaking independent of the particular urban area. Therefore, the concept aims to make statements that are usable with any ULS implementation, with a special focus on the GAS area, which serves as this dissertation's unit of observation, as outlined in Section 2.5.
- Following this claim for generalizability, the implementation concept aims to move within the boundaries of being too rigid or too soft. In this context, rigidity refers to a concept that is not dynamic enough to take into account the specific environment and its dynamics regarding a ULS. And in this context, soft is understood as providing a concept that does not have practical usability due to overly generic statements. Hence, these circumstances can be described as the field of tension with which this implementation concept needs to cope.
- As already specified, ULS can be implemented by either 'merging' smaller, existing UL initiatives into a structured system or through the 'top-down' implementation of a larger ULS with the help of independent streams. Thus, the suggested implementation concept takes both possibilities into account and aims to support them with suggestions that are equally applicable to both.
- Having these circumstances in mind, the suggested implementation concept needs to be understood as lane markings that should be broken down for each specific ULS implementation undertaking. Consequently, this dissertation makes general statements that need to be specified for the particular context because the details of any ULS implementation can differ extensively.
- Based on this, it should be understood that the suggested implementation concept is considered to be ideal-typical, meaning that the particular ULS implementation may differ significantly, and not all elements and suggestions can, in reality, be considered. Therefore, the suggested implementation concept does not make any statement about the chances of success for other implementation procedures, which may also lead to success. It needs to be understood as a reference framework that

includes the identified necessary elements that should be considered when implementing ULS and then provides suggestions for the use of those elements.

- Furthermore, the suggested implementation concept for ULS aims for a neutral perspective in the collaboration of different stakeholder groups given that a ULS implementation undertaking is always dependent on different stakeholder groups. Thus, the implementation concept aims for neutrality without any particular concentration on any of the identified stakeholder groups. Consequently, it aims to be applicable to all kinds of consortia, that might differ in detail but make adaptable statements with an ideal-typical understanding.
- In line with the understanding of implementation as a project, the suggested implementation concept for ULS is centered around a specific PM philosophy, namely hybrid management, combining classic waterfall planning with agile elements to achieve fitting and successful ULS implementations in practice. This hybrid management philosophy is further outlined in this section and is structured in an iterative procedure that encompasses several cycles.
- All in all, the implementation concept contributes to the understanding of ULS implementation in several ways: First, it structures the implementation process in several phases and encompasses all phases. Second, it identifies elements that need to be considered throughout the implementation process. Third, with those results, it gives recommendations about how these elements can be embellished in the sense of generally applicable guidelines. Finally, it provides a straightforward iterative way for operations steering of a ULS implementation undertaking.

The suggested cross-phase implementation concept for ULS is displayed in Figure 18. As seen in the figure, it is divided into the four phases of initiation, preparation, effectuation, and examination. These phases are discussed in further detail in Sections 4.5.1 through 4.5.4. There is a focus on the effectuation phase because it is understood to be the core of the implementation, with impacts on the operational processes. Consequently, the effectuation phase is discussed in particular detail. This ends with Section 4.5.5, which provides an illustrative example of the application of the suggested implementation concept for ULS.

Generally, the cross-phase adaptable implementation concept for ULS is rooted in a hybrid PM philosophy. This hybrid philosophy includes a combination of traditional

and linear PM with agile components and is expected to suit explorative settings best (Baird and Riggins, 2012). Because the implementation of ULS can be considered to be explorative with the aim of putting a new idea into an existing environment, this hybrid PM philosophy is suggested.

The hybrid philosophy allows for an in-depth planning phase, which is necessary due to the required fit between the respective ULS and its environment but is flexible enough to allow iterations that encompass incremental steps for achieving the most suitable result in a highly innovative, fast-paced environment with unclear requirements. The latter two are considered the key advantage of this philosophy. This iterative procedure refers to findings from other scholars as going «*back and forth*» (Gammelgaard, 2015, p. 348) is central for ULS implementation undertakings, which includes constant questions of decisions taken, including implementation management. It is further expected from the literature that a hybrid philosophy contributes to a focus on the value of the specific undertaking and high levels of customization for the specific problem (Baird and Riggins, 2012), which are of critical importance in ULS implementation undertakings.

Examples of reasons for starting new iterations are given in further detail in Section 4.5.3. It must be noted that due to the iterative character of the implementation concept, a detailed discussion of its application can only be given ex post, after a ULS implementation was successfully completed, when the iterations can be described further. However, this dissertation describes an illustrative example in Section 4.5.5.

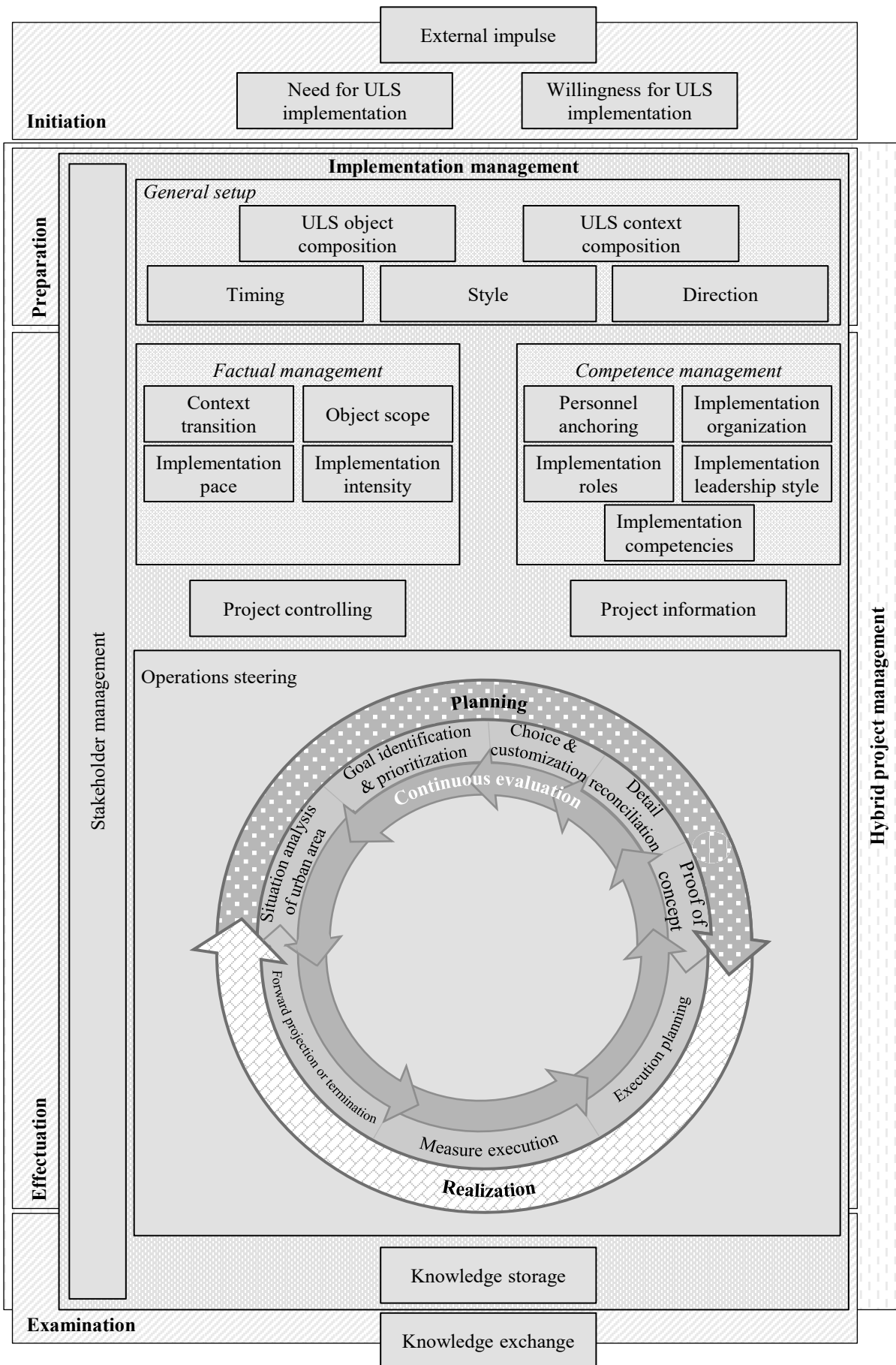


Figure 18. Cross-phase adaptable implementation concept for ULS

4.5.1 Initiation

Any ULS implementation starts with the phase of initiation where it is initially unclear if an actual project will result from it. This circumstance is different from many types of projects, especially company-internal projects, where specific goals usually need to be achieved with related measures – the new project, often predetermined by management. However, ULS implementation undertakings differ significantly from these ‘typical’ projects, mainly for the following three reasons:

- First, ULS implementation undertakings rely on interorganizational collaboration, where several actors need to work together. One actor alone is not expected to achieve a successful ULS implementation.
- Second, these actors are often not only from different types of industries but also originate from private and public organizations. This includes stakeholders from various backgrounds and particularly local authorities.
- Third, it is initially often unclear what exactly should be achieved with the setup of a ULS implementation undertaking. Due to different goals in various available dimensions, prioritization is usually necessary.

Because of these factors, a general description of the initiation phase within the cross-phase implementation concept for ULS can hardly be given. Generally, it must also be again noted that the situation in every urban area differs, which also has implications for the initiation phase. Nevertheless, the initiation phase of the ULS implementation concept normally emerges from one of the following four situations, which are listed in no special order:

- *Existence of a real problem*: There is a particular real problem given and/or growing that needs to be counteracted, such as growing emissions or increasing traffic congestion.
- *Investment for the ‘greater good’*: Local stakeholders want to achieve an improvement in the urban area, often particularly in regard to the quality of life for residents.
- *Marketing purposes*: Stakeholders, especially private ones, want to be perceived as sustainable by, for example, their customers, and they therefore want to invest in UL measures.

- *Political incentives*: There are incentives available for local stakeholders to engage in UL-related measures due to inactivation from the (national) authority.

Regardless which of the above-mentioned impulses arise, the motivation for a ULS implementation undertaking needs to be evaluated and discussed further. For this purpose, public events are particularly necessary so that stakeholders can engage and bring in their perspectives. Consequently, it is recommended that workshops be set up using different formats to achieve an active interchange of ideas that culminates in the first vision for a ULS. These events should take place over a sufficient time frame so that they get all relevant stakeholders engaged and so that the ULS idea can emerge.

However, it cannot be expected that these events will not result in issues being raised, and it has to be anticipated that various initial barriers will arise. These initial barriers are mainly caused by two circumstances, always individually pronounced, depending on the on-site situation:

- *Divergent interests*: This can be considered a normal barrier when various stakeholders come together, building on differing perspectives that need to be reconciled throughout the initiation phase and culminating in a multidimensional prioritization.
- *Lack of sufficient resources*: Other typical barriers that can hold back stakeholders from various industries are personnel or financial constraints. These constraints need to be considered and an individual plan formulated.

While these barriers can be described as routinely difficult and complex in detail, this dissertation suggests measures to overcome these barriers in the following. Which measures should be taken and whether singly or, where necessary, in combination must be individually evaluated.

- *Extrinsic motivation*: The authority can choose to incentivize private stakeholders by offering advantages for their participation in the ULS implementation. These advantages can lead to further motivation from stakeholders to become engaged and reassess their interests.
- *Mediation*: External mediation experts can be embedded in workshops to achieve reconciliation between the different stakeholder groups. These experts can be

deployed when discussions among stakeholders do not move forward in an advantageous way.

- *Political force*: In contrast, there can be disadvantages for stakeholders that exclude themselves from the ULS implementation, such as higher taxes being levied. However, this is not typically preferred by not only private stakeholders but also authorities that do not want to actively intervene in the market.

Because overcoming these initial barriers can be complex and time-consuming, this dissertation recommends setting up a ‘pre-project’ that can ideally be led by the local authority in an intermediary role. Such a pre-project idea has also been described by other scholars. See, for instance, Gammelgaard (2015), who perceived it as beneficial.

If such a pre-project is successful, one of the following states – which are depicted as elements in the cross-phase ULS implementation concept – needs to be achieved:

- *Need for ULS implementation*: It is clear that it is necessary to introduce a ULS to achieve an improvement in the existing challenges of a particular urban area. This state can consequently only be occupied if there are particular challenges present in the respective urban area that a ULS can ease directly or indirectly.
- *Willingness for ULS implementation*: The stakeholders in a particular urban area are determined to introduce a ULS. This state is mainly occupied when stakeholders are open to innovation and want to achieve a more sustainable urban area, particularly for local residents.

With the occupation of one of the above-mentioned states, the initiation phase is completed and the actual ULS undertaking emerges, moving into the preparation phase.

4.5.2 Preparation

The subsequent phase of preparation is concerned with all preparatory decisions that are considered fundamental and generally valid for the specific ULS implementation. These decisions are mainly connected to the implementation management and its setup to ensure a fit between the procedure and the individual situation in the urban area.

Because the elements of implementation management – *object composition*, *context transition*, *timing*, *style*, and *direction* – that are to be considered have already been discussed in detail in Section 4.4.1, with a focus on the general setup, this section

underscores those findings and provides a brief overview of the possible barriers to achieving a fitting preparation phase.

The preparation phase is mainly related to the setup of ULS implementation management, especially the establishment of a first ULS vision that needs to be addressed because this has implications for the implementation management and later project procedures. Hence, the interrelation of the latter with all other decisions is profound and must be a focus area. With the recommendations given in Section 4.4.1 in mind, the following main barriers can typically arise during the preparation phase can be mitigated by the application of the appropriate measures, as outlined below:

- *Loss of stakeholder support:* While the initiation phase typically ends with good intentions from the involved stakeholders, these plans for engaging with a ULS implementation can evaporate during the preparation phase. Hence, the stakeholders need to continue being persuaded and, where appropriate, incentivized to keep them onboard. It is suggested that workshops be organized to discuss these aspects. Furthermore, it is also recommended that stakeholders along the logistics chain be included to ensure a ULS implementation across all logistic services. If possible, several stakeholders for each step in the logistics chain should be involved.
- *Insufficient resources:* Coming from the initiation phase with the vision of establishing a ULS, in the preparation phase, this vision gets more detailed. This includes rough resource planning. It is normal for resources to pose a barrier in this phase due to limited financial or personnel resources. To overcome this barrier, it is recommended that funding opportunities be sought from not only the local stakeholders but also on a national or international level, such as funds from the European Union or dedicated sustainability funds.
- *Mishandling of high levels of complexity:* Both the ULS vision and the setup of implementation management are highly complex tasks, and this circumstance can be seen as a barrier. Consequently, to successfully achieve both, it is necessary to handle the complexity through the application of reasonable complexity management strategies. It is recommended that a first feasibility study be deployed that builds on a modularization of not only the ULS vision but also implementation management setup. This decreases the complexity and helps to handle various sublines.

- *Excessive striving for perfection*: Although a good fit between the ULS vision as an implementation object and the respective urban area as an implementation context is generally necessary, the preparation phase needs to avoid striving for perfection. Otherwise, this iterative process of ensuring fit between the two aspects takes too much time, and the implementation gets lost in the details. As outlined, a high-level ULS vision that is, for example, based on a design thinking approach and supplemented, for instance, by an analysis such as SWOT, is sufficient to move on.

The preparation phase can be considered a success and the basis to move on to the next effectuation phase when the general setup of implementation management is achieved. There are no quantitative measures available for this, but the qualitative measure of acceptance must be evaluated. It is essential to have acceptance for the ULS implementation from the affected stakeholders in the pertinent urban area. For the purpose of measuring, surveys and interviews can help assess the circumstances. If necessary, the general ULS implementation management may need to be developed further until the required acceptance level is achieved. With this, the ULS implementation can move to the effectuation phase.

4.5.3 Effectuation

With entry into the effectuation phase, the tangible part of an implementation begins. Many frameworks and procedural models from research and practice focus only on this part, neglecting the other phases either completely or by only recognizing the other phases briefly and without further explanation or recommendations. Because this dissertation follows a broad understanding of the term ‘implementation’, the cross-phase implementation concept for ULS incorporates the information in previous sections as a basis for the effectuation of any ULS.

It becomes clear from Figure 18 that implementation management and its elements play vital roles in the effectuation phase. These elements are discussed in detail in Section 4.4, so this section concentrates on the element of operations steering. This element is discussed in the following with a focus on possible barriers to its operationalization and thinkable actions for overcoming these barriers.

Operations steering

In general, the operations steering of the effectuation needs to be carried out by the appointed functional experts and their respective teams, because these people represent the operational level of the ULS implementation. Consequently, the organization and communication between implementation management and the operational level need to be appropriate to ensure proper steering. Furthermore, the operational level builds on the decisions and preliminary considerations of implementation management in the preparation phase. These preliminary considerations lay the groundwork for the steps that are involved in operations steering, as depicted in Figure 18. Operations steering is commonly subdivided into ‘planning’ and ‘realization’ steps, each with different sub-steps. The planning step refers to all decisions regarding the detailed planning of the ULS, which builds on the mentioned ULS vision that emerged from the prior phases. The realization step refers to all decisions necessary for realizing the ULS in a tangible, physical way in a particular urban area. This dissertation suggests allowing sufficient time for each of these steps in any ULS implementation to ensure no hasty decisions are made. In the following, the sub-steps of operations steering element in the cross-phase ULS implementation concept are described in detail:

Planning

- *Situation analysis*: The first step in the planning of operations steering is the situation analysis, which includes an in-depth analysis of the specific urban area. This analysis goes beyond the high-level analysis of the earlier implementation management. Generally, this in-depth analysis is recommended to assess the demand for ULS-related measures, and it can be oriented toward further demand-driven planning. Here, the contingency analysis suggested in this dissertation (see Section 4.1) comes into play to suggest situational factors that should be analyzed in detail. With insights about these factors – an individual interpretation can be applied, for example, where only a selection of key factors is analyzed – and the on-site situation, a summary of the implementation context can be given that allows for conclusions to be drawn from in the following steps. Furthermore, existing initiatives need to be identified and their inclusion ensured.
- *Goal identification and prioritization*: With the in-depth situation analysis in hand, the next step is the goal identification and prioritization process. As outlined, goals

related to ULS originate from different dimensions (see Section 2.3.2). While the implementation management is already concerned with the high-level goals in the factual management element, the operational level needs to break these goals down and match them with the situation analysis. The situation analysis may lead to these goals and their composition changing profoundly. As a result, the operational level needs to work closely with the implementation management and relevant stakeholders to reassess their goals and prioritizations because this step has further implications for the conceptual design of the respective ULS.

- *Choice and customization:* Because goal prioritization for specific urban areas can differ significantly, a unique ULS vision needs to be further developed based on the existing high-level ULS vision from the preparation phase, possibly also including existing initiatives. This is refined in the step of choice and customization that refers to the process of choosing appropriate UL concept components from the range of available components, customizing the individual components, and then forming them in a coherent ULS. At this step, the qualitative assessment suggested in Section 4.2 comes into play and helps to refine the choice of UL concept components. Based on the general assessment, the specific assessment turns back to the contingency analysis and goal prioritization to ensure a high level of fit between these aspects. With this, further refinement is necessary.
- *Detail reconciliation:* The ULS vision is further refined in the step of detail reconciliation. Here, the design factors suggested in Section 4.1.2 can help to achieve detailed customization of the various UL concept components. In addition, best practices from other urban areas can be analyzed and may contribute to the detailed reconciliation of the ULS vision that is recommended to be modularized. This step is considered very important because it lays the foundation for the further steps of actual realization. Consequently, the operational level needs to work in close cooperation with implementation management and affected stakeholders to ensure a fitting concept. Furthermore, the preliminary decisions from the preparation phase in terms of, for example, the implementation pace or intensity, need to be questioned and readjusted where necessary.
- *Proof of concept:* The detailed reconciliation is considered the basis for the proof of concept. This encompasses a final feasibility check of the planned ULS and

contributes to the mitigation of risks, validation of critical requirements concerning its application, and an acceptance test of the affected stakeholders. It is recommended that this be built on detailed simulations showing the effects of a ULS for the particular urban area in each of the modules. It is recommended that this is done by external experts with sufficient knowledge about simulations in complex environments. Furthermore, it can help to build an overview of the ULS and its effects on the urban area for marketing purposes, which can be based on the taxonomy of Benjelloun *et al.* (2010).

Realization

- *Execution planning:* With the entrance into the realization step based on the proof of concept, execution planning can now take place. For each of the modules of the ULS vision, a separate pilot program needs to be set up that is independent of the others but also shows their interrelationship and provides a way of combining them when they are put into practice. For this purpose, it is necessary to set up detailed capacity planning, especially in terms of financial and personnel resources. Moreover, it needs to be planned where tangible resources are procured from. This planning can culminate in a Gantt chart supporting the overall plan. If necessary, legal framework conditions need to be created or existing ones adjusted to ensure a successful realization (e.g., for underground transport systems). This execution plan needs to be aligned with and communicated by the operational level with the stakeholders in the urban area to ensure acceptance.
- *Measure execution:* Based on an accepted execution plan, the measures for putting the ULS vision into practice need to be carried out. This includes all actions that contribute to the deployment of the related ULS modules in the specific urban area. Where tangible resources such as e-trucks, hubs, or cargo bikes are part of the various ULS modules, they need to be procured and customized according to the proof of concept. The measures then must be deployed in the day-to-day business of the affected process, culminating in changes in the operational processes of the various stakeholders, including not only local businesses but also potentially affecting private parties, depending on the specific ULS. It is recommended that sufficient time be allotted to realizing all of the steps.

- *Forward projection or termination*: When all measures are fully executed, an assessment is recommended to decide on the step of a forward projection or termination of the various measures. While the proof of concept and all planning-related activities ensure a high level of fit between the ULS and the respective urban area, reality can differ due to recent developments that could not be considered before and other factors. Consequently, the assessment needs to show how successful the contribution of the ULS is with achieving the prioritized goals. Depending on the individual ULS, these influences can be seen earlier or later in the process. Therefore, it has to be individually determined when the assessment can take place. Based on the assessment results, the relevant stakeholders need to decide if the ULS measures should be continued or terminated.
- *Continuous evaluation*: Throughout the entire operations steering element, it is suggested that a continuous evaluation of the implementation process be carried out to ensure a seamless process. For this purpose, implementation management needs to act as a monitoring organ, setting up individually designed monitoring criteria that fit the specific ULS implementation. These monitoring criteria can be composed of KPIs from the dimensions of economic, ecological, and societal goals, depending on the individual goal prioritization. The performance indicators suggested in Section 4.1.3 can also be utilized. These aspects need to be continuously checked through an adjustment analysis. Where necessary, countermeasures should be taken to return to original goals, working particularly closely with participating stakeholders. At the end of the implementation, it can be recommended that there is a check for the aspects of acceptance level, degree of application, and implementation adequacy, following Kolks (1990).

In Figure 18, the element of ‘operations steering’ is intentionally displayed in a circle, aiming for an iterative characterization. This iterative manner contributes to a permanent back and forth that is aimed at reaching the best possible fit between the specific urban area (implementation context) and the ULS (implementation object) as a significant factor for success. Consequently, a permanent questioning from this perspective is necessary for the decisions made in operations steering. If the questioning leads to the recognition of required reworks, a further ‘loop’ – going back, improving the respective decision, and moving on – must be completed. In the following, there are examples of reasons for new loops (alphabetically ordered and unranked):

- *Contextual changes:* As outlined, the individual situation in a particular urban area shows the implementation context for the corresponding implementation undertaking. Therefore, this dissertation suggests an in-depth contingency analysis of the area (see Section 4.1). While this situation analysis can be considered cumbersome and time-consuming, it is necessary for ensuring a high degree of fit between the implementation object ULS and the implementation context urban area. However, there can be changes in the urban area over the course of an implementation undertaking for reasons such as the market entry of new players impacting the local logistics flows. This may have implications for the ULS implementation, and the ULS may have to be altered. These changes are highly individual; therefore, this dissertation does not aim to give an exhaustive list of examples. Nevertheless, it is recommended that the context of the ULS be closely monitored.
- *Discrepancies with stakeholders:* A further iterative loop in operations steering may also originate from discrepancies with the stakeholders, namely, internal, participating ones, and externally affected ones. Difficulties can arise with the participating organization if, for example, the promised participation does not materialize as expected. Where intensive reconciliation efforts by the implementation undertaking with respective stakeholders fail, there could be an attempt to compensate for this failure with either a more profound participation from another internal stakeholder or a search for a new stakeholder. If both countermeasures fail, the ULS implementation must be altered to work without the stakeholder that departed. External stakeholders need to also be managed, especially to achieve acceptance. It is suggested that this be done in close collaboration with implementation management (see Section 4.4.4).
- *Economic infeasibility:* During the operations steering element, there may be cases where it is determined that the ULS is not economically feasible in the long run. While many UL concept components need to be subsidized, at least initially, a ULS normally needs to aim for self-sustaining economic carrying over the long term. When this goal cannot be reached due to the conceptual design of the respective ULS, a further loop needs to be initiated in operations steering with the aim of establishing an economically feasible ULS. This may include profound alterations to the conceptual design of the respective ULS, but it is unavoidable in such cases in order to ensure long-term success. It is suggested that the different modules of the ULS first

be investigated to determine if only one UL concept component is deficient. If that is the case, it may be sufficient to alter only this aspect of the ULS in a further operational loop.

- *Missing impact on KPIs:* When the ULS is fully implemented, it needs to be evaluated for how it impacts the individually set KPIs, depending on the aforementioned goal prioritization. It may be the case that the ULS does not impact the evaluated KPIs in the way that was previously expected. When this is the case, it needs to be determined where the missing impact originated. It is again suggested that the various ULS modules be independently evaluated to find the origins. This can lead to insights about the impact on the KPIs. With this information, it can be decided if the impact on the KPIs is actually necessary or if the implemented ULS is considered already sufficient. With a sufficient ULS, no further alteration is necessary. Where this is not the case, a further operational loop may be needed to adjust the ULS, with the aim of achieving the expected impact on the predefined KPIs.
- *Technological infeasibility:* Despite all efforts in the ULS conceptual design, there might be cases where it turns out that, in practice, the ULS is not yet feasible due to incompatibility with necessary technology. Because this may originate in the details of some of the UL concept components that comprise the ULS, it is suggested that these concept components and their technical configurations be investigated in detail. Furthermore, technical difficulties may occur at the intersection of two UL concept components, which calls for further customization to ensure their interoperability. Consequently, it may be necessary in both cases to go through the operations steering element again in another loop with the aim of eliminating the infeasibilities. Where this is not achieved, it is suggested that the ULS conceptual design be amended to exclude the technologically infeasible parts of the ULS.

When the operations steering is successfully passed through, the effectuation of the ULS implementation is complete, and it can move on to the next phase.

4.5.4 Examination

Once there is a successful ULS implementation, the final phase of the examination is reached. While the body of literature suggests understanding the term ‘examination’ in the context of implementation as monitoring the performance, this dissertation suggests a different focus for the specific case of ULS: The ‘classical’ understanding is

incorporated in the ‘operations steering’ element during the effectuation phase, with the suggestion made that a continuous iterative evaluation be planned to realize the specific ULS. It is advantageous for the evaluation to not occur at specific milestones, but instead be carried out throughout the entire effectuation process. However, a final examination takes place by considering the success factors outlined in Section 4.3. Hence, the examination phase predominantly builds upon the successful ULS implementation and refers to the final examination of the implementation from an external perspective, encompassing the operational measures as well as implementation management to ensure a ‘*knowledge storage*’ and a ‘*knowledge transfer*’ which are suggested as central elements for this phase. The latter elements are discussed in the following, with a focus on possible barriers and suggestions for overcoming them:

Knowledge storage

The element of knowledge storage is concerned with storing all relevant information drawn from the ULS implementation and making it widely available. Thus, it builds on the elements of project controlling and project information, which both provide data. Associated parties that are part of the ULS implementation can function as experts whose knowledge must be extracted and added to create adequate written knowledge. While intraorganizational knowledge management is usually the basis for competitive advantage and, therefore, needs to be safeguarded from external parties, the case of the interorganizational ULS differs in widely significant ways, such as the ULS contributing to a better quality of life in the urban area. Consequently, it is suggested that knowledge about how to achieve successful ULS implementations be made publicly available to ensure a transfer of this generated knowledge and ultimately achieve further ULS implementations in other urban areas. This also contributes to establishing best practices. Thus, it is recommended that knowledge storage be carried out structurally, in databases that are optimally accessible to external parties. A public website with in-depth information about the ULS implementation undertaking is one possibility. However, when making data publicly available, participating stakeholders and their company-related information in particular can represent a burden because private companies often do not want to release data. Therefore, it is suggested that the knowledge storage aspect be discussed in detail with the affected stakeholders to ensure their consent to sharing knowledge about the particular ULS implementation.

Knowledge exchange

With the collected information about the particular ULS implementation in the knowledge storage, knowledge exchange with external parties from all around the globe can be initiated. Other ULS implementations may have an interest in the findings of the successfully implemented ULS and the accompanying procedure. Consequently, with this element, the implementation undertaking serves as an information point for external exchange and can be understood as the final element to consider.

In addition to the collected information, the knowledge exchange contributes to establishing public awareness for the successful ULS implementation. Achieving awareness is also simultaneously the most significant barrier. To overcome this circumstance, it is suggested that pragmatic measures be taken, such as displaying information about the ULS project on a project-owned website, regularly writing newspaper articles or possibly even academic articles or participating in TV documentaries about ULS in order to achieve awareness. This can be done by anyone involved in the ULS implementation. With the achievement of awareness, external parties conducting a ULS implementation can get actively involved in a knowledge exchange by, for instance, setting up mutual workshops. This may even go so far as stakeholders from the successful ULS consulting on other ULS projects over a longer time frame. Exchanging the generated knowledge is considered the basis for further successful ULS implementations.

4.5.5 Illustrative example of application

This section describes an illustrative example of an application of the suggested implementation concept for ULS. Because the concept pursues a hybrid PM philosophy with a combination of classical linear sequences and agile iterative sequences, it is not possible to fully display any iterative loops that may be necessary in practice. Consequently, this example discusses only a sequential procedure, which differs significantly from reality. As every ULS implementation differs in crucial ways, the application of the suggested concept is also always highly individual, which needs to be distinguished. However, the illustrative example strictly follows the phases suggested in the implementation concept, which is presented following a description of the initial situation.

Initial situation

The example is concerned with an urban area with a population of 150,000 and growing that sits on a mostly flat surface without any significant hills. The infrastructure relevant for goods transport is well developed but consists mainly of roads and rails. Accesses to the urban area via water or air are not available. In the larger picture, the urban area is situated at the edge of the country and is not a major industrial hub. The local industry is very heterogeneous, without a concentration of any particular industry. This mainly consists of mid-sized players, but there are some larger companies in an industrial zone of the area. The e-commerce industry in the urban area is growing rapidly, mainly driven by private consumers and resulting in a growing number of delivery vans in the urban area, which often park on roads, blocking them. As a consequence, the residents are dealing with more and more traffic congestion. Connected to the increase in traffic are the related emissions, given that the means of transportation are almost exclusively powered with fossil fuels. These developments had recently led to a noticeable negative impact on the quality of life for the area's inhabitants.

These problems are now recognized by local stakeholders such as the local industry, residents of the urban area, and especially the newly elected local authority with a sustainability focus. Consequently, the primary initial aim for the local authority is to reduce the traffic related to the transportation of goods, which would consequently also reduce emissions. Therefore, the local authority takes up the challenge and wants to initiate a ULS implementation undertaking. However, thus far, there have been no UL initiatives in the urban area. Hence, there are no existing projects to be taken into account.

Initiation

In this example, the newly elected local authority's focus on sustainability-related topics can be considered the external impulse for the uptake of a ULS implementation undertaking (*'External impulse'*). In this circumstance, the ball is set rolling in terms of encountering the rising challenges in the specific urban area. The identified success factors are considered throughout the process, and the local authority gets in touch with other stakeholder groups to initially discuss possible UL-related measures. This is done by organizing public workshops where residents and local industry are invited. For this purpose, the local authority informs the public and local industry stakeholder up front

with informal talks, publications, flyers, or advertisements in the local newspaper. This is done to reach as many stakeholders as possible to get them engaged in and reflecting on the current situation, its challenges, and possible measures that are related to the creation of a ULS.

With these workshops and talks, an initial plan emerges step-by-step for encountering the most pressing problems (*'Need for ULS implementation'*). Furthermore, the sense of a need for the ULS implementation and the willingness to have a ULS implementation are both heightened by these workshops (*'Willingness for ULS implementation'*). This clarifies what is necessary in the urban area and which stakeholder groups are willing to participate in at first. Therefore, a first goal prioritization takes place based on the challenges and possibilities. These findings culminate in an initial foggy ULS vision that encompasses the deployment of alternative means of transportation in combination with a hub system. With these measures, the willingness for a ULS implementation crystallizes.

Preparation

Based on the results of the initiation phase, it becomes clear that the stakeholders in the urban area want to implement a ULS. Consequently, upon entry into the preparation phase, the responsible parties set up implementation management in accordance with the guidelines of the implementation concept for ULS.

First of all, the foggy ULS vision is further detailed (*'ULS object composition'*) based on the formulated problem statement for the area, which is that traffic flows should be reduced, leading to less congestion and fewer emissions. While the suggested ULS vision is built on alternative means of transportation and a hub system, it is now focused on the logistic flows in the CEP market due to the growing e-commerce activities of private consumers in the urban area. Furthermore, the foggy ULS vision is modularized in two independent pilots to handle the complexity. Based on this, the urban area context (*'ULS context composition'*) is further analyzed. For this purpose, a high-level contingency analysis is carried out to achieve a preliminary fit of the foggy ULS vision to the context and to the goals of the undertaking. The implementation management decides to focus on two specific spatial regions in the urban area to start with putting the ULS vision into practice. Consequently, two 'sub-visions' are sketched out for these regions. To counteract the growing challenges in the urban area, it is discussed to start

with the work on the ULS as soon as possible (*'Timing'*), while keeping in mind that adequate time is necessary to achieve a fit between the implementation object and the implementation context. Due to the fact that the local key stakeholders seem open to working on the ULS and want to get actively engaged, there is a discussion of how to implement the ULS (*'Style'*). Additionally, because a high degree of participation from the affected stakeholders can be expected in this urban area, a participatory implementation style is selected to ensure continual involvement throughout the process. With this choice, implementation management promises that acceptance for the ULS undertaking is achieved, particularly from the general public. Notably, because the public is not familiar with activities encompassing UL measures in the urban area, and because a participatory implementation style was chosen, the ULS vision is put into practice with a top-down approach (*'Direction'*). For this reason, the local authority sets up a central entity for all UL-related activities. With the help of a PM philosophy ensuring a well-developed ULS vision in combination with agile elements (*'Hybrid project management'*), the preparation for the ULS implementation undertaking is completed.

Effectuation

After entering the effectuation phase, the implementation management takes care of factual decisions (*'Factual management'*) to ensure a proper fit of the ULS vision to the urban area. First of all, specific objectives are defined. These are translated into measurable KPIs. For this example, a particular percentage reduction of goods transport traffic is set that is subdivided into two pilots where implementation management decides to introduce these pilots using an overlapping strategy (*'Context transition'*), where the current situation is continuously transferred to the new status. This is done to ensure a step-by-step process and ease risks in terms of upcoming implementation barriers. Furthermore, the foggy ULS vision gets more detailed in this phase (*'Object scope'*). Hence, the implementation management turns to a good practice analysis from other urban areas to draw conclusions for their project. With this enhanced ULS vision, external consultants are assigned to carry out a feasibility study specifically for this urban area. While the overall results of the feasibility study are positive, there are minor changes needed in the ULS vision to ensure a fit with the implementation context. The feasibility study also allows conclusions to be drawn about how quickly to implement the ULS vision (*'Implementation pace'*), which suggests a slow but robust procedure.

The related measures are carried out with medium intensity (*'Implementation intensity'*) to ensure acceptance from the relevant stakeholders.

In addition to the factual dimension, competencies for implementation management are sketched (*'Competence management'*). For this purpose, the implementation management is formally set up as a PM team, and consequently, personnel (*'Personnel anchoring'*) with sufficient experience, such as from large projects or the public domain, are permitted to move forward with the project. In this example, a joint venture is founded by the participating stakeholders. The entitled parties are set up in a structure (*'Implementation organization'*) that includes a supervisory board composed of members of the stakeholder groups, an operations implementation management president, and functional experts, each with their own team. Following this, the supervisory board decides on the significant strategic decisions for the ULS that the president, experts, and teams plan and realize (*'Implementation roles'*). The joint venture is led with a standardized participation approach (*'Implementation leadership style'*) to ensure engagement. Finally, the deployed parties are trained for the specific project demands (*'Implementation competencies'*).

In addition, simultaneously with factual and competence-related decisions, the setup implementation management manages the relevant stakeholders (*'Stakeholder management'*) by first analyzing the stakeholders. This starts with the information gathered in the initiation and preparation phases, focusing on the extensive workshops that were held. However, the urban area is further analyzed to identify other possible stakeholders and their interests. This encompasses not only the already participating stakeholders but also other groups. After this analysis, the respective interests are reconciled based in particular on regular open discussions with implementation management that aim at achieving positive impacts from the ULS that will be implemented for any group in the urban area. Furthermore, implementation management sets up controlling measures (*'Project controlling'*), primarily focusing on a project structure plan to successfully mitigate risks coming up throughout the project. Information from the controlling directly contributes to information events (*'Project information'*) that create awareness about the measures being taken in the urban area related to the ULS implementation.

With the implementation management in place, operations, composed of the experts and their teams, is able to start its work (*'Operations steering'*) under implementation management's guidance. While an iterative process is carried out, the project group focuses on the following steps: For further detailing of the feasibility study and the respective ULS vision, an in-depth situation analysis is carried out based on a contingency analysis. This leads to a further goal identification and prioritization, where it becomes clear that, indeed, lowering the traffic volume is the most pressing problem to focus on with the ULS. With this information, operations assess the UL concept components in a choice and customization process to come up with a complex hub system in specific areas and the deployment of e-trucks and cargo bikes. In the step of detail reconciliation, the project group comes to the conclusion that 18 e-trucks and 47 cargo bikes are necessary, each with specific technical requirements. This information about the ULS is successfully proven to work in practice by the external assignment of a proof of concept. Having completed the planning phase of the operations steering, the realization phase begins with execution planning. This makes clear where, when, and how to start with introducing the hub system and alternative means of transportation, and it is performed by the measure execution subsequently. While the iterative process calls for continuous evaluation throughout the process, after the successful realization, the ULS is evaluated further to decide on its forward projection or termination.

Examination

With the start of the last phase of the ULS implementation undertaking, namely the examination, implementation management can look back on successfully implementing two independent pilots and merging them into an overall ULS. However, the implementation work is not done because the examination of the ULS implementation takes place in conjunction with the final evaluation, based on the identified success factors.

For this purpose, implementation management builds a central digital storage (*'Knowledge storage'*) to ensure the generated insights are saved beyond the implementation undertaking. This digital storage is built on the results of the project controlling and project information elements (see above) that are set up during the effectuation of the ULS implementation. With the aim of full transparency, implementation management decides to put all related data that are not personnel related

into digital storage. This way, implementation management contributes to maintaining the level of acceptance among stakeholders in the urban area and provides valuable insights for other ULS implementation undertakings.

The establishment of the digital storage simultaneously represents the beginning of an exchange with parties outside the urban area (*'Knowledge exchange'*). To ensure that other implementation undertakings related to ULS can learn from the insights generated throughout this project, implementation management actively engages in an exchange with any interested parties. This includes, for example, their appearance at exhibitions as speakers or discussants.

Concluding remarks

Primarily due to the fact that the situation in any urban area is highly individual, which can be further evaluated by the application of a contingency analysis based on the identified criteria reviewed in Section 4.1, an iterative manner is suggested for the ULS implementation. Because of this, the illustrative example is too static to represent the dynamics of a real-world project that would require extensive iterative back and forth on many kinds of decisions, such as to achieve a fitting ULS conceptual design. Furthermore, burdens blocking the successful ULS implementation, such as the withdrawal of a key stakeholder, can arise dynamically throughout the implementation process. These problems require individual answers based on the individual situation. Consequently, a pragmatic search for possible solutions is suggested. However, due to the limits of this dissertation, these circumstances are not further discussed here. Hence, the illustrative example has to be understood as limited, especially in these two circumstances. Nevertheless, these conditions must be noted in any application of the implementation concept on any ULS implementation undertaking.

5 Conclusion

After considering the empirically validated findings in Chapter 4, Chapter 5 places the results in the broader research setting. While Section 5.1 reflects on the answers to the research questions through a discussion of the contributions to the theoretical KB, Section 5.2 discusses the managerial implications of this dissertation and how the findings can contribute to successful implementations of ULS. The last Section, 5.3, turns to the limitations of this thesis and ends with ideas for future research.

5.1 Contributions of this research

This section of the thesis positions the findings in the broader research context. Therefore, a brief summary of the answers to the research questions is given. Next, a discussion of the results' implications for other implementation activities follows. Finally, a short review of this study's theoretical contributions is presented.

Answers to the research questions

The overarching research question, RQ_0 , which was concerned with the successful implementation of ULS, was subdivided into five RQs – RQ_1 to RQ_5 . In the next paragraphs, the answers to each of the RQs are discussed, culminating in the conclusions for RQ_0 .

RQ_1 was concerned with the question of generating insights into the situational factors and design variables that affect the conceptual design of ULS. To address this question, a contingency analysis of the conceptual design phase of ULS was conducted using CT as its basis. Due to the highly individual nature of urban areas, particular situational factors form an integral part of the process of a profound in-depth analysis because they are the basis for the ULS conceptual design. With CT in mind, this research suggested a CT framework for the contingency analysis, based on a differentiation of three categories of situational factors, namely, exogenous, urban area-related, and endogenous situational factors. With this categorization, the dissertation identified six exogenous, sixteen urban areas-related, and six endogenous situational factors that also must be analyzed for each urban area as a basis for the ULS conceptual design. Each of the identified factors was discussed briefly to gain a deeper understanding of them. Furthermore, the second part of the RQ, asking about design variables, was also

investigated. In this respect, this dissertation suggested four relevant categories (fundamentals, stakeholder, technical configuration, and operational processes), each with four design factors contributing to the ULS conceptual design and to help ensure high levels of customization. In addition to that, this research provided suggestions about performance indicators that contribute to a high level of fit between the implementation object (ULS design) and the respective context (urban area).

RQ₂ focused on the choice of UL concept components for the ULS conceptual design and asked how to do it with respect to the individual situation in the respective urban area. Due to the manifold of UL concept components, this dissertation suggested a two-step procedure to safeguard the decisions made for or against particular UL concept components. Thus, this research developed a qualitative assessment framework that is applicable in general in respect to the current state of knowledge about the identified UL concept components, excluding regulatory measures, for the first step. This assessment framework consisted uses seven dimensions to generate impressions that are based on the most essential aspects. By its application, the decision for the preselection of UL concept components can be supported. Two examples were given for the concept components of e-trucks and periphery hubs. For the second step, this research suggested a specific qualitative assessment in conjunction with the findings of the situation analysis, for example, based on the contingency analysis proposed before, that characterizes the respective urban area.

With *RQ₃*, the investigation turned to the implementation process and sought to identify the success factors that need to be considered for implementing ULS. Against the backdrop of a broad understanding of the process of implementation that encompasses planning activities, this dissertation developed six general success factors that are applicable for the overall implementation process. These are concerned with adaptable insights into the critical factors to consider with every ULS implementation. Furthermore, this research evolved more detailed success factors that were categorized within four phases (initiation, preparation, effectuation, and examination) and five dimensions (strategy, organization, operation, communication, and finance) to culminate in three success factors each. With their consideration, this research suggested a basis for successful ULS implementations. For their operationalization, two kinds of measures – implementation-related ones and output-related ones – were proposed.

RQ₄ emphasized the implementation management necessary for the context of ULS, along with its setup. First of all, the term ‘implementation management’ was transferred to the ULS context, encompassing both functional and institutional aspects. Furthermore, this dissertation suggested the setup based on several elements that were identified. First, the proposed general setup encompassed the elements of object composition, context composition, timing, style, and direction, which are subject to the preparation phase of an implementation undertaking. Second, in the effectuation phase, this dissertation advised which elements are encompassed by factual management (decisions about the elements of context transition, object scope, implementation pace, and implementation intensity), competence management (encompassing personnel anchoring, implementation organization, implementation roles, implementation leadership style, and implementation competencies), stakeholder management, project controlling, and project information. Each element was discussed in detail, including general recommendations suitable for any ULS implementation undertaking.

RQ₅ asked how an adaptable implementation concept tailored for the context of ULS can look like to achieve successful implementations. For this purpose, this research developed a cross-phase implementation concept that encompasses four phases (i.e., initiation, preparation, effectuation, and examination). With this concept, it was proposed that different consortia can orient themselves toward it due to its adaptability. In addition, the concept was based on a hybrid PM philosophy that brings classical forward waterfall planning together with agile elements to account for the highly dynamic environment in an urban area. By doing so, this cross-phase implementation concept put the answers to *RQ₁* through *RQ₄* into a larger perspective and located them within it. Furthermore, the concept was discussed in detail with a focus on the perspective of TOC to identify the potential constraints that may arise during its application and recommendations about possibilities to overcoming them.

With the proposed findings as the answers to *RQ₁* through *RQ₅*, this dissertation contributed to answering *RQ₀*. By the application of the findings, encompassing the conceptualization of ULS and their realization, both expressed in the implementation process, it was proposed that ULS can be successfully implemented in practice. To exemplify this, an illustrative example of the application of the collected results of this research was discussed at the end of Chapter 4. These findings are meant to be adaptable, so they must be broken down for each specific ULS implementation undertaking.

Implications for other implementation activities

Whereas this dissertation focused on the implementation of ULS, the results imply contributions to other implementation activities, too. In the following, the transferability of the central pillars of the results is briefly discussed in light of these other activities.

As outlined, there is a classical, phase-based understanding of the implementation, and there is a broad, integrative one. This research followed on the broad implementation understanding to ensure a fit between the planning and realization activities, which both contribute to a successful implementation in practice. Due to the expanding complexity of today's environment, it is advisable to adopt this broad understanding for other implementation undertakings. With isolated planning and realization-related activities, it is argued that more and more plans stay visions without any realization at all. Consequently, this separation needs to be broken through.

Furthermore, the implementation concept builds on a hybrid PM philosophy, combining elements from waterfall planning with agile elements. Again, due to the increasing complexity of today's environment and, consequently, also of many implementation undertakings, a hybrid PM philosophy is recommended to be transferred to projects that are subject to high levels of uncertainty and interdependence with the surrounding environment. For many projects, it is generally advisable to question the classical waterfall philosophy, particularly in terms of interorganizational implementation undertakings, where this hybrid philosophy can help align interests significantly due to its iterative character. This means it can contribute to significantly improving the fitting of implementation objects to their respective implementation contexts.

An additional pillar on which the results of this research foot on is the broadening of elements of an implementation undertaking beyond the operations steering. While many implementation-related publications focus mainly on key operational steps that need to be taken, the results of this dissertation show that that is too short of an idea. The results indicate that implementation is connected to various elements, including competence management, that need to be considered and need to be adjusted to the specific case. With a focus on possible arising barriers and strategies to overcome them, based on the TOC perspective, this way of thinking can be transferred to other implementation activities, contributing to successful undertakings in a range of contexts.

Theoretical contributions

This section serves as a reflection on the overall research project through a discussion of the dissertation's theoretical contributions in relation to the theoretical shortcomings (outlined in Section 1.2). Due to the rooting of this research in an intersection of different research streams (see Section 2.2), the contributions have widespread implications for these literature streams.

TS1 referenced the currently insufficient level of knowledge about the assessment and customization of UL concept components in terms of their implementation, with special consideration of varying circumstances in different urban areas. This dissertation addressed these shortcomings by identifying and analyzing a manifold of UL concept components. With the application of CT for the conceptual design phase of ULS, resulting in a diverse body of situational factors and design variables, it laid out the basis for the for customizing UL concept components. This dissertation provided a starting point for more in-depth research by developing a general assessment framework and discussing the use of special assessments based on the individual situation analyses.

TS2 emphasized the lack of research about combining UL concept components to form ULS, especially how these components can be designed taking into consideration their implementation in practice. The results of this dissertation advance the body of knowledge in this respect by taking a holistic perspective of UL, which is often requested by scholars. In addition to the contingency analysis and the two-step assessment procedure, this research identified design variables for the combination and customization of the identified UL concept components. Furthermore, it pointed to certain performance indicators for gathering information about the fit between the ULS (implementation object) and its respective urban area (implementation context).

TS3 highlighted the undifferentiated treatment of implementation in UL projects that lacks empirically confirmed analyses with a systematic investigation of ULS implementation. Against the backdrop of the broader understanding of implementation, this dissertation identified success factors for the overall ULS implementation and certain phases of an implementation. Moreover, this research provided recommendations for ULS implementation management based on the identification of critical elements for consideration. Putting it into a larger perspective, it proposed a cross-phase adaptable implementation concept that is based on a hybrid PM philosophy

and systematically tailored for ULS, rounded off by empirical validation from various perspectives.

5.2 Managerial implications

Urban areas worldwide face the various challenges outlined in Section 1.1. These include expanding urbanization, the particular growth of e-commerce activities, and rising customer expectations, all of which lead to increasing numbers of delivery vehicles, higher emissions, and more noise subsequently. Hence, it becomes more and more crucial to ease these challenges with smart solutions such as the concepts summarized under the umbrella term of UL. Therefore, these concepts must be put into practice and implemented on a large scale. This research consequently dealt with the specific parts of the ULS implementation process that can be considered particularly difficult to handle, as described in Section 1.1. While the research results of this dissertation are presented in detail in Sections 4.1 through 4.5, they are discussed here with respect to the identified managerial challenges (see Section 1.1). Furthermore, an application of the developed implementation concept is sketched out to demonstrate to practitioners what these results imply for their practice-related environment.

Overview of the implementation process for ULS

The suggestion of an adaptable cross-phase implementation concept, tailored for ULS and supplemented with recommendations, of this research can help practitioners orient toward and tackle ULS projects. From this concept, it became clear what steps need to be taken, which barriers can arise, and which stakeholders to include. Primarily due to the fact that this ULS implementation concept goes beyond the pure operational steps that most studies have focused on in the context of implementation, this dissertation presents a broad overview with the possibility for guidance, adaptable for a range of ULS undertakings. Such an overview of the implementation process for ULS had not previously been presented. With this, the aforementioned managerial challenges can be tackled, as the following paragraphs outline:

MCI focuses on the search and customization of UL concept components because practitioners tend to lack an overview of the available solutions and how they can be customized in conjunction with the individual specific on-site situation. This research identified the known UL concept components, categorized them into five segments, and

discussed how to assess and customize them. With the help of the developed assessment framework, practitioners gain a simple overview of which UL concept components exist and how they perform in specific dimensions. In addition, practitioners can orient the customization process of UL concept components on the basis of the contingency analysis and the associated design variables.

MC2 put an emphasis on the problem of designing ULS under consideration of their implementation, as in practice, visions often do not get realized because the pathway to manifesting that vision is not considered from the start of the project. In response, this dissertation addressed the issue by highlighting a broad understanding of the implementation process, encompassing planning a ULS design that includes a map to its realization. This way, practitioners are encouraged to break through the classical separation of these two phases. With the identified success factors and a contingency analysis that provides an in-depth, iterative way of fitting the ULS vision to the specific urban area, help is offered for practitioners to overcome this managerial challenge.

MC3 draws attention to the struggles of implementing ULS in practice in general due to the lack of a guiding concept tailored to that particular circumstance. With the integration of the results of this research, namely the carried-out contingency analysis, the developed guidelines for the qualitative assessment of UL concept components, as well as the identified success factors, the proposed adaptable cross-phase implementation concept for ULS helps to solve this issue. Practitioners can apply this concept to urban areas, especially in the GAS area, to start ULS implementation undertakings and tackle these problems in practice.

Consequently, this research can be considered strongly practice-oriented, not least also because of the chosen DSR methodology. In conclusion, the course of this study made it clear that the scientific call to close the research gap in the area of ULS implementation corresponds with the desire of practitioners to conduct in-depth discussions around the topic.

Application of the developed implementation concept for ULS

As outlined, the developed cross-phase implementation concept for ULS with integrated findings from this research must be applied in practice to achieve an impact. This needs to be initiated, especially by practitioners that are entrusted with UL-related measures in a particular urban area. Consequently, this dissertation can only act as a starting point,

outlining a set of general guidelines that must be broken down and specified based on the individual ULS implementation undertaking. As these undertakings differ significantly due to the individual circumstances of urban areas, the findings of this dissertation were intentionally kept at a relatively high level that was combined with a holistic perspective on UL concept components and the ULS implementation process to guarantee the aimed adaptability, specifically, their application in a wide range of different urban areas. Hence, it must be emphasized again that the findings presented in this dissertation must be considered ideal-typical. In practice, the ideal-typical findings may need to be altered for the individual situation. Thus, practitioners are advised not to slavishly follow the recommendations but instead to decide individually to have a pragmatic view of paving the way for successful ULS implementations in practice.

Nonetheless, the application of the developed implementation concept can have implications for any ULS undertaking. Especially the emphasis of this research on a hybrid PM with an iterative manner to ensure a high level of fit of the ULS with the specific urban area and the focus on overcoming potential barriers to implementation need to be named here. With this, the implementation concept seeks application by practitioners who form consortia consisting of stakeholders alongside the logistics chain and the respective local public authority as the best-case scenario.

In conclusion, it is proposed that the four barriers named in the introduction (see Section 1.1) can be overcome by practitioners applying the findings of this research. While the findings in the body of literature about the two barriers of (1) successful funding composition for UL-related measures and (2) the findings of stakeholder involvement were each considered and incorporated in this research, they were not areas of concentration. Rather, this research focused on overcoming the barriers caused by (3) a lack of fitting UL concepts and (4) implementation planning and execution. Based on specific guidelines for the ULS conceptual design aimed at achieving a high level of fit between the implementation object (ULS) and the respective implementation context (a specific urban area), incorporated in an adaptable cross-phase implementation concept for ULS and supplemented with recommendations for actions, successful implementations of ULS in practice can be expected in the future.

Thus, the goal of this research will be achieved if these findings contribute to the successful implementation of ULS in urban areas. For this reason, it is desired that those

in the practice of this field take up the recommendations of this research and apply them to actual ULS implementation undertakings. Last but not least, a further desire is the advancement of the generated recommendations through the interplay of practice and the scientific community.

5.3 Limitations and further research

While this dissertation is located within a thoroughly investigated research domain (UL research), is based on well-established theories (i.e., CAST, CT, ST, and TOC), and follows a rigorous research methodology (i.e., DSR), there are still limitations that can be discerned. The following paragraphs outline the content-related and methodology-related limitations concerning the overall research approach. Afterward, avenues for further research are sketched.

Content-related limitations of this thesis encompass the holistic and integrative perspective on the research setting, its limited scope due to the chosen unit of observation and the missing quantitative insights into the ULS implementation process. The dissertation at hand investigated the overall ULS implementation process based on the derivation of a managerial (see Section 1.1) and a theoretical relevance (see Section 1.2). With the positioning of this dissertation at the intersection of implementation research and UL research, the broad scope of the research setting is revealed. Thus, this research made use of a holistic and integrative perspective, leading to results that are kept adaptable for different urban areas. This accounts for all parts of this dissertation's results (i.e., Sections 4.1 through 4.4 and culminating in the implementation concept in Section 4.5). Therefore, it is recommended that these results be interpreted as guidance that must be customized to particular contexts, which will lead to more in-depth results in certain elements of this research. This is recommended for research in the future.

Furthermore, the entire research process focused on urban areas in the GAS area due to the possibility of partial comparison given that the characteristics were considered relatively similar. For instance, among other examples, the same types of vehicles are used in these urban areas (outlined in Section 2.5). Hence, the scope of this research and its results are limited by the fact that the situation in other urban areas outside the GAS area may differ significantly. For example, megacities of more than 10 million inhabitants may be clustered in several city centers, resulting in a different

implementation concept for ULS in those locations. Nevertheless, also for the GAS area, the results of this research need to be interpreted as ideal-typical outcomes that may need to be altered in practice based on the individual situation. Consequently, it can be recommended that future studies enrich the urban area-specific research on ULS implementation by incorporating perspectives from particular instances.

The findings of the present dissertation may also be limited due to the qualitative research approach that was taken. With this approach, the investigated phenomenon of ULS implementation was systematically described, and the research gaps were closed, but the results were not verified by a large-scale survey. Especially from a practitioner's point of view, this can be an undesirable circumstance given that decisions throughout a ULS implementation undertaking are often driven by hard facts, such as financial aspects in regard to particular UL concept components. Particularly in the logistics industry, which is typically characterized by low margins, financial aspects are considered vital for decision-making. Nevertheless, future research may draw from this dissertation's results and deepen certain elements with respect to a quantitative research approach. The findings of the contingency analysis, with its identified situational factors and design variables, is the predominant call for quantitative research, meaning a focus on their interrelationships, weighting, and prioritization.

Methodology-related limitations of this thesis encompass the limited number of interviews and their composition, the subjective interpretation of the collected data, and the missing final in-practice validation of the research results. The applied methodology of DSR, consisting of several loops that combine the KB (body of literature) and the environment (practice) in the design cycle, made use of semi-structured interviews for the validation of this dissertation's results. Consequently, it is based on a qualitative empirical validation, resulting in a limited number of interviews that represent a small overall sample. Thus, it can be concluded that generalizability is limited to some extent, although saturation was reached, where no additional insights from further interviewees were expected to enhance the findings of this research. Additionally, while the sample was carefully composed to include all relevant stakeholders' perspectives (e.g., LSPs, shippers and receivers, public authority), the interviewees were geographically concentrated in the GAS area. Whereas this was an intentional aim due to the chosen unit of observation (urban areas in the GAS area), it can be concluded that the validity of the results is proven only in this area and is, therefore, limited. Furthermore, although

the named techniques included steps that were taken specifically to counteract potential biases (see Section 3.3), the possibility of bias cannot be entirely excluded. Therefore, it must be noted that with a different environment and a different composition of interviews, the results could possibly be different in parts. Thus, it is recommended to carry out longitudinal studies in the future to enhance the further development of the research results.

In addition, this dissertation's results suffer from the subjective interpretations of the researcher carrying out the investigation, which is a typical limitation of qualitative research methods. This subjectivity encompasses the interpretation of the literature review (see also Section 2.1), as well as the data gathering using the DSR methodology (see Section 3.3). This subjectivity is in line with the chosen research paradigm of interpretivism. To minimize subjective bias, the research results were validated in the form of semi-structured interviews with practitioners from various perspectives, all having a connection to the subject of UL. Nevertheless, this research does not claim to be exhaustive (e.g., the identified situational factors or design variables may still be interpreted differently from another researcher's perspective), and therefore, further aspects may be uncovered. Thus, future research is called for to further validate and enrich this dissertation's outcomes.

Although the followed research methodology of DSR included external validation of the research results with a range of practitioners as part of the design cycle to ensure an iterative further development of the research results, this validation remains only theoretical. Because this dissertation's outcomes aim to contribute to the practical implementation of ULS, especially by the culmination of the outcomes in the developed cross-phase adaptable implementation concept, a final validation – also in the sense of the DSR methodology – would be their application in practice. Consequently, this research calls for the formation of consortia in practice that orient toward these research results. Such an application of this dissertation's contributions can act as an additional cycle in the DSR methodology to ensure the practicability of the outcomes in not only theoretical scenarios but also in the real world. With this, further development of the results is perceived as possible. Thus, this dissertation may act as a starting point for practice-oriented future research undertakings to expand and enlarge the contributions of this research.

Two further research avenues are suggested in the following in addition to the indicated directions: Over the course of conducting this research, it became clear that the implementation understanding needs to be deepened in the context of ULS. While this dissertation is rooted in an integrative perspective and based on an eclectic theoretical access to the research phenomenon, scholars are required to better understand the mechanisms alongside the whole process. Against this backdrop, a recommendation is made to further investigate selected elements of the ULS implementation process with the aim of extending the findings of this dissertation. For this purpose, the application of other theoretical lenses may contribute to the exploration and deepening of the understanding of ULS implementation. Next to the theoretical contribution, the final recommendation for future research is strongly connected with this dissertation's purpose of contributing to managerial impact in practice. Whereas this research provides an implementation concept for ULS, it needs to be studied from practice, including how it functions in the real world and what can be learned from it. Thus, it is recommended to conduct case study research over the course of a complete ULS implementation undertaking in specific urban areas.

6 References

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Appendix

A Extract of the interview guideline

The criteria are written in bold, and the associated questions are listed below the criteria.

Fidelity with real-world phenomena

- Does the artifact reflect the real world adequately and sufficiently? If not, how can this aspect be improved?
- Is the artifact feasible for use in the real world? If not, how can this aspect be improved?

Level of detail

- Does the artifact provide an appropriate level of detail? If not, how can this aspect be improved?
- Is the artifact profound enough to ensure orientation for practitioners? If not, how can this aspect be improved?

Generality

- Is the artifact general enough to ensure widespread adaptability? If not, how can this aspect be improved?
- Can the artifact be operationalized in a variety of contexts? If not, how can this aspect be improved?

Robustness

- Is the artifact consistent throughout its entirety? If not, how can this aspect be improved?
- Do you think that the artifact is mutually exclusive and collectively exhaustive? If not, how can this aspect be improved?

Simplicity

- Is the artifact suitable for use by practitioners? If not, how can this aspect be improved?
- Can the artifact be used easily in practice? If not, how can this aspect be improved?

Comprehensibility

- Is the artifact easy to understand? If not, how can this aspect be improved?
- Is there anything in the artifact that needs further explanation?

Completeness

- Is there anything missing in the artifact that would be expected?
- Do you think the artifact can be extended?

Miscellaneous

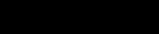
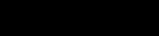
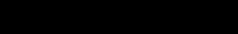
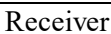
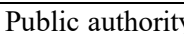
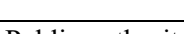
- Is there anything left to discuss?

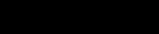
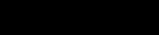
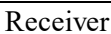
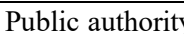
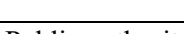
B Qualitative assessment of urban logistics concept components

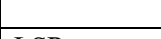
For the sake of completeness, all assessed UL concept components are displayed below, including the ones discussed exemplarily in section 4.2.1. The segmentation and sequence follow the representation displayed in Table 4.

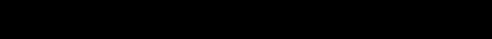
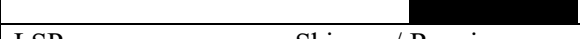
Notes: L = low, H = high. The black bars visualize the assessment outcomes for the different dimensions.

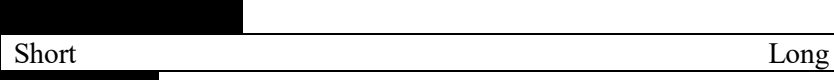
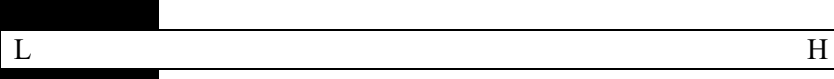
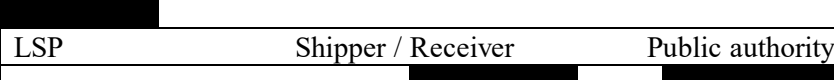
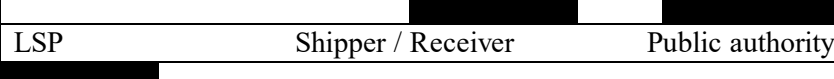
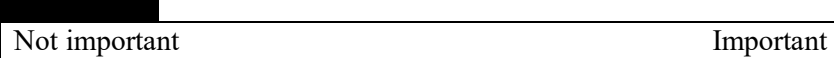
Alternative delivery options

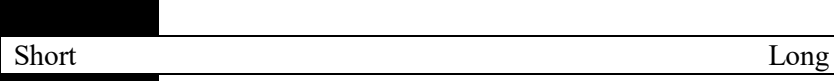
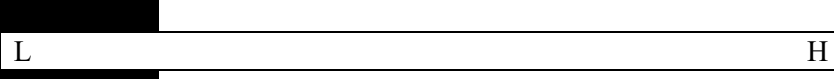
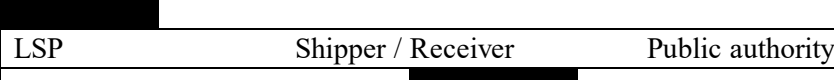
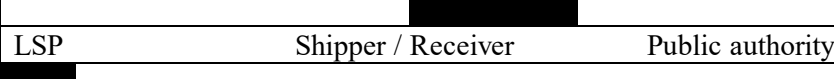
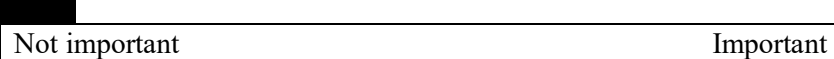
UL concept component	Dimension	Qualitative assessment
In-car delivery	Importance for a ULS	 L  H
	Maturity level	 L  H
	Duration of implementation	Short  Long
	Costs	 L  H
	Leading stakeholder	LSP  Shipper / Receiver  Public authority
	Involvement of stakeholders	LSP  Shipper / Receiver  Public authority
	Legal considerations	 Not important  Important

UL concept component	Dimension	Qualitative assessment
In-home delivery	Importance for a ULS	 L  H
	Maturity level	 L  H
	Duration of implementation	Short  Long
	Costs	 L  H
	Leading stakeholder	LSP  Shipper / Receiver  Public authority
	Involvement of stakeholders	LSP  Shipper / Receiver  Public authority
	Legal considerations	 Not important  Important

UL concept component	Dimension	Qualitative assessment
Off-hours delivery	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

UL concept component	Dimension	Qualitative assessment
Parcel boxes	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

UL concept component	Dimension	Qualitative assessment
Parcel lockers	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

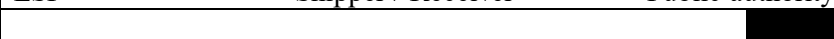
UL concept component	Dimension	Qualitative assessment
Parcel shops	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

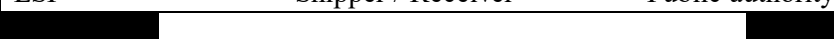
Alternative means of transportation

Short-haul

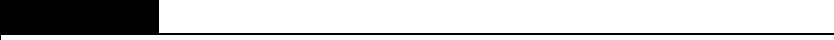
UL concept component	Dimension	Qualitative assessment		
Delivery robots	Importance for a ULS			
		L	H	
	Maturity level			
		L	H	
	Duration of implementation			
		Short	Long	
	Costs			
		L	H	
	Leading stakeholder			
		LSP	Shipper / Receiver	Public authority
	Involvement of stakeholders			
		LSP	Shipper / Receiver	Public authority
	Legal considerations			
		Not important	Important	

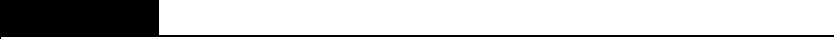
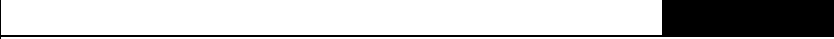
UL concept component	Dimension	Qualitative assessment		
Drones	Importance for a ULS			
		L	H	
	Maturity level			
		L	H	
	Duration of implementation			
		Short	Long	
	Costs			
		L	H	
	Leading stakeholder			
		LSP	Shipper / Receiver	Public authority
	Involvement of stakeholders			
		LSP	Shipper / Receiver	Public authority
	Legal considerations			
		Not important	Important	

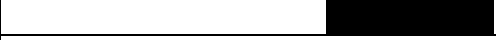
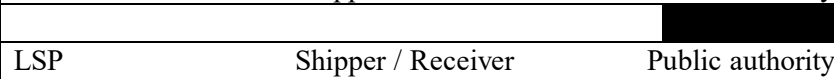
UL concept component	Dimension	Qualitative assessment
(E-)Cargo bikes	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

UL concept component	Dimension	Qualitative assessment
E-Trucks	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

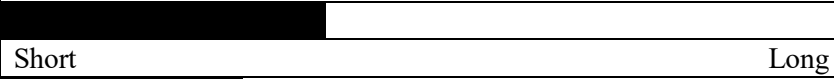
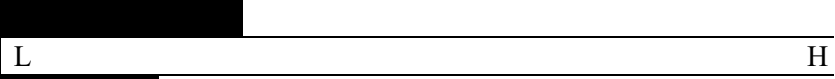
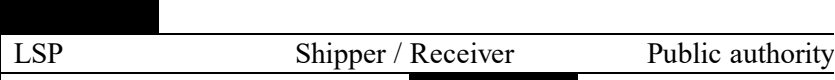
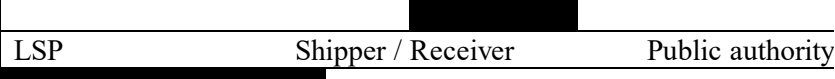
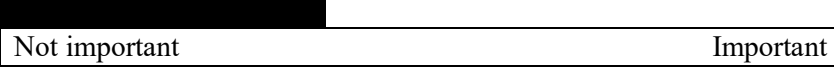
Long-haul

UL concept component	Dimension	Qualitative assessment
Cargo tramway	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

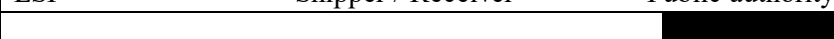
UL concept component	Dimension	Qualitative assessment
Rail freight	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

UL concept component	Dimension	Qualitative assessment
Under-ground transport systems	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

Consolidation of logistics services

UL concept component	Dimension	Qualitative assessment
Crowd-sourced delivery	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

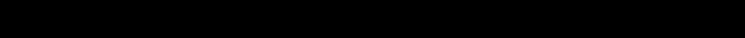
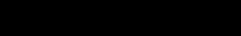
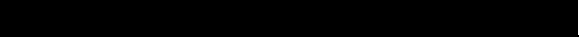
UL concept component	Dimension	Qualitative assessment
Macro-hub	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

UL concept component	Dimension	Qualitative assessment
Micro-hub	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

UL concept component	Dimension	Qualitative assessment
Periphery hub	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

UL concept component	Dimension	Qualitative assessment
Resource sharing	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

Information systems

UL concept component	Dimension	Qualitative assessment
Intelligent transport system platform	Importance for a ULS	 L H
	Maturity level	 L H
	Duration of implementation	 Short Long
	Costs	 L H
	Leading stakeholder	 LSP Shipper / Receiver Public authority
	Involvement of stakeholders	 LSP Shipper / Receiver Public authority
	Legal considerations	 Not important Important

Curriculum Vitae

Raphael Preindl

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Education

09/2018-09/2021	UNIVERSITY OF ST. GALLEN , St. Gallen, Switzerland Ph.D. Candidate in Management
09/2017-09/2018	UNIVERSITY OF MANCHESTER , Manchester, United Kingdom Master of Science in Business Analytics: Operational Research and Risk Analysis
09/2015-12/2015	UNIVERSITY OF SOUTH WALES , Cardiff, United Kingdom Bachelor of Arts (Hons) in Logistics and Supply Chain Management (Double Degree)
10/2013-09/2016	BADEN-WUERTTEMBERG COOPERATIVE STATE UNIVERSITY , Heidenheim, Germany Bachelor of Arts in Business Administration

Professional experience

09/2018-09/2021	UNIVERSITY OF ST. GALLEN , St. Gallen, Switzerland Research Associate and Project Manager at the Institute of Supply Chain Management (ISCM-HSG)
12/2018-09/2021	LOGISTICS ADVISORY EXPERTS GMBH , Arbon, Switzerland Project Manager for SCM and logistics-related projects
07/2017-09/2017	ATOS INFORMATION TECHNOLOGY GMBH , Munich, Germany Intern at Atos Consulting
10/2016-06/2017	KOCHTRANS PATRICK G. KOCH GMBH , Munich, Germany Executive Assistant to CEO
09/2013-09/2016	KOCHTRANS PATRICK G. KOCH GMBH , Munich, Germany Cooperative Student Program

Extracurricular activities

01/2021-05/2021	UNIVERSITY OF ST. GALLEN , St. Gallen, Switzerland Member of the Academic Jury for the 50 th St. Gallen Symposium
10/2017-09/2018	UNIVERSITY OF MANCHESTER , Manchester, United Kingdom Elected Class Representative for more than 70 postgraduate students