ULaaDS
URBAN LOGISTICS AS AN ON-DEMAND SERVICE

Getting uncertainties on the radar in urban logistics policies

ULaaDS D6.1: Typology of uncertainties in policy making and urban planning for sustainable urban logistics

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Project Abstract

ULaaDS sets out to offer a new approach to system innovation in urban logistics. Its vision is to develop sustainable and liveable cities through re-localisation of logistics activities and re-configuration of freight flows at different scales. Specifically, ULaaDS will use a combination of innovative technology solutions (vehicles, equipment and infrastructure), new schemes for horizontal collaboration (driven by the sharing economy) and policy measures and interventions as catalysers of a systemic change in urban and peri-urban service infrastructure. This aims to support cities in the path of integrating sustainable and cooperative logistics systems into their sustainable urban mobility plans (SUMPs). ULaaDS will deliver a novel framework to support urban logistics planning aligning industry, market and government needs, following an intensive multi-stakeholder collaboration process. This will create favourable conditions for the private sector to adopt sustainable principles for urban logistics, while enhancing cities' adaptive capacity to respond to rapidly changing needs. The project findings will be translated into open decision support tools and guidelines.

A consortium led by three municipalities (pilot cities) committed to zero emissions city logistics (Bremen, Mechelen, Groningen) has joined forces with logistics stakeholders, both established and newcomers, as well as leading academic institutions in EU to accelerate the deployment of novel, feasible, shared and ZE solutions addressing major upcoming challenges generated by the rising on-demand economy in future urban logistics. Since large-scale replication and transferability of results is one of the cornerstones of the project, ULaaDS also involves four satellite cities (Rome, Edinburgh, Alba Iulia and Bergen) which will also apply the novel toolkit created in ULaaDS, as well as the overall project methodology to co-create additional ULaaDS solutions relevant to their cities as well as outlines for potential research trials. ULaaDS is a project part of ETP ALICE Liaison program.

Keywords

Urban logistics, sustainability, uncertainty, policy making, SULP, SUMP

Copyright statement

Executive summary

City administrations across Europe intensify their efforts to foster sustainable urban logistics with the help of Sustainable Urban Logistics Plans. This policy note calls for a pro-active take on uncertainties in the development and implementation of Sustainable Urban Logistics Plans (SULPs). Due to the complexity and highly dynamic nature of urban logistics systems, uncertainties are inevitable in guiding the transition towards sustainable logistics solutions.

Planners and policy makers should be able to address these uncertainties in their policies for sustainable urban logistics. SULPs are typically set for time horizons of 5 up till 15 years which makes it even more difficult to select upfront a set of suitable policy measures that remain effective for the full term of the plan. Planners thus have the difficult task to establish a SULP that sets direction but is also apt to respond and incorporate new, unforeseen, developments. Only then a SULP will be able to avoid or mitigate undesired developments as well as to incorporate or capitalise on those developments that are considered positive in fostering sustainability.

By unpacking the concept of uncertainty - often mindlessly used, but elusive in nature – this policy note contributes to practices of policy making that explicitly recognize the changing circumstances under which that policy is developed and implemented. A typology is presented that enables policy makers to distinguish five types of uncertainties in the development and implementation of SULPs: external uncertainties, chance, organizational uncertainties, causal uncertainties and value uncertainties.

The typology of uncertainties can enhance SULPs in at least three ways:

1. It supports a wider acknowledgement of uncertainty in policy making of urban logistics as it shows the wide range of uncertainties that are inevitably part of strategic planning policies.
2. It can be used as an ‘uncertainty scan’ to advance the exploration of uncertainties in the various phases of development and implementation of SULPs. As such, it complements the Topic Guides on SULP and SUMP cycle (see Table 2).
3. Finally, it serves as a building block to incorporate uncertainties proactively in the design and management of policy strategies and actions, strengthening the capacity of SULPs to respond to uncertainties.

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1. Introduction

1.1 Fostering sustainability in the dynamic sector of urban logistics

It is increasingly argued that urban logistics have a major role in the transition to more sustainable cities. Urban logistics are responsible for 39% of transport CO2 emissions and around 8% of CO2 emissions world-wide. This encompasses all activities concerned with moving goods into, out from, through or within the urban area made by light or heavy vehicles, including service transport and demolition traffic, as well as waste and reverse logistics (Lindholm, 2013). In Europe, freight constitutes 6% of total CO2 emissions and 30% of transport CO2 emissions (European Commission, 2018). Meanwhile, traffic congestion continues to increase while the average load factor in cities is estimated at 25% (Meyer & Meyer, 2013). As the sector keeps growing rapidly, with for instance an estimated growth of 78% of only the last-mile deliveries up till 2030 (WEF, 2020), the negative impact on the environment and liveability in cities is likely to increase.

With citizens, community organizations and specific interest groups calling for good quality public space, clean air and safe streets, and national and international climate agreements requiring cities to reduce their carbon footprint, it is not surprising that city administrations across Europe intensify their policy measures to foster sustainable urban logistics. Such measures include legislation, window times, subsidies for zero emission vehicles, low and zero emission zones, congestion charges, etc. To stimulate an integrated policy approach, the European Union is promoting the development of Sustainable Urban Logistics Plans (SULPs), as an independent policy plan or, preferably, well integrated with a Sustainable Urban Mobility Plan (Rupprecht Consult, 2019). Some of the first cities implementing a SULP include Edinburgh (Scotland), Groningen and ‘s-Hertogenbosch (The Netherlands), Mechelen (Belgium), Stuttgart (Germany), Vienna (Austria), Alba Iulia (Romania), Almada (Portugal), Balchik (Bulgaria), Burgos (Spain), Dundee (UK), Lucca (Italy), Serres (Greece), Trondheim (Norway).

In developing Sustainable Urban Logistics Plans city administrations are however confronted with the complex and highly dynamic nature of urban logistics. It is a sector with an enormous web of “very different transport operations and logistics activities and requirements” (CIVITAS, 2015) with varied levels of interdependencies. This web includes logistics operators, shippers planning agencies, transport industry, vehicle industry, (Figure 1) and also indirectly receivers, citizens, special interest groups . How all these actors respond to, compete and collaborate with each other is not only influenced by the actors’ ambitions and capacities, but also by policy incentives, other city developments and macro level developments, such as economic changes, demographic trends and technological innovations (see also Dablanc, 2007). Technological innovations, in particular, unfold at a dazzling speed within urban logistics, including e-mobility, self-driving delivery vehicles, warehouse & last mile delivery platforms. Hence, urban logistics is a highly dynamic sector whose future can only

be predicted to some extent. Consequently, policy makers are confronted with uncertainties in guiding urban logistics towards more sustainable directions.

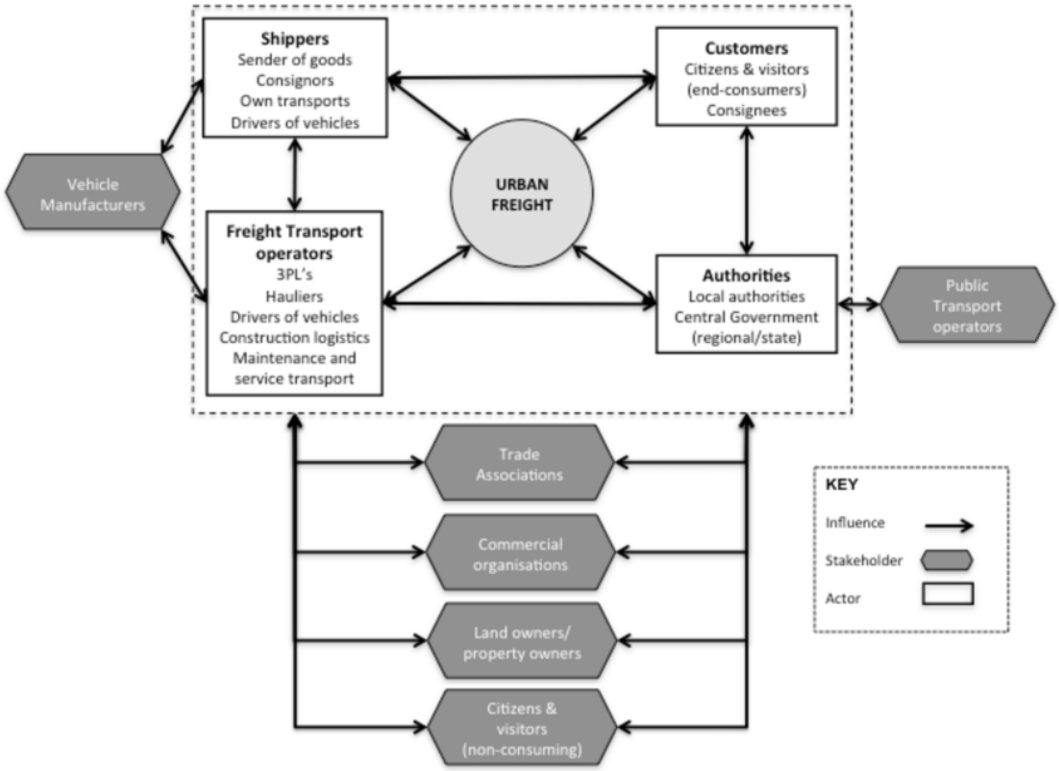


Figure 1 The web of actors involved in urban logistics (Lindholm, 2012, p.90)

The capacity of Sustainable Urban Logistics Plans to respond to and deal with uncertainties is therefore increasingly seen as a key ingredient for effective policies. In their policy note on making urban freight more sustainable, CIVITAS stresses that due to the lack of detailed data in combination with the 'huge complexity and heterogeneity of urban freight', developing a targeted policy is complicated and difficult (2015, p.11). In their recent review on the implications of the COVID pandemic for Urban Mobility Plans, POLIS and Rupprecht Consult stress that 'Cities need to safeguard and protect their critical transport infrastructures and assets, while also dealing with pressing chronic stresses that are related to societal issues. Cities should be able to prepare the existing physical and digital infrastructure to be able to adapt to unforeseeable changes' (p.9).

In SUMPs and SULPs cities develop their vision on mobility and logistics by laying out a strategy for the long-term, sometimes more than a decade to come. Building adaptive capacity is especially important given the long-time span of such plans. Logistics developments and challenges will continue to evolve during the preparation and implementation of SULPs. Thus, it is crucial that SULPs are apt to respond and incorporate new developments. On the one hand, such new developments can disrupt the suitability of policy measures. For instance, Uber-like urban freight solutions can shift urban freight demand and flows, potentially undermining urban freight consolidations centres that are implemented by the city and based on established transport routes of traditional logistics providers. Moreover, a crisis such as natural disaster may damage key infrastructures for a longer time period, creating a need to rethink policy measures. On the other hand, new developments can also create opportunities to realise policy goals in a faster or better way. For example, when the

development of smart containerization would take off, realizing zero emission city logistics may become easier as possibilities for last mile delivery via light electric vehicles will massively increase. Similarly, without ignoring its severe negative consequences, the COVID-19 pandemic has also created windows of opportunity for various cities (e.g., Budapest, Milan, London) to enhance their cycling networks and dedicate more space to active travel and cycle logistics. Hence, without capacity to adapt, SULPs run the risk of guiding change based on an outdated understanding of reality, instead of supporting resilient and robust sustainable urban logistics systems.

This policy note contributes to the development of adaptivity in SULPs by providing an enhanced understanding on *why* uncertainties matter for effective urban logistics policies and *what* type of uncertainties can be identified.

The targeted audience for this policy note is policy makers and consultancies in the field of urban logistics. It specifically discusses the implications of uncertainties in the development of urban logistics policies and plans at city level. Instead of offering a simplistic definition of uncertainties, this deliverable unpacks the concept and provides examples on how different uncertainties challenge policy making. The document also acts as a guide for policy makers, offering a number of suggestions on how to advance the exploration of uncertainties as part of the steps of the SULP/SUMP cycle (Figure 2).

As such, this policy note is an essential building block for the novel framework on strategic decision making for SUMPs or SULPs for adaptive urban logistics systems, which will be developed in Deliverable 6.4, and the take-aways for adaptive policy making of Deliverable 6.5. It also informs the opportunities and constrains for upscaling logistics innovations as discussed in WP5.

1.2 Objectives

This policy note on getting uncertainties on the radar when developing and implementing Sustainable Urban Logistics Plans or equivalent public policies, serves three aims:

- Increase awareness of the uncertainties that are part of urban logistics developments and why it is essential to acknowledge these uncertainties in public policies for urban logistics.
- Provide a typology that can assist urban planners and related policy makers in identifying relevant uncertainties.
- Present concrete steps to advance the exploration of uncertainties as part of the steps of the SULP/SUMP cycle, and a number of pointers on how to create room in SULPs to avoid or mitigate undesired developments. Besides, the policy note shows pathways to incorporate or capitalise on those developments that are considered positive for the SULP.

1.3 Focus and Methodology

Analysing the role of uncertainty in the development and implementation of urban logistics policies, this policy note focuses specifically on European cities and their Sustainable Urban Logistics Plans.

The term policy refers to public policies developed by city administration and oriented at fostering the transition towards more sustainable urban logistics. This policy note is not so much focused on individual measures. Instead, it discusses how in designing sets of policy measures – bundled in a SULP and/or SUMP – policy makers can create possibilities to respond to foreseen and unforeseen change.

The analysis of the dynamic nature of the urban logistics and related uncertainties, as well as the presented typology of uncertainties are based on:

- a review of academic literature on policy making in urban planning/governance;
- a scan of expected changes based on the provisional trend report of ULaads (D3.2) and other trend reports on urban logistics;
- an inventory of uncertainty acknowledgement in SUMP/SULPs.

The suggestion on how to incorporate uncertainties in policy making are structured along the lines of the SUMP (Figure 2) and SULP (Figure 3) cycles.

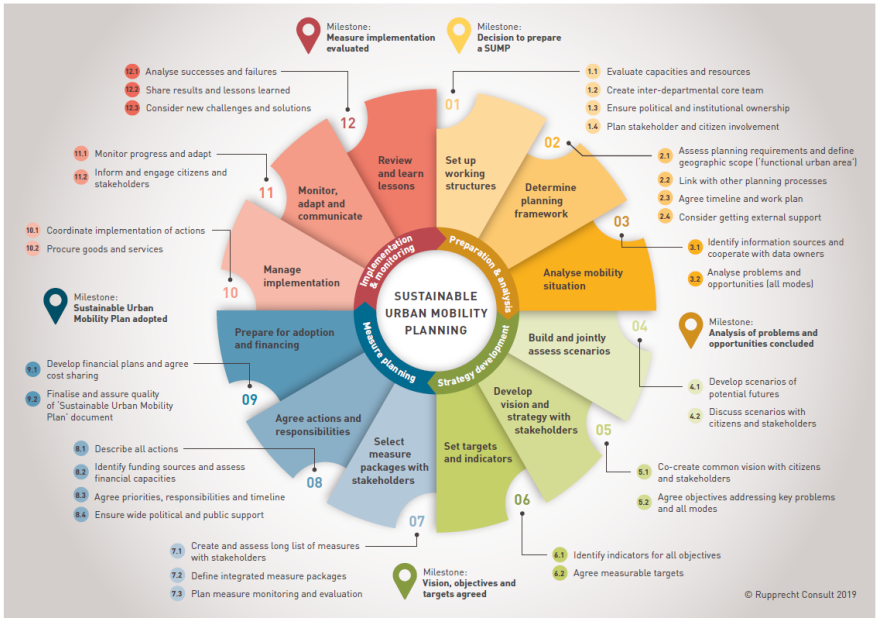


Figure 2 The 12 Steps of Sustainable Urban Mobility Planning (2nd Edition) – A planner's overview (Rupprecht Consults, 2019, p. 31)

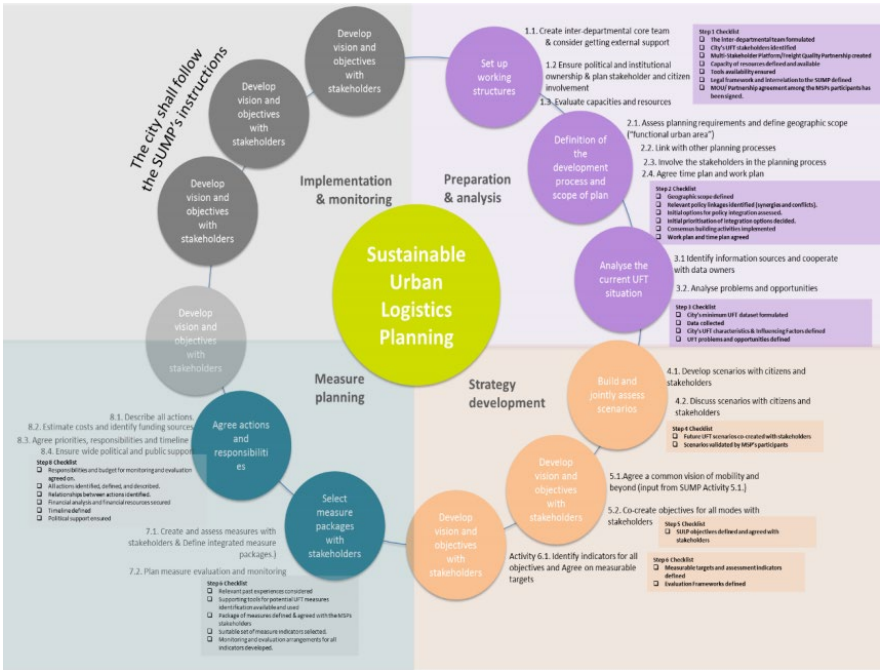


Figure 3 SULP cycle integrated within SUMP (Aifandopoulou, G., Xenou, 2019, p. 34)

1.4 Reading guide

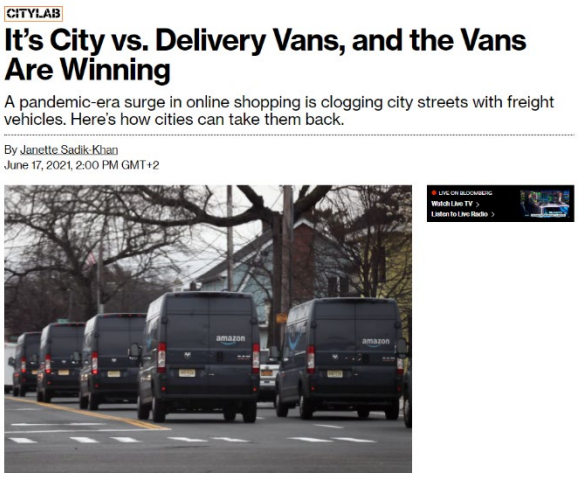
This policy note is structured as follows: The next section discusses how urban planners are challenged by uncertainties in developing urban logistics policies. Section 3 works towards a typology of uncertainties that can support urban planners in mapping the uncertainties that may affect their urban logistics policies. The final section, section 4, offers a reflection on how these typologies can aid the development of Sustainable Urban Logistics Plans that are responsive to foreseen and unforeseen change.

2. How urban planners are challenged by uncertainties in developing urban logistics policies

Urban logistics are growing both in size and complexity. Urban planners work hard to mitigate the negative effects, but their policies are challenged by uncertainties on the long-term. This section briefly discusses city logistics complexity, the current SULP methodology and the need for adaptivity to deal with urban logistics policy dilemmas.

2.1 The complexity of urban logistics

A growing range of stakeholders, including logistics operators, retail business, city administrations and local action groups calls for more action in reducing the impact of urban logistics on the environment and public realm in cities (Figure 4). As part of this movement, active public policy interventions become more numerous with the development of SULPs as the prime example. Typically, SULPs consist of a strategically selected set of diverse policy measures, including vehicle emission norms, (dynamic) city access regulation, public space management, urban design, subsidy schemes, public campaigns, trials and monitoring. This diversity of measures indicates that the transition towards sustainable urban logistics is one that includes multiple policy domains at multiple scales, leading to change processes with different speed


CITYLAB

It's City vs. Delivery Vans, and the Vans Are Winning

A pandemic-era surge in online shopping is clogging city streets with freight vehicles. Here's how cities can take them back.

By Janette Sadik-Khan
June 17, 2021, 2:00 PM GMT+2

Figure 4 Blog heading on the impact of delivery vans on city life (Bloomberg City Lab, June 17, 2021)

rates and at different levels of interaction. Hence, the type of transformation of concern here is one of a complex system transformation (Janjevic et al, 2019).

Guiding such a complex transition comes with challenges for urban planners. The first challenge is that the development of the urban logistics sector is coupled with the development of many other systems (Janjevic et al, 2019). Logistics systems, as well as the cities they are embedded in, are open systems, meaning that they are sensitive to changes in their context (Portugali, 2006, Batty, 2018). In order to remain functional and vital, they need to be responsive to changing consumer preferences, new technological opportunities, changes in national or European legislation or disruptions in the real estate market, etc. Issues related to urban logistics can thus not be addressed without also taking into account their (dynamic) context.

The second challenge is the partly self-organizing nature of urban logistics developments due to the large number of actors involved (Janjevic et al, 2019). The actions and interactions of one actor triggers actions by other actors, to which yet others respond. For instance, the combination of existing home delivery facilities with the platform economy led to the emergence of platforms for food delivery (e.g., Deliveroo, Thuisbezorgd, Uber Eats), which in turn triggered many restaurants to add on-demand catering services to their business operations. Subsequently, widespread societal acceptance of these home deliveries opened up opportunities for start-ups on instant delivery of groceries (e.g., Gorillas, Flik, Zapp), further spurring the growth of delivery bikes, scooters and cars. This, in turn, leads to concerns about safety and liveability in densely populated urban areas, along with a significant increase in packaging waste amongst other side effects.

Such processes of self-organization imply that changes in an urban logistics system of a specific city are not necessarily centrally coordinated nor designed (Rauws et al., 2020). Instead, a part of these changes emerge spontaneously out of the action-response interactions between numerous actors (Moroni et al., 2020). The new logistics patterns and routines they give rise to at city level are unpredictable in the sense that they could not be deduced from the sum of all individual actions. The span of control of urban planners, as well as of all other actors, on how urban logistics evolves within their city is thus limited.

2.2 Navigating complexity in urban logistics policies; shaping the future while leaving room to adapt

Despite these complexities – the open and partly self-organizing nature of urban logistics systems - urban planners are expected to guide urban logistics developments towards politically agreed goals. The goals for SULPs are typically set for time horizons of 5 up till 15 years (e.g., “Zero emission city logistics in 2030”). These longer time spans are important for keeping an eye on the bigger picture, as quick fixes might bring benefits now, but can be detrimental in the long term. They are also essential in for providing direction to stakeholders and for creating a degree of certainty for private investments and operational logistics models. However, the longer time spans make it even more

difficulty to select upfront a set of policy measures most suitable for reaching agreed goals given the dynamics within the sector and the limited predictability of future urban logistics developments.

Urban planners are thus confronted with a fundamental tension: public policies are expected and required to guide the transition towards sustainable urban logistics into desired directions. Unavoidably, the decisions and investments taken here and now as part of these policies structure further developments and thus will make some futures more likely than others. Notwithstanding, the complexity of urban logistics and the related uncertainties imply that unexpected opportunities and barriers may emerge over time, or that selected policy measures proved to be less suitable or even counter-productive. In developing Urban Sustainable Logistics Plans, urban planners thus do have a difficult task of finding an effective balance between setting direction while leaving room to adapt.

2.3 The strengths of the SULP approach

The complexity of urban logistics developments and their interplay with other city developments is to a large extent acknowledged in topic guides for developing SUMPs and SULPs (Rupprecht Consult, 2019; Aifandopoulou, G., Xenou, 2019), see figures 2 & 3. For preparing a SULP, the topic guide advises amongst others:

- To assess the current urban logistics system characteristics, identify influential contextual factors and explore the linkages with other planning processes. This points at the importance of acknowledging the sensitivity of urban logistics developments to other city developments and contextual changes.
- To intensively involve relevant stakeholders, from the earlier stages of the process all the way up to the evaluation. This points at the need to incorporate the interdependencies between actors in the processes of developing a SULP by developing shared understandings of the problems and potential solutions, as well as coordinating actions amongst different actors for more effective implementation.
- To set up systematic monitoring and learning activities, to evaluate if policy measures are indeed effective and if adaption is required. This points at the importance of considering the relationship between policies and the urban logistics system as a dynamic process that continues to evolve when the SULP is approved and implemented.

Although the SUMP/SULP cycle gives the impression of a rather linear policy making process, the authors are keen to stress that it is “an idealised and simplified representation of a complex planning process. In some cases, steps may be executed almost in parallel (or even revisited), the order of tasks may be adapted occasionally to specific needs, or an activity may be partially omitted because its results are available from another planning exercise” (Rupprecht Consult, 2019 p. 17). Overall, the guideline provides helpful suggestions for urban planners to get a grip on the complexity of urban logistics systems in which they want to intervene.

2.4 The need for pro-actively strengthening adaptivity in SULPs

Limited attention is given, however, to *how* SULPs can cope with this complexity by adapting to new developments, let alone how the capacity to adapt can already be *pro-actively* generated during the development of a SULP. This appears to be especially problematic when reviewing some of the recently published SULPs of European cities. Most of them read as a single pathway to low emissions or zero emission urban logistics, providing a detailed set of policy measures and fixed time plan for implementation, but no attention for how the SULP will be adapted and remains functional if reality unfolds differently than expected (See Table 1). Put differently, these SULPs are based on an understanding of the situation of the 'here and now', exploring potential future developments based on current problem perceptions and on solution spaces that are considered viable today. Obviously, this is an important and good start in the pursuit of sustainable city logistics, but the future will hold surprises, both good and bad ones, and a SULP can and should be prepared for that.

Table 1 Quick scan on attention for uncertainties in 9 SULP/SUMP with logistics section

	Acknowledging uncertainty					**Exploring uncertainty**							**Incorporating uncertainty**			
REVIEWED SULP	Risks	Uncertainty	Complexity	Unexpected	Unforeseen / unpredictable	Scenarios	Trends	Modelling	Pilots / experiments	Joint sensemaking	Monitoring	Pathways	Flexibility	Learning	Alternative policy options	Adaptation strategy
Alba Lulia	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	YES	NO	YES	NO	NO	NO
Bremen	NO	NO	NO	NO	NO	YES	YES	YES	YES	NO	YES	NO	YES	YES	YES	NO
Edinburgh	YES	NO	NO	NO	YES	NO	YES	NO	NO	YES	YES	NO	YES	NO	NO	NO
Groningen	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	YES	NO	NO	NO	NO	NO
London	YES	NO	YES	NO	NO	NO	YES	YES	YES	NO	YES	NO	YES	YES	NO	YES
Lucca	NO	NO	YES	NO	NO	NO	NO	YES	YES	YES	YES	NO	NO	NO	NO	YES
Mechelen	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES	NO	NO	YES	NO	NO
Stockholm	NO	NO	NO	NO	NO	NO	YES	NO	YES	NO	NO	NO	NO	NO	NO	NO
Vienna	YES	NO	NO	NO	NO	YES	YES	YES	YES	YES	NO	YES	NO	NO	NO	NO

This table is based on a quick scan of terms potentially indicating the acknowledgement, exploration and incorporation of uncertainties in SULPs or SUMPs, with specific attention to logistics. The selection of the SULPs and SUMPs has been made randomly, but informed by the availability of documentation.

The review of the SULPs in Table 1 is organised along three dimensions: acknowledging, exploring and incorporating uncertainties. For each dimension a number of keywords has been selected that provide an indication of whether and how uncertainties are addressed in the respective SULP document. The keywords 'Risk', 'Uncertainty', 'Complexity', 'Unexpected', 'Unforeseen / Unpredictable' hint at whether uncertainties are recognised as an explicit part of development and implementation of sustainable logistics policies. The keywords 'Scenarios', 'Trends', 'Modelling', 'Pilots / experiments', ' Joint sensemaking', 'Monitoring', 'Pathways', indicate whether these uncertainties are explored. This can be either by actively exploring potential futures, or by taking a close look on how development unfold and how to make sense of them. Finally, the keywords 'Flexibility', 'Learning', Alternative policy options', 'Adaptation strategy', offer an indication of whether any measures are taken pro-actively to ensure the capacity to deal with and adapt to uncertainties.

Developing SULPs with the capacity to adapt is key, especially given their long-term policy goals. Logistics developments and challenges will continue to evolve during the preparation and implementation of SULPs. For these SULPs to remain effective under changing conditions, urban planners can proactively develop mechanisms in SULPs that enable incorporating and exploiting unforeseen opportunities and keep off or mitigate unexpected negative changes. Strengthening the adaptive capacity of SULPs starts with an enhanced awareness of the uncertainties that are part of urban logistics developments.

3. Towards a typology of uncertainty

In guiding urban logistics towards more sustainability, urban planners and decision makers develop sets of policy measures and take deliberate actions. Doing so, they are unavoidably confronted with uncertainties that provide (un)expected opportunities or barriers in fostering sustainable urban logistics. According to Zandvoort et al. (2017) urban planners should gain an enhanced understanding of the type of uncertainties faced for at least three reasons. First, if urban planners only partially understand the logistics systems of their city and interconnectedness with other systems, policy measures may be redundant or inadequate. Second, policy making for urban logistics based on a simplistic understanding of uncertainties can mean decisions and interventions are insufficiently adaptive and thus potentially unfit for guiding dynamic urban logistics systems. Third, structuring the long-term transition towards sustainable urban logistics under conditions of uncertainty come with a moral responsibility: who benefits from these interventions, who may experience adverse consequences, and which measures can be taken to avoid disproportionate effects given the uncertain conditions?

In support of a more comprehensive consideration of uncertainties in SULPs, this section starts with unpacking the concept of uncertainty. It then presents a typology of uncertainties with the aim to assist urban planners and related policy makers in identifying relevant uncertainties in urban logistics. The application of this typology is illustrated using ULaaDs trials as case study.

3.1 Unpacking uncertainty as a concept

While uncertainty is very much part of everyday life – people constantly make decisions without a comprehensive knowledge over the situation faced. Thus, *uncertainty* is an elusive term which generally indicates a lack of knowledge. This lack of knowledge can be a consequence of limited information and understanding, but also results from the fact that some aspects are simply unknowable. Uncertainties are "real or relevant for people because of the consequences or different possible outcomes that flow from them and their implications for action" (Dewey p. 38 in Abbott, 2005). For urban planners working on sustainable urban logistics policies, this can mean that it is considered uncertain whether a city's logistics system is apt for new innovative modes of transport, how new logistics innovations will play out in different type of neighbourhoods, or to which degree policy will be able to trigger behavioural change amongst, shippers, citizens or logistics operators. This lack of knowledge potentially frustrates the development of sustainable logistics solutions and thus may require policy actions.

Uncertainty can thus be defined as "a perceived lack of knowledge, by an individual or group, that is relevant to the purpose or action being undertaken" (Abbott, 2005 p. 238). There are four aspects important to note:

1) The emphasis on "perceived lack of knowledge" indicates that uncertainty has a subjective dimension (Bradly & Drechsler, 2013). Whether information or a proposition about a situation is considered as sufficient and valid for undertaking action is depending on the judgement of those involved. For instance, if decision makers have to decide about the implementation of times windows for deliveries in a city centre area, one of the questions that may arise is if they believe that the traffic simulation model on which this intervention has been tested provides sufficient certainty about the effectiveness of the window times. The subjective dimension of uncertainty indicates that it is as much about underlying perspectives and worldviews as it is about data and analysis.

2) Uncertainty expresses a lack of knowledge that goes beyond risks (Johnson & Busemeyer, 201). In the case of risks, outcomes are unknown but the probability for these outcomes to arise is known. For example, when implementing a parcel locker in a neighborhood, it might be unknown which citizens will use the locker and how often, but based on earlier cases, a probability distribution can be provided on the share of residents that shifts from home delivery to delivery of their goods to the parcel locker. Uncertainties are not limited to risks. They also include situations in which both outcomes and probabilities are unknown, even to the degree that ranges of potential outcomes cannot be envisioned and surprises might be on the horizon (e.g., COVID-19 impact on city logistics).

3) The nature of uncertainty is diverse (Zandvoort at el. 2017). As noted earlier, incomplete knowledge, a lack of reliable data or insufficient means for thorough analysis of the situation can be a source of uncertainty. This so called *epistemic uncertainty* can potentially be reduced by gathering more information or conducting further analysis, if time and means allows. For instance, before investing in electric or hydrogen charging infrastructure for last-mile delivery vehicles, city authorities may want to investigate the actual shares of different fuel types of logistics vehicles operating within their city limits to better understand (potential) demand for this infrastructure. Other uncertainties are a fundamental and intrinsic aspect of urban logistics due to the complexity of the system. The dynamics of action-response interactions between numerous actors generate all kinds of non-linear processes of change that are simply impossible to predict in detail. See the example in 2.1 of the disruptive change in urban logistics triggered by the rise of the platform economy. Such *ontic uncertainties* cannot be reduced nor avoided. Finally, *ambiguity* is a third and final kind of uncertainty. Ambiguity links back to the subjective dimension of uncertainty, stressing that actors rely on different frames of reference in making sense of reality and how they want to act in relation to that reality. Hence, uncertainty does not only arise from a limited understanding of how reality works, but also from different, sometimes opposing, views on reality. Actors are for instance confronted with uncertainty if 'limits to growth' perspectives compete with 'sustainability through innovation' perspectives in being the dominant frame for decision making about sustainable urban logistics.

4) Degrees of uncertainty may differ (Walker, 2003; Kwakkel, 2010). Not all uncertainties are as deep and fundamental as the ontic uncertainties discussed above. Various levels or degrees of uncertainty can be distinguished, ranging from uncertain developments of which the probability can be calculated, to fundamental unknowns in which the only certitude is that certainty is unknowable. The more complex the system, the higher the rate of change, the wider the impact of changes, the more diffuse the response to these changes, and the longer the time range for which these have to be considered, the deeper the level of uncertainty about a situation. This implies amongst others that when considering logistics issues in isolation (e.g., storing, routing, transport modes), their level of uncertainty can be shallow. However, when these issues are addressed integrally in a SULP as part of a long-term strategy for change, interdependencies increase as well as the range of affected actors and their potential responses. It is thus likely that SULPs are confronted with deep uncertainties.

Unpacking the concept of uncertainty clearly shows that a differentiated approach to dealing with uncertainty in needed. The above indicates that, even in complex urban logistics systems, levels of uncertainty may differ depending on the scope of the policy measure. It also teaches us that uncertainties differ in nature and are partly in the eye of the beholder. These diverse characteristics of uncertainties in policy design offer a starting point for SULPs that address these uncertainties effectively.

Integrating uncertainties in SULPs starts with providing a tool that enables policy makers to recognize, identify and address them accordingly. We will therefore propose a typology of uncertainties. Various typologies are available in the planning and policy science literature. However, most of these are distinguishing degrees or types of uncertainties in rather general terms, such as the degree of complexity, the level of knowledge or the level of disagreement (see e.g., Christensen, 1985; De Roo, 2010; Islam and Susskind, 2013).

With the aim to support a differentiated view on uncertainty that connects with the practices of urban planners and policy makers, we choose to build upon the typology as proposed by John Abbott (2005). His framework is positioned in the realm of strategic urban planning. It explicitly acknowledges the challenging role of planners in pushing the boundaries of the possible in an attempt to provoke and accelerate change while uncertainties also increase.

Two additional arguments for selecting Abbott's typology follow from the above analysis unpacking the many dimensions of uncertainty. First, it distinguishes between uncertainties that are part of the planning process (e.g., the formulation and implementation of the SULP at city level) and uncertainties related to the environment in which a planning effort is undertaken (e.g., the wider context in which the SULP is deployed). This distinction is essential when casting urban logistics systems as complex systems that are open and nested (see 2.1). These systems, including their uncertainties, can only be understood when taking into account their relations with and dependencies of other systems. Second, it explicitly acknowledges ambiguity as a source of uncertainty that transpires 'values and aspirations of actors involved in or affected by planning' (Abbott, 2005 p. 244). This is an important set of uncertainties to include as the effort to transition to more sustainable logistics solutions is, at least partly, driven by changing values and aspirations about the impact of urban logistics on liveability in cities and the global climate.

3.2 Navigating uncertainty: a typology

This section presents the typology of uncertainties. Building on Abbott (2005) and tailored to SULPs, five types of uncertainties are distinguished (Figure 5). The aim of the typology is to assist urban planners and related policy makers in identifying relevant uncertainties for the development and implementation of SULPs.

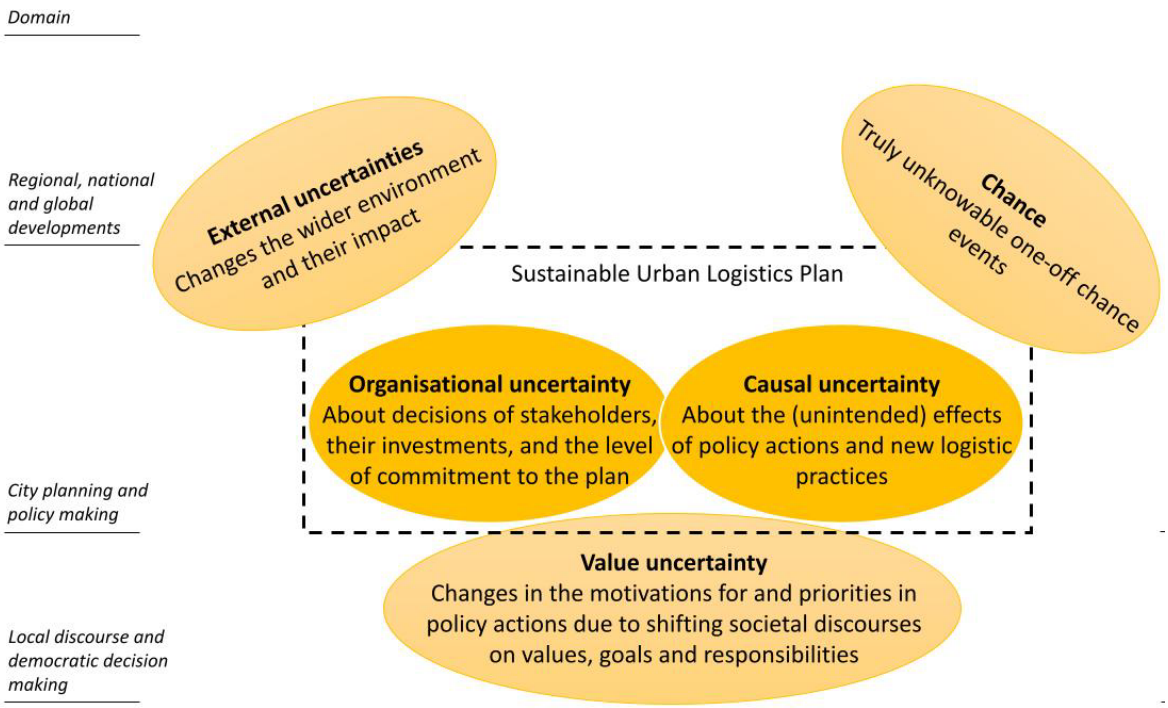


Figure 5 Typology of uncertainties

External uncertainties and chance are contextual to SULPs. They are about developments which unfold beyond the city-level, at a regional, national or global scale. Examples of **external uncertainties** are new EU regulations, decisions by global logistics players and disruptive technological innovations such as bar codes, the internet and smartphones. They are developments that generate possibilities and constrains for cities transitioning towards more sustainable urban logistics without local actors having the capacity to influence these developments. Textbox 1 provides several examples of such potential external uncertainties.

Textbox 1 Examples of external uncertainties in planning for sustainable urban logistics

- **Self-driving vehicles:** will automated rovers become an additional mode of home deliveries? How quickly will security and safety concerns be taken away and traffic regulations be adapted?
- **3D-printing:** will this technology disrupt the spare part sector by printing parts on-demand and at strategically situated city freight hubs? To what extent will this decrease the need for inventory space? Which supply flows of polymers and raw materials will it generate and will logistics providers adapt their services accordingly?
- **Big Data:** is increasingly used by logistics operators, but will it become a feasible instrument for city administrations to get grip on the millions of logistics activities in their cities? And if so, which types of dynamic city access regulation or route guidance may it support?
- **Smart containerization:** will new container formats and processes accelerate urban logistics innovations by replacing inefficiently-sized containers for urban environments and avoiding the need for re-consolidation? How will LEVs and cargo bike solutions profit from this innovation? To which degree will smart containerization be hampered by the required redesign of logistics infrastructure, vehicles and equipment for handling the new standard?
- **Online marketplaces:** how will these platforms that enable sharing of goods, assets, and services further transform urban logistics and shift urban freight demand and flows? To what extent are on-demand freight delivery services and instant deliveries from dark stores becoming normal practice? And which boundaries will be set for the flexibilization of the working force by governments?

The examples above have been derived from PwC CEE Transport & Logistics Trend Book (2019), McKinsey's 'Fast forwarding last-mile delivery – implications for the ecosystem' (2018) and DHL Trend Radar (2021)

Like external uncertainties, **chance** is also about contextual developments. However, this type of uncertainties is about sudden, one-off events. For instance, they include geopolitical events, economic crises and natural and humanly induced disasters. Recent examples are the eruption of the Eyjafjallajökull volcano on Iceland in 2010 causing weeklong disruptions of European air traffic, the financial crisis of 2008 triggered by the subprime mortgage bubble, and recently the COVID-19 pandemic. Textbox 2 discusses the disruptive effects of the outbreak of the pandemic as a sudden event and offers a reflection on the implications for urban logistics.

Textbox 2 ULaaDS reflection on the impact of COVID-19 on urban logistics

The ULaaDS project kicked-off in the midst of the COVID-19 pandemic and the consortium partners regularly reflect on the implications of the pandemic on urban logistics (e.g., the speednetworking on post-COVID logistics solutions, November 2020). Four insights:

Disruption and uncertainty The outbreak of COVID-19 restructured, at least temporally, cities and societies. The consequences of the virus and the preventive measures that were, and still are, taken suddenly became a new 'order parameter' in the organization of urban life. The pandemic shows the latent instability of logistics systems, urban systems and society at large. High levels of connectivity and interdependency not only enabled a quick spread of the virus, but also resulted in disrupted supply chains and brought economies to a hold. Moreover, the pandemic is a prime example of the difficulty to predict while having limited knowledge of the situation, exemplified by the large fluctuations in the estimated degree of infectivity and the numbers of potential casualties at the start of the outbreak. It shows the immense challenge of navigating deep uncertainties created by a sudden event. And still the uncertainties about the long-term consequences of COVID are substantial, including health implications, social inequalities, geopolitical changes.

Boost to urban logistics The mobility restrictions and lock-down measures against the spread of COVID-19 gave a boost to the already fast-growing urban logistics sector (e.g., Settey et al, 2021). The sales of established platform webshops increased, resulting in a substantial growth of parcel deliveries. More interestingly, many more commercial and service companies started or extended their online ordering services, making grocery deliveries, fashion services or high-end diner experiences at home a possibility in many places (see also Willems et al, 2021). As part of this development, small and medium size enterprises organised themselves in city wide online platforms in an attempt to stimulate citizens to support their local businesses. All in all, urban logistics expanded as a broader range of both entrepreneurs and consumers got familiar with the possibility of online shopping.

New questions The pandemic also brought to the forefront questions about the organization of public space and urban logistics. As mobility was severely restricted, the quality of the public spaces, including streets, squares and parks, received renewed attention. Whom should these spaces primarily serve? Is the dominance of the car still acceptable? Cities experimented with temporal closing of roads to create more living space and installed improvised bikes lines. This tendency of favouring pedestrians and cyclists over cars also impacts urban logistics, as it is likely to increase the need for LEVVs and cycle logistics solutions. Moreover, the experienced vulnerability of global supply chains triggered stronger calls for organizing demand and supply on a more local level, including food hubs and markets of vintage clothing.

Opportunities The extended first-hand experiences of businesses, citizens, as well as politicians, with online shopping, combined with the triggers for rethinking the city, creates opportunities for upscaling solutions for sustainable urban logistics solutions.

While external uncertainties and uncertainties by chance themselves cannot be influenced by urban planners, policy makers and other actors at city level, these actors can prepare and implement actions for dealing with the consequences of these uncertainties. For instance, whether 3D printing will indeed become an established technology in the spare part sector is uncertain (Textbox 1). However, businesses, logistics service providers and city administrations can explore the potential implications of this technology and possible sustainability gains by setting up a joint pilot. Used this way, piloting is a means to get a grip on potential futures by testing how external uncertainties might work out when embedded in existing city logistics systems (Quak et al., 2016). Chance uncertainties are more difficult to prepare for, as these are unknowable one off-events. Nevertheless, actors can strengthen responsive capacity of logistics systems, for instance, by using serious gaming. Insights resulting from these games can be used to consider how recovery actions can be oriented at fostering sustainable logistics solutions, rather than building back non-sustainable operations.

The other three types of uncertainties of the typology are related to the urban level. Causal uncertainties and organizational uncertainties are positioned in the domain of city planning and policy making. Value uncertainties can be identified in local discourses and democratic decision-making processes, such as city council decisions, referenda, media reports and community action and protests.

Causal uncertainties relate to cause-effects relationships. These can be about logistics developments in the city, such as the effects of the recent growth of dark stores for instant grocery delivery on the liveability at street level. They can also be related to the outcomes of policy interventions. For instance, the implementation of a zero-emission zone in the inner city may lead to the unintended side effect that shops and businesses will relocate themselves just outside of these zones to ensure their access by fossil fuel vehicles and to avoid investments for updating their own fleet.

While causal uncertainties relate to the objects of sustainable urban logistics, **organizational uncertainties** are about the subjects - the actions and intentions of the people and organizations involved in the developments and implementation of SULPs. These uncertainties arise from stakeholder interests, priorities, decisions and their level of commitment to measures and policies. As urban logistics typically includes a wide range of actors and developing more sustainable logistics solutions requires collaboration and coordination, organisational uncertainties are almost unavoidable. The priority of a large logistics service provider on setting up cycle logistics solutions may for instance shift if leadership changes or when profit numbers drop. In a similar vein, the initial support of local entrepreneurs for a consolidation centre at the edge of the city may decline if adjustments appear to be needed to their business operations, undermining the business model of the consolidation centre.

The fifth and final type of uncertainty is **value uncertainty**. Value uncertainties are often implicit in urban logistics policy making, but nevertheless influential. They include changing discourses on societal values and goals and the perceived responsibilities of related stakeholders. For instance, the emergence of a circular economy discourse or a strong call for localism can impact the goals of SULPs and responsibilities of stakeholders. In case of the former, measures to improve sustainability will aim at an integral approach of urban logistics to leasing, reusing and recycling of goods. In the latter case, making urban logistics more sustainable would potentially be seen as the need to stimulate

local production and consumption chains, for instance with regard to food, clothes and waste. Thus, changing discourses affect which goals and responsibilities are considered appropriate. Next to organically evolving discourses, value uncertainties also relate to changes in political priorities. In response to shifting societal discourses, but also due to political opportunities, politicians and decision makers may adjust their agendas. While positioned at the local level, as this is where they shape urban logistics policies by stakeholders who propagate certain values, values tend to travel and be transferred globally. An excellent recent examples is Greta Thunberg and her Fridays for Future, in which a small action led to a global movement that was quickly adopted locally.

To further demonstrate how casual, organizational and value uncertainly impact sustainable urban logistics plans, we draw from the experiences within the ULaaDS consortium (Textbox 3). As part of the ULaaDS project, a series of trials have been set up to foster sustainable logistics solutions in the cities of Bremen, Groningen and Mechelen. In all three cities, these trials are part of long-term policy efforts aimed at more sustainable urban logistics. While the trials are small in size and still in the developing phase, they clearly show that reality forces stakeholders to undertake additional measures to keep the trial on track.

Textbox 3 Examples of causal, organizational and value uncertainties in ULaaDs Trails.

- **Operational hick-ups due to safety issues**: A consolidation centre has been setup at the edge of the city with the idea to carry out last mile delivery by cargo bike. However, the central road connection between the consolidation centre and the inner city is perceived as dangerous by the cargo bike drivers (causal uncertainty)
- **Bankruptcy:** a central partner in a public-private partnership for the development of a platform system for vehicle sharing and freight consolidation goes bankrupt, critical knowledge and experience is lost and the initiative needs to be rethought (organizational uncertainty)
- **Reorganization:** key persons changing jobs, re-organizations and mergers and acquisitions mean that priorities of stakeholders shift and that commitment to the trial has to be rebuilt from scratch. Due to these organizational dynamics initiatives on cargo hitching and containerized cargo bike delivery have difficulties to get up to speed (organizational uncertainty)
- **Struggles over data:** to evaluate the trials operational data is essential. Logistic services providers are however not keen to share this data, to protect potential competitive advantages. While one can consider this struggle to be one of contractual accuracy, it also illustrates a dilemma at value level: are the trials meant to foster sustainability by supporting private innovations or by providing open source best practice setups? (value uncertainty)

Causal uncertainty, organizational uncertainties and value uncertainties can be addressed more directly as they mostly unfold at city level. Policy makers as well as other actors involved in the development of sustainable urban logistics solutions are directly involved in these local developments and can thus try to reduce the uncertainties. For instance, this can be done by testing interventions in simulation models or by inviting devils advocates to critically evaluate policy measures before implementation. Organizational uncertainties can amongst others be reduced by close and ongoing interaction between stakeholders, clearly defining actions and responsibilities, and agreeing on a roadmap for implementation and risk management. Value uncertainties can be addressed by joint sense making and an ongoing dialogue between stakeholders on underlying values and ambitions of SULPs.

However, despite the efforts aimed at mitigation, uncertainties will remain. The complexity of urban logistics means that in most cases reducing causal, organizational and value uncertainties that are related to the development of SULPs is only possible to a limited extent. This is not only because of a lack of means and time. It is also extremely difficult to get a grip on all potential developments, organizational dynamics and their implications in detail in advance, due to the high amount of interactions and interdependency between logistics actors. Additionally, humans, policy makers not excepted, have great difficulty in painting a realistic picture of uncertainties. At an individual level, we tend amongst others to be overconfident about the accuracy of our forecasts and favor information that confirms support pre-established ideas (Jones & Sugden, 2001). At group level, our understanding of uncertainties is distorted by group thinking, as we tend to suppress deviant viewpoints and dismiss early warning signals as false alerts or minor, unimportant errors in our understanding of the situation (Janis, 1982). Hence, uncertainties in the context of SULPs are inescapable.

Embracing uncertainties, next to reducing them, is thus a necessity in the development and implementation of SULPs. Embracing uncertainties means explicitly acknowledging the possibility of disruptive or favorable changes, incorporate this possibility in the policy making process and proactively strengthening the capacity of SULPs to respond to unforeseen change. The presented typology provides a start for embracing uncertainties in urban logistics policies.

4. Conclusions

4.1 How a typology of uncertainty enhances SULPs

This policy note calls for a pro-active take on uncertainties in the development and implementation of Sustainable Urban Logistics Plans (SULPs). Due to the complexity and highly dynamic nature of urban logistics systems, uncertainties are inevitable in guiding the transition towards sustainable logistics solutions.

Planners and policy makers should be able to address these uncertainties in their urban logistics policies. SULPs are typically set for time horizons of 5 up to 15 years, which given the dynamics within the sector, makes it even more difficult to select a set of suitable policy measures that remain effective for the full term of the plan. Planners thus have the difficult task to establish a SULP that sets direction but is also apt to respond and incorporate new, unforeseen, developments. Only then will a SULP be able to avoid or mitigate undesired developments as well as to incorporate or capitalize on those developments that are considered positive in fostering sustainability. By unpacking the concept of uncertainty, this policy note contributes to practices of policy making that explicitly recognize the changing circumstances under which that policy is developed and implemented.

A typology is presented that enables policy makers to distinguish five types of uncertainties in the development and implementation of SULPs: external uncertainties, chance, organizational uncertainties, casual uncertainties and value uncertainties (Abbott, 2005). There are three ways in which this typology can enhance SULPs:

- Support a wider acknowledgement of uncertainty in policy making of urban logistics.
- Enable the exploration of uncertainties affecting a specific SULP.
- Serve as a building block for incorporating uncertainty in policy strategies and actions for sustainable urban logistics.

4.2 Acknowledging uncertainty

Showing the wide range of uncertainties, the typology can serve as a vehicle for SULPs that acknowledge and embrace uncertainties in guiding the transition towards sustainable logistics solutions. The typology helps to critically reflect on policies that (implicitly) build on the premise that optimal solutions for the future can be prescribed ‘here and now’, and that the pathway towards this future can be defined in detail in advance. This brief suggests that such a premise is an illusion which actually hampers effective logistics policies. Instead, more can be achieved by recognizing that the future may turn out differently than expected, despite serious efforts to understand and predict it. Acknowledging uncertainty is not to say that strong visions on desirable futures are superfluous. Rather the opposite, they are key in mobilizing actors to undertake the urgently needed actions in making cities and their logistics systems more sustainable. However, when realizing these visions via SULPs, uncertainty should be anticipated.

Acknowledging uncertainty in SULPs requires, amongst others, an ongoing analysis of how policy measures and actions interact with the context, processes of joint sense making and learning, and room to refine and adapt (a part of) the SULP if necessary.

The guidelines for the development of SULP (and SUMP) already include various important steps for addressing uncertainties, including an assessment of the urban logistics system and its context, stakeholder involvement and monitoring and learning (see section 2.3). However, in most published and formalized SULPs, little attention is paid to uncertainties, their impact and how to address them.

The typology can help to overcome this limitation by supporting policy makers and stakeholders to explicitly address uncertainties in various steps of the SULP cycle (Figure 2).

4.3 Exploring uncertainty

The presented typology can be used as an 'uncertainty scan' in order to stimulate a proactive exploration of uncertainties in the development and implementation of SULPs. Policy makers and stakeholders can use the typology to map uncertainties collectively. The use of such an uncertainty scan could be especially beneficial for the following steps of the SULP and SUMP cycle (Rupprecht Consult, 2019; Aifandopoulou, G., Xenou, 2019, see figures 2 & 3)

Table 2 Contributions of the uncertainty scan in exploring uncertainties, based on the steps of the SULP/SUMP cycle

Phase	**Step**	**Uncertainty scan** (related action between brackets)	**Type of uncertainty**
Preparation and analysis	01 Set up working structures	Map uncertainties regarding capacity and resources (1.1), political support (1.3), stakeholder and citizens involvement (1.4)	Organizational uncertainties, Value uncertainties
	02 Define the development process and scope of the plan	There is already attention for links to other planning processes. Further improvement is to identify barriers and opportunities that may arise if other regional and local planning processes might face delays or are adjusted (2.2)	External uncertainties
	03 Analyse UFT situation	Already much attention for potential external uncertainties by the use observatories on global trends and descriptive analysis on influence factors (3.1, 3.2). Further improvement is to identify which developments may potentially lead to a fundamental shift in the problem analysis.	External uncertainties, chance
Strategy development	04 Build and jointly assess scenarios	Include the possibilities of one-off chance events (4.1). Be transparent about the uncertainties of the assumptions behind these scenarios during the assessment and invite a	All

		devil's advocate to prevent group thinking (4.2).	
	05 Develop vision and objectives with stakeholders	No additions	
	06 Set target and indicators	Acknowledge that various pathways can lead to successful realization of the SULP's objectives when setting targets and indicators.	Organizational uncertainties, Causal uncertainties
Measure planning	07 Select measure packages with stakeholders	Keep an eye on the interdependencies created when defining integrated measure packages (7.1). Ensure capacity and time for joint sense making of assessment and monitoring of measures (7.2)	Organizational uncertainties, Causal uncertainties, Value uncertainty
	08 Agree actions and responsibilities	Explore collectively potential changes which may disrupt funding, cause actors to redraw or increase commitment and reconsider priorities and responsibilities (8.2, 8.3). Identify uncertainties in securing political and public support (8.4).	Organizational uncertainties, Value uncertainty
	09 Prepare for adaption and financing	No additions, planning for contingencies to help achieve resilience against potential changes in income streams is already advised.	
Implementation and monitoring	10 Management implementation	Risks assessment and contingency activities are already advised. Specific attention might be required for unexpected spillover effects between actions that become apparent during implementation (10.1).	Casual uncertainties
	11 Monitor, adapt and communicate	No additions, as both monitoring of the implications as well as external developments is already advised.	
	12 Review and learn lessons	Devote attention to the situatedness of lessons learnt, as changing time-space	All

		configurations might imply these lessons loose relevance (12.2)	

4.4 Incorporating uncertainty

While the above is about advancing the exploration of uncertainties in the development and implementation of SULPs, a next a next step is to incorporate uncertainties proactively in the design and management of SULPs. Some potential measures to increase the capacity to respond to uncertainties are already mentioned in Section 3, including piloting, developing redundancy in the packages of measures, creating flexibility in how actions can be carried out and focusing on desired outcomes rather than output.

The development of a systematic approach in which the characteristics of uncertainties inform policy measures to strengthen the adaptive capacity of SULPs is the topic of a next ULaaDS deliverable; 'D6.4 A novel framework on strategic decision making for SUMPs or SULPs for adaptive urban logistics systems'. The typology developed in the current policy brief provides an important building block for such a systematic approach.

Acronyms

Acronym	Meaning
D	Deliverable
EC	European Commission
GA	Grant Agreement
O	Objective
P	Product
SUMP	Sustainable Urban Mobility Plan
SULP	Sustainable Urban Logistics Plan
T	Task
ULaaDS	Urban Logistics as an on-Demand Service
UFT	Urban freight transport
WP	Work Package

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