Future-proof your SULP: an adaptive approach to guide urban logistics towards sustainability

ULaaDS D6.4: A novel framework on strategic decision-making for SUMPs or SULPs for adaptive urban logistics systems

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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, strategic planning, adaptive policy-making, SUMP, SULP, resilience, comparative analysis, uncertainty, EU

Copyright statement

Executive summary

Developing and implementing a Sustainable Urban Logistics Plan (SULP) is challenging due to the involvement of diverse stakeholders, unpredictable processes, innovations, and events affecting city logistics. This complexity poses a risk to the desired transition, requiring policymakers to strike a balance. They must set stringent targets for the sustainable urban logistics transition within a specified timeframe while maintaining flexibility to address unforeseen developments. Therefore, policymakers need to proactively assess and comprehend uncertainties impacting logistics policies, integrating adaptive capacity into plans to ensure effectiveness under changing conditions, with a willingness to revisit and adjust policy actions as necessary.

This study provides a valuable understanding of the strategies deployed by local policymakers in urban logistics to effectively manage future possibilities and their consequences. These valuable insights serve as the foundation for the development of an adaptive approach to urban logistics policy-making. A strategic framework is presented, which incorporates adaptive capacity-building strategies aligned with the various phases outlined in the current EU SULP guidelines.

Three main findings on how policymakers address uncertainties in the development and implementation of urban logistics policies emerge. These were established by combining a literature review, analysis of policy documents and fourteen in-depth expert interviews with local policymakers of European cities.

1. Policymakers are well aware that their policy-making practices are confronted with uncertainties, and different types of uncertainties are generally well-recognized.

2. Despite being aware, policymakers struggle to give equal attention to various uncertainties in the policy process. This is influenced by organizational challenges, such as resource constraints and limited political attention, as well as by the elusive nature of uncertainties and perceived urgency. Their primary focus is on potential shifts in political stands or changes in public opinion affecting logistics policies, with minimal attention given to unforeseen disruptions on the urban logistics system by one-off events, such as the COVID-19 pandemic, technological innovations, or uncertainties in more global developments, for instance, a hick-up in the out roll of electric vehicles. This raises concerns about policymakers' awareness of potentially disruptive effects from uncertainties they encounter infrequently or know little about.

3. Four methods that policymakers use for mapping uncertainties have been identified. These are forecasting, foresight, exploring by testing, and exploring by consultation (Figure 6, p 26). Each of these methods comes with strengths and weaknesses, and policymakers tend to use several in parallel.

To enhance the effectiveness of Sustainable Urban Logistics Plans (SULPs) in dynamic situations, this study suggests steps that boost adaptability. By improving the adaptive capacity in the SULP-cycle, urban logistics policies can evolve from a linear planning process for a single preferred future to a more flexible approach accommodating multiple potential futures. This enables shorter feedback

loops between the urban logistics situation and policy-making. The "adaptive SULP-cycle" is presented in Figure 1. Each phase of the existing SULP-cycle, represented by the four blue quadrants, is complemented with strategies for boosting adaptivity in the outer ring of the figure. These strategies include:

- Raising awareness about the complexity of the urban logistics system.
- Mapping uncertainties that may affect the urban logistics situation and the related policy goals.
- Adopting adaptive strategy principles in the urban logistics policy design.
- Increasing robustness of urban logistics policy measures.
- Acting responsively during policy implementation.

Building adaptivity into SULPs is hard work. Expecting policymakers to strategically identify and leverage new, sometimes unexpected, developments is realistic only if they are provided with the time and resources to gain a thorough understanding of the complexities of urban logistics systems. This requires regular consultations with local stakeholders and experts, reliable data on logistic flows, future-proofing policy actions, and a mandate to experiment, learn and adapt.
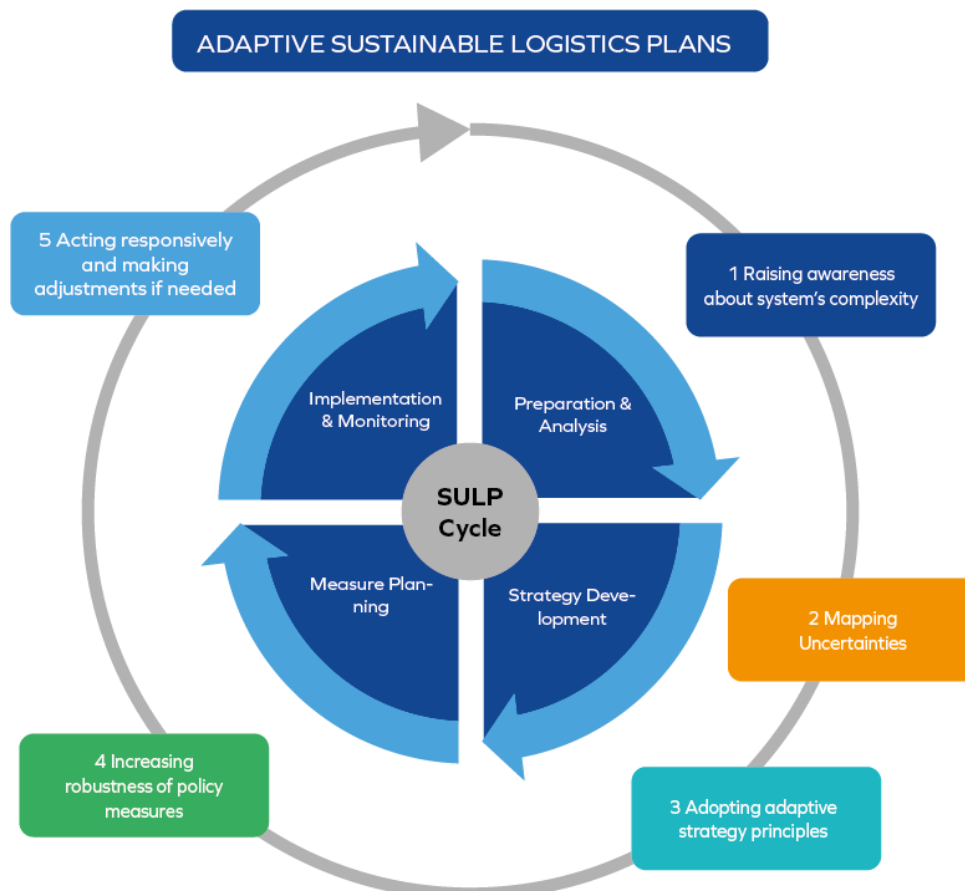

Figure 1 The adaptive SULP-cycle; proposing 5 steps to enhance the adaptive capacity of Sustainable Urban Logistics Plans

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1. Introduction

1.1 Background

The rapid growth of urban logistics in recent years has had a significant impact on the urban landscape. Today e-commerce enables citizens and businesses to access a wide range of on-demand delivery services tailored to their wants and needs. But this growth hasn't been uniquely positive, as the sector also makes a sizable contribution to traffic congestion, noise pollution and CO_2 emissions (Bertolini et al., 2008; Demir et al., 2022). With the number of last-mile deliveries expected to further increase by 78% worldwide by 2030 (World Economic Forum, 2020), urban logistics stakeholders are starting to recognize the need to transition to more sustainable modes of operation. In line with this, the European Union has set an ambitious target to achieve cleaner cities, aiming to cut CO_2 emissions by 90% in 2050 (European Union, 2020). European cities thus face the challenge to drastically limit transport-related emissions in inner cities and boost more sustainable city logistics. To help policymakers set the course on the road to sustainability, guidelines have been developed for the implementation of urban mobility and logistics policy plans – also referred to as Sustainable Urban Logistics Plans (SULPs) (Aifandopoulou and Xenou, 2019). A SULP contains a long-term vision of the desired state of logistics in a city and is supported by goals and corresponding actions. A growing number of European cities is adopting the SULP methodology to foster sustainable city logistics, amongst others due to the commitment of the 424 major cities on the TEN-T network to have mobility plans including sustainable logistics actions by 2025 (European Commission, 2021).

However, developing and implementing a Sustainable Urban Logistics Plan is complex due to the wide range of stakeholders involved and multiplicity of processes, innovations and events that impacts city logistics, of which some are hard to predict (ULaaDS Deliverable 6.1; Janjevic et al, 2019). This complexity can jeopardize the desired transition and requires a balancing act on behalf of policymakers: on the one hand they need to set strict enough targets to achieve the transition within the given time frame, and on the other hand, plans must be flexible enough to be able to deal with unforeseen future developments and events. Thus, it is imperative for policymakers to actively explore and understand the uncertainties that potentially impact their logistics policies, and to build adaptive capacity into their plans to keep them effective under changing conditions and revisit them if needed (see also ULaaDS Deliverable 6.1).

To date, city logistics policies and research pays little attention to the effort local policymakers put forward to deal with the complexity of city logistics systems and the related uncertainties (Haarstad et al, 2023). A better understanding of the strategies and tactics policymakers deploy in getting a grip on potential future developments and their impact can contribute to adaptive policy-making in sustainable urban logistics and strengthen SULPs. As policymakers' existing strategies and tactics can be very informative in grounding more adaptive urban logistics policies, this policy note addresses this knowledge gap.

1.2 Objectives

In this policy note we present a strategic framework to deal with uncertainty in sustainable urban logistics planning, informed by the experiences of local logistics policymakers in European cities. The main <u>objective</u> of this policy note is to suggest strategies local policymakers can employ to incorporate adaptivity into their SULPs and keep them effective under changing circumstances in the long-term.

For this, the following <u>questions</u> are addressed:

1. What types of uncertainties influence logistics policies and how are local policymakers confronted with these uncertainties when developing and implementing SULPs?

2. How do local policymakers explore and deal with uncertainties that may affect policies for sustainable urban logistics?

3. How can local policymakers address uncertainties systematically and keep SULPs effective in the long-term?

By answering these questions, this policy note aims to make the following <u>contributions</u>:

- Provide methods that urban planners and policymakers can use for identifying uncertainties that may affect their city logistics policies.

- Assist urban planners and policymakers in developing strategies to deal with uncertainties up front (when developing policies) and along the way (when executing policies) in order to keep SULPs effective under changing conditions and revisit them if needed.

- Present a coherent approach to building adaptive capacity in sustainable urban logistics by integrating various concepts stemming from planning theory and public administration. The result is a strategic framework wherein adaptive capacity-building strategies are applied to the different stages of the existing EU SULP guidelines.

1.3 Methodology

The data to inform the strategic framework for adaptive capacity-building is collected via multiple research methods that provide an answer to the three research questions. The complete research design is presented in Figure 2 and indicates which research methods were used to answer each research question and how the strategic framework is informed by (academic) literature, policy documents, and the experiences of policymakers involved in urban logistics.

Following the research design (Figure 2) it can be seen how ULaaDS Deliverable 6.1, the workshop at the ULaaDS Study Visit in Mechelen (16 May 2022), the policy document analysis and the literature review form the input for the introductory survey and the interviews that were held with fourteen local policymakers from the field of urban logistics. The collected data from all research methods

combined compose the input of the strategic framework that is created to enhance the adaptive capacity of SULPs (see Figure 1 on Page 6).

A first round of data collection (literature study and the workshop) revealed that the rather theoretically informed concept of uncertainty and approaches to deal with them strategically were not always resonating with every day, often intuitive, tactics of local policymakers. Therefore, it was decided to combine the introductory survey with an interview to establish an understanding of how policymakers perceive the topic of uncertainty in their daily policy practices on sustainable city logistics planning. Consequently, however, the survey in itself has no explaining power. It was limited to mapping the types of uncertainties that local policymakers recognise and some of their experiences in how these uncertainties affect policy-making in the participating European cities. However, by using the survey entries as a starting point for the interviews with these policymakers, we were able to get an in-depth understanding of how they are confronted with uncertainties when developing and implementing policy solutions for more sustainable urban logistics.
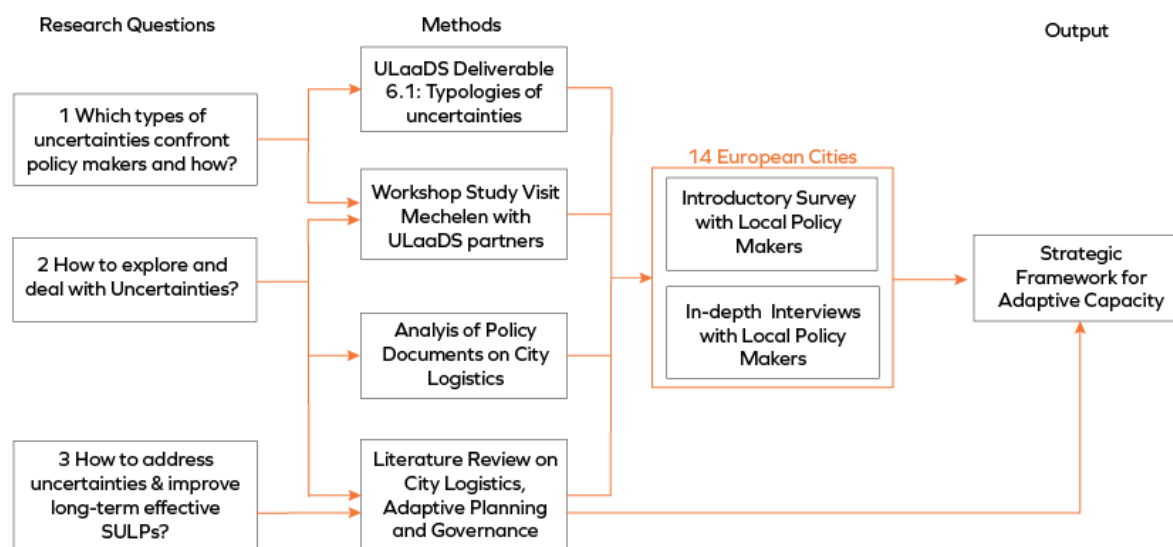
Figure 2 Systematic overview of the research design

The data collection has been completed for six months, of which the surveys in combination with the interviews were conducted in the period from June 2022 to October 2022. Table 1 gives an overview of the participating European cities; all participants were either local policymakers in the field of urban logistics or closely involved by having an advisory role (Milan and Edinburgh).

Table 1 Overview of the research case studies.

	European City	Surface (km2)	Population size	Urban logistics policy
1	Antwerp (BE)	205	530.000	In development
2	Bergen (NO)	445	287.000	Integrated into Green Strategy, the development of a SULP is being discussed
3	Bremen (DE)	318	569.352	Mentioned in the SUMP but only broadly + mentioned in the business development plan broadly
4	Budapest (HU)	525	1.752.000	In development
5	Edinburgh (SCO)	263	518.500	The idea of logistic hubs is included in the city centre transformation plan
6	Leuven (BE)	57	101.000	Integrated into the climate action plan
7	Mechelen (BE)	65	87.000	There is a covenant with stakeholders in logistics, and the SUMP contains a single sentence about logistics.
8	Milan (IT)	182	1.371.000	In development
9	Munich (DE)	460	2.230.600	No
10	Oslo (NO)	426	700.000	Integrated into the climate strategy/ climate budget
11	Stockholm (SE)	187	979.000	Yes, the Stockholm Freight Plan
12	Turku (FI)	246	195.000	Integrated in their Climate Plan 2029
13	Wiesbaden (DE)	204	279.000	Yes
14	Groningen (NL)	185	235.000	Yes

1.4 Ethical considerations

Considering the criteria for ethically responsible conduct, all research participants were asked for their voluntary consent to record the audio of each interview and to analyse the collected data. The researchers informed each participant at the start of the interview that they could end their involvement at any time and without providing a reason. Additionally, anonymity is protected by omitting any private or geographical information from the report and limiting data analysis to the three researchers who are engaged in this research. Each participant received a unique ID code that

was assigned at random to ensure that quotes or other research data could not be traced back to the research participants or the individual cases.

The summary of study subjects (shown in Table 1) reveals a Northwestern European focus. Although unintentional, this can be attributed to the involvement of ULaaDS partners and the more advanced development of city logistics policies in Northwestern European cities. By including the cities of Budapest and Milan in the case selection, we aimed to establish a more balanced selection of European cities.

1.5 Reading Guide

The structure of the policy note is as follows: In Section 2, it is shown how urban logistics systems are inherently uncertain and why, to respond to and manage these (unexpected) developments, urban logistics systems need adaptive solutions. Section 3 outlines five categories of uncertainty and discusses the practical ways in which policymakers are faced with them. Section 4 presents information on potential approaches to explore uncertainty, the approaches that policymakers employ, and whether it is considered relevant to explore uncertainties in the formulation of urban logistics policies. Section 5, which concludes, offers strategies for enhancing the adaptive capacity of the SUMP or SULP and clarifies potential challenges to adaptive urban logistics policy-making.

2. Why does uncertainty matter in sustainable urban logistics planning?

2.1 The complex system of urban logistics

The requirement for local authorities is responsible for to develop sustainable urban logistics plans is growing stronger across Europe (European Commission, 2021). This is a serious responsibility as defining, designing, and implementing a logistics plan which contributes to economic, social and environmental sustainability is highly challenging.

One reason is that the development of the urban logistics sector is coupled with the development of many other systems (Browne et al., 2023). Logistics systems are open systems, which means that they are sensitive to changes in their context (Portugali, 2006; Batty, 2018). To remain functional and vital, they need to be responsive to changing consumer preferences, new technological opportunities, changes in national or European legislation and global crises such as the Covid pandemic and the war in Ukraine. Issues related to urban logistics can thus not be addressed without also taking into account their (dynamic) context.

Another reason is that urban logistics is partly self-organizing due to the large number of actors involved (Janjevic et al., 2019). These stakeholders - including citizens, local businesses, and logistics operators, among others - have different interests, responsibilities and capacities to take action.

Actions and interactions of actors trigger actions by other actors, to which yet others respond. Such processes of self-organization imply that changes in the urban logistics system of a specific city are not necessarily centrally coordinated or 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.

Amidst this complexity, planners and policymakers are expected to guide city logistics towards more sustainability, enabling urban functions and activities while decreasing environmental impacts and enhancing liveability. Developing SULPs, they set long-term goals, providing direction to logistics stakeholders, and design policy packages that gear city logistics towards a desired future. However, due to the "open" character of the urban logistics system, the impact of contextual developments and the heterogeneous web of stakeholder unexpected opportunities and barriers may emerge over time, or selected policy measures proved to be less suitable or even counter-productive. In developing Urban Sustainable Logistics Plans, urban planners thus have the difficult task of finding an effective balance between setting direction while acknowledging and being responsive to the many uncertain developments that can potentially impact the planning process.

2.2 Planning for sustainable urban logistics amidst uncertainty

Uncertainty can be defined as "a perceived lack of knowledge, by an individual or group, which is relevant to the purpose or action being undertaken" (Abbott, 2005 p. 238). Uncertainties may result from incomplete knowledge or a lack of reliable data, different sense making frames of actors, or an intrinsic aspect of the many action-response interactions between actors in urban logistics systems. The more complex the system, the more difficult to navigate. The rate of change can be higher, the impact wider, the response to these changes more diffuse. In turn, the longer the time range for which these have to be considered and the deeper the level of uncertainty about a situation (Walker et al, 2003; Kwakkel et al, 2010).

Uncertainties have the potential to significantly impact effective formulation and execution of urban logistics plans. Drawing from the work described in Deliverable D6.1, we reiterate the importance of planners and policymakers gaining a better understanding of the uncertainties that their policy plans face, for at least three reasons (Zandvoort et al., 2018):

1. Urban logistics plans may be redundant or inadequate if urban logistics systems and interconnectedness with other systems are only partly understood.

2. Developing urban logistics plans based on a limited acknowledgement of uncertainties may mean that policies are insufficiently adaptive and thus potentially unfit for guiding dynamic urban logistics systems.

3. Structuring the long-term transition towards sustainable urban logistics under conditions of uncertainty comes 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?

Ideas on how planners and policymakers can address uncertainties in their plans have evolved over time. Classical planning approaches were based on the idea that the practice of planning was unambiguous and that stakeholders acted and responded rationally (Woerkum et al., 2011). The departure point was that the "planning situation" was well-known, and the future was a desired world which was broadly agreed upon and which could be predicted and achieved through a straightforward policy plan. The available knowledge created the confidence to estimate policy outcomes and the interest stakeholders would attach to them.

Over time, planners and policymakers realized that such approaches were unable to deal with the dynamic and complex realities that they plan for. Picking and acting on one carefully chosen and static strategy over time prevented them from adjusting to developments and acting on new information. This gave way to new planning approaches which left policy plans with more "wiggle room" to keep functioning after the occurrence of an unforeseen event, adapt to new circumstances and evolve by responding to change. Examples of these newly emerging approaches are, 'Mixing Scanning', which distinguishes and combines fundamental decisions and incremental decisions (Etzioni, 1973), 'Strategic Choice Approach' emphasizing the interconnectedness of choices in public planning (Friend and Hickling, 2012), "Real options framework" allowing urban designers to cope with uncertainties in a more structured way and offers the possibility to quantify the added value of flexibility options (Coppens et al, 2021), and the "Dynamic Adaptive Planning" approach proposes a strategy that policymakers can follow to develop a policy which includes urgent short-term actions and the creation of a flexible long-term framework that can be adjusted over time (Walker et al., 2013). As such, policymakers are encouraged to continuously adapt their strategy to reach predefined goals, instead of developing a strategy that potentially loses its significance after the occurrence of an unforeseen event.

The traditionally limited attention to the role of uncertainties in planning and the need for more adaptivity applies especially to urban logistics planning. A possible explanation for this is the relative "newness" of the policy field to local city planners. Local authorities' transportation departments have traditionally focused on passenger transport, leaving freight transport to be regulated by private parties (Lindholm, 2013, Haarstad et al., 2023). Recently, these authorities have become more aware of the significant contribution they can make in "greening" urban logistics. But they lack the expertise and knowledge to navigate the complexity of the topic, develop strategies for effective planning and collaborate with other departments and private sector stakeholders along the way (Bjørgen & Ryghaug, 2022; Akgün et al., 2019; Lindholm, 2013). The limited availability of resources (time, budgets, personnel) in combination with a much larger number of stakeholders compared to the passenger transport that is typically organized in one transport authority, puts further strain on local authorities' efforts to effectively plan for the future.

To contribute to adaptive policy-making in sustainable urban logistics, this policy note suggests strategies local policymakers can employ to incorporate adaptive capacity into their SULPs to keep them effective under changing circumstances in the long-term. As preparatory steps, a framework for mapping different types of uncertainties is proposed and it is assessed whether and how local policymakers are confronted with these uncertainties when developing and implementing SULPs.

3. Identifying uncertainties in sustainable urban logistics planning

Given the limited knowledge and resources that local policymakers have available to develop and implement urban logistics policy plans, the first question to ask is to what extent they are aware of different uncertainties and potential consequences for urban logistics planning in the long term. Section 3.1 identifies the various uncertainties that affect sustainable urban logistics planning. Section 3.2 shows whether and how European policymakers are confronted with such uncertainties.

3.1 What types of uncertainties

Academic literature presents an extensive number of categorizations of uncertainties. Most of these distinguish 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). Following the argumentation presented in ULaaDS D6.1 we build upon the typology as proposed by John Abbott (2005). This 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 complexity of urban logistics systems, as outlined earlier in the text. 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 sensitive to changes in their context. 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.

In the typology, five types of uncertainties are distinguished: *value uncertainty*, *organizational uncertainty*, *causal uncertainty*, *external uncertainty*, and *chance uncertainty*. Previously, we have made the first step in integrating the uncertainty framework of Abbott in the field of sustainable urban logistics (Figure 3) (ULaaDS_D6.1). This shows how the types of uncertainties relate to sustainable urban logistics.
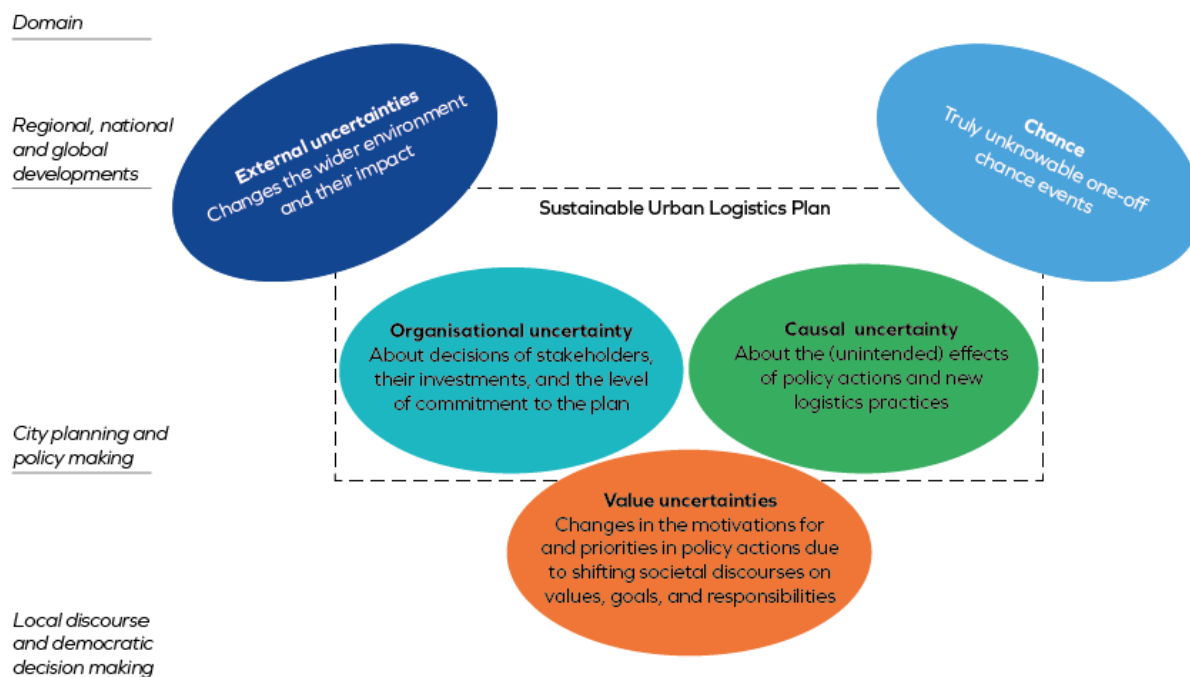
Figure 3 Types of uncertainties surrounding sustainable urban logistics policy-making (ULaaDS D6.1)

External uncertainties are contextual to SULPs and unfold beyond the city-level at regional, national, or global scales. They find their origin in economic, social, or environmental processes and generate opportunities and constraints for cities transitioning towards more sustainable urban logistics without local actors having the capacity to influence these developments (Abbott, 2005). Technological innovations such as electric vehicles, autonomous driving, 3D-printing, big data and smart containerization are examples of this (Technical innovations are further discussed in ULaaDS D3.1). *Chance uncertainties* are also contextual to SULPs, but these are sudden, one-off events that have a single and unannounced effect on the environment and lie beyond the control or influence of authorities or other stakeholders. Examples here are the COVID-pandemic, the war in Ukraine, the global financial crisis in 2008 and the eruption of the Eyjafjallajökull volcano in Iceland in 2010. While external and chance uncertainties lie beyond the control of urban planners, policymakers and other actors at the city level can prepare and implement actions for dealing with the consequences of these uncertainties.

Organizational and causal uncertainties are positioned in the domain of city planning and policy-making. *Organizational uncertainties* arise from the actions and interactions of people and organizations that engage in the development and implementation of a SULP. Organizational

uncertainties are practically unavoidable as they arise from stakeholder interests, priorities, decisions, and the level of commitment of people and organizations to measures and policies. An example is the implementation of low emission zones or vehicle restrictions which may force existing logistics operators to reorganize their modes of operation while providing business opportunities for new players. *Causal uncertainties* are about cause-effect relationships, either intended or unintended. Examples are the impact of policy interventions (e.g. businesses relocating themselves to the edges of zero-emissions zones) or developments in the logistics domain (e.g. the rapid growth of cargo bike logistics with unintended consequences for traffic safety).

Finally, *value uncertainties* play out in local discourses and democratic decision-making processes, such as city council decisions, referenda, media reports and community initiatives. They follow from changing discourses on societal values, goals, and the perceived responsibilities of related stakeholders, and might ultimately result in policymakers changing their agendas. 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.

The next section investigates whether and how local policymakers in the field of urban logistics are confronted with uncertainties in their daily practice, based on the presented typology.

3.2 How are policymakers confronted with uncertainties in sustainable urban logistics planning?

Awareness of the different uncertainty types that surround policy-making is the first step in dealing with uncertainties. Insights from surveys and interviews with 14 logistics policymakers in European cities reveal to what extent local policymakers are confronted with uncertainties when developing and implementing sustainable urban logistics plans.

All participating policymakers state that they, as part of their policy practice, keep an eye on future developments that might influence their plans. They also gave examples of unforeseen developments that they dealt with while developing or implementing urban logistics policies.

> *"A traffic accident involving a truck killing two children resulted in strong public reactions. The effect on our logistics policy: accelerated development of a safe freight route planner and the intention to create guidelines for construction logistics in the city" (C923)* - Value uncertainty.

> *"The public opinion towards sustainable urban logistics has changed. Companies even ask what [the city's] ambitions towards sustainable urban logistics are, so that they can adapt their company policy to it. The effect on our city logistics: the aldermen approved the development of a SULP, which is currently ongoing." (C923)* - Value uncertainty & Organizational uncertainty

> *"COVID led to a significant increase in vehicle deliveries to homes and closure of city centre businesses." (C574)* - Chance uncertainty

During interviews policymakers were asked what types of uncertainties they encountered in their day-to-day policy practice. The interviews indicate that a general unawareness on the topic of urban

logistics with public administration and the lack of a pre-existing urban logistics plan generates value uncertainty in policy development and implementation, as positions of decision makers remain unclear.

> *"Logistics is not such a popular topic, and it does not get the same ... not the same attention as other topics" (C483)*

Unpredictability of political standpoints and the political agenda, as the basis for the development and modification of SULPs, are another important cause for value uncertainty mentioned by interviewees.

> *"An institutional system that is not solid is another uncertainty that you can list. In our city, and country there are changes, especially after every election because then the whole institutional system is down and then rearranged." (C637)*

> *"Yes, most uncertainties we have in mind, but we mainly focus on the political decisions that may change in the future." (C293)*

Organizational and causal uncertainties are also often mentioned in the process of policy-making. Examples of organizational uncertainty are the unknown actions of logistics stakeholders in response to pilots and new policy measures. Examples of causal uncertainty are the unintended side effects of pilots and implemented policy measures. The quote below shows how both types of uncertainties appeared in combination. For both examples, increased data availability can aid decision-makers in comprehending the effects of their policies.

> *"After implementing a new circulation plan and time windows for delivery, we saw the number of kilometres driven for deliveries go up. Logistics companies now have to drive out of each city zone to re-enter another zone and do deliveries there. And if [longer routes] means they cannot deliver in time within the given time windows, they add an extra vehicle with a lower load factor." (C851)*

Overall, it is clear that policymakers are well aware that their policy-making practices are confronted with uncertainties, and the different types of uncertainties are generally well-recognized. Next, we investigate what types of uncertainties policymakers are most concerned with.

3.3 What uncertainties have the most impact on sustainable urban logistics planning?

In the introductory survey for the interview, policymakers were asked to point out the type of uncertainty that they are the most and least concerned with when planning for sustainable urban logistics. Value uncertainty concerns policymakers the most when preparing or implementing their policy plan (Figure 4). As explained above, this relates to potential changes in political standpoints or potential changes in public opinion regarding logistics that may impact their policy process.

**With what type of uncertainty are you most and least
concerned with when planning for sustainable logistics?**

Most concerned   Least concerned
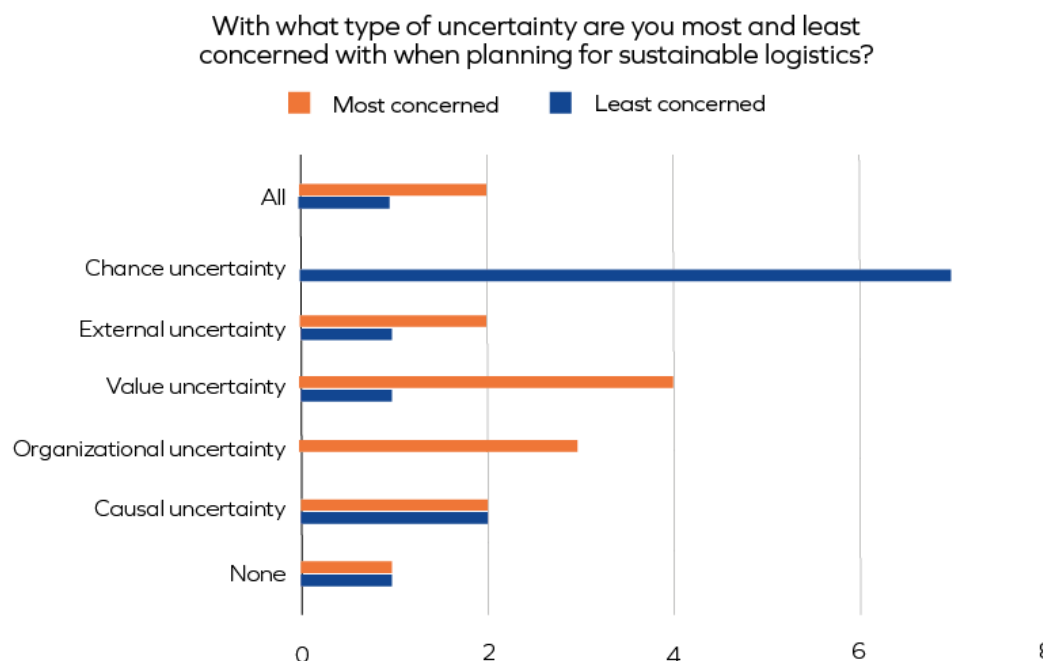
Figure 4 Uncertainties of most and least concern to urban logistics policymakers

Policymakers indicate that they are least concerned with chance uncertainties. Interviewees clarify that they are least concerned with this type of uncertainty as they see it as being beyond their control:

> *"Like what's the real statistical likelihood of certain things happening? That's difficult. Because for instance climate change, because... of course something's going to happen, but you just don't know when."* (C253)

> *"Yes, that's outside the circle of influence"* (C923)

In addition, policymakers mentioned they felt they were unable to take proactive measures to deal with chance uncertainty, which was why they were least concerned with this uncertainty. In the context of limited resources (personnel, budgets) cities need to prioritize policy actions, and chance uncertainty is low on the list of priorities to deal with proactively.

To summarize, respondents show awareness of uncertainties but are unable to give them equal attention in the policy process. This is partly due to their nature and position outside the scope of influence of policymakers, but also due to a lack of resources and perceived urgency. An obvious explanation is that uncertainties that are most apparent to policymakers are also the ones experienced as being most urgent. This leaves the question of whether policymakers are sufficiently aware of the potentially disruptive effects of uncertainties that they don't encounter often or know little about, such as a pandemic, cyberattacks or extreme natural hazards). In the next section, we ask how policymakers may explore uncertainties more actively to broaden their understanding of the range of uncertainties and their potentially disruptive effects.

4. Exploring uncertainties in sustainable urban logistics planning

Uncertainty is often linked to the degree of existing and available knowledge about the future. Hence, it is useful to delve into the strategies that can be used to increase this level of knowledge (4.1). The next section identifies possible strategies based on literature (4.2). Then, we look at whether and how European policymakers actively explore uncertainties (4.3).

4.1 Which methods can be used to explore uncertainties in sustainable urban logistics planning?

Not only do uncertainties have various origins, they also continuously arise during the planning process as a result of new decisions and developments. Therefore, it is useful to think of methods to explore uncertainty while preparing and implementing a sustainable urban logistics plan. Van der Steen (2018) distinguishes three types of methods that can help make sense of future developments: forecasting, foresight and exploring by testing.

In *forecasting*, quantitative scenarios are developed using model simulations to estimate the future effects of certain policy measures and the impact of triggers in the environment (van der Steen & Twist, 2020). Forecasting can help improve policy responses to foreseen developments and ensure that policymakers prepare required actions and interventions. Forecasting methods are dependent on input data on past and present developments, which are ideally retrieved through monitoring programs that keep track of the urban logistics systems and measure policy effects. As such, forecasting is useful to identify expected and plausible futures and the related uncertainties based on calculated effects of (future) trends and policy effects.

Using *foresight*, stakeholders question and imagine the future together, often resulting in visual and story-like future narratives (Neef et al., 2020). These future visions are established via discussions, storytelling, design-charrettes, debates and "thinking-out-loud" (van der Steen, 2018; van der Steen & Twist, 2020). The result can take the form of "stories, pictures, movies, mood boards or other creative expressions (van der Steen, 2016, p32). Imagined possible and desired futures can be used to broaden the viewpoints of stakeholders and rethink the perceived present reality. Scenarios are then projected back into the present to assess the consequences of that imagined future for actions of stakeholders in the present (van der Steen, 2016; Van der Steen, 2018). Thinking about a range of possibilities using scenarios can provide local policymakers "with more confidence" to deal with uncertainties (Burt & van der Heijden, 2003). Foresight is less bound to models and allows for non-linear thinking, the use of qualitative data and the imagination of more radical futures.

In *exploring by testing*, policy measures are "tried out" in pilots and experiments. This allows policymakers and practitioners to experience how potential future developments or consequences

of measures may play out. Piloting or testing is seen as an essential step in much of new policy development as it provides opportunities to test and map the potential risks and consequences without disturbing the urban environment (Kato & Ahern, 2008). Monitoring these pilots can reveal causes and effects of developments that ensue from policy measures and reveal the perceptions and responses of stakeholders. This gives city planners and local policymakers the chance to make mistakes and learn from pilots by bringing the future forward (van der Steen, 2018). This approach resembles the "learning-by-doing" approach (Kato & Ahern, 2008) but on a smaller scale, or in an online environment (e.g. by using a 'Digital twin').

The three types of methods for exploring uncertainty are summarized in the table below (Table 2). Next, we address which methods and tactics local policymakers use to explore uncertainty in their daily policy-making practice.

Table 2 Overview of the three strategies to explore uncertainties.

	Type of data	Methods addressed in literature	Results
Forecasting	Quantitative, use of numerical data	Model calculations	Numerical visualizations, expected and plausible futures, trends
Foresight	Qualitative data, use of narratives	Discussions, storytelling, design charrettes, debates, thinking out loud	Narrative visualizations, possible and desired futures, network relationships.
Exploring by testing	Quantitative and Qualitative	Pilots, tests, experiments in physical or online environments.	Testing the policy measure's feasibility, consequences and opportunities

4.2 Do European policymakers see relevance in exploring uncertainties in sustainable urban logistics planning?

As stated earlier, gaining awareness of uncertainties is the first step in dealing with uncertainty (Termeer et al, 2015; Kato & Ahern, 2008). Once aware, policymakers can choose to use instruments and strategies to design policies that better respond to uncertainties (Barg & Tyler, 2009; Woodruff, 2016). Therefore, in the introduction survey, participants were asked to give a score on the relevance of exploring uncertainties and their impact on policy goals for policy performance.

How relevant is it to explore uncertainties and their influence on policy plans?

1 = not relevant <> 10 + very relevant
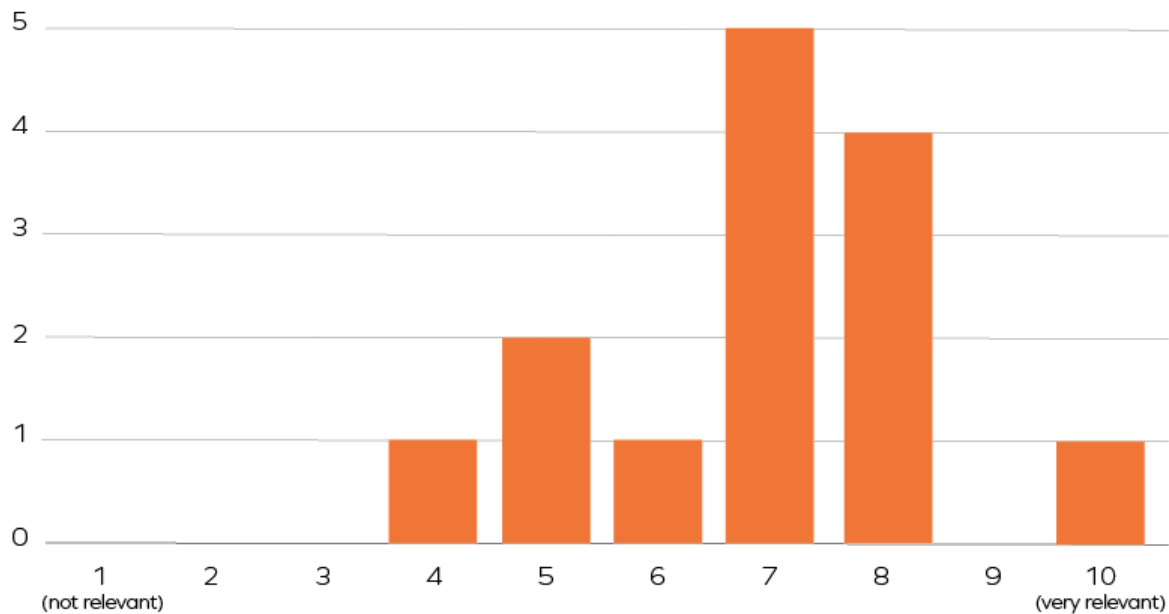
Figure 5 Distribution of the grades in relation to the relevance of exploring uncertainties.

As mentioned before, participants generally acknowledge the uncertainties that surround the policy field of urban logistics. But when asked to elaborate on their grading, the interviewees' priorities varied when it came to exploring uncertainties. For example, the interviewee who graded the exploration of uncertainty as very relevant (score of 10) stated that this practice is very important because many uncertainties surround even the smallest decisions:

> "We try to have a reasonable amount of market analysis. to be aware of what's going on in our urban sphere. [policymakers] spend time learning and developing their competencies to be able to see what's happening in the market and then how to process the uncertainty that's related to that. because when you go down to micro decisions, how do we redefine this street? There are always millions of uncertainties." (C253)

The interviewee who scored exploration as "somewhat relevant" (score of 5) also highlights the many changes and uncertainties to deal with in policy planning but explains that the effort needed to proactively make sense of uncertainties does not outweigh the potential benefits.

> "As I mentioned, the uncertainties are not the main focus for us. We try to keep flexible and to react if we see that situations change. But not beforehand. There are so many possibilities of how the situation can change. And if we think about all these possibilities, I think it's too much input for the smaller output" (C293)

The "flexibility" mentioned by the interviewee suggests an awareness of potential changes and unexpected developments. It also suggests that policies are established in such a way that they are able to respond to sudden events. Overall, the relevance of exploring the uncertainties is assessed

on average with a seven out of ten by the panel of local policymakers of 14 European cities, which gives reason to assume that cities are trying to actively make sense of unforeseen developments in their policy-making practice. Whether the three approaches mentioned earlier are employed is demonstrated in the paragraphs that follow.

4.3 How do European policymakers explore uncertainties in sustainable urban logistics planning?

This section reports on the extent to which the participating policymakers use forecasting, foresight and exploring by testing as methods for exploring uncertainties when planning for sustainable urban logistics. Interestingly, our findings indicate that a fourth method can be distinguished based on the practices of policymakers, namely 'exploring by consultation.'

Forecasting

In forecasting, historical data is used as input to make informed estimates on the direction of trends and to distil probable futures and related uncertainties. Out of fourteen cities interviewed, ten either already use or express their wish to use forecasting methods to explore uncertainties and signal potential future developments in the field of urban logistics. Interviewees mention using a wide range of techniques, from the use of models, projections, and future scenarios, for which input is provided by quantitative analyses of trends, periodic or long-term monitoring and surveys. One way in which cities utilize forecasting is to gain a better understanding of their cities' urban logistics system and their future performance. For instance, monitoring of transport movements (such as how many trucks enter the city centre or how many kilometres they travel for deliveries) provides input for the calculation of projections (e.g. how much are transport movements expected to grow in the future) (C574). These projections are then used to establish and evaluate policy targets. Another way cities use forecasting is to estimate probabilities of various future scenarios. Based on input data, cities calculate the effects of certain policy measures and estimate the magnitude of their consequences (C851). This is to get to grips with how sets of policy measures make some futures more likely than others.

Foresight

Foresight uses narrative and qualitative data to explore possible futures and the related uncertainties in a collaborative setting (e.g. group discussions, and creative workshops). All cities mentioned using foresight when planning for logistics. This shows that policymakers acknowledge the value of involving stakeholders in the policy-making process to explore the interests and reactions of private and public stakeholders during the development phase and implementation phase of their SULP.

In how the participants apply foresight techniques, a distinction can be made between sessions with stakeholders within the governmental organization, and sessions with stakeholders outside the local administration, such as logistics operators and businesses. In the former case, interviewees indicated to use counselling with colleagues and strategic cross-department meetings to brainstorm about

potential developments, pitching potential policy measures with a "core team" of experts. In the case of the latter, policymakers frequently involve external stakeholders in the process of logistics planning to explore uncertainties and generate insight into the interests and actions of other players. Interviewees mention the organization of workshops, amongst others as part of EU-projects and urban logistics forums, in which policy objectives or qualitative scenarios are discussed, or arranging public hearings where local stakeholders can express their opinions and thoughts on the planning process as well as preferable futures.

Exploring by testing

Out of fourteen cities, eleven mentioned using the "exploring by testing" strategy to assess the uncertainties related to specific urban logistics solutions. Their efforts mostly take the form of pilots, which are considered a suitable approach to test multiple solutions, investigate how policy measures will unfold, and map the reactions and perspectives of stakeholders in their cities. Additionally, interviewees mention that pilots enable the exploration of negative or unforeseen consequences in a controlled manner. Furthermore, the experimental and time-restricted set-up of pilots makes it easier to get approval of the pilot by decision-makers, as indicated by the quote below.

> *"We used the word pilot to make sure it's just temporary and there are no major obligations like that. It doesn't have to be like this forever, you just want to get more knowledge." (C463).*

> *"[I use] a pilot thing to show the CEO and some other colleagues that this is the way it should be" (C637)*

> *"The tests had to be done in the craziest amount of time possible. Everything has to be done yesterday at this very short time window. But they made it. They got the tests done. They demonstrated that this would work" (C253)*

Cities mentioned physical pilots performed at various locations in the city. One interviewee however mentioned testing new policy measures with the help of a "digital twin," where the urban environment was virtually replicated in an online tool. This method can help evaluate the effects of the logistics solution in a fictitious manner and allows for a quick exploration and analysis of data generated by the pilot (see also LEAD, 2023).

> *"(..) You can also check whether there is a negative effect, or whether there is an unintended negative effect. So, I think that's the added value of those digital twins. [..] If you use that well and analyse the data, it shows you what you don't want. And yes, I can also share those results with people here." (C851)*

Exploration by Consultation

The analysis for policy maker's practices points at a fourth type of method for exploring uncertainties, additional to the three suggested strategies. To better understand potential developments and estimate their effects, local policymakers tend to use informal meetings with their networks, for example through short conversations or phone calls. In addition, policymakers keep an eye on newsletters, LinkedIn posts or podcasts which all provide information on new developments or innovations. This strategy can be characterized as exploring uncertainty through (informal) *consultation*.

Yielding qualitative data, however, *consultation* is neither structured nor organized as is the *foresight* technique. As a policy maker illustrates, it is about maintaining contact with logistical actors and getting to know the various stakeholders as a key method for keeping tabs on one another's progress, comprehending one another's interests and signalling new development early on (C603). This informal information gathering strategy is also mentioned by other policymakers:

> *"Currently, we also have more contacts with the [colleagues working in the] cities around us. And, it has been informally discussed that we should look at the topic of city logistics all together [to access each other's knowledge] so we can jointly discuss and agree upon the future of city logistics." (C923)*

> *"I wish I could say that it [information sharing between colleagues] is that structured, that we do that every once in a while, with colleagues. But I think we're not that far. In a way, I would say that's a pro of working in an open landscape because you can talk a lot with your colleagues [informally during the day], but it is not like there is something [formal meeting(s)] arranged" (463)*

Since local policymakers report that they also frequently use these actions to monitor developments, stay in touch with stakeholders, or have data checked with the appropriate parties, we could presume that this fourth way of exploring uncertainties is primarily used for strengthening their own information position in a large network of actors. This finding resonates with a study performed by Wilkinson (2011) in which informal strategies emerged as a success factor in relation to planners' response toward dealing with some types of uncertainties. The use of these informal processes gives planners the space and time to improvise and to base their next step on the tacit knowledge that they acquired.

The four strategies to explore uncertainties are summarized in Figure 6 below.

Figure 6 Visualization of the four methods for mapping uncertainties

5. Strategies to build adaptive capacity in sustainable urban logistics planning.

In the previous chapters we discussed why uncertainty matters when planning for sustainable urban logistics. Using data from interviews and surveys held with policymakers in 14 European cities, we identified the extent to which policymakers deal with uncertainties in their day-to-day practices, and what they do to actively explore uncertainties. In this chapter, we ask how local policymakers can address uncertainties systematically in their planning processes in order to keep SULPs effective in the long-term.

The SULP-cycle is taken as a starting point for answering this question. For each of the four phases, from preparation of the plan to implementation, we propose strategies policymakers can deploy in dealing with uncertainties in guiding city logistics towards more sustainable futures and thus how to develop more adaptive Sustainable Urban Logistics Plans.

The European Union promotes 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). The SULP guidelines aim to provide a strategic and integrated approach for urban logistics policies. SULPs specifically aim to improve the coordination between urban logistics actors and data/information availability to contribute to better urban planning and integration of urban logistics transport into the city's operations (Aifandopoulou & Xenou, 2019, p10). The SULP guidelines are structured along the lines of a SUMP approach. This means that policymakers are encouraged to build a plan in four phases:

- Phase 1 - Preparation and analysis phase, meant to set up working structures, determine the planning framework and analyse the urban logistics situation.

- Phase 2 - Strategy development phase, meant to build and assess scenarios, develop a vision and strategy with stakeholders, and set targets and indicators.

- Phase 3 - Measure planning phase, to select measure packages with stakeholders, agree on actions and responsibilities, and prepare for adoption and financing.

- Phase 4 - Implementation and monitoring phase, to manage implementation, monitor, adapt and communicate, and review and learn lessons.

To keep SULPs effective under changing circumstances, we propose to expand existing SULP guidelines with steps that strengthen its adaptivity. By enhancing the adaptive capacity in the SULP-cycle, urban logistics policies can move beyond a linear plan process for one preferred future to a process which caters to multiple potential futures and enables for shorter feedback loops between the urban logistics situation and policy-making.

The "adaptive SULP-cycle" is presented in figure 7. Each phase of the existing SULP-cycle, represented by the four blue quadrants, is complemented with strategies for boosting adaptivity in the outer ring of the figure. These strategies include:

- Raising awareness about the complexity of the urban logistics system.

- Mapping uncertainties that may affect the urban logistics situation and the related policy goals.

- Adopting adaptive strategy principles in the urban logistics policy design.

- Increasing robustness of urban logistics policy measures.

- Acting responsively to changes and making policy adjustments if needed.

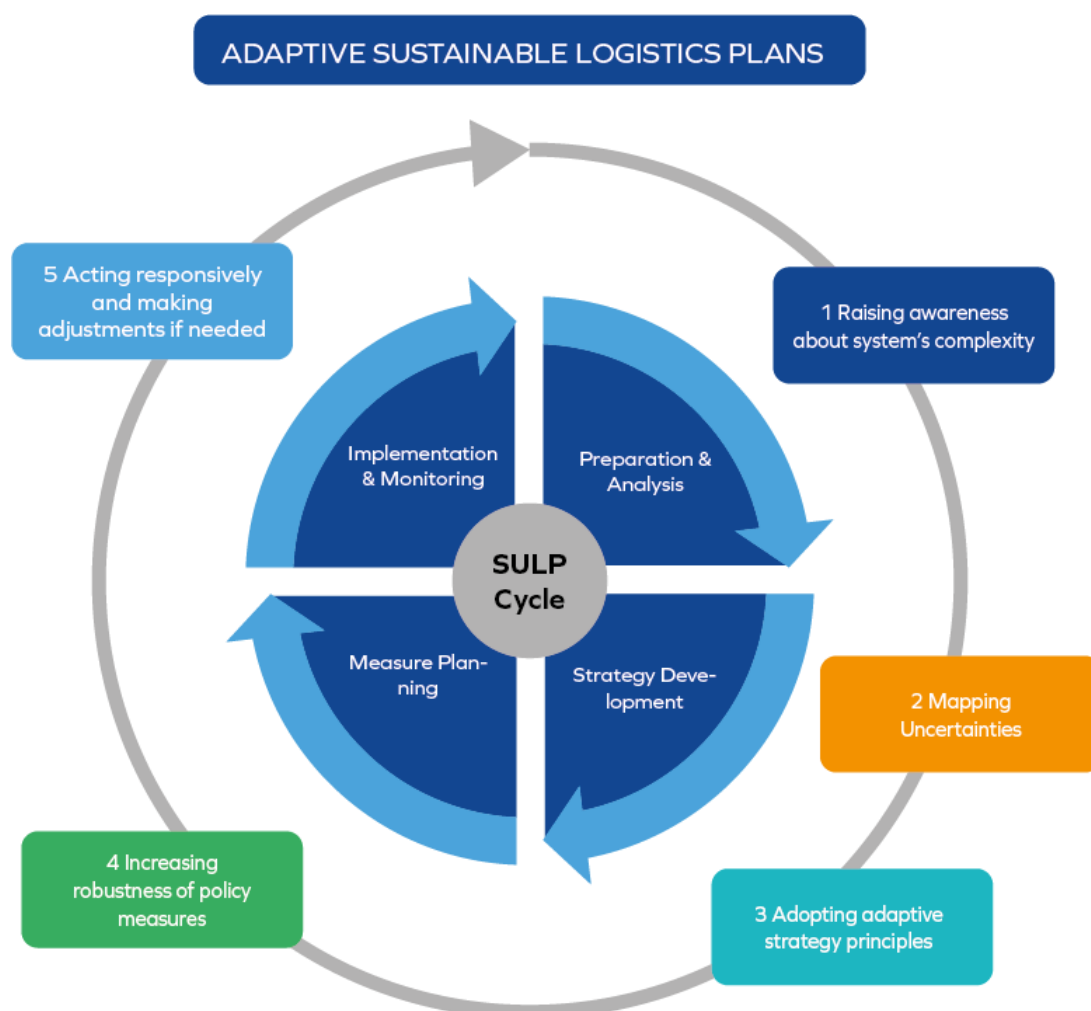These five strategies are discussed one by one below.

Figure 7 The adaptive SULP-cycle; proposing 5 steps to enhance the adaptive capacity of Sustainable Urban Logistics Plans

5.1 Raising awareness about the logistics system's complexity

Willingness to invest in adaptivity starts with acknowledging the complexity of the urban logistics system. As addressed in section 3, the highly interconnected and dynamic character of urban logistics systems is important for policymakers, logistics stakeholders, and public decision-makers to be aware of, since it creates uncertainties that may have an impact on urban logistics planning in the long run. Increased awareness about the system's complexity enables them to communicate about the complexities of urban logistics with policy target groups and can set the stage for adaptive actions. It contributes to a policy approach in which investing in the capacity to map and deal with unforeseen processes, events, policy effects or business innovations is not seen as something extra. Instead, acknowledging complexity comes with the realization that adaptability is a crucial element in robust and effective urban logistics policies in the long run (c.q. Kupers & Colander, 2014).

Raising awareness about the complexity of the urban logistics sector is about explicating the coupling with the development of many other systems (ULaaDS D.6.1), and thus the need for sensitivity to changes in, for instance, consumer preferences, new technological opportunities, changes in national or European legislation and global crises such as the Covid pandemic and the war in Ukraine. Recognizing complexity is also about acknowledging the emergent nature of new logistics patterns and routines (Janjevic et al, 2019). These emerge spontaneously out of the action-response interactions between numerous actors and cannot 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.

There are multiple methods and activities that can boost awareness of urban logistics' complexity among stakeholders, targeting both policy designers and target groups. Examples include:

- Conducting policy and stakeholder network analyses, which shed light on relationships between policy domains and actors, their interdependence, volatility, and vulnerability (Figure 8).

- Developing causal loop diagrams that enable the visualization of how logistics processes, hubs and flows are interrelated (Figure 8).

- Via storytelling and city walks and workshops that create encounters with stakeholders' experiential knowledge on urban logistics operations as they are embedded in city everyday life.

Increased awareness of the complexity of urban logistics systems is essential in analysing the urban logistics situations, creating support for adaptive policies amongst target groups, and for setting up productive working structures, and thus supplements phase 1 of the SULP-cycle.
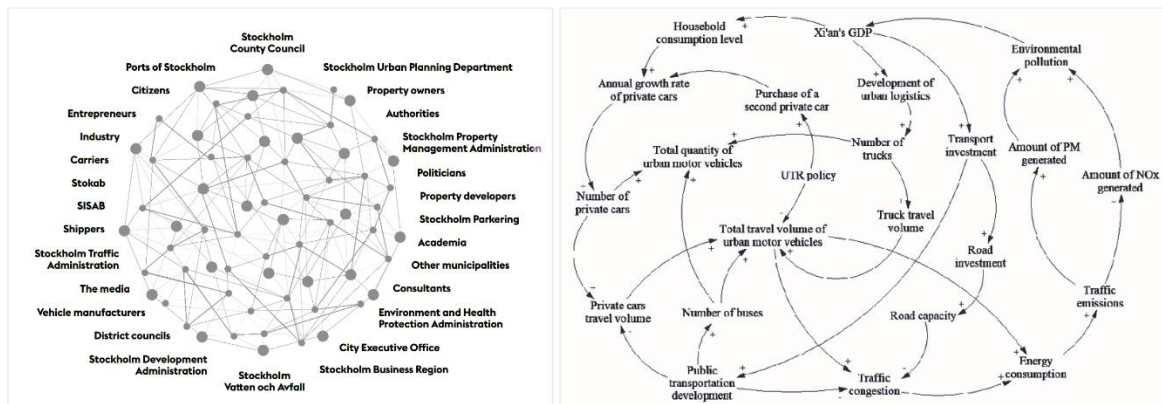
Figure 8 Example of a policy and stakeholder network analysis (City of Stockholm) (left) and a causal loop diagram (Shi et al., 2019) (right)

5.2 Mapping uncertainties

When stakeholders have gained awareness of the complexities of urban logistics systems, two follow-up actions are advised to build adaptive capacity into the strategy development phase of the SULP-cycle: first, mapping uncertainties (this section), followed by the adoption of adaptive strategy principals (5.3). Mapping uncertainties aims to provide a stronger basis of the development and assessment of scenarios that is proposed in the classic SULP-cycle in phase 2.

By unpacking the concept of uncertainty - often casually used, but elusive in nature - the range of possible futures that is considered can be broadened (ULaaDS D6.1). The mapping exercise consists of the systematic delineation of possible uncertainties. For this, policymakers can employ the four methods that were outlined in section 4.3 (see also Figure 9):

- Forecasting can be used to make informed estimates on the direction of trends using historical quantitative data and to distil probable futures and related uncertainties.

- Foresight techniques use narrative and qualitative data to explore possible futures and the related uncertainties in a collaborative and organised setting.

- Exploring by testing allows for exploring the effects of and responses to local and specific logistics solutions in a relative controlled manner.

- Exploring by consultation aims to keep tabs on progress of stakeholders, comprehending one another's interests and signalling new developments early on through informal and unstructured contact with stakeholders and experts.

Figure 9 Visualization of the four methods for mapping uncertainties

Using these methods, policymakers can identify uncertainties that can be categorized using the types outlined in section 3.1.

- **Organizational uncertainties** - About shifting stakeholder interests, priorities, decisions, and their level of commitment (e.g. key persons changing jobs, bankruptcy of a central stakeholder, shifting business strategies).

- **Causal uncertainties** - About the (unintended) effects of policy actions (e.g. businesses relocating themselves to the edges of zero-emissions zones) and new logistics practices (e.g. the effects of the growth of dark stores on liveability).

- **Value uncertainties** - Changing in the motivations for and priorities in policy actions due to shifting societal discourses on values, goals, and responsibilities (e.g. struggles over data ownership, emergence of a circular economy discourse or a strong call for localism).

- **External uncertainties** - Changes in the contextual environment that are beyond the city level and the scope of influence of involved actors (e.g. 3D-printing, big data, and smart containerization).

- **Chance uncertainties** - Sudden, one-off events that have an unannounced effect on the urban logistics system (e.g. COVID-pandemic, the war in Ukraine, the eruption of the Eyjafjallajökull volcano in Iceland in 2010).

Mapping uncertainties systematically will support scenario building and assessment. In more general terms, it contributes to the realization that guiding urban logistics towards more sustainable pathways is surrounded with uncertainty. Thus, in the development of a vision and strategy with stakeholders - also part of phase 2 of the SULP-cycle - an approach is needed that results in a SULP that remains effective under changing circumstances in the long-term.

5.3 Adopting adaptive strategy principles

Integrating or cultivating complexity into logistics policy design requires the adoption of adaptive strategy principles. Inspired by modernism and technocratic decision-making, public policy making and city planning in the 20th century aimed to predict, design and control city developments (Marshall, 2009; De Roo & Rauws, 2012). It has resulted in policies with the tendency to reduce complexity and uncertainty in the name of efficiency, fuelled by a deterministic understanding of the city's metabolism that would allow for fail-safe plans and policies (Ahern, 2011). The legacy of this planning approach can also be found in many of the present SULPs of European cities (see ULaaDS D6.1).

When taking the complexity seriously, however, the modernistic principles need to be complemented with more adaptive planning principles. These are principles that enable and prepare urban logistics plans to respond to changing conditions so that these plans are effective for the range of possible futures that can emerge out of the complex interactions in urban logistics systems. In the section, we highlight five of these principles to enhance the strategy development that is part of phase 2 of the SULP-cycle.

It is important to note that the introduced principles concern the overall approach through which public policymakers can guide urban logistics changes more adaptively. Sections 5.4 and 5.5 will provide suggestions for making individual policy measures more robust and responsive.

Five principles for adaptive urban logistics policy-making:

1. **Visioning for enabling adaptive navigation**. Ideally, visioning results in inspiring images and stories about preferable futures that show new possibilities and also motivates actors to align their actions (Shipley & Michela, 2006). Because of these images of preferred futures, however, visioning is often positioned opposite to more adaptive and flexible policies that are built on the assumption that the future is open and uncertain. Such counter positioning is incorrect as a strong vision of a preferred future is essential for adaptive policy-making as it provides a sense of direction. When a sense of direction is absent, policymakers and other stakeholders do not know when to adapt and in which direction. For instance, when the instalment of a zero-emission zone triggers the reallocation of small shops to areas outside the city centre, a future vision on urban logistics in this particular city provides a point of reference for assessing whether such a reallocation is desirable, and if not, in which direction policy measures should be adjusted.

2. **Guiding principles for an open city.** When translating a long term vision into urban logistics policies, it is essential to focus these policies as much as possible on general guiding principles. These are principles that are simple in nature and provide bounding conditions while leaving room for a range of possible actions (Moroni et al., 2020). Examples of such guiding principles include a rule that in areas with a urban density higher than X, pick-up points need to be integrated with existing urban facilities; or that in area X, urban functions with more than Y deliveries a day should have an internal loading bay from year Z onwards; or, that in urban zone X, non-food and non-medical goods have to

be delivered during the night from year Y onwards. These principles do not define a desirable configuration of the urban logistics systems in detail. Instead, due to their general, but not necessarily less strict formulation, they provide guidance to the myriad of planned and unplanned actions that shape and embed logistics in the urban. In other words, general principles are meant to guide a city that is open rather than closed, dynamic rather than stable, incomplete rather than flawless (Sennett, 2006).

3. A staged/incremental approach. This implies taking the layering or patching of policy actions (Howlett and Rayner 2007, 2013) as an acceptable and even preferred way of policy-making. Implementing policy actions incrementally allows for taking into account changes in urban logistics systems and external conditions that unfold over time. For example, a layered implementation of a zero-emission zone that leaves room for improvisation may start with an awareness campaign amongst shop owners on the impact of their deliveries. Based on their responses, cooperation between the shop owners and bike delivery companies for local delivery might be established or a free-trial period of electric delivery vehicles for local shop owners (See ULaaDS D5.2 p48-50 or Gemeente Groningen, 2021). The next step could be a phased introduction of a zero-emission zone using entry permits. All in all, an incremental approach allows for adjusting policy actions to ongoing changes, such as the responses of shop owners. Design policy actions that generate modularity & multifunctionality can be supportive of an incremental approach (Ahern, 2011). Modularity implies that urban logistics functions can function relatively independently and can also be extended through mingling and matching with other modular components (Sanchez & Mahony, 1996). Examples of these are the mobile micro hubs (see ULaaDS D4.7 *forthcoming*) with mobile parcel lockers, bike parking or seating areas. Multifunctionality can be achieved through intertwining/combining logistics with other urban functions and allows for stacking or time-shifting urban logistics functions. For instance, by combining logistics hubs with bus depots, underground car parking or sports venues.

4. Experimentation and learning. Using the adaptation space that is generated with an incremental approach requires investments in experimentation and learning. Experimentation is a process of 'trial-and-error' to find a way to deal constructively with uncertainty (Sanderson, 2009) by doing something novel (McFagden & Huitema, 2017). For instance, by experimenting with potential novel ways of micro consolidation provides insights in how the future of urban logistics may look like. The experiences obtained with the experiments can be put to use in developing policies that anticipate certain micro consolidation practices. However, translating experiences into policy innovation does not happen spontaneously and instead requires learning. Learning refers to the process of reflecting on policy actions, the spatial and institutional setting, and possible changing circumstances (Argyris and Schön, 1996; Nair & Howlett, Nair & Howlett, 2017). The obtained knowledge can then be used to inform decisions on whether and how policies should be adapted to improve the fit between the policy objectives, the intervention, and the current circumstances, to realize synergies with other policy actions, and to reduce undesired effects. Learning can amongst others be facilitated with systematic monitoring of policy actions, stakeholder fora, and replication strategies (ULaaDS D2.2 and D5.6 *forthcoming*).

5. Building resilience through stakeholder involvement. Conditional to the above principles is a structural involvement of stakeholders. Complementing the emphasis on stakeholder involvement in

the traditional SULP-cycle, adaptive policy-making provides an additional motivation to invest in stakeholder involvement. Involving a wider range of stakeholders allows for activating more resources and perspectives in responding to (unexpectedly) changing circumstances (Tyler, 2009; Innes & Booher, 2010). As stressed above, this may include weighting the effects of policy actions against the range of preferred futures or the stamina and flexibility to cater for an incremental approach. For instance, building a coalition of local stakeholders can make an incremental implementation of sustainable logistics solutions driven by a long-term vision more resilient to disruption in the provision of new vehicles, the bankruptcy of local partner organizations or unexpected new logistics demands as witnessed during the Covid-19 pandemic.

5.4 Increasing robustness of policy measures

Strategy development and the adoption of adaptive strategy principles in phase 2 of the SULP-cycle, results in a basic SULP outline specifying a vision, strategy, targets, and indicators. In the measure planning phase (phase 3), measure packages are specified together with stakeholders, with whom agreements are reached on actions and responsibilities. Also, the plan is prepared for adoption and financing.

It is important to increase robustness of policy measures in this stage of SULP development to make sure that measures remain effective under changing circumstances and a plan B is in place. For this, policymakers can tap into their knowledge of possible uncertainties gained through the "mapping exercise" (5.2). Uncertainties can be specified as threats and opportunities to specific SULP measures, as well as for their level of uncertainty. Subsequently, appropriate actions to make policy measures more robust can be identified with a specification of who should take action, of what kind, where and when. Based on the framework of Dynamic Adaptive policy-making (Walker et al., 2013b), certain opportunities can be anticipated by *seizing* actions, and uncertain opportunities by *exploiting* actions. Certain threats can be anticipated by *mitigating* actions, which can be taken in advance to reduce the adverse effects of a policy, and *reducing* actions can be taken to reduce or spread the risk of possible adverse effects of a policy. Table 3 provides an overview of the type of actions that can be taken to increase robustness, illustrated with an example of the implementation of a ZE-zone.

Table 3 Actions for increased robustness with an example of the implementation of a ZE-zone (framework based on Walker et al., 2013).

Type of uncertainty	Degree of uncertainty	Action if change arises	Example: zero-emission zone
Opportunity	Low	Seizing likely opportunities	Improved air quality Awareness campaign with citizens science app
Opportunity	High	Exploiting potential opportunities	Alternative use of public space Temporal street furniture

Threat	Low	Mitigating expected negative side effects	Protest of SME's Provide shared electric vehicles. Implement transition period
Threat	High	Reducing likelihood of potential undesired effects	Cost overruns of surveillance systems Pilots Use proven technology

Identifying "when to take adaptive action" in the measure planning stage is a major challenge, as no one knows for sure how unforeseen developments will materialize and what "the right moment" is to step in. In some cases, it might help to define so-called "signposts" to monitor when actions are needed to guarantee the progress and success of the policy. Critical values of signpost variables are specified beforehand, beyond which actions should be implemented to ensure the policies progress in the right direction and at proper speeds (Walker & Marchau, 2017). Such signposts can however only be defined for developments that can be objectified and quantified to some extent: for instance, when implementing a zero-emission zone, bandwidths can be defined for the amounts of incoming or outgoing logistics traffic, coupled with actions for when amounts for traffic drop below this bandwidth or surpass this bandwidth. For example:

- Levels of traffic that fall below a certain bandwidth might signal that restrictions are too strict and need to be relaxed, to keep inner-city businesses accessible or prevent the adverse effect of businesses moving out of the city centre. It is important that policymakers keep an eye on such unforeseen developments through consultation with businesses and residents in city areas to which low-emission zones apply.

- Levels of traffic that surpass the bandwidth might imply that restrictions are not strict enough and that too much traffic is still entering the zero-emission zone on a day-to-day basis.

5.5 Acting responsively during policy implementation

The implementation of the SULP is coupled with continuous monitoring and a regular review of progress and results (phase 4). In this stage, it is important to be alert and "ready to adapt," i.e., act responsively and make adjustments if needed.

Information on the progress of SULP and the impact of policy measures is obtained through monitoring programmes. Although systematic monitoring, reflection and learning are often seen as secondary issues in policy practice, they are crucial for more adaptive policymaking (see 5.3). Policymakers are advised to continuously keep an eye on the possible uncertainties identified in the mapping exercise (5.2), to see whether new developments or unforeseen policy effects arise. In turn, policy measures can be adapted to realign them with the SULP objectives, or, in extreme cases, SULP

objectives need reconsideration. In their Dynamic Adaptive Policy-making framework, Walker et al. (2013b) distinguish four types of responsive actions:

- *Defensive actions*, meant to tackle disturbances to the policy measure.

- *Corrective actions,* imply the adjustment of the policy measure to ensure a better fit between policy goal, policy measure and the changed situation.

- *Capitalizing actions*, taking advantage of opportunities that can improve the performance of the policy measure.

- *Reassessment* of the policy goals and policy measures, initiated when the overall logic of the SULP lost its validity.

To act responsively, policymakers need to ensure that they have the means and mandate to undertake appropriate action, for which the repertoire can be used that was defined in 5.4 (who, what, where, when).

Table 4 Actions for increased responsiveness with an example of the implementation of a ZE-zone (framework based on Walker et al., 2013).

Degree of adaptation	Action	Example: zero-emission zone
Adapt within SULP objectives	Defensive against disturbances	Illegal entries of ZE zone • Information campaign • Intensify surveillance & fines
Adapt within SULP objectives	Corrective to unexpected changes	Spontaneous informal cross-docking • Adjusting coverage of zero-emission zone
Adapt within SULP objectives	Capitalization by embracing changes to add value	Furthering health benefits • Greening the city • Foster walkability
Reconsider SULP objectives	Reassessment of the policy goals and policy measures	Ongoing societal protest, structural technical failures

6. Organizational challenges for adaptive urban logistics policy-making

Building adaptivity into SULPs is hard work. The steps proposed in the previous section provide policymakers with some direction on how to do this. During this process, however, organizational conditions can become barriers in the development of adaptive SULPs. Policy makers were inquired about the possibilities in their current position to structurally identify and communicate about uncertainties and integrate them in policy design and political decision making processes. The interviewed results show policymakers experience several organizational challenges.

An overview of the challenges experienced by policymakers is provided in Table 5. 'Code frequency' indicates how often the type of barrier was mentioned by policymakers. Most mentioned are the 'lack of resources,' 'political culture and lack of awareness', and 'lack of strategic vision', which are barriers that are closely intertwined.

Table 5 Organizational barriers to development of adaptive SULPs

Barrier category	Code frequency	How developing adaptiveness is hampered
A general lack of resources	14	A lack of resources prevents local policymakers to structurally explore uncertainties and to make well informed policy designs
Lack of political awareness	12	Limited political attention for urban logistics makes it difficult to mobilize stakeholders and to secure sufficient resources
Lack of strategic vision	12	A lack of a local, regional, or national vision on urban logistics hampers adaptive navigation by local policymakers
Narrow institutional procedures	9	Narrow funding requirements and procedures within institution hinders local policymakers in adapting their policy objectives and actions
Absence of legal framework	5	Missing a regulatory framework prevents local policymakers to adapt policy measures and set up experiments
Urban logistics as a fragmented policy field	3	The involvements of multiple departments within local authorities make it difficult to come to shared actions and efforts.

The **lack of available resources** is mentioned most frequently, meaning a lack of funding, time, and data to build adaptive SULPs. This substantially hampers the possibilities of policymakers to gain a deep understanding of the city's urban logistic system, to identify new developments and opportunities early on and to make well informed policy design decisions.

This finding is in line with literature, as Akgün et al. (2019), Lindholm (2013) and Bjørgen & Ryghaug (2022) state that lacking the necessary information and data makes it challenging for local policymakers to define the urban logistics network and its related uncertainties.

The limited resources for urban logistics policy-making with local governments is also illustrated by the little staff capacity allocated. Of the 14 analysed European cities, only 2 allocated more than 1 Full Time Equivalent (FTE) to urban logistics policy-making. In most cities, urban logistics is dealt with by only one policy maker who is often responsible for a larger policy package. Because of the lack of resources and limited capacity, policymakers indicate that they mostly act reactively to uncertainties rather than proactively. Integrating logistics policies with urban mobility policies might be a way to enlarge resources, as the latter is typically better funded and staffed.

How much of your working time is dedicated to the topic of urban logistics (in FTE; Full Time Equivalent)?

Do you work together with colleagues of your city administration on the topic of urban logistics?
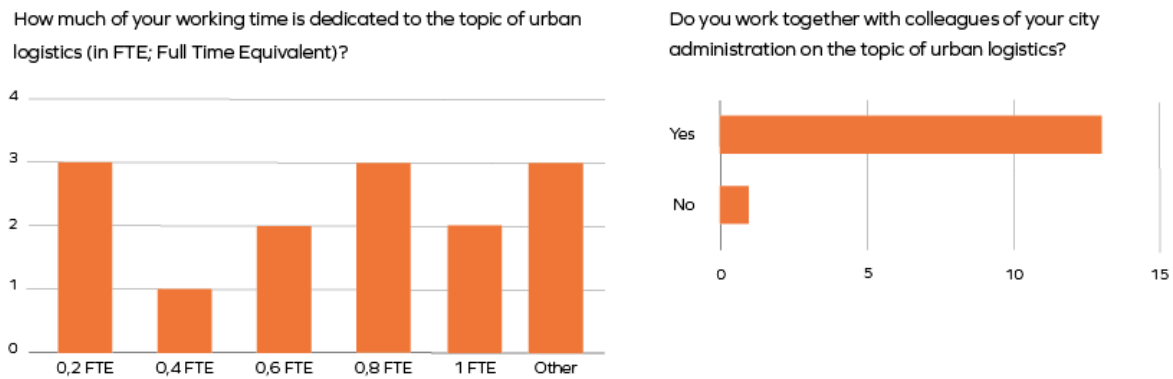
Figure 10 An overview of the number of FTEs allocated to working on urban logistics (left and whether the interviewees do so alone or with (a) colleague(s) (right)

Lack of resources is closely related to a perceived lack of **political awareness and support** amongst logistics policymakers**.** Without political support, policymakers find it difficult to mobilize a large group of stakeholders and to generate public support. A lack of political interest also forces policymakers to invest efforts into gathering funding elsewhere, for instance by taking partaking in national or international collaborative (research) projects and networks:

> "(..) Nothing would be realized if it was not for the European funding that we receive for that. And so where are we with that SUMP? Nowhere for now. That intention is there, but it will only be realized when we happen to be part of a consortium or where there is room to work on that SUMP, or that that is the deliverable or that we can take actions. (..) So yes, it depends on those European subsidies" (C483)

This finding underscores that experimentation and a staged approach, as advocated in the adaptive SULP cycle, can be instrumental in raising political awareness.

Limited political attention also hampers the development of a **strategic vision on urban logistics** as a basis for coordinated action. The absence of a policy strategy on urban logistics, at local, regional or national level, means that policymakers lack direction in developing their policy measures. As stressed in 5.3, visioning is also key for adaptive navigation as policymakers and other stakeholders can only know when to adapt and in which direction if they can assess new (unexpected) development) considering a long-term vision on the future of urban logistics. Furthermore, interviewees indicate that the absence of a strategic vision often means the **absence of a legal framework.** This complicates the implementation of policy actions and conducting experiments, putting further strain on the ability of policymakers to initiate changes and explore potential futures. Meanwhile, interviewees stress the need for strategic visions and legal frameworks that provide flexibility and offer room for adjusting policy actions, thus giving them the opportunity to gain experience and explore uncertainties that arise over time:

> "We need to come up with a roadmap in some way, but you never know what happens by 2030, so you can't expect to implement it step by step, 100%. There's always like. Yeah. You always have to go with the flow, I guess, except that things change, and things can happen." (C603)

The challenge of combining long-term visioning legal frameworks and a degree of openness and flexibility resonates well with the principles for adaptive policy-making as introduced in 5.3. We argued that strategic visioning should be accompanied with guiding principles for an open city, which allows for incrementality and experimentation.

Other challenges mentioned are the institutional procedures and fragmented character of the urban logistics policy field. **Narrow funding requirements and institutional procedures** can hinder local policymakers from adjusting to developments in the field and incorporating lessons learned, for instance, insights gained through experimentation. When developing project proposals, interviewed policymakers indicate that they are required to define intended outcomes and expected benefits for the city in great detail. This creates a static structure in which budgets are solely granted when projected outcomes are achieved. In addition, policymakers feel forced to deliver on projected outcomes in fear of having to return the budgeted funds, even if they find during the project's implementation or testing phase that certain measures or actions are not likely to be as effective as initially proposed. The lack of flexibility in institutional arrangements is an important barrier to building adaptive SULPs and to incorporate flexibility in the process to learn throughout time.

> "A reflection on our political decision-making process that makes it really complicated to adapt for unforeseen events (...) just because we have to be really explicit. Like when I have to write a report to the council where I say my plan for spending. It has to be really specific." (C603)

> "The sword of Damocles is always that you don't want to have to give back your funding. So, you have to be able to prove that you did what was in the plan that you would do. "(C851)

Here again, the guiding principles for an open city (5.3) may provide inspiration for rethinking funding requirements and institutional procedures. Rather than provide detailed criteria, fixed steps and narrow time schemes, such requirements and procedures can focus on the overarching goals and public values in combination with a best effort obligation. This would give more agency to policy makers in implementing effective policy actions in a volatile context.

Finally, interviewees note that urban logistics is a highly **fragmented policy domain**, which means that the topic generally does not belong to one department in the city's administration. Policymakers face difficulties when multiple departments need to be 'on board' for certain actions, and time and effort are needed to combat ignorance on sustainable urban logistics in other policy fields.

> "Yes, it is always difficult to engage colleagues, for example in a new project. Because with new things there is always resistance. And this is separately from the politics because our colleagues are also often …eh… suspicious is perhaps a big word, but they then shrug their shoulders" (C483)

On the one hand this barrier shows the need for adaptive policies making as it supports policy makers in dealing with such organisational uncertainties. On the other hand, this barrier can also turn into an opportunity when policymakers can build multidisciplinary 'coalitions' around urban logistics, by tapping into a broad spectrum of political support (e.g. in domains of transport, urban planning,

climate adaptation), and as a result, generate multiple avenues for actions and multiple sources of funding.

To conclude, the fact that urban logistics is a newly emerging policy domain within local governments with still limited resources and attention from political decision-makers results in constraints for more adaptive urban logistics policy-making. Expecting policymakers to identify and anticipate new and sometimes unexpected developments and put them to use strategically, is only realistic if they are granted the time and resources to develop a more comprehensive understanding of the complexities of urban logistics systems and the related uncertainties. This requires regularly consulting local stakeholders and experts, reliable data of logistics flows, future-proofing policy actions and the mandate to experiment, learn, adapt and try again.

7. Conclusions

This study provides a valuable understanding of the strategies deployed by local policymakers in urban logistics to effectively manage future possibilities and their consequences. It demonstrates that policymakers are well aware that their policy-making practices are confronted with uncertainties, and different types of uncertainties are generally well-recognized. However, it also indicates that policymakers struggle to provide equal attention to various uncertainties in the policy process. One reason for this are the organizational challenges; policy makers face resource constraints, limited political awareness and a lack of strategic visioning. Another reason is the elusive nature of uncertainties and a perceived difference in the level of urgency of different types of uncertainties. This raises concerns about policymakers' awareness of potentially disruptive effects from uncertainties they encounter infrequently or know little about.

Four methods that policymakers use for detecting uncertainties have been identified. These are *forecasting, foresight, exploring by testing, and exploring by consultation*. While the first three are well-established in the literature, 'exploring by consultation' could be added as a fourth and new method based on the interview data. Exploring by consultation aims to keep tabs on progress of stakeholders, comprehending one another's interests and signalling new developments early on. It relies on maintaining regular and informal contact with stakeholders as well as participating in conferences, network-events, and online fora. The method looks similar to foresight; however, this method is neither as organized nor structured compared to foresight and offers a way to explore uncertainties through informal consultation with colleagues, network actors, and logistical stakeholders. Each of the four methods comes with strengths and weaknesses, and policymakers tend to use several in parallel.

To enhance the effectiveness of Sustainable Urban Logistics Plans (SULPs) in dynamic situations, this study suggests steps that boost adaptability. By improving the adaptive capacity in the SULP-cycle, urban logistics policies can evolve from a linear planning process for a single preferred future to a more flexible approach accommodating multiple potential futures. This enables shorter feedback loops between the urban logistics situation and policy-making.

Presenting the "adaptive SULP-cycle", each phase of the existing SULP-cycle is complemented with strategies for boosting adaptivity. These strategies include:

- Raising awareness about the complexity of the urban logistics system.

- Mapping uncertainties that may affect the urban logistics situation and the related policy goals.

- Adopting adaptive strategy principles in the urban logistics policy design.

- Increasing robustness of urban logistics policy measures.

- Acting responsively to changes and making policy adjustments if needed.

Building adaptivity into SULPs is hard work. The analysis indicates that policymakers face organizational constraints. As urban logistics is a newly emerging policy domain within local governments, resources and awareness amongst political decision-makers are still limited. Expecting policymakers to strategically identify and leverage new, sometimes unexpected, developments is realistic only if they are provided with the time and resources to gain a thorough understanding of the complexities of urban logistics systems. This involves regular consultations with local stakeholders and experts, reliable data on logistic flows, future-proofing policy actions, and a mandate to experiment, learn and adapt.

Acronyms

Acronym	Meaning
AI	Artificial Intelligence
AV	Autonomous Vehicles
D	Deliverable
EC	European Commission
GA	Grant Agreement
ICT	Information and Communication Technology
LF	Load Factor
LSP	Logistics Service Provider
O	Objective
ODD	On-demand Delivery
P	Product
PPP	Public Private Partnership
PM	Person Month
SUMP	Sustainable Urban Mobility Plan
SULP	Sustainable Urban Logistics Plan
T	Task
UC	Use Case
UCC	Urban Consolidation centre
UFT	Urban Freight Transport
ULaaDS	Urban Logistics as an on-Demand Service
WBS	Work Breakdown Structure
WP	Work Package
VUR	Vehicle Utilisation Rate
ZEV	Zero Emission Vehicle

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