



NEXTLOGIC

Methodological approach

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Author(s)

Name	Organisation
Sjors Martens	Breda University of Applied Sciences (BUAS)
Gonzalo Puig-Samper	Luxembourg Institute of Science and Technology (LIST)
Salvatore di Dio	MUV
Tomas Navarrete Gutiérrez	Luxembourg Institute of Science and Technology (LIST)

Reviewers

Name	Organisation	Date
Simone Bosetti	LuxMobility (LuxM)	2026-07-16
Edoardo Marcucci	Università degli studi Roma Tre (UniR3)	2026-08-07
Jesper Bláfoss Ingvarðson	Technical University of Denmark (DTU)	2026-08-07
Valerio Gatta	Università degli studi Roma Tre (UniR3)	2026-08-10
Rafael Afonso	Universite du Luxembourg (UniLU)	2026-08-30

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1. Executive summary

Deliverable D1.2 *Methodological Approach* establishes the common methodological foundations that will guide the implementation, monitoring and evaluation of the NEXTLOGIC project. Developed within Work Package 1 (Setting the Stage), it addresses Tasks 1.3 (Impact Evaluation Framework) and 1.4 (Co-creation Methods) by defining a harmonised framework for assessing project impacts and supporting stakeholder engagement throughout the development and demonstration of the NEXTLOGIC solutions.

The deliverable is organised around two complementary methodological pillars. The first is the **NEXTLOGIC Impact Evaluation Framework**, which provides a structured methodology for evaluating the environmental, economic and social impacts of the project's solutions. Building upon established evaluation approaches, particularly the CIVITAS Evaluation Framework, it has been adapted to address the specific challenges of urban freight logistics, integrated mobility, public space reallocation and climate-neutral urban development. The framework identifies the expected impacts associated with the five NEXTLOGIC solution families (i.e. Microhubs, Smart Loading Zones, 15-minute Multimodal Hubs, Incentive and Reward Mechanisms, and Electrification of Urban Logistics) and defines a common set of impact indicators together with the corresponding quantification methods and implementation procedures. The proposed methodology ensures methodological consistency across all pilot cities while remaining sufficiently flexible to accommodate differences in local contexts, data availability and implementation maturity.

The second pillar is the **NEXTLOGIC Stakeholder Engagement and Co-creation Framework**, which recognises that the successful implementation of urban logistics solutions depends on the active participation of a broad range of stakeholders, including public authorities, logistics operators, infrastructure managers, citizens and research organisations. The deliverable therefore proposes a structured methodology for stakeholder identification, analysis, engagement and collaborative decision-making. It combines established participatory approaches with practical guidance for selecting appropriate co-creation methods throughout the different phases of the project. To support their practical implementation, the deliverable is complemented by the **online NEXTLOGIC Engagement Toolbox, which provides a user-friendly collection of co-creation methods**, practical guidance and supporting resources that cities and project partners can use to plan and facilitate participatory activities. Supporting stakeholder mapping and engagement planning templates are also provided to facilitate the implementation of co-creation activities across the pilot cities.

Together, **these two frameworks establish a common methodological reference for all NEXTLOGIC activities**. They provide the basis for consistent monitoring and evaluation of project outcomes while ensuring that the design, implementation and validation of the proposed solutions are informed by continuous stakeholder participation. The frameworks are conceived as living instruments that will evolve throughout the project as new evidence, data and lessons learnt emerge from the pilot demonstrations. The methodologies presented in this deliverable will support the subsequent work packages, including the development of the NEXTLOGIC digital platform, the co-development of the project solutions, the implementation of the pilot demonstrations and the final impact assessment and replication activities.

As such, D1.2 represents a key milestone in establishing a robust, transparent and transferable methodological foundation for the project, contributing to the wider objective of enabling more sustainable, efficient and climate-neutral urban logistics systems across European cities.

Keywords: Evaluation Framework, Impacts, Indicators, Stakeholders, Engagement, Participation, Co-creation, Onboarding

2. Objectives

This section describes the specific objectives of Deliverable 1.2 (D1.2) in the context of the NEXTLOGIC project and Work Package 1 (WP1). It explains how the work performed aligns with these objectives and confirms their achievement.

2.1 Overall NEXTLOGIC objectives and link to D1.2

NEXTLOGIC aims to develop a digitally empowered co-design platform to help eight EU Mission Cities transform urban logistics and mobility towards climate neutrality by 2030. The project's specific objectives are set out in the Grant Agreement and include: (i) developing integrated transport and urban planning tools (O1), (ii) creating digitally-empowered tools for dynamic curbside management (O2), (iii) redefining multimodal hubs (O3), (iv) proposing solutions for infrastructure reallocation (O4), (v) involving stakeholders in co-design (O5), and (vi) conceiving new business and financial models (O6).

Deliverable 1.2 directly supports all six of these objectives. **It outlines pilots' expected impacts, defines recommended impact indicators, outlines the requirement and capabilities of stakeholder engagement, and provides a toolbox with co-creation methods tailored to pilots and solutions.** Without D1.2, the subsequent technical development (WP2), solution co-design (WP3), piloting (WP4), and impact assessment (WP5) would lack the necessary impact factors, evaluation criteria, and co-creation methods and coordination.

2.2 WP1 objectives and D1.2 contribution

Work Package 1, "*Setting the stage*", has four tasks, each with specific objectives. D1.2 is built from the combined efforts of two of these tasks (Task 1.3 and 1.4) while building upon the findings of Task 1.1. The results of D1.2 contribute to the data acquisition framework by identifying the data requirements of the impact evaluation framework, and by using co-creation methods to stimulate data acquisition and management, as shown in Table 1.

2.3 Objectives of this deliverable

The scope of D1.2 is limited to qualitative and quantitative desk research, complemented by primary data collected via semi-structured interviews with city representatives. It does not include primary data collection from logistics operators or citizens, as these will be conducted in later WPs. The deliverable is intended for project partners, the European Commission, and other Mission Cities interested in replicating NEXTLOGIC approaches.

The solutions implemented in NEXTLOGIC share the ultimate objective of promoting sustainability in urban areas by reducing the environmental impacts of urban logistics, enhancing its social benefits on the local population, and ensuring that the transition to other practices in urban logistics is economically viable. These dimensions are reflected across all expected outcomes (EO) of the project, whose achievement should be assessed through an impact evaluation framework applied across the pilots. The impact evaluation framework has different links with the rest of **WP1**, which either feed the framework or apply it to evaluate the expected impacts of the project. **WP2 (Co-developing the NEXTLOGIC innovative technology platform)** uses the framework to generate impact metrics for the pilots within the digital twin platform, based on the evaluation carried out in **WP5 (Assessing impacts and replicating solutions)**. Meanwhile, **WP3 (Co-developing solutions for climate neutral cities)** and

WP4 (Piloting solutions in the NEXTLOGIC cities), which focus on the development of the solutions and the implementation of the pilots, provide the data and evidence required for the evaluation, following the indicators recommended in the impact evaluation framework.

Table 1. Contribution of Deliverable 1.2 to WP1 tasks and objectives

WP1 Task	Objective	How D1.2 interacts with it
Task 1.1	Analyse trends, drivers and links between urban logistics, urban space and climate neutrality	The trends, drivers, and links are incorporated in the impact evaluation framework in Section 5, while the interaction between the three elements is facilitated by co-creation methods in Section 8.
Task 1.2	Develop a data acquisition and management framework	The impact evaluation framework specifies which methods and data are required in Section 6, and co-creation methods can streamline data acquisition discussions in Section 10.
Task 1.3	Establish an impact evaluation framework	The expected impacts of the pilots across sustainability dimensions are assessed to support the identification of key impact issues and the recommendation of meaningful impact indicators in Section 6.
Task 1.4	Implement co-creation methods	An overview of the required means for stakeholder engagement is suggested in Section 9 and a toolbox of co-creation methods is provided with potential tailoring to pilots and solutions in Section 10.

As the pilots have not yet started, the impact evaluation framework cannot define a detailed methodology to be followed by each pilot and city. Instead, it provides recommendations on the expected impacts and the indicators to be estimated. The framework also outlines the methods that may be used to estimate the different indicators, together with the associated data requirements.

Within NEXTLOGIC, stakeholder engagement and co-design methods are pursued as expected outcome (**EO2**). This outcome strives to ensure that logistics operators, businesses, and citizens are actively involved in shaping urban freight solutions. This need for engagement and co-design is recognised generally, but each work package requires a more tailored approach to co-creation methods.

- For **WP2**, how the technology platforms are constructed by or can make use of co-creation methods requires an overview of key challenges and opportunities for the platforms.
- For the solutions of **WP3**, the reliance on co-creation differs, as well as the phasing, so potential methods and timing per solution is required.

- For the cities and the pilots in **WP4**, engaging with local stakeholders is essential for an effective uptake and longevity of interventions.
- Also, the evaluation of **WP5** can benefit from considering co-creation methods for the definition of and assessment of evaluation criteria, especially social criteria.

Given that WP1 is about setting the stage, the co-creation methods overview of D1.2 cannot provide a tailored prescriptive overview for each WP, pilot city, or solution. Instead, it can provide a toolbox of usable methods and suggest salient moments and formats for co-creation per city, platform, and solution.

The co-creation methods in this document will therefore describe the necessity of stakeholder engagement, the different challenges that rely on stakeholder engagement and co-design, and which methods and stakeholders should be deployed at which moment in the pilot or solution introduction. It should be treated as a resource of recurring methods and stakeholder configurations. The deliverable presents suggestions for stakeholders, methods, and planning which should raise awareness about the necessity of stakeholder engagement and co-design and provides pilot leads with a starting point for integration.

More specifically, D1.2 was designed to achieve the following objectives:

- Identify the expected impacts of the pilots across sustainability dimensions.
- Provide recommendations on key impact areas to be evaluated and define meaningful impact indicators.
- Provide an overview of stakeholder engagement strategies in logistics and map the stakeholder involvement throughout the NEXTLOGIC pilot process.
- Provide a toolbox of co-creation methods, grouped and phased according to pilot specifications and solution requirements.

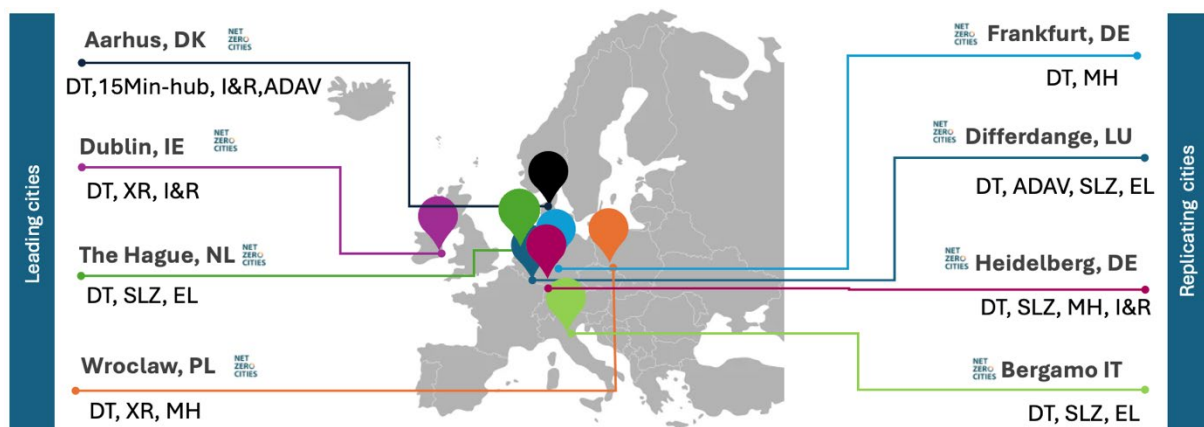
3. Introduction

This section introduces the methodological foundations of Deliverable D1.2. It first provides an overview of the NEXTLOGIC pilot cities and their role in the project before presenting the rationale for the two complementary frameworks developed in this deliverable: the Impact Evaluation Framework and the Stakeholder Engagement and Co-creation Framework. Together, these frameworks provide a common methodological basis for assessing the impacts of the NEXTLOGIC solutions and for supporting participatory planning and implementation activities across the pilot cities, while allowing adaptation to their specific contexts and needs.

3.1 Overview of the NEXTLOGIC cities and pilots

The NEXTLOGIC pilots aim to design, test, and validate innovative, data-driven solutions for sustainable urban mobility and logistics, supporting cities in their transition towards climate neutrality. By deploying “digital-by-default” tools in real-life environments, the pilots seek to improve efficiency, reduce environmental impacts, and optimise the use of urban space, while ensuring scalability and transferability across different urban contexts.

The **eight pilot cities** represent a diverse set of urban environments, enabling the project to address a wide range of challenges, including congestion, inefficient last-mile delivery, and competing demands for curbside space. The pilots implement complementary solutions such as **Multimodal Hubs, Electrification in urban freight, Mobile Microhubs, Incentive and Reward mechanisms and dynamic curbside management approaches, including Smart Loading Zones and flexible use of public space.** Figure 1 shows the NEXTLOGIC cities and provides an overview of the NEXTLOGIC pilots.



DT=Digital Twin; XR= eXtended Reality; ADAV = Advanced Data Analytics and Visualisation; MH = Mobile Microhubs; SLZ=Smart Loading and Unloading Zones; 15Min-hub = 15-minutes Multimodal Hubs; I&R = Incentives and Reward mechanisms; EL.= Electrification of urban freight

Figure 1. The NEXTLOGIC cities and overview of the NEXTLOGIC pilots

A common feature across all pilots is the use of data-driven approaches, including Digital Twins (DT) to support planning, simulation, and operational optimisation. These are complemented by technologies such as data analytics, and visualisation tools, enhancing both system performance and decision-making processes.

In addition, the pilots promote the integration of urban logistics into broader mobility and spatial planning strategies, including extending the 15-minute city concept to freight. Strong emphasis is also placed on stakeholder engagement through co-creation processes and incentive mechanisms,

ensuring user acceptance and long-term sustainability of the solutions. Table 2 provides an overview of the expected results in the eight pilot cities.

Table 2. NEXTLOGIC expected results of the pilots

Pilot city		Expected results
Leading cities	Aarhus (DK)	Development and validation of 15-minute Multimodal Hubs integrating mobility, and logistics; improved accessibility and reduced emissions through DT and ADAV based planning and co-created urban designs, and enhanced stakeholder acceptance of multimodal hubs.
	Dublin (IE)	Implementation of a Smart Bike Parking Digital Twin enabling real-time parking management, improved infrastructure planning, and enhanced compliance and stakeholder acceptance.
	The Hague (NL)	Deployment of Smart Loading Zones; improved curbside efficiency, reduced congestion and emissions, enhanced data-driven curbside management, and zero-emission freight policies.
	Wroclaw (PL)	Implementation of Mobile Microhubs with cargo bikes supported by DT and XR tools; increased delivery efficiency, reduced congestion and emissions, and strengthened stakeholder collaboration.
Replicating cities	Bergamo (IT)	Deployment of Smart Loading Zones, assessment of EV charging infrastructure for freight vehicles supported by DT; improved space allocation, reduced emissions and congestion, and enhanced stakeholder acceptance of urban logistics solutions.
	Differdange (LU)	Deployment of Smart Loading Zones, assessment of EV charging infrastructure for freight vehicles supported by DT and ADAV; optimisation of loading/unloading zones and improved urban space utilisation through data-driven decision-making.
	Frankfurt (DE)	Deployment of Mobile Microhubs supported by DT to improve last-mile logistics efficiency and scalability through knowledge transfer and replication strategies.
	Heidelberg (DE)	Implementation of Smart Loading Zones and Mobile Microhubs with cargo bikes supported by DT; increased curbside efficiency, reduced illegal parking, optimisation of loading/unloading zones and improved urban space utilisation through data-driven decision-making.

Overall, the pilots provide a coherent yet diverse set of use cases that enable cross-city learning and contribute to the replication and scaling-up of effective urban mobility and logistics solutions across Europe. The following table provides a summary of the tools and solutions of NEXTLOGIC that will be piloted in each city.

Table 3. NEXTLOGIC pilots' tools and solutions by city

Pilot City		Tools				Solutions			
		DT	XR	ADAV	15Min-hub	MH	SLZ	EL	I&R
Leading cities	Aarhus (DK)	X		X	X				X
	Dublin (IE)	X	X						X
	The Hague (NL)	X					X	X	
	Wroclaw (PL)	X	X			X			
Replicating cities	Frankfurt (DE)	X				X			
	Differdange (LU)	X		X			X	X	
	Heidelberg (DE)	X				X	X		X
	Bergamo (IT)	X					X	X	

DT=Digital Twin, XR= eXtended Reality; ADAV = Advanced Data Analytics and Visualisation; MH = Mobile Microhubs; SLZ=Smart Loading and Unloading Zones; 15Min-hub = 15-minutes Multimodal Hubs; I&R = Incentives and Reward mechanisms; EL= Electrification of urban freight

3.2 Establishing the NEXTLOGIC evaluation framework

The first part of this deliverable (Sections 4 to 7) reports on the achievements of Task 1.3, which is aimed at the development of an impact evaluation framework for NEXTLOGIC. The work carried out followed a mixed-methods approach, organised into two main phases:

- **Specification of expected impacts**

The impacts of NEXTLOGIC solutions are analysed through a literature review including the scientific literature and previous implementations of the solutions. City-specific expected impacts are also identified through consultation with the consortium partners. Impact target variables are defined for each of the impacts following the definitions and categories provided by the CIVITAS Evaluation Framework [1]. This phase provides an overview of relevant impacts to be estimated for each of the solutions, as well as the cross-cutting expected impacts of the project and their interconnection to overarching sustainability targets, such as sustainable development goals and climate neutrality targets.

- **Impact indicators analysis and recommendations**

This phase provides recommendations concerning the impact indicators to be quantified for each solution. The methods to estimate the indicators, as well as their data requirements, are specified. The section provides further guidance for the leading cities to implement the framework, considering common expected impacts across solutions and the reported data collection methods of each pilot.

3.3 Defining the NEXTLOGIC co-creation methods

The second part of the deliverable (sections 8 to 10) presents the results of the work done under Task 1.4 regarding local stakeholders' engagement and co-creation methods in the NEXTLOGIC pilot cities. Activities were developed along two main phases:

- **Literature and project review of co-creation methods**

Through a literature review on publications dealing with stakeholder engagement, co-design, and co-creation in city logistics, an overview is created of prevalent co-creation methods in city logistics, recurring pitfalls, and different formats of implementation. Past projects from consortium partners were consulted, as well as academic literature from databases such as Web of Science, WorldCat, and Google Scholar. This phase provides an overview of potential co-creation methods in city logistics and suggests a framework for co-creation in NEXTLOGIC.

- **Stakeholder analysis and tailoring**

A general overview of recurring stakeholders is provided and specified for each pilot city and solution through brief surveys. Depending on the type of challenge presented by the solutions, a tailored co-creation process is outlined, tailored to the pilot stakeholders, and solution requirements. Based on the goal of the pilot and the involved stakeholders, specific engagement tactics are more logical or effective. The suggestion of a wider collection of tactics and strategies can be linked to specific context, allowing for ad hoc tailoring during the piloting phase.

3.4 Structure of the report

The remainder of this deliverable is structured as follows:

- **Section 4 – Rationale and design of the impact evaluation framework in NEXTLOGIC:** explains the methodological basis of the framework, its relationship with the CIVITAS Evaluation Framework, and its suitability for the scale and nature of the NEXTLOGIC pilots.
- **Section 5 – Specification of expected impacts:** identifies and describes the expected impacts associated with Microhubs, Smart Loading Zones, 15-minute Multimodal Hubs, Incentive and Reward Mechanisms, and the Electrification of Urban Logistics. It also identifies cross-cutting impacts common to several solutions.
- **Section 6 – Selection of the impact indicators and quantification methods:** presents the recommended impact indicators for each NEXTLOGIC solution, together with the proposed calculation methods, data sources and data requirements. It also introduces the economic indicators to be considered.
- **Section 7 – Implementing the impact evaluation framework:** summarises the impacts recommended for monitoring across the pilot cities and explains how the framework will remain adaptable as pilot activities, data availability and evaluation needs evolve.
- **Section 8 – Rationale and design of the Stakeholder Engagement Framework in NEXTLOGIC:** defines the overall approach to stakeholder participation, including participation levels, relevant co-creation formats, stakeholder involvement throughout the pilot implementation process, and common engagement pitfalls.

- **Section 9 – Stakeholder analysis:** presents the methodology for stakeholder mapping, identifies the main stakeholder categories involved in urban logistics interventions, and provides recommendations for their involvement in NEXTLOGIC.
- **Section 10 – Co-creation methods:** describes the types of challenges addressed by the NEXTLOGIC pilots and presents suitable co-creation methods for the different engagement phases, from stakeholder mapping and onboarding to engagement, alignment, negotiation, co-creation and monitoring. It also provides guidance for tailoring the methods to each pilot city.
- **Section 11 – Conclusions:** summarises the main findings of the deliverable and presents the next steps for applying and further developing the impact evaluation and stakeholder engagement frameworks.

The annexes provide detailed supporting material complementing the methodological frameworks presented in the main body of the deliverable, namely:

- **Annex A – Stakeholder mapping per pilot city:** provides the detailed stakeholder maps for Aarhus, Dublin, The Hague, Wrocław, Bergamo, Differdange, Frankfurt and Heidelberg.
- **Annex B – Stakeholder engagement planning per pilot city:** presents the proposed stakeholder engagement planning tailored to the specific context and needs of each pilot city.

4. Rationale and Design of the Impact Evaluation Framework in NEXTLOGIC

4.1 Goal and Scope

The goal of the impact evaluation framework is to **assess the impacts of the NEXTLOGIC pilots on the three pillars of sustainability: environment, society, and economy, as well as its impacts on the transport system and energy**. To ensure consistency and comparability, the framework follows the categories and nomenclature proposed by the **CIVITAS Evaluation Framework** [1].

The scope of the impact evaluation framework covers the NEXTLOGIC pilot measures implemented in the leading cities. Its design is sufficiently generic to also support application in the replicating cities. The framework focuses on assessing the impacts generated by the implemented measures rather than evaluating the implementation process itself. Grounded in the CIVITAS Evaluation Framework, this approach aims to assess measures based on the impacts they generate, which ultimately represent the primary objective of all the measures. The approach also facilitates comparability across different pilots [1]. Consequently, recommended indicators focus on the impacts generated by the pilots and not on key performance indicators (KPI) related to the implementation/operation of the pilots.

4.2 Building on the CIVITAS Evaluation Framework

The impact evaluation framework follows **the structure of the CIVITAS Evaluation framework**, which is focused on the **before-and-after assessment of the pilots**. The framework is divided into nine steps, from selection of expected impacts to results analysis (Figure 2).

The definition of the impact evaluation framework, described in this deliverable, specifically concerns the **definition of expected impacts** and the **selection of impact indicators** (Steps 1 and 2). In the selection of impact indicators step, this deliverable also provides recommendations regarding the **methods used for the quantification of impact indicators** and outlines the **data requirements**.

The specification of the expected impacts consists of identifying potential impacts (positive or negative) of the pilots. The identification is grounded in previous projects, and the scientific and grey literature. In this framework, the identification step employs the impact categories provided by the CIVITAS Evaluation Framework to support the comparability of pilots' outcomes, regardless of the type of measure being implemented. As such, the **economy dimension of sustainability** is not considered in terms of impacts but rather in terms of financial effort of the measures and their efficiency [1]. This differentiation relies on the fact that economic impacts can hardly be associated exclusively to the pilot, being dependent on broader economic trends. This argument is consistent with the small scale of the pilots implemented in NEXTLOGIC. However, economic indicators are discussed and recommended in Section 6.6.

Impacts are classified into **direct or wide impacts** depending on whether the impact is a direct effect of the implemented measures (e.g. lower tailpipe emissions due to the shift to electric cargo vans), or a consequence of those effects (e.g. improvement of the air quality in the city). In addition, impacts are classified according to the importance to achieve sustainability goals: key, supplementary, and state (i.e. refer to conditions potentially leading to positive impacts to achieve sustainability goals) [1].

The recommendations regarding the selection of impact indicators is made based on two criteria: **significance and complexity** [1]. The significance of the indicator concerns how much information the indicator provides in relation to the investigated impact. Its complexity refers to the facility of

computing the indicator, including the nature and amount of the data needed. As for the other steps, the proposed framework aims to rely as much as possible on the indicators provided by the CIVITAS Evaluation Framework. However, these are adapted or modified considering pilots nature, data availability, timelines, and capabilities within the consortium. These criteria are also used to determine the methods used for the quantification of indicators, as multiple methods can be often used to quantify a given indicator.

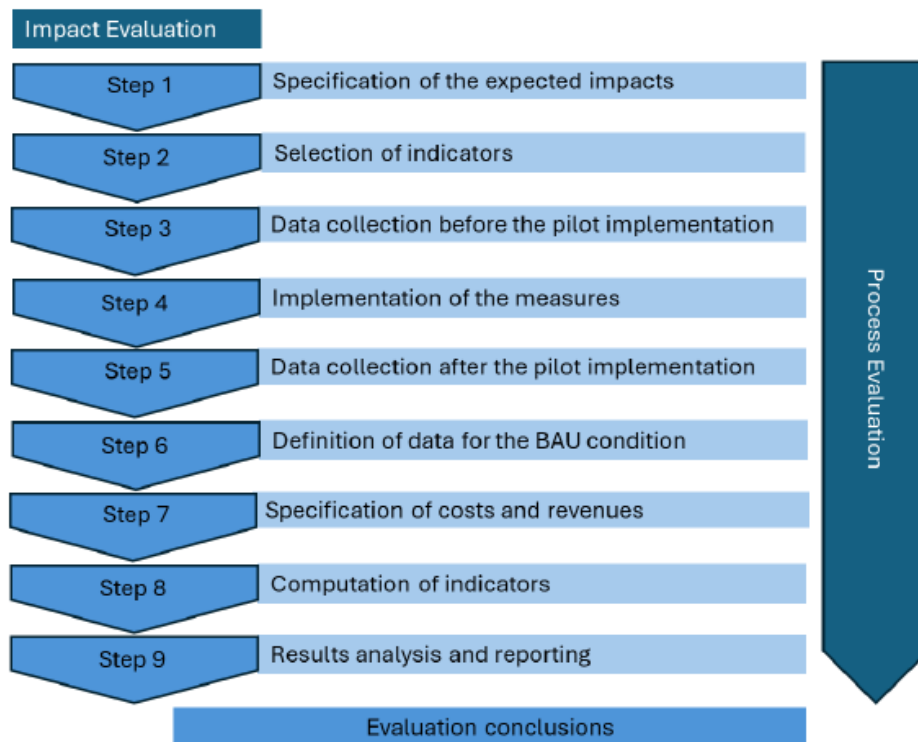


Figure 2. Main steps of the Impact evaluation framework. Source: CIVITAS [1]

4.3 Suitability to NEXTLOGIC

4.3.1 Scale of the Pilots

The use of pilots is widespread in urban research as they provide a proof-of-concept of a solution before large scale implementation, serve to increase the social awareness on the investigated subject, and provide a first insight into expected impacts. However, the small scale of most of the pilots comes at the expense of obtaining a partial or incomplete view of its expected impacts at larger scales, such as the city level. This difficulty is specifically observed for indirect consequences of the measures (i.e. wide impacts), or due to the nature of the impacts. Many of the expected impacts caused by urban mobility policies depend on social changes (e.g. behaviour) that vary substantially across urban areas due to, for instance, different income levels. Such a variability hinders the extrapolation of observed impacts on a pilot scale to larger scales.

The **impact evaluation framework described in this deliverable is centred on pilots**, so as to gather empirical evidence from the pilots and due to the nature of some of the impacts. Nonetheless, its potential upscaling is discussed in Section 5 due to the relevance of large-scale assessments to support policy-making to achieve global objectives, such as climate neutrality.

4.3.2 Nature of the Impacts

The impacts expected from the pilots cover a wide variety of dimensions directly related to sustainability (e.g. environmental impacts) and involving other sectors, such as the transport system. Some of the expected impacts directly concern the sample of the population using the pilot and are often related to behavioural shifts and perception. The heterogeneity of impacts, along with the pilots' scale, requires a **hybrid impact evaluation framework** that is capable of capturing **pilot-specific impacts**, while also providing a **harmonised framework** that can be integrated into the digital twin platform.

The proposed impact evaluation framework consists of an analytical framework tailored to each of the pilots. This enables the calculation of impacts that are relevant to the specific context of each pilot, while ensuring consistency across evaluations and allowing meaningful comparison of impacts between pilots.

5. Specification of Expected Impacts

This section identifies the **expected impacts of the NEXTLOGIC solutions** and aligns, when possible, the definition of the impacts with the impact categories and impact target variables provided by the CIVITAS Evaluation Framework. The expected impacts are first identified for the solutions, regardless of the pilot location. Subsequently, expected impacts are identified and described for leading cities where solutions will be implemented.

Digital enablers (digital twin, extended reality, and data analytics) are implemented across all pilots to varying degrees. Therefore, within the impact evaluation framework, these solutions are not assessed independently but rather considered as catalysts for the expected impact gains generated by the other NEXTLOGIC solutions. This approach also reflects the difficulty of isolating the specific impacts attributable solely to these digital solutions.

5.1 Microhubs

5.1.1 Overview

Mobile Microhubs are small urban distribution points where goods are transferred from larger vehicles to low-emission vehicles, such as cargo bikes, often providing additional functions such as parcel lockers, shared loading zones, or waste consolidation [2]. The objective of Microhubs is to improve last-mile logistics efficiency, reduce tailpipe emissions, and decrease traffic congestion by replacing traditional urban consolidation centres located at peripheral urban areas by smaller facilities located closer to businesses and final consumers [3].

Several implementations of Microhubs across the world have successfully proven their feasibility [3]. As highlighted in deliverable **D1.1 (Urban logistic challenges)**, the success of Microhubs and, therefore, their potential positive impacts are dependent on a series of key factors. The identified key factors range from delivery density in the area of the Microhub to governance aspects regarding operators collaboration and regulatory support [3].

5.1.2 Expected impacts

Table 4 presents a summary of the expected impacts of Microhubs with cargo bikes and provides the corresponding impact target variables, as defined in the CIVITAS framework [1].

Energy, environment and transport system

The expected outcome of Microhubs regarding the environment is primarily a reduction in tailpipe emissions when they are paired with cargo bikes or light electric vehicles for last-mile freight distribution [4], [5]. Similar results were reported for the few studies available for Mobile Microhubs in Rio de Janeiro [6], Barcelona and Valencia [5], and Brussels [7]. These three studies present the reduction of traffic congestion as an expected impact, although no measurement is provided to confirm this finding. Additionally, studies assessing Microhubs report that the use of light-duty vehicles for last-mile delivery leads to a higher total distance [4], [8], which could negatively impact traffic congestion. Comparative empirical assessments demonstrate that substituting conventional light commercial vans with cargo bikes via urban Microhubs yields significant reductions in per-parcel energy consumption and total vehicle distance travelled, particularly in dense historical city centers [9].

Table 4. Expected impacts of Microhubs

CIVITAS category	CIVITAS type	Impact target variable	Expected Impact
Environment	Key (Direct) ^a	Climate impact of vehicles	Reduction in greenhouse gas emissions
Environment	Key (Direct)	Pollution impact of vehicles	Reduction in tailpipe pollutants emissions (e.g., PM ₁₀ , NO _x)
Environment	Key (Direct)	Transport noise emissions	Reduction in noise pollution
Environment	Key (Wide)	Air quality	Improvement of the air quality in the urban area
Environment	Supplementary (Direct)	Transport visual impact	Reduction in urban space occupation linked to conventional urban freight vehicles (e.g. frees up curbside space)
Transport System	State (Direct)	Facilities/conditions allowing alternatives for urban freight distribution: B2B and B2C ^b	Enables the use of low-emission vehicles for the last-mile delivery to businesses and citizens
Transport System	Key (Wide)	Road congestion	This indirect impact depends on the effects of Microhubs on the total distance travelled per parcel
Transport System	Not defined	Service level	Context-specific impact. It refers to stakeholders' perceived service level and delivery time
Energy	Key (Direct)	Energy sustainability of urban transport	Increase in the share of non-fossil fuel energy used for last-mile delivery
Society	Key (Wide)	Citizens' health	Reduce health issues related to pollutant emissions, noise pollution, and traffic congestion
Society	Not defined	Local services	Rise in the number of nearby citizens and businesses with increased access to goods and services
Society	State (Direct)	Safety of road network	Reduction in the number of operations of conventional urban freight vehicles

^a Direct impacts are expected effects of the measure, while wide impacts are expected as a consequence of those effects. ^b Originally defined as two different impact target variables in the CIVITAS evaluation framework [1].

The shift to light-duty vehicles for last-mile delivery is expected to equally reduce noise pollution [5] and improve road safety [7]. An improvement of road safety was identified as the top-ranked criterion for citizens concerning the implementation of Mobile Microhubs in Brussels, followed by emissions reduction, traffic congestion reduction, and decrease in the urban space occupied by trucks [7]. Environmental impacts appear as identified criteria by other stakeholders (logistics service providers, shippers, receivers) [7], showcasing the significance of environmental concerns in the implementation of Mobile Microhubs in Europe. These stakeholders also ranked in the top position the receiver and shipper satisfaction and the punctual and secure pick-ups [7]. Efficiency and time gains are discussed

as expected positive impacts of Mobile Microhubs or depots [7], [10], although the effect of Microhubs appears to be more conditional to the specific context of the city, as different qualitative conclusions are reported in the literature. Some authors reported no major impact on customers' perceived service level and delivery time [6], while results from other pilots indicate shorter delivery time per parcel [3]. Other authors found that excessive reliance on Microhubs for transshipment could lead to longer customer waiting times [11].

Society

Building on the stakeholder analysis provided in the literature [7], positive impacts on road safety appear to be the most important criterion for citizens. This positive impact has been described by other authors, as Microhubs were reported to increase pedestrian safety and urban liveability [8]. Overall, social impacts of Microhubs are linked to the reduction of conventional freight urban vehicles and travelled distances [2]. Some of these positive impacts (e.g. visual nuisance) are included in the Transport System category, in line with the CIVITAS Evaluation framework. Other social impacts of Microhubs are very context-specific [2]. Eventually, they can improve accessibility to some goods and services for nearby citizens and businesses, thereby supporting the 15-minutes city concept [8].

The environmental benefits brought by Microhubs could eventually lead to improved citizens' health and urban liveability. Specifically, the expected reduction of tailpipe emissions, noise, and traffic congestion may reduce the incidence of related diseases and improve human wellbeing in urban areas.

5.2 Smart Loading Zones for smart and dynamic curbside management

5.2.1 Overview

Smart Loading Zones (SLZ) can be defined as "stop delimited areas, where freight loading and unloading operations take place, equipped with technology that provides real-time information for vehicle detection, parking space monitoring, and parking assignment" [12]. SLZ go beyond the concept of loading zones, which arose as a solution for the negative externalities of last-mile delivery across cities [3]. The *smart* aspect directly tackles the challenges faced in the implementation of loading zones due to a lack of tools and data for the proper management of freight curbside management [12]. SLZ propose a dynamic curbside management of loading zones accounting for their supply and demand according to time, location, type of user, etc. [13].

5.2.2 Expected impacts

Table 5 presents a summary of the expected impacts of SLZ and provides the corresponding impact target variables [1].

Energy, environment and transport system

SLZ are expected to improve freight curbside management, thereby providing more availability of parking space for (un)loading operations. A larger availability of curbside parking space is expected to reduce travel time in last-mile delivery, which in turn, reduces the energy consumption of vehicles, tailpipe emissions and illegal parking (e.g. double-parking) [14]. Although not treated as an impact in the CIVITAS Evaluation framework, reduced fuel consumption translates into lower operating costs [14]. Evaluating transport providers' (stated) preferences reveals that flexible curbside management—when combined with targeted parking reservation systems and pricing incentives—substantially increases regulatory compliance and reduces cruising time spent searching for loading space [15].

The reduction in CO₂ emissions has been already observed across various cities, such as Zapopan [14] and Zaragoza [16], thanks to reduced cruising and idling. Furthermore, the decrease in illegal parking is expected to reduce traffic congestion and noise pollution [14], [17]. Although categorised as environmental impacts within this framework, these environmental impacts have further effects on human health. For instance, air pollution is estimated to cause approximately 7 million premature deaths [18], while noise pollution deeply affects human health and wellbeing (e.g. sleep disturbance) [19].

Society

According to the literature, social implications of SLZ appear as a consequence of the environmental benefits linked to the reduction of cruising practices and illegal parking. Eliminating or reducing these practices through SLZ is expected to reduce impacts on citizens' health by reducing pollutants emissions, noise, and stress associated with traffic congestion [17], while the resulting reduction in congestion itself constitutes a societal benefit in its own right. Mitigating these practices is also expected to improve road safety in the concerned areas [17].

Table 5. Expected impacts of SLZ

CIVITAS category	CIVITAS type	Impact target variable	Expected Impact
Environment	Key (Direct)	Climate impact of vehicles	Reduction in greenhouse gas emissions
Environment	Key (Direct)	Pollution impact of vehicles	Reduction in tailpipe pollutants emissions (e.g., PM ₁₀ , NO _x)
Environment	Key (Direct)	Transport noise emissions	Reduction in noise pollution
Environment	Key (Wide)	Air quality	Improvement of the air quality in the urban area
Environment	Supplementary (Direct)	Transport visual impact	Reduction in urban space occupation linked to conventional urban freight vehicles (e.g. frees up curbside space)
Transport System	Key (Wide)	Road congestion	Reduction in the time of last-mile delivery due to the decrease in cruising and idling practices
Energy	Key (Direct)	Transport energy demand	Increase in the efficiency of last-mile freight delivery due to shorter delivery times and reduced fuel consumption
Society	Key (Wide)	Citizens' health	Reduce health issues related to pollutant emissions, noise pollution, and traffic congestion
Society	State (Direct)	Safety of road network	Reduction in the number of illegal parking (e.g. double parking) due to (un)loading operations
Society	State (Direct)	Misuse of (un)loading zones	Reduction in the misuse of (un)loading zones (e.g. bicycles illegal parking)

Society	State (Direct)	Multipurpose use of (un)loading zones	Use of (un)loading zones for different purposes over the day/week
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Other impacts specific to the leading city: The Hague

Beyond the impacts reported for the solution, the SLZ deployed in the city of The Hague are expected to generate two additional impacts related to the management and utilisation of loading and unloading zones. The first concerns the reduction of zone misuse. Currently, loading and unloading zones in The Hague are sometimes occupied by illegally parked bicycles, reducing their availability for freight operations. The dynamic management of SLZ is expected to mitigate this issue by enforcing more effective access control and time-slot allocation. The second relates to the flexible, multi-purpose use of (un)loading zones. By enabling time-differentiated management of (un)loading zones, the same physical space can be assigned to different uses throughout the day or week. A (un)loading zone used for freight deliveries in the morning, for example, could be repurposed as a terrace during the evening.

The expected impacts of the SLZ in The Hague depend, however, on a regulatory constraint regarding loading and unloading operations conducted outside SLZ. The full benefits of the solution can only be achieved if operators are required to carry out these operations within SLZ, unlike the current situation where such activities may still take place outside the designated zone.

5.3 15-minute Multimodal Hubs

5.3.1 Overview

The 15-minute Multimodal Hub concept arises as an effective solution to expand the span of the 15-minutes city concept beyond urban core areas. The main idea of the 15-minutes city is that basic necessities can be satisfied by amenities (e.g. hospital, grocery store, school) within 15 minutes of walking time [20]. Such an urban transformation is expected to have environmental benefits by reducing car dependency; social benefits by enhancing community, mental health and physical exercise; and economic benefits by lowering transportation costs and promoting small businesses [21]. Parcel locker adoption indicates that spatial proximity, 24/7 access, and direct integration with public transport hubs serve as primary determinants for consumer pickup acceptance and efficiency [22].

The reliance on multiple mobility modes, including public transport, can effectively support the extension of the 15-minutes city concept beyond urban core areas [21]. Multimodal Hubs are expected to be a key enabler of this evolution by providing a transition between different transportation lines and by increasing the number of services offered within these areas (e.g. logistics activities). This twofold objective allows to integrate urban logistics into the 15-minutes city concept, highlighting the role of urban logistics to increase accessibility to certain services (e.g. through e-commerce) [3].

5.3.2 Expected impacts

As showcased in D1.1, the novelty of the 15-minutes Multimodal Hubs means there is limited actual experience with them, and therefore limited insight into their expected impacts. Similarly, the integration of urban freight and last-mile logistics into the 15-minute city concept is identified as a key research gap in the literature [23]. This section focuses on mapping potential impacts arising from the implementation of Microhubs as a general concept, and their use to facilitate the implementation of the 15-minute city. Table 6 presents a summary of the expected impacts of 15-minute multimodal hub and provides the related impact target variables [1].

Table 6. Expected impacts of 15-minutes Multimodal Hubs

CIVITAS category	CIVITAS type	Impact target variable	Expected Impact
Environment	Key (Direct)	Climate impact of vehicles ^a	Reduction in greenhouse gas emissions
Environment	Key (Direct)	Pollution impact of vehicles ^a	Reduction in tailpipe pollutants emissions (e.g., PM ₁₀ , NO _x)
Environment	Key (Direct)	Transport noise emissions ^a	Reduction in noise pollution
Environment	Key (Wide)	Air quality	Improvement of the air quality in the urban area
Environment	Supplementary (Direct)	Transport visual impact	Reduction in urban space occupation linked to loading and unloading operations
Transport System	State (Direct)	Facilities/conditions allowing alternatives for urban freight distribution: B2B and B2C	Enables the use of low-emission vehicles for the last-mile delivery to businesses and citizens
Transport System	Supplementary (Direct)	Physical integration between transport modes	Facilitates the change between different transportation modes
Transport System	Key (Wide)	Road congestion	This indirect impact depends on the effects of Multimodal Hubs on the total distance travelled per parcel
Transport System	Key (Wide)	Accessibility	Increase the possibility of reaching other neighbourhoods in the urban area
Transport System	Key (Wide)	Modal shift towards public transport and active modes	Increase the number of persons shifting from private cars to public or active modes of transportation
Energy	Key (Direct)	Energy sustainability of urban transport	Increase in the share of non-fossil fuel energy used for last-mile delivery
Society	Key (Wide)	Citizens' health	Reduce health issues related to pollutant emissions, noise pollution, and traffic congestion
Society	Not defined	Local services	Rise in the number of nearby citizens and businesses with increased access to goods and services
Society	State (Direct)	Safety of road network	Increase road and pedestrian safety near the 15-minute Multimodal Hub
Society	Supplementary (Direct)	Citizens' perception of the appropriateness of implemented measures	No reported impact in the literature. The expected impact is to increase the share of citizens that agree with the 15-minute Multimodal Hub

^a Applies to last-mile delivery operations and, potentially, to passenger transportation due to the multimodal nature of the proposed Microhub to enhance the role of public transport in the 15-minutes city.

Energy, environment and transport system

The expected impacts of the 15-minute Multimodal Hub on the environment and the transport system CIVITAS categories are primarily related to the shift in last-mile delivery operations. The literature points to the implementation of Microhubs together with low-emission, last-mile delivery modes, as an important lever for the reduction of tailpipe emissions [4], [8], [24]. For instance, the shift to cargo bikes is expected to provide significant tailpipe emission savings compared to last-mile delivery using vans and trucks. This shift can also reduce other impacts linked to last-mile delivery, such as noise, urban space occupation and road safety [8].

The reduction in environmental impact is expected to be amplified in business models based on the full collaboration between parcel operators, as these scenarios were reported to lead to lower vehicle kilometres [25]. Total distance travelled is an important aspect in the outcomes of last-mile delivery from Microhubs because of the smaller load limits of low-emission vehicles and cargo bikes compared to vans and trucks. A higher total distance travelled per parcel was identified as a trade-off associated to the use of electric vans and tricycles for last-mile delivery [4], [8]. A dense network of Microhubs and collaboration among operators are, therefore, identified as key aspects for the reduction in tailpipe emissions [8].

The impacts on the environment and the transport system go beyond logistics in the case of the 15-minute Multimodal Hub, as this solution also concerns passenger transportation. Expected impacts on the transport system consist of a better physical integration between transport modes, an increase in the shift towards public and active transportation modes, and an increase in the accessibility to other neighbourhoods within the urban area [21]. Concerning impacts on the environment, the potential benefits described for last-mile delivery could be also observed for passenger mobility as a result of the shift to public and active modes (e.g. cycling).

Society

The expected impacts of the 15-minute Multimodal Hub on society are linked to the reduction of conventional freight vehicles entering the urban area, which leads to increased pedestrian safety and better liveability [8]. The integration of logistics and public transport can equally improve the accessibility to some services across individuals with different socioeconomic characteristics (e.g. income), which are brought closer to businesses and final consumers. This factor is showcased in the literature for designing 15-minute neighbourhoods [26]. The expected impact can be achieved thanks to the installation of parcel lockers and other services in the Multimodal Hub, or due to the multimodal aspect of the solution, which eventually leads to reduced travel times.

Other impacts specific to the leading city: Aarhus

A specific impact on society that will be equally interesting for this solution is to improve citizens' perception on the implemented measures to improve sustainability.

5.4 Incentive and Reward mechanisms

5.4.1 Overview

Incentive and Reward mechanisms, including gamification, aim to facilitate changes in human behaviour for a variety of goals, such as climate change mitigation [27]. These mechanisms include

financial incentives (e.g. subsidies), non-financial incentives (e.g. social recognition), and behavioural and policy incentives (e.g. nudges).

Incentive and Reward mechanisms have been applied in the context of sustainability with the objective of strengthening the engagement of individuals towards pro-environmental behaviours. For instance, reward apps have been implemented across different countries to encourage consumers to choose low-carbon commodities and adopt sustainable behaviours (e.g. recycling) [28]. Regarding the transport sector, several studies evaluate the introduction of incentive and reward mechanisms on the adoption of public transport and active modes [29], [30]. Certain authors have explored the introduction of carbon reduction incentives for the use of electric delivery vehicles, off-peak delivery, and freight pooling [31], [32], as well as the use of gamification approaches in urban logistics [33].

5.4.2 Expected impacts

The implementation of Incentive and Reward mechanism remains relatively unexplored in the field of urban logistics compared to the other NEXTLOGIC solutions [3]. Currently, it is unclear whether the positive impacts observed after the implementation of this type of mechanisms remain once the incentives are removed [27], [30]. This aspect constitutes a challenge for the impact evaluation framework, as assessment over long periods of time can be unfeasible due to the limited duration of the project. In addition, the different stakeholders involved in urban logistics may result in heterogeneous impacts [33], while unequal access to the digital technologies (i.e. often hosting Incentive and Reward mechanisms) can give a biased picture of generated impacts [3].

Given the large heterogeneity of Incentive and Reward incentives and their different expected impacts, this section specifically focuses on the Incentive and Reward mechanisms that will be implemented in Aarhus and Dublin within NEXTLOGIC [34]. Therefore, expected impacts are provided for each of the cities.

Aarhus

The Incentive and Reward solution in Aarhus aims to encourage early collection of parcels from the 15-minute Multimodal Hub. Similar mechanisms were implemented in Denmark by PostNord Denmark to decrease the risk of locker saturation during the month of December.

The proposed mechanism is expected to increase the availability of lockers thanks to the early collection of parcels. From a user perspective, this measure can lower delivery times as it avoids overcrowding of the hub parcels. This impact can be estimated by measuring the mean parcel collection time before-and-after the implementation of Incentive and Reward mechanisms. An improvement in the delivery efficiency can also lead to a reduction in the number of re-delivery trips due to lockers saturation. As such, it could potentially lead to a reduction in road congestion, and in energy use. In the case of using fossil fuel vehicles to deliver parcels to the 15-minute Multimodal Hub, this will in turn lead to lower pollutant and GHG emissions. Similar expected impacts are described in the literature [35], while also emphasising the reduced delivery costs that this policy could entail. These potential impacts heavily depend on whether the Incentive and Reward mechanisms trigger a behavioural change among final consumers. All the expected impacts described above are already detailed for the 15-minutes Multimodal Hub being implemented in Aarhus (Table 6). As such, they are not specified in Table 7, which focuses on Incentive and Reward mechanisms.

The Incentive and Reward mechanism may increase the awareness of citizens toward the implemented solution, including the 15-minute Multimodal Hub. This aspect was already considered in the expected

impacts of the latter solution, as it is a specific aspect of interest for the city of Aarhus (Table 6). It is recommended to define an impact target variable to measure citizens' engagement with the pilot and assess whether the pilot effectively encourages earlier parcel collection.

Table 7. Expected impacts of the reward and incentive mechanisms foreseen in Aarhus

CIVITAS category	CIVITAS type	Impact target variable	Expected Impact
Society/ Transport System	Not defined	Change in behaviour	Reduction in the delivery time of parcels
Society	Not defined	Engagement with the pilot	Increase in the number of sign-ups and active users after the first interaction

Dublin

The proposed Incentive and Reward mechanisms are expected to encourage a modal shift towards cycling, as well as a better use of bike parking systems. A better utilisation of bike parking systems is expected to reduce the transport visual impact produced as a result of overcrowded bike parking systems. Other expected impacts on energy, environment and the transport system correspond to those associated with the modal shift towards cycling. However, at the scale of the pilot, these impacts will remain marginal and difficult to capture.

The Incentive and Reward mechanism, including gamification elements, can increase the engagement of citizens and businesses with the pilot [36]. It is therefore important to measure both the level of engagement and whether it effectively leads to the targeted behavioural change, as these factors are key to achieving the expected benefits (Table 8).

Table 8. Expected impacts of the reward and incentive mechanisms foreseen in Dublin

CIVITAS category	CIVITAS type	Impact target variable	Expected Impact
Environment	Supplementary (Direct)	Transport visual impact	Reduction in urban space occupation linked to undesired bike parking
Society/ Transport System	Not defined	Change in behaviour	Increase in the number of people cycling
Society	Not defined	Engagement with the pilot	Increase in the number of sign-ups and active users after the first interaction

5.5 Electrification of Urban Logistics

5.5.1 Overview

Urban freight transportation is responsible for approximately 25% of the CO₂ emissions caused by urban transportation in Europe, and 30 to 50% of pollutant emissions [37]. Despite its important environmental footprint on climate change, urban freight traffic represents a relatively small share of overall urban traffic [37]. These aspects highlight the decarbonisation of urban freight transportation as a particularly high-leverage pathway to reduce GHG, directly supporting the climate change mitigation objectives of cities across Europe, as exemplified by initiatives such as NetZeroCities [38].

Similarly, the decoupling of the freight transport sector from fossil fuel-based energy system and economic growth is highlighted as a key principle for building a sustainable transport system within planetary boundaries [39].

Despite its major role in achieving urban logistics sustainability, the electrification of urban logistics poses significant challenges in terms of infrastructure, maintenance, investment and changes upstream in the electricity supply chain. The expected environmental benefits of urban logistics electrification can only be achieved with the introduction of the corresponding infrastructure (e.g. charging stations), the decrease in the total cost of ownership of electric vehicles, the adaptation of the supply (e.g. electricity capacity), the adaptation of last-mile delivery vehicles to the delivery density context, and the shift towards a renewable energy-based electricity grid [3].

5.5.2 Expected impacts

Table 9 presents a summary of the expected impacts of electrification and provides the corresponding impact target variables [1].

Energy, environment and transport system

Expected impacts from urban logistics electrification mainly pivot around the reduction of GHG and pollutant emissions. The literature agrees that electrifying urban logistics, particularly last-mile delivery, leads to significant emission reductions [40]. Simulation-based scenarios grounded in the electrification of the urban freight fleet have estimated these gains for The Hague area [41], and Madrid [42], among others. However, reported estimates often rely on direct emissions, which can give a flawed picture of the sustainability of the measure. Instead, works must cover the whole supply chain of electric freight vehicles when calculating their expected impact, for instance, on climate change. This methodological approach includes the three scopes of emission calculation (i.e. scope 1, 2, and 3), avoiding flawed claims regarding electric vehicle emissions (e.g. zero-emission vehicles) and accounting for the displacement of environmental burdens to upstream sectors (e.g. electricity production, batteries manufacturing) and other geographical areas [43].

As showcased in deliverable D1.1, electrification should be accompanied by urban planning measures to entirely achieve the expected sustainability benefits [3]. This same aspect is discussed for The Hague area, where electrification alone led to approximately the same travelled distance as in the baseline scenario. The reduction observed for consolidation policies (e.g. Microhubs) suggests that coupling both solutions, alongside the consideration of electric vehicles load factor, could boost the sustainability outcomes of the pilot [41]. In this sense, road congestion should be assessed for policies concerning urban freight electrification, especially considering the projected growth in e-commerce. Additionally, the effects of electrification on road congestion also affect the outcomes of the solution concerning noise emissions.

Society

The social impacts of urban logistics electrification depend on the type of electric vehicles being implemented (e.g. e-cargo bikes, e-vans). Overall, the reduction in tailpipe emissions is expected to reduce the impacts on citizens' health. As described for previous solutions, whenever road congestion is improved due to route efficiency gains or reduction in the number of last-mile delivery vans and trucks, electrification could also lead to improved road safety and urban liveability.

Other impacts specific to the leading city: The Hague

In the city of The Hague, the expected impacts are reported to depend on the availability of charging infrastructure. It is difficult to determine whether the pilot itself will lead to an increase in charging points, as such infrastructure is considered more a prerequisite for achieving sustainability benefits than a direct outcome of the pilot. Similarly, another key precondition identified for achieving the expected sustainability outcomes concerns the current possibility for companies to apply for exemptions allowing the use of fossil fuel vehicles within zero-emission zones, based on economic constraints or the lack of adequate charging infrastructure, among other.

A city-specific expected impact for The Hague consists of increasing the interest of businesses and citizens in the implemented solution. This effect has been pursued since the beginning of the project by engaging local stakeholders in the implementation of the pilot.

Table 9. Expected impacts of electrification of urban logistics

CIVITAS category	CIVITAS type	Impact target variable	Expected Impact
Environment	Key (Direct) ^a	Climate impact of vehicles	Reduction in greenhouse gas emissions
Environment	Key (Direct)	Pollution impact of vehicles	Reduction in tailpipe pollutants emissions (e.g., PM ₁₀ , NO _x)
Environment	Key (Direct)	Transport noise emissions	Reduction in noise pollution
Environment	Key (Wide)	Air quality	Improvement of the air quality in the urban area
Transport System	Key (Wide)	Road congestion	This indirect impact depends on the effects of electrification on the total distance travelled per parcel
Energy	Key (Direct)	Energy sustainability of urban transport	Increase in the share of non-fossil fuel energy used for last-mile delivery
Society	Key (Wide)	Citizens' health	Reduce health issues related to pollutant emissions, noise pollution, and traffic congestion
Society	State (Direct)	Safety of road network	This impact depends on the type of electric vehicles being deployed. Reduction in road traffic could positively affect safety of the road network
Society	Supplementary (Direct)	Citizens' and businesses' perception of the appropriateness of implemented measures	The expected impact is to increase the share of citizens and businesses that agree with the solution

5.6 Cross-cutting expected impacts

In light of the expected impacts identified for each NEXTLOGIC solution, this section presents the impacts that are common across most of the solutions. The purpose of this cross-solution comparison is twofold: to provide an overall picture of the project's expected impacts, and to subsequently

facilitate a consistent comparison of pilot outcomes against each impact. The common impacts are summarised in Table 10.

Table 10. Common expected impacts across most of NEXTLOGIC solutions

CIVITAS category	CIVITAS type	Impact target variable	Expected Impact
Environment	Key (Direct) ^a	Climate impact of vehicles	Reduction in greenhouse gas emissions
Environment	Key (Direct)	Pollution impact of vehicles	Reduction in tailpipe pollutants emissions (e.g., PM ₁₀ , NO _x)
Environment	Key (Direct)	Transport noise emissions	Reduction in noise pollution
Environment	Key (Wide)	Air quality	Improvement of the air quality in the urban area
Environment	Supplementary (Direct)	Transport visual impact	Reduction in urban space occupation linked to conventional urban freight vehicles (e.g. frees up curbside space)
Transport System	Key (Wide)	Road congestion	This indirect impact depends on the effects of Microhubs on the total distance travelled per parcel
Society	Key (Wide)	Citizens' health	Reduce health issues related to pollutant emissions, noise pollution, and traffic congestion
Society	State (Direct)	Safety of road network	Reduction in the number of operations of conventional urban freight vehicles

6. Selection of the impact indicators and quantification methods

The recommended impact indicators are designed to address the expected impacts identified in the previous section. Wherever possible, these indicators are based on those provided by the CIVITAS Evaluation Framework. Given the differing timelines and resources available across the pilots, multiple methods are proposed for several indicators where appropriate.

6.1 Microhubs

Table 11. Recommended impact indicators and methods for Microhubs

Impact target variable	Recommended impact indicator	Recommended method and data needs
Climate impact of vehicles	Average CO ₂ -eq emissions	Life-cycle assessment relying on data from: Before-and-after surveys to Microhub operators and/or pilot data
Pollution impact of vehicles	Average air pollutant emissions	Life-cycle assessment relying on data from: Before-and-after surveys to Microhub operators and/or pilot data
Transport noise emissions	1) Share of inhabitants reporting to be annoyed by transport noise 2) Noise levels	1) Before-and-after surveys to citizens 2) Life-cycle assessment
Air quality	<i>Discarded wide impact due to the scale of the pilot</i>	
Transport visual impact	Share of vehicles irregularly parked	- GPS data - Data on fines before-and-after pilot implementation
Facilities/conditions allowing alternatives for urban freight distribution: B2B and B2C	- Share of cargo bicycle deliveries in all transportation modes routed through Microhubs	- Microhub data - Before-and-after surveys to Microhub operators
Road congestion	<i>Discarded wide impact due to the scale of the pilot</i>	
Service level	1) Likert scale on satisfaction 2) Average time of delivery	1) Before-and-after surveys to Microhub receivers (companies to which parcels are delivered from the Microhub) 2) Traffic simulation
Energy sustainability of urban transport	1) Number of delivery vehicles in the Microhub (split by electric, combustion, and cargo bikes) 2) Share of renewable energy in the Microhub energy consumption	- Microhub data - Before-and-after surveys to Microhub operators
Citizens' health	- Cumulative number of years lost: Disability Adjusted Life Year (DALY)	- Life-cycle assessment
Local services	Number of receivers using the Microhub	- Before-and-after surveys to Microhub receivers - Pilot data
Safety of road network	1) Number of accidents with the use of delivery vehicles (small, medium) and cargo bicycles 2) Citizens' perception of road and pedestrian safety (Likert scale)	1) Data from Microhubs operators: before-and- after survey 2) Before-and-after surveys to citizens

6.2 Smart Loading Zones for smart and dynamic curbside management

Table 12. Recommended impact indicators and methods for SLZ

Impact target variable	Recommended impact indicator	Recommended method and data needs
Climate impact of vehicles	Average CO ₂ -eq emissions	Life-cycle assessment relying on data from: - Traffic simulation - Operators - Before-and-after surveys to operators
Pollution impact of vehicles	Average air pollutant emissions	Life-cycle assessment relying on data from: - Traffic simulation - Operators - Before-and-after surveys to operators
Transport noise emissions	1) Share of inhabitants reporting to be annoyed by transport noise 2) Noise levels	1) Before-and-post surveys to citizens 2) Life-cycle assessment
Air quality	<i>Discarded wide impact due to the scale of the pilot</i>	
Transport visual impact	Share of vehicles irregularly parked	Parking data from the SLZ
Road congestion	1) Average delivery time for a sample of Origin-Destination (OD) pairs 2) Congestion perception of residents (Likert scale)	1) - Traffic simulation - Operators data - Before-and-after surveys to operators 2) - Before-and-after surveys to citizens
Transport energy demand	Estimated energy demand	Life-cycle assessment relying on data from: - Traffic simulation - Operators - Before-and-after surveys to operators
Citizens' health	- Cumulative number of years lost: Disability Adjusted Life Year (DALY) - Share of individuals reporting respiratory disorders	- Life-cycle assessment - Before-and-after surveys to citizens
Safety of road network	1) Number of accidents 2) Citizens' perception of road and pedestrian safety (Likert scale)	1) Operators and municipality data 2) Before-and-after surveys to citizens
Citizens' perception of the appropriateness of implemented measures	Share of inhabitants and businesses considering the measures implemented in the pilot to be acceptable	Before-and-after surveys to citizens

6.3 15-minute Multimodal Hubs

Table 13. Recommended impact indicators and methods for 15-minute Multimodal Hubs

Impact target variable	Recommended impact indicator	Recommended method and data needs
Climate impact of vehicles	Average CO ₂ -eq emissions	Life-cycle assessment relying on Before-and-after surveys to operators and citizens
Pollution impact of vehicles	Average air pollutant emissions	Life-cycle assessment relying on Before-and-after surveys to operators and citizens
Transport noise emissions	1) Share of inhabitants reporting to be annoyed by transport noise, 2) Noise levels	1) Before-and-after surveys to citizens 2) Life-cycle assessment
Air quality	<i>Discarded wide impact due to the scale of the pilot</i>	
Transport visual impact	1) Share of vehicles irregularly parked 2) Perception of residents (Likert scale)	1) Operators' data or before-and-after surveys to operators 2) Before-and-after surveys to citizens
Facilities/conditions allowing alternatives for urban freight distribution: B2B and B2C	- Number of cargo-bikes used in the pilot area per inhabitant (B2B and B2C) - Number of city boxes/smart lockers per inhabitant	- Multimodal hub data - Before-and-after surveys to operators
Physical integration between transport modes	Ratio between the number of passengers interchanging at intermodal hubs and population of the pilot area	- Multimodal Hub data - Before-and-after surveys to citizens
Road congestion	1) Average delivery time for a sample of Origin- Destination (OD) pairs 2) Congestion perception of residents (Likert scale)	1) Operators' data or before-and-after surveys to operators 2) Before-and-after surveys to citizens
Accessibility	Accessibility index: combination of public transport connectivity, connectivity of bike network, road congestion (Likert scale)	- Before-and-after surveys to citizens
Modal shift towards public transport and active modes	Modal shares on trips	Before-and-after surveys to citizens
Energy sustainability of urban transport	Number of delivery vehicles in the Multimodal Hub (split by electric, combustion, and cargo bikes)	- Multimodal Hub data - Before-and-after surveys to operators
Citizens' health	- Cumulative number of years lost: Disability Adjusted Life Year (DALY) - Share of individuals reporting respiratory disorders	- Life-cycle assessment - Before-and-after surveys to citizens
Local services	Ratio between the number of city functions reachable within 15 minutes from stops/stations in the outskirt area of the city and the number of city functions reachable within 15 minutes from stops/stations in the city centre	- Data from the municipality - Before-and-after surveys to citizens
Safety of road network	Citizens' perception of road and pedestrian safety (Likert scale)	Before-and-after surveys to citizens
Citizens' perception of the appropriateness of implemented measures	Share of inhabitants considering the measures implemented in the pilot to be acceptable	Before-and-after surveys to citizens

6.4 Incentive and Reward mechanisms

Because of the different Incentive and Reward mechanisms implemented in NEXTLOGIC leading cities, the recommended impact indicators and methods are indicated for each of the leading cities implementing these solutions.

Aarhus

Most of the expected impacts arising from the implementation of Incentive and Reward mechanisms in Aarhus are the same as those expected from the 15-minute Multimodal Hub to be installed in the city. The recommended impact indicators for the Incentive and Reward mechanisms focus on their success and whether they cause a change in citizens behaviour regarding the time to collect parcels. A retention rate indicator is recommended to estimate if users remain active after signing-up in the platform (Table 14).

Table 14. Recommended impact indicators for incentive and reward mechanisms in Aarhus

Impact target variable	Recommended impact indicator	Recommended method and data needs
Engagement with the pilot	Number of new/recruited users (n)	Pilot data
	Number of active users after first interaction (n)	Pilot data
	Retention rate (%): Share of sign-ups that become users	Pilot data
Change in behaviour	Parcel collection time before and after the implementation of incentive and reward mechanism (time units)	Pilot data

Dublin

The expected impact of Incentive and Reward mechanisms on the transport visual impact can be estimated by monitoring the number of irregularly parked bicycles. The use of this indicator supports comparability with other NEXTLOGIC pilots as it was also recommended for them. Depending on the available data sources, the indicator can be quantified based on data from sensors or from surveys (Table 15). Additional indicators recommended for the pilot in Dublin aim to measure the success of incentive and reward mechanisms by quantifying the number of sign-ups that remain active users after the first use, and whether the pilot triggered the expected change in behaviour.

Table 15. Recommended impact indicators for incentive and reward mechanisms in Dublin

Impact target variable	Recommended impact indicator	Recommended method and data needs
Transport visual impact	1) Share of bicycles irregularly parked (%) 2) Perception of residents (Likert scale)	1) Sensor data 2) Before-and-post surveys to citizens
Engagement with the pilot	Number of new/recruited users (n)	Pilot data
	Number of active users after first interaction (n)	Pilot data
	Retention rate (%): Share of sign-ups that become users	Pilot data
Change in behaviour	Share of inhabitants out of those involved in the pilot that report an increase in the use of bicycles after the pilot (%)	Before-and-post surveys to citizens

6.5 Electrification of urban logistics

Table 16. Recommended impact indicators and methods for the electrification of urban logistics

Impact target variable	Recommended impact indicator	Recommended method and data needs
Climate impact of vehicles	Average CO ₂ -eq emissions	Life-cycle assessment relying on data from: - Traffic simulation - Operators - Municipality (Zero-emission zone)
Pollution impact of vehicles	Average air pollutant emissions	Life-cycle assessment relying on data from: - Traffic simulation - Operators - Municipality (Zero-emission zone)
Transport noise emissions	1) Share of inhabitants reporting to be annoyed by transport noise 2) Noise levels	1) Before-and-post surveys to citizens 2) Life-cycle assessment
Air quality	<i>Discarded wide impact due to the scale of the pilot</i>	
Road congestion	1) Average delivery time for a sample of Origin- Destination (OD) pairs 2) Congestion perception of residents (Likert scale)	1) Operators' data, before-and-after surveys to operators, or traffic simulation 2) Before-and-post surveys to citizens
Energy sustainability of urban transport	Number of delivery vehicles (split by electric, combustion, and cargo bikes)	- Operators' data - Municipality's data (Zero-emission zone) - Before-and-post surveys to operators
Citizens' health	1) Cumulative number of years lost: Disability Adjusted Life Year (DALY) 2) Share of individuals reporting respiratory disorders	1) Life-cycle assessment 2) Before-and-post surveys to citizens
Safety of road network	1) Number of accidents 2) Citizens' perception of road and pedestrian safety (Likert scale)	1) Operators' and municipality's data 2) Before-and-post surveys to citizens

6.6 Economic indicators

Economic indicators aim at estimating the financial effort of the implementation of the measures, as well as their efficiency (i.e. effects compared to cost) [1]. The indicators recommended do not reflect impacts but rather provide an estimate of the cost of the measures that allows us to compare the measures between them. The economic indicators refer to each pilot, rather than to each specific solution, as some pilots implement various solutions.

The recommended economic indicators follow the list provided by the CIVITAS Evaluation Framework, which outlines total yearly net cost and efficiency as the main indicators to be computed [1]. These total costs are also required to calculate the efficiency of the measures, as the ratio between the

relative change of selected indicators for each category (e.g. relative change of environment first level indicators) and the total yearly net cost. Table 17 details the recommended economic indicators.

The computation of the total yearly net costs requires data from the local administration, private companies, and citizens. Alternatively, the costs could also be estimated relying on data from business plans. One challenge in terms of data acquisition lies on the fact that, when relying on primary data, the information may only become available after the pilot has been completed [1].

Table 17. Description of the recommended economic indicators

Indicator	Description	Data requirements
Total yearly net cost	Quantifies the yearly net cost of the pilot by considering capital investments, operating costs, and revenues.	<ul style="list-style-type: none"> - Infrastructure costs - Other fixed costs - Operating costs - Revenues
Ratio between relative change in sustainability impacts and total yearly net cost	Estimates the efficiency of the pilot by comparing the relative change in sustainability indicators to the total yearly net cost of the pilot	<ul style="list-style-type: none"> - Relative change in the chosen indicators among those recommended in the impact evaluation framework - Total yearly net cost

7. Implementing the Evaluation Framework

This section describes how the NEXTLOGIC Impact Evaluation Framework will be implemented throughout the project. It outlines the practical application of the framework across the pilot cities, ensuring a consistent yet flexible approach that accommodates the diversity of local contexts, implemented solutions, and data availability. The framework is conceived as a living instrument that will be progressively refined as the project advances and new evidence emerges from the pilot demonstrations.

7.1 Summary of the recommended impacts to be monitored

In total, 18 impact target variables are identified as relevant for the pilots, with six being common to at least three of the pilots. Conversely, only one impact variable is relevant only for one of the pilots (Table 18).

Table 18. Recommended impacts to be monitored across the pilots.

Impact target variable	Wroclaw	The Hague	Aarhus	Dublin
Climate impact of vehicles	Yes	Yes	Yes	No
Pollution impact of vehicles	Yes	Yes	Yes	No
Transport noise emissions	Yes	Yes	Yes	No
Transport visual impact	Yes	Yes	Yes	Yes
Facilities/conditions allowing alternatives for urban freight distribution: B2B and B2C	Yes	No	Yes	No
Road congestion	No	Yes	Yes	No
Accessibility	No	No	Yes	No
Physical integration between transport modes	No	No	Yes	No
Service level	Yes	No	Yes	No
Energy sustainability of urban transport	Yes	No	Yes	No
Transport energy demand	No	Yes	No	No
Citizens' health	Yes	Yes	Yes	No
Local services	Yes	No	Yes	No
Modal shift towards public transport and active modes	No	No	Yes	No
Safety of road network	Yes	Yes	Yes	No
Citizens' perception of the appropriateness of implemented measures	No	Yes	Yes	No
Engagement with the pilot	No	No	Yes	Yes
Change in behaviour	No	No	Yes	Yes

The communality of impacts across the pilots is relevant to compare the outcomes of each pilot and subsequently derive conclusion for decision-making. However, in order to be totally comparable, impacts from the pilots should be estimated using the same impact indicators, as outlined in the previous section. The chosen impact indicators depend on the availability of data and resources in each of the pilots. This explains the reason behind the proposition of alternative indicators and methods in the previous section.

7.2 A Living Evaluation Framework

The proposed evaluation framework has been designed to capture pilot-specific impacts while ensuring the highest possible level of comparability across pilots. However, the diversity of expected impacts creates a trade-off with this objective, as several impacts are inherently linked to the specific contexts of individual cities and pilots. Likewise, the heterogeneity and small scale of the expected impacts require the application of multiple assessment approaches, including analytical tools such as Life Cycle Assessment (LCA) and the collection of primary data through surveys and stakeholder engagement. Whenever possible, the framework proposes alternative indicators and methods, recognising that the feasibility of implementation may differ across pilots.

The evaluation framework should therefore be considered a **living document that can be adapted to evolving project needs, available tools, and data constraints**. In this respect, the framework highlights the importance of integrating data generated in other work packages to support the assessment process. Such data may enable both ex-ante evaluations based on simulation results and ex-post evaluations relying on data collected during pilot implementation. In both cases, close collaboration across work packages is essential to ensure consistency, data availability, and the robustness of the evaluation process.

The **main challenges** associated with implementing the proposed evaluation framework relate to **data availability and potential delays in pilot implementation**. Mitigation measures for both challenges include the use of alternative data collection and estimation methods, such as simulations.

Beyond addressing data gaps, these methods also offer **opportunities** to upscale the framework to broader levels of analysis, such as the city scale, thereby supporting decision-making regarding the contribution of these policies to wider objectives, including carbon neutrality targets.

Furthermore, the proposed framework provides a **common methodological basis for assessing and comparing pilot outcomes across different implementations**. This allows the framework to be transferred to replicating cities by incorporating additional impacts that are specific to their local contexts.

8. Rationale and design of the Stakeholder Engagement Framework in NEXTLOGIC

City logistics as a sector is confronted with a wide variety of challenges pertaining to, amongst others, urban space use, sustainability, and fleet functioning. These issues are too complex to be solved by a singular actor and often **involve multi-level decisions and processes**. It is necessary to align the stakeholders, objectives, action potential, and perspectives on the challenges in order to improve the chance of acceptance and optimise the operation of new solutions. Within NEXTLOGIC, the co-creation methods outlined in the following sections of this D1.2 provide potential tools and planning suggestions to facilitate such alignment. Yet apart from the need to include multiple stakeholders, the degree of involvement is another level that should be specified.

To set up and streamline the **co-creation process and identify useful co-creation methods**, this section sets out a **stakeholder engagement framework¹ tailored for the NEXTLOGIC city pilots**. This framework provides an overview of organisation factors and required considerations for the implementation of co-creation in the NEXTLOGIC pilots.

8.1 Participation levels

Even when stakeholder engagement and co-creation are included in the development of solutions for city logistics challenges, **there is no guarantee that the joint challenges are approached in full joint knowledge production**. In freight quality partnerships (see below), for instance, engagement is sometimes limited to solely sharing of best practices [44], and sometimes participants are not involved in decision making processes but instead participate as passive listeners [45]. In these cases, stakeholder engagement is enabled, but co-creation is not necessarily achieved. This can limit the potential of "shared situational awareness" (SSA) and "joint knowledge production" (JKP) [46], [47] and will ultimately limit the degree of acceptance or optimisation later in the design process. Yet, simultaneously, not every random passerby should be considered in the co-creation of specialist city logistics solution. A measure to distinguish different levels of participation provides a more applied plan to stakeholder engagement.

Sherry Arnstein introduced the **Ladder of Citizen Participation** as a tool to understand the redistribution of power in moments of participation (see Figure 3) [48]. The ladder identified eight steps of power distribution ranging from non-participation to full redistribution of power to citizens in urban planning matters. The **non-participation** levels (1 and 2) involve external stakeholders in the process but use the contact to lecture or educate those present in the 'correct' way of working; effectively negating participation possibilities, and keeping power solely in the hands of a single authority. The **tokenism** levels (3 to 5) do schedule participation sessions to gather input, but the power to follow up on the suggestions is still squarely in the hand of a singular authority. Finally, **citizen power** (level 6 through 8), see the participants gain decision making power, ranging from trade-offs and bargaining (level 6) to full power distribution to the involved parties (level 8).

¹ The stakeholders engagement or participation framework described in this D1.2 complements and details the broader framework and strategy that is included in D6.1 (Initial Plan for dissemination and exploitation), namely in section 5 (Stakeholders engagement and outreach), where the local co-creation and pilot-related engagement activities are framed in the wider engagement at project and European-wide level.

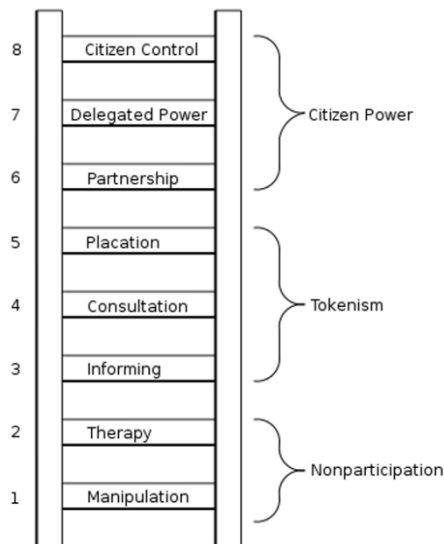


Figure 3. Arnstein's Ladder of Citizen Participation

Arnstein's ladder shows a differentiation of power distribution in co-creation sessions that provides a structure towards differentiated co-creation in NEXTLOGIC. The three levels of Arnstein's ladder can be reinterpreted into a **more operational framework**, tailored to city logistics. Regardless of the operationalisation, in all cases, the levels of participation are considered as actual participation wherein stakeholder input is collected; only the degree of their involvement (frequency and agency) differs. The reinterpretation can be found in Table 19.

Table 19. Translation of Arnstein's Ladder into NEXTLOGIC participation levels

Arnstein label	Arnstein description	NEXTLOGIC adaptation	NEXTLOGIC label
Non-Participation	External stakeholders are educated in the correct way	Presenting prototypes to external stakeholders to familiarise them and make usability tweaks	Acceptance Facilitation
Tokenism	Interested parties are consulted but with no decision-making power	Stakeholders directly affected or dealing with the solution is consulted and alignment of goals is sought	Joint Knowledge Production
Citizen Power	External stakeholders are made responsible for (parts) of the decision-making process	Directly involved universities, governments, and industry partners in a pilot together shape the design, positioning, and process of a solution	Design Optimisation

The NEXTLOGIC stakeholders' engagement framework distinguishes three levels of participation, relying on building acceptance by users, ensuring SSA and JKP by directly affected stakeholders, and an inclusive yet steering design process by a core group. This implies a distinction in types of stakeholders, which will be discussed in 9.2. Yet the core tripart division provides an organisational

framework NEXTLOGIC pilots. The power dynamics according to the level of participation are outlined in Figure 4 (based on [49]).

Organised in three levels of involvement, NEXTLOGIC solutions have different opportunities to build upon co-creation. This organisation allows for a tailored engagement plan, depending on which stakeholder is included in which group. With the framework in place, different methods to engage with stakeholders can be studied.

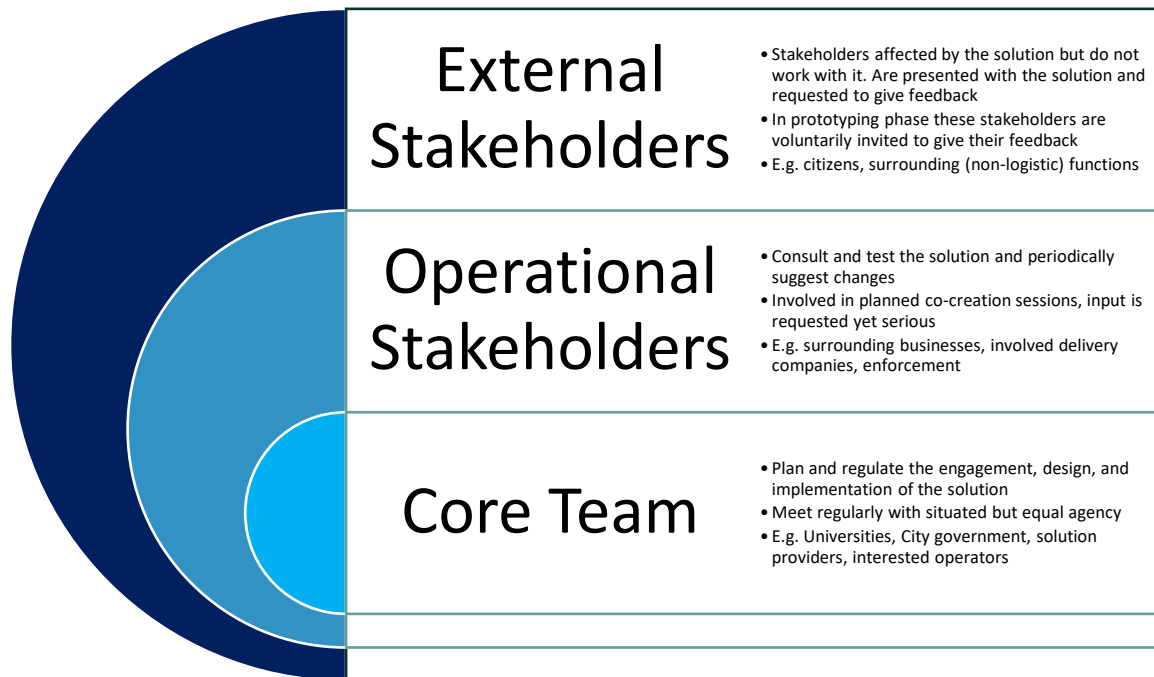


Figure 4. Power dynamics depending on the level of participation

8.2 Building on existing co-creation methods in urban logistics

Despite its relevance in scarce urban space, contested sustainability ambitions, and fleet optimisation, stakeholder engagement and co-creation has been studied relatively little in relation to last-mile logistics [50]. Still, recent projects and initiatives have pursued different formats of stakeholder engagement in different co-creation methods. Reflecting on these earlier examples identifies **differences in timing for co-creation and highlights potential methods.**

8.2.1 Timing of stakeholder engagement and co-creation

A key consideration in earlier stakeholder engagement in city logistics is the **involvement of stakeholders in an early phase of the pilot or development.**

In 2020, the Urban Freight Lab in Seattle introduced the Seattle Neighborhood Delivery Hub after identifying common interest among varying members of a workgroup [51]. To capitalise on this shared interest, the project itself was launched with a stakeholder engagement workshop in order to understand motivations and requirements. Key stakeholders were subsequently selected based on their level of desired engagement and activity. Similar to the NEXTLOGIC framework, this project identified a core group (planning committee), a group of stakeholders that operate and provide for the hub, and a group that tests an activity at the hub. Through planned digital surveys, the planning committee gathered relevant insights on site selection and on preferred design characteristics. In doing

so, the design could be adapted to participating stakeholder goals, anticipate operational challenges, and identify and facilitate business models for scaling.

This project highlights the need for an early engagement of varying stakeholders, to generate a motivated core group, include relevant insights, and ensure acceptance due to consistent consultation.

While early on stakeholder contacting, onboarding, and engaging is a key step in city logistics pilots, it does not exist in a vacuum. In the 2019 SMOOTH project [52], economic, technical, stakeholder, and legislative factors were studied to determine obstacles for scaling up. Herein, again, the value of stakeholder engagement was apparent, as it was a means to align goals and ambitions along a mutually accepted vision. Yet, the SMOOTH project showed that even with mutual trust and fluent information exchange amongst stakeholders, technical factors are essential for a productive collaboration. This requires information accessibility, data privacy, security and reliability, as well as data exchange infrastructure, to be in place before further project goals could be reached. **Stakeholder engagement and co-creation methods must therefore start with, and build on joint discussions of a data exchange.** In NEXTLOGIC, Task 1.2 is arranging such discussions amongst project partners, but if other key stakeholders are included in the pilot core team, these technical factors should be the first elements of co-creation.

These two projects showed the **importance of early involvement of stakeholders**. Yet these studies were relatively limited in their later co-creation, focusing on consultation through surveys for instance. However, **not all stakeholders need to participate all the time, and full decision making can, depending on the context, still be delegated to a core team only.** Still, multiple studies recognise that not involving relevant stakeholders in the decision making process can cause difficulties later on in the process [47], ranging from dissatisfaction with an increase in costs [50], to their dissatisfaction with the ultimate quality of transport services leading to a negative assessment of local democracy [53]. Involving stakeholder in varying ways in the design process can mitigate such condemnation.

8.2.2 Freight Quality Partnerships

Instead of a concrete method, **Freight Quality Partnerships are formats in which stakeholder engagement is ensured.** These are defined by Lindholm and Browne as "A long-term partnership between freight stakeholders concerned with urban freight, that on a formal or informal basis meet regularly to discuss (and sometimes find solutions to) problems and issues that occur in the urban area" [45]. These partnerships differ from standard public-private partnerships in that it stems not just from financial agreements, but in that it strives for a **functioning local ecosystem in freight transport.** This already makes these partnerships more in line with the alignment of actor rationales or a common vision, than with individual gain [52], [54]. These partnerships provide benefits for the stakeholders in the shape of information sharing, cooperation and taking part of the development of the urban freight situation in the city [47].

The value of these partnerships then lies in an initial mapping, onboarding, and aligning of involved stakeholders in local freight challenges; an initial agreement to collaboration built on communal goals. This provides a strong basis for NEXTLOGIC pilots and co-creation processes, specifically as core team or operational stakeholders. Therefore, **present freight partnerships offer established starting points of stakeholder collaboration when implementing NEXTLOGIC solutions.**

Despite the strong foundation for stakeholder engagement in freight partnerships, there are weaknesses in the format. Quak et al. specifically highlight the risk of unequal participation [47]. This can mean underrepresentation of specific sectors or a shortcoming of participation during the sessions because of a lack of preparation or passive listening. Stakeholder engagement therefore should not become an obligatory structured task; it should be measured and timed, acknowledging different levels of stakeholders and their requirements.

For NEXTLOGIC, freight quality partnerships are an essential starting point when implementing the technological solutions in the pilot, as these partnerships start from *a priori* collaborating logistics stakeholders that already have gone through some process of alignment.

8.2.3 Living Labs

By far the most commonly used form of stakeholder engagement and co-creation, although simultaneously the most elusive, is **Living Labs (LLs)**. Recurring definitions see LLs as **a form of public-private partnership that collaborates in creating, prototyping, and testing new solutions in real-life contexts** [55]. Within city logistics, LLs have been used in multiple projects such as CITYLAB, BUGA:log, Freight Transport Systems of the Future, and GREEN-LOG, amongst others, each with slightly different structures and focus [47], [49], [56], [57], [58], [59]. The recurring characteristics however fit well within the NEXTLOGIC objective of co-creation.

In general LLs rely on direct citizen involvement, real-world experimentation in a controlled environment, and the involvement of stakeholders from the quadruple helix according to the principle of open innovation. As such, LLs differ from freight partnerships in that LLs involve stakeholders outside of the logistics sector as well, and have a real-world local testing site, instead of a collaboration contract around joint issues only. Stakeholders can have a variety of roles ranging from instigators who orchestrate the LL, providers who provide new solutions, users who will have to take up the solution, and utilisers which are organisations that benefit from the results [60]. Within the diverse consortium of NEXTLOGIC and its pilot, and the desired urban application of the NEXTLOGIC solutions, LLs offer a fruitful co-creation format that pursues increased acceptance, SSA amongst multiple stakeholders, and optimisation of designs through real-world testing.

While LLs offer a concrete framework for ensuring co-creation with a wide variety of stakeholders, the specifics of this methodology can be distinguished in two formats [61]: **Logistic service Living Labs** and **Urban Freight Transport Transition Living Labs** [46]. The former are privately driven collaborations that aim to pursue a more grounded level of acceptance by testing their solution actively with the client. Herein the focus is on solution co-creation with end-users, corresponding to collaborative product development by already incorporating the client as well as the competition [62], [63]. Urban Freight Transport Transition LLs instead are focused on the collaboration between public, private, and academic partners, focusing on a transition process. These LLs often have a longer-term goal, such as sustainable logistics, and thrive on the long-term collaboration of quadruple helix actors. This second form of LLs fits better with NEXTLOGIC pilots, as the collaborative development of NEXTLOGIC solutions requires the collaboration of more stakeholders, integration into the urban fabric *and* development of technical solutions, instead of mainly the latter.

LLs are flexible co-creation frameworks based on the collaborative, real-world setting, experimentation. The process consists of repeated prototyping, piloting, and testing. This ultimately also requires repeated consulting and involving stakeholders in workshops or other input sessions.

LLs as a collaboration framework provide both space for freight quality partnerships to be involved, while simultaneously allowing operational and external stakeholders to co-create NEXTLOGIC solutions. **The systematic nature of LLs makes them suited as a pilot structure within NEXTLOGIC.**

8.3 Stakeholder engagement in the NEXTLOGIC pilot implementation process

Within NEXTLOGIC, new solutions to last-mile city logistics are implemented in pilot cities to pursue sustainability targets. The pilots will have to be set up, implemented, executed, monitored, and evaluated. To shape this process, a phasing for the pilot process has been defined, outlining the steps within which stakeholder engagement and co-creation must happen (see Figure 5).

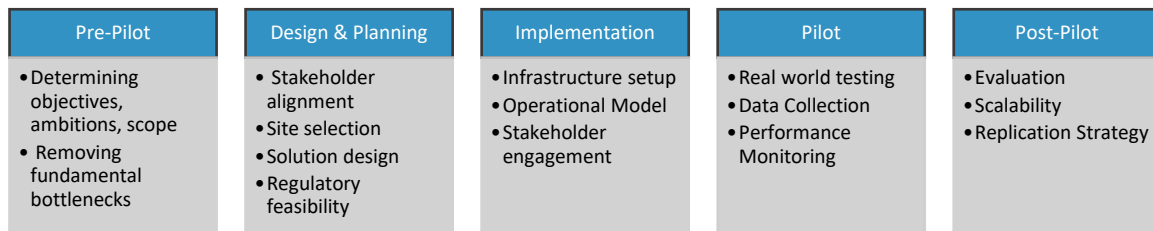


Figure 5. NEXTLOGIC pilot implementation process

The steps of the pilot process each have different objectives and as such, the kind of stakeholder engagement differs, as well as the profile of the stakeholder involved. Previous studies have already stressed the importance of early involvement, but throughout the piloting process, during the design, implementation, and action phases for instance [64], different forms of stakeholder engagement can be identified. Based on the Public Participation Pillars by the International Association for Public Participation [65], stakeholder involvement steps in NEXTLOGIC are shown in Figure 6 and described below.

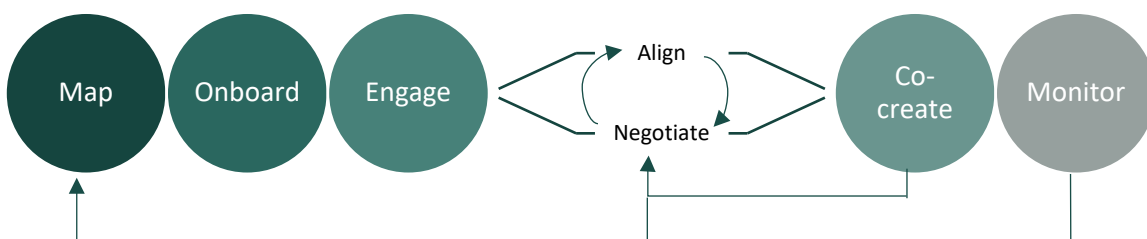


Figure 6. Stakeholder involvement steps

• Mapping Phase

The mapping phase identifies which actors have a stake in the project. This means identifying local agents, involved companies, knowledge institutions, governmental departments, and other key players (see 9.2 for an overview) who are affected by the proposed solution. Next to this identification, these stakeholders will have to be grouped based on influence and interest [66], or influence, legitimacy, and urgency [67], in order to determine their role in the project as core team, operating stakeholder, or external stakeholders, and their timing of involvement. This step ends with a mapping of the stakeholders, as a starting point for stakeholder involvement.

- **Onboarding Phase**

After identifying the main stakeholders that must be involved, the process of onboarding begins, which means inviting stakeholders to actually join the pilot in a structured way. This step requires the clear explanation of the goals of the pilot, scope, timeline, and expectations of stakeholders. As such, before this step, the main scope and ambitions of the pilot will have to be determined by the core team. Next to that, this requires the setting up of the required infrastructure: communication channels, data repositories, and general information. Stakeholders both internally and externally will have to be onboarded in this phase, so that they are all on board with the coming pilot.

- **Engagement Phase**

With the key stakeholders on board, the challenge is to keep them involved and updated throughout the pilot. This relies on a systematic involvement of the onboarded stakeholders through a communication plan, feedback channels, and updates, within which each stakeholder is aware of *what they get out of each meeting and the pilot itself* (updates, opportunity to steer, Q&A, etc.). Streamlining data exchanges and required pilot input is regulated in this step. While essentially an upkeep step, this phase requires the built-in flexibility to recognise shifts in direction, when stakeholders identify arising problems.

- **Alignment & Negotiation Phases**

These two phases happen in an iterative tandem. As stakeholders often have varying and competing actor rationalities (goals, ambitions, expectations, etc. about cost, speed, control etc.) there is a need to ensure these differences are reconciled. This requires probing expectations, but also limitations of solutions or local context. Co-creation methods can facilitate the conversations with core stakeholders to a) expose conflicting expectations, b) reaching compromise, and c) creating a unified narrative to group the pilot under. This step ensures that the rest of the co-creation steps happen around an agreed upon and consistent core narrative.

- **Co-creation Phase**

With the solution set up and the implementation prepared, the actual co-creation can begin. Through different interaction formats, this phase sees operational stakeholders implement their ideas in a design, tests the utility by external stakeholders, and runs the implementation of the solution. Here a broader collaboration is necessary so that opinions, impact, and effects are monitored and shared. Quick adaptations or different simulation sessions can help shape the solution into a continued staple in the city. Co-creation can take multiple shapes, such as of co-design of solutions (e.g. Microhubs), collaboration processes, tailoring to space (e.g. SLZ), and joint interpretation (e.g. with the help of a digital twin).

- **Monitoring Phase**

Occurring both during and post-pilot, the last step which relies on stakeholder engagement is the evaluation and monitoring. Apart from data monitoring, this step also involves evaluating the satisfaction, engagement, and frustrations of stakeholders. These results can be used to shift the pilot design, or can circle back to mapping steps to involve different stakeholders, or alignment steps, in order to agree on changing goals. The monitoring phase then shifts back

and forth between monitoring the process through clear check-ins and updates, and looking ahead at the further implementation of the tested solution.

In addition to final decision-making, eXtended Reality (XR) and Digital Twins (DT) platforms serve as a shared visual language during the Alignment and Co-creation phases. These tools help bridge the gap between technical logistics metrics and urban planning goals, enabling diverse stakeholders (e.g. municipal officials and private courier operators) to visually simulate and negotiate trade-offs in real time.

Although introduced as phases due to their timely beginning, some of the stakeholder involvement happens continuously (engagement for instance), while others are more specifically timed (e.g. monitoring must come after co-creation). Given the nature of the phases, their occurrence can be linked to the steps of the pilot in NEXTLOGIC, giving a clear overview of the stakeholder engagement framework throughout the pilot implementation process. This overview can be found in Figure 7 while the specific actions or methods related to each phase can be found in Section 10.

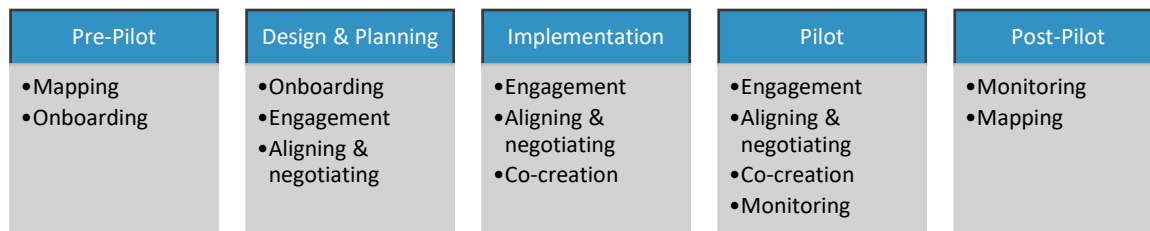


Figure 7. Stakeholder involvement phases in NEXTLOGIC pilot implementation processes

Whether the pilot takes the shape of a living lab or whether there are systematic workshop plans with carefully selected stakeholders, the NEXTLOGIC engagement framework provides a backbone for the kinds of activities throughout pilot durations. Although the solutions, challenges, and local contexts may differ, the actions outlined in this framework are required to a greater or lesser extent in each context in order to ensure a strong stakeholder base in an urban logistics solution.

8.4 Common pitfalls in stakeholder engagement

Even with a stakeholder engagement framework in place, and with stakeholders actively engaged, there are several key pitfalls that might undermine co-creation processes. Based on practical experiences of consortium partner MUV, and the findings of Kluge et al. [68], common pitfalls can be identified that pertain to NEXTLOGIC pilots, some related to the process of participation, others relating to the understanding of technological solutions. Next to the identification of the pitfall, this section outlines how each pitfall can be mitigated. The pitfalls mostly occur during the onboarding, engagement, and co-creation phases.

- **Target expectation mismatch**

Stakeholder involvement processes that are highly demanding in terms of time or money risk seeing lower levels of participation, or a larger degree of dropout throughout the project [69]. This is especially the case if the required demand is not communicated clearly. However, contextual factors can convince stakeholders to participate despite a high demand - especially relevant for operational stakeholders for instance. As also stressed in D1.1, specifically the degree of individual benefits has a positive influence on the willingness to collaborate, especially for operators [68]. Despite pursuing pilot-wide impacts, ensuring participation by a

variety of stakeholders relies on the clear and continuous explanation and clarity of the individual benefit for stakeholders. If these benefits are not sufficiently identified or stressed, pilots may risk losing participation by particular stakeholders.

- **Technical onboarding friction**

The first few minutes of a user's experience are the most dangerous for project retention, as many people quit if the initial setup is too difficult. Common pitfalls include overly complex registration forms, confusing privacy permissions, or a lack of clear instructions on how the tracking technology fits into a normal daily routine. To avoid losing users before the project even starts, technical processes should be broken down into simple, educational steps. This furthermore requires the recognition of varying levels of technical proficiency among stakeholders [68]. Making the transition from "downloading" to "active use" as smooth as possible is key to building a large and reliable database of participants. To ensure the technical proficiency is considered, the onboarding and engaging process explicitly reflects on the communication infrastructure and repeatedly checks in in order to align the goals. A communication strategy should therefore be prepared before onboarding fully takes place, ensuring the breaking up of complex technical demands.

- **Technological expectation mismatch**

A significant challenge in urban mobility projects is the gap between what stakeholders imagine and what the technology can actually do. Digital tools are at times approached as a "magic solution" that can fix complex logistics issues instantly, which leads to disappointment when technical limits are reached. Even with realistic expectations, the capabilities and limitations of the technological solutions in NEXTLOGIC can cause mismatched expectations. It is essential to have honest conversations early in the process to define clear goals and explain the realistic capabilities of the technological solution. By managing these expectations from day one, you build a foundation of trust and prevent future frustration among your partners and the community.

- **One-size-fits-all approach**

Engagement strategies often fail when a single method is forced onto different cities without considering their unique local cultures. A specific workshop format or communication style that sees great success in one region might be completely ignored or misunderstood in another. True "thick participation" requires a hyper-local approach where tools are flexible enough to be combined or adjusted based on neighbourhood habits. Instead of a generic top-down plan, the strategy must prioritise local mobilisation and adapt its storytelling methods to resonate with the specific identity of each city. For this reason, the NEXTLOGIC stakeholder engagement framework insists on the establishment and maintenance of clear communication patterns during the engaging phase. Next to that, the alignment and negotiating phase are tailored with methods explicitly contextualise the way of working and exchange among varying stakeholders.

- **Lack of feedback loops**

Participation fatigue sets in quickly when stakeholders feel like their input or data is disappearing into a "black box" without leading to any real-world change. If users do not see regular evidence of how their input is influencing city planning or decision-making, they will

likely lose motivation and stop using the platform. Maintaining trust requires an honest and constant flow of information that connects user activity to specific project outcomes. Showing people the direct impact of their efforts is the most effective way to turn a short-term game into a long-term civic habit. To this end, the engaging phase keeps a running communication structure going, to ensure that results are regularly communicated. During co-creation and monitoring, the results of the pilot should be clearly and regularly communicated to allow for adjustments.

- **Lack of follow up**

Although initially phrased as ambitions and goals, throughout the participation process, the long-term application should be clear. In the NEXTLOGIC stakeholder engagement framework, the tandem between co-creating and monitoring allows for an updated idea of the efficacy of variations of the technology. Specifically relying on the monitoring phase, an iterative run back to mapping and onboarding throughout the project is required to ensure business opportunities are grasped when they arrive. While not a key impact assessment criterion, for the longevity of stakeholder engagement, identifying a long-term solution during the actual piloting is an important step. As a concrete recommendation, businesses already involved in the proposal should play an active role in defining the business models for future solutions. Where feasible, they should also be positioned as the operators of those models beyond the funding period, acquiring the necessary licenses and commercial rights from other partners. Treating this process as an explicit outcome of the monitoring loop, rather than a post-project concern, allows viable ownership arrangements to emerge and be tested while the pilots are still ongoing.

8.5 The NEXTLOGIC Stakeholder Engagement Framework in summary

This section has discussed several aspects of stakeholder engagement frameworks in urban logistics. **Stakeholder engagement and participatory processes serve to increase acceptance of implemented solutions, build on shared situational awareness and joint knowledge production, and optimises final designs and implementations.**

To ensure these actions, **different stakeholders must be involved in different degrees**; a core team to determine scope and objectives, operational stakeholders that must use the implemented solutions, and external stakeholders that are affected by the solution integration.

Starting with existing stakeholder collaborations, such as freight quality partnerships, or previous living labs, ensures a strong local embedding, that ensures a strong network can be involved early on. If such a pre-existing network is not yet in place, pilots are advised to follow the steps of the NEXTLOGIC Stakeholder Engagement Framework, while avoiding common pitfalls. Based on Urban Freight Transport Transition Living Labs, the framework consists of several steps described in Figure 8.

The framework provides a structure along which to integrate stakeholders more closely into the pilot. However, in order to concretise and localise this framework, the mapping phase is the main bottleneck to pass through before the pilot can begin. Next section will analyse the key stakeholder categories and provide a stakeholder analysis per pilot challenge.

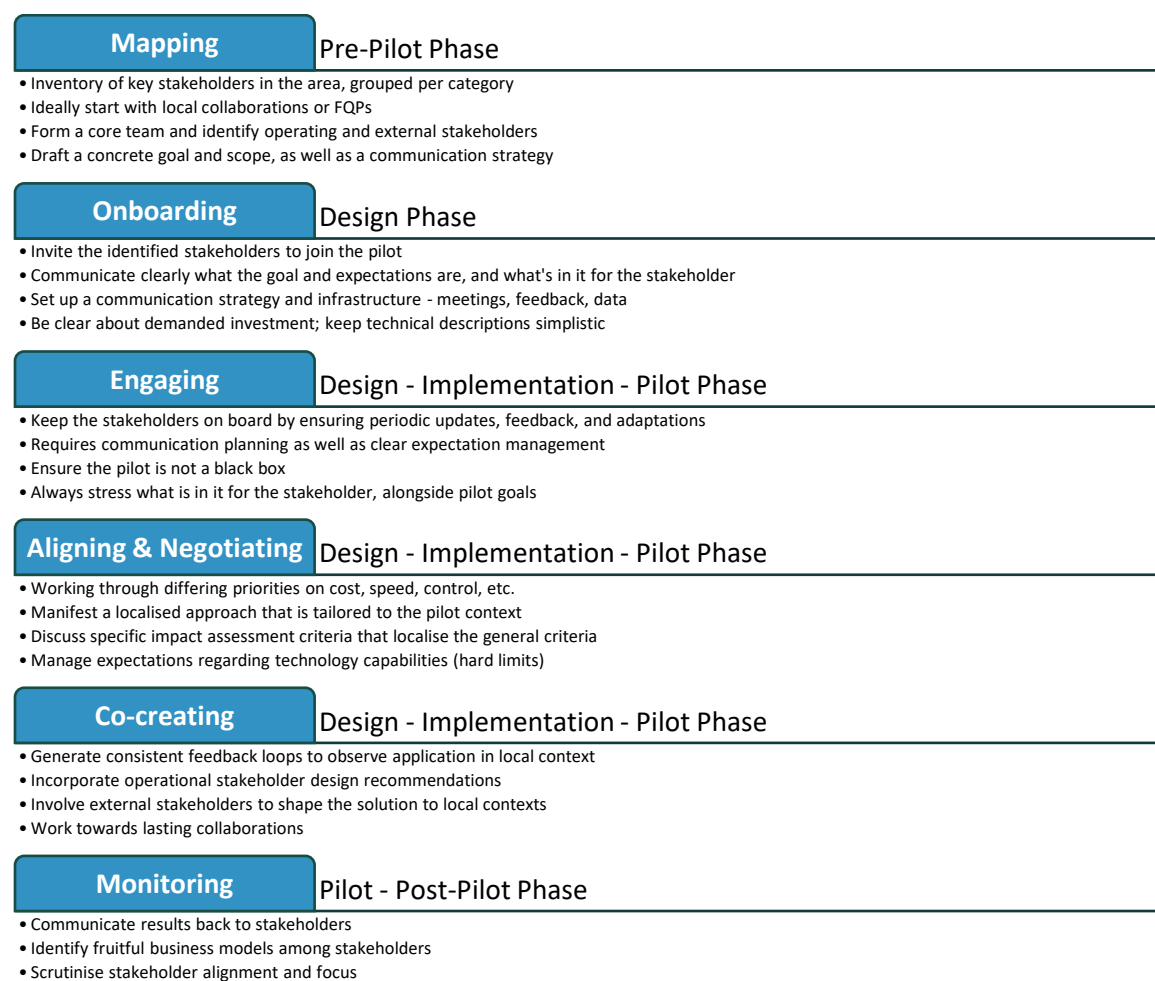


Figure 8. NEXTLOGIC Stakeholder Engagement Framework

9. Stakeholder analysis

With a framework in place, the identification of relevant stakeholders should be a tailored activity. Overlapping with the mapping phase, identifying stakeholders, their relations, investment, and timing is an essential step in the pre-pilot phase. This section presents an approach to map stakeholders, outlines recurring stakeholders in city logistics projects, and maps the stakeholders involved in each pilot, to facilitate the planning and integration of co-creation methods.

9.1 Stakeholder mapping

Stakeholders are defined as "any group or individual who can affect or is affected by the achievement of the organisation's objectives" [70]. Within NEXTLOGIC, these actors differ per pilot city, per challenge addressed, and per solution integrated. In the NEXTLOGIC Stakeholder Engagement Framework, there's already a **distinction of stakeholders in core team, operational, or external stakeholders**.

Yet mapping stakeholders requires a different way of organising. Stakeholder involvement should go beyond solely including 'internal' stakeholders (consortium partners, or local pilot actors with decision making powers). These internal stakeholders are seen as more important than 'external' stakeholders who are affected by an intervention but have no influence. This is a too simplistic dichotomy, as the focus should be on the nature of the problem, which determines whether a stakeholder is relevant and important at a specific moment during the pilot [71]; whether they should be a core team, or an operational or external stakeholder. To ensure a stakeholder mapping methodology that allows for such flexibility, two stakeholder mapping frameworks are combined.

Mendelow introduced the **stakeholder matrix**, wherein each stakeholder is scored on influence, and on interest. Based on the scoring of each, a stakeholder will fall in one of four quadrants, which determines the required level of involvement and communication, as shown in Figure 9 [66]. This initial inventory drafts an idea of involved stakeholders and how prone they are to influence or derail a project. As an initial filter of who should be considered in the stakeholder overview for NEXTLOGIC pilots, this is a useful overview, but to account for fluctuating importance throughout different phases, the Stakeholder Salience Model by Mitchell, Agle, and Wood offers a more dynamic alternative [67].

The **Stakeholder Salience Model** maps stakeholders based on three variables: power, legitimacy, and urgency. This model goes beyond the degree of disruption an actor can cause (power + interest), but evaluates their claim in the context, and at specific times.

- **Power:** Similar to Mendelow's influence; the capacity of the stakeholder to decide or influence the course through resources, authority or pressure, regardless of resistance.
- **Legitimacy:** Whether a stakeholder has a recognised, valid relationship to the challenge and pilot. This can shift, depending on the focus process - an enforcement officer for a smart loading zone is a legitimate source for matters of implementation, but not during design for instance.
- **Urgency:** Relevance determined by a time sensitive involvement, or a critical claim about an experienced effect. This characteristic can propel a stakeholder to a relevant involvement due to their momentary direct affectation.

The Stakeholder Saliency Model allows for a more distinctive mapping of stakeholders into different categories that can change in relevance throughout the pilot. The different categories are explained in Table 20 [67].

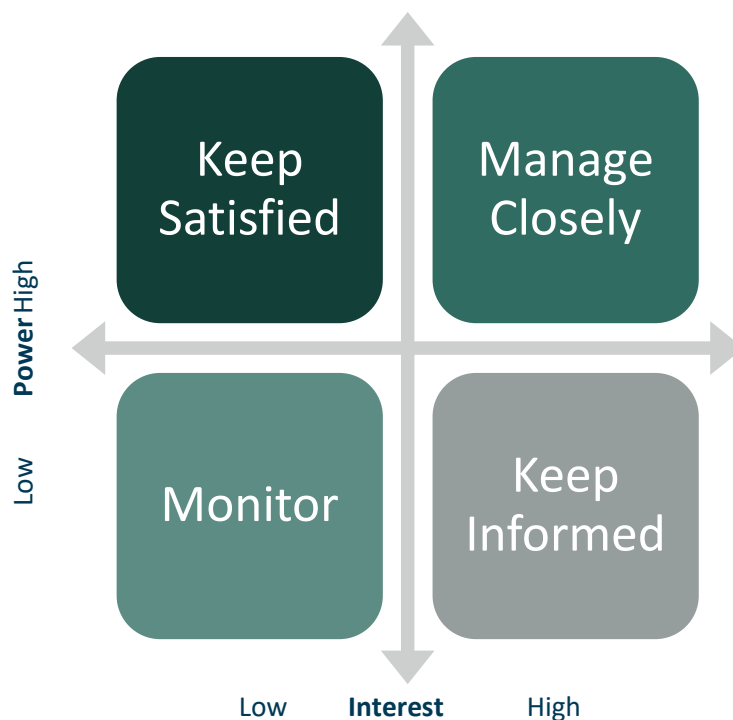


Figure 9. Mendelow's Stakeholder Matrix

Table 20. Mitchell et al. Stakeholder Typology explanation

Attributes	Description
Power only	Can exert influence but currently has no legitimate claim or urgent issue
Legitimacy only	Has a valid relationship but no power or urgency — e.g. charity
Urgency only	Vocal and pressing but lacks power or legitimacy — often "nuisances"
Power + Legitimacy	Influential and recognised; their expectations influence fundamental regulation
Power + Urgency	Can act forcefully without legitimacy — potentially coercive or disruptive
Legitimacy + Urgency	Have valid, urgent claims but rely on others to advocate for them
Power + Legitimacy + Urgency	All three — top priority; <i>must</i> be involved

For NEXTLOGIC, stakeholder mapping will then be done through the following steps:

- **Identify stakeholders involved or affected by the solution implementation**

This requires checking with existing collaborations, such as freight quality partnerships, or study recurring stakeholders in city logistics, as outlined in 9.2.

- **Score the level of power and interest per stakeholder**

This mapping on the Mendelow stakeholder matrix allows for an initial filtering of stakeholders that must be involved in the pilot, either closely, periodically, or specifically.

- **Score the power, legitimacy, and urgency per stakeholder per Pilot Phase**

Per phase, and more specifically, per topic in each phase, some stakeholders will have a larger role to play than others. Some may even have a role to play all the time, while some only have to be involved at a singular stage. This allows for the mapping of stakeholders along the timeline, already creating a fluent engagement plan.

- **Place the stakeholders in Core Team, Operational, or External Stakeholder categories**

Following the NEXTLOGIC Stakeholder Engagement Framework, stakeholders with continuously high power, legitimacy, and urgency should be grouped in the core team, responsible for the planning of the pilot. Stakeholders with repeated high to medium levels should be grouped in operational stakeholders and engaged at moments of urgency and legitimacy. Finally, groups with high urgency at specific moments should be grouped in the external stakeholder category; their input is important, but on specific matters.

These steps map out the stakeholder relations in the pilots. However, the steps outlined are still general. A specification in which stakeholders to involve or even assess is required.

9.2 Common stakeholders in urban logistics interventions

Urban logistics as a research field tends to engage with recurring stakeholder categories. Clustered along government, academia, logistic businesses (retailers and transport providers), and end users, city logistics often rely on quadruple helix stakeholders, although each in a different level of engagement [72], [49]. Different studies have identified the strengths and responsibilities of actors from each cluster, already allowing for some identification of power, legitimacy, and urgency [73], [74]. When studying several systematic reviews of the governance systems of city logistics, as well as logistics projects, a list of recurring stakeholder categories can be drafted, with specific strengths and responsibilities highlighted [72], [73], [58], [52], [75], [44], [74], [49]. Next to that, NEXTLOGIC deliverable D6.1 (Initial Plan for dissemination and exploitation) also presented a key stakeholder overview. This format is built upon. Next to this overview, the interviews undertaken in Task 1.1 from NEXTLOGIC and outlined in D1.1 [3], some other key stakeholder categories can be identified based on the suggested solutions. Electrification for instance is highly dependent on a grid operator, while Smart Loading Zones and other curbside logistic solutions are dependent on enforcement of newly imposed legislation. Furthermore, local government actors can be specified regarding the required expertise. Next to policymakers, mobility specialists, data analysts, or road authorities can be distinguished as specific variations on this category. Combining all these actors results in an overview of recurring stakeholders in urban logistics, as shown in Table 21.

Table 21. Recurring stakeholders in urban logistics

Stakeholder group	Examples	Role in NEXTLOGIC	Expected benefits
Cities, policy makers and public authorities	Cities and local governments; urban planners; policymakers; road authorities; relevant committees; traffic managers	Use of NEXTLOGIC solutions and tools; participation in co-creation and pilots; uptake of policy recommendations and planning approaches	Improved urban logistics planning; better curbside and space management; evidence-based decision-making
Logistics and mobility operators	Delivery companies; fleet managers; logistics service providers	Participation in pilots; testing and validation of solutions (e.g. Microhubs, Smart Loading Zones)	Optimised last-mile logistics; cost savings; improved operational efficiency
Businesses and retailers	Urban businesses; retailers; commercial actors	Indirect participation through pilots and stakeholder engagement activities	Improved delivery reliability; increased efficiency and reduced logistics costs
Technology providers and industry	ICT providers; mobility tech companies; solution providers	Development, integration and validation of digital tools and solutions (e.g. Digital Twins, data platforms)	Innovation opportunities; development of scalable solutions and services
Research and academia	Universities; research centres; RTOs	Scientific dissemination; development of methodologies and tools; analysis and validation of results. Neutral, intermediary role to bring stakeholders together [64], [50]	Access to data, case studies and research outputs; contribution to scientific knowledge
Citizens and civil society	Residents; civil society organisations	Participation in co-creation activities; feedback during pilot implementation; behavioural engagement	Cleaner air; reduced congestion; improved mobility options and quality of life; improved delivery efficiency
Infrastructure provider	Public transport companies; parking garage owners; bicycle providers	Supply vehicles; infrastructure; pilot locations; operational knowledge	Reduced congestion; balanced urban modal split; improved efficiency; reduced parking problems
Industry associations	Freight Quality Partnerships; NGOs; Business Improvement Districts	Represent collective private-sector interests; facilitate dialogue between public and private stakeholders	Optimised last-mile logistics; cost savings; improved operational efficiency
Grid operator	Electricity companies; EV charging facilities supplier	Participate in electrification pilot; monitor the capacity and KPIs	Organised net usage; increased efficiency in charging infrastructure
Enforcement	Local police; sensor and camera facilities	Enforce regulations surrounding the proposed interventions; monitor compliance	Reduced congestion; improved quality of life; improved efficiency; reduced parking problems

9.3 Stakeholders mapping per pilot city

The mapping methodology as outlined in 9.1 was applied to each of the pilot cities of NEXTLOGIC. The pilot descriptions follow the understanding outlined in D1.4 (Inception Report) [76]. The information on involved stakeholders from the interviews chronicled in D1.1 is used for this mapping [3], together with follow up specifications based on the categories identified in 9.2. The result of this mapping is reported in Annex A. Per pilot, potential stakeholders are identified per category, their potential function described, and they are characterised based on power and influence. Subsequently, their power, legitimacy, and urgency are mapped per implementation phase in the pilot. Based on this overview, stakeholders are divided into core team, operational, and external stakeholders per pilot. These overviews provide a starting point for further mapping and onboarding during piloting in WP4.

10. Stakeholder engagement and Co-creation methods

The NEXTLOGIC pilots strive to implement innovative solutions in the pursuit of more sustainable city logistics. They do so in collaboration with a variety of stakeholders that have a changing influence on the design, solution integration, and results communication.

This section introduces specific stakeholder engagement and co-creation methods tailored to specific moments and challenges in a pilot. It does so through the online **NEXTLOGIC Engagement Toolbox**, provided by MUV.

10.1 Types of challenges in the NEXTLOGIC pilots

Following the NEXTLOGIC Stakeholder Engagement Framework, there are several phases in which stakeholders can be engaged: **mapping, onboarding, engaging, negotiating/aligning, co-creating, and monitoring**. Some phases, like onboarding and engaging, focus on inviting stakeholders to join and keep them involved, while other phases, such as co-creation, rely on an explicit contribution by stakeholders to the integration of the solution. Based on the pilot and solution descriptions and stakeholder overviews from the previous section, specific moments or "challenges" can be identified in which stakeholder engagement is required, specifically onboarding, aligning, and co-creation:

- **Generating interest**

Several pilots, such as Wroclaw, use the pre-pilot phase to map and onboard interested stakeholders, such as logistics operators or industrial collaborations. This initial round of co-creation or stakeholder engagement determines which specific actors should be involved as operational stakeholder or even in the core team. This first step often requires the involvement of external actors who need to be convinced of the value of the pilot. This challenge is present in each pilot, although some pilots rely on a diverse group of stakeholders earlier on in the process, such as electrification and 15-minute multimodal hubs.

- **Spatial contestation**

Some solutions, such as SLZs and Microhubs, require an implementation in public space. Some pilot cities, such as The Hague, involve a public space committee to regulate this inclusion, while others are more reliant on discussions and alignment with property owners, like Bergamo and Heidelberg. Both acquiring the space, as well as the design and regulation of the space is a topic that relies on alignment, negotiation, and co-creation. This can be done both with public authorities, property owners, and local retailers or residents. As such, contested use of space becomes a major topic requiring stakeholder engagement.

- **Solution design**

Apart from contested use of space, the solution itself can also be tailored to the local situation as well as to the needs and desires of the stakeholders. The Microhubs specifically benefit from a tailoring to the specific uses. Similarly, incentive and rewards apps or campaigns thrive on the alignment with involved stakeholders. If the solution needs specific users to make use of it, co-creating the solution itself can improve the efficiency of use as well as the acceptance. Design co-creation is then another key challenge for some NEXTLOGIC pilots.

- **Interactive understanding**

All pilots make use of the Digital Twin to gather data during the pilots. Partially this is evaluative, assessing the efficacy of the pilot for different impact assessment criteria. However, especially signification of data with a variety of stakeholders, through advanced visualisations for instance, can go beyond straightforward communication. To ensure each stakeholder feels heard and recognised in the gathered data, more co-creative methods are required to make data sharing an interactive and inclusive activity. Monitoring therefore can become a communal task.

These recurring challenges may occur depending on the solutions pursued. Each challenge furthermore has a specific moment in the pilot where it can be addressed. To give a general idea of when in each pilot a specific challenge can occur depending on the solution, an overview of each solution is provided in Table 22.

Table 22. Recurring challenge occurrence per solution

		Pre-Pilot	Design	Implement	Pilot	Post-Pilot
Microhubs	Interest	X			X	
	Spatial contest	X	X	X		
	Solution Design		X	X	X	X
	Interactive Understanding				X	X
Smart Loading Zones	Interest	X		X	X	
	Spatial contest	X	X	X	X	X
	Solution Design		X			
	Interactive Understanding	X			X	X
15-min. Hubs	Interest	X			X	
	Spatial contest	X		X	X	
	Solution Design		X		X	
	Interactive Understanding	X			X	X
Incentives & Rewards	Interest	X	X	X	X	
	Spatial contest					
	Solution Design		X	X		
	Interactive Understanding	X				X
Electrification	Interest	X				
	Spatial contest	X		X		
	Solution Design					
	Interactive Understanding	X			X	X

This overview shows the following:

- **Microhubs** specifically deal with design co-creation. As the hub must be created and tailored to the need of the users, exactly the inventory and processing of design needs has to be done before, and during the pilot.
- **Smart Loading Zones** deal with specific localisation challenges. As curbsides must be selected and utilised differently, this will require alignment, both in positioning and regulation (e.g.

enforcement). The focus on where to position the SLZ and who is responsible for maintenance is a recurring matter before, during, and after the pilot.

- **15-minute Multimodal Hubs** are solutions that affect multiple stakeholders, even outside of the logistics field. This makes all the challenges (involving relevant stakeholders, positioning it fine, designing it for varied use, and communicating results clearly) all occur together during the pilot phase. This requires strong co-creation methods with diverse stakeholders.
- **Incentives & Rewards** instead has no spatial contestation. However, this solution is challenged by who can be involved in development, use, and rewarding of the solution. I&R as a solution requires clear onboarding and engaging of a behavioural ecosystem. This means engaging stakeholders and their interaction throughout the process.
- **Electrification** instead is focused on achieving sustainability impact assessment criteria. In order to convince multiple stakeholders to shift and facilitate the change, a clear illustration of the benefits is required. The communication should be tailored to the users and stakeholders, hence focusing this pilot on strong data gathering and communication together with stakeholders.

10.2 Methods for each stakeholders' engagement phase

This section outlines **concrete co-creation methods that can be used for different purposes in the stakeholder engagement process**. The methods described in this section are collected, detailed, and kept up to date in the **NEXTLOGIC Engagement Toolbox**, an online, openly accessible resource maintained by MUV². The Toolbox turns the Stakeholder Engagement Framework of Section 8.3 into a practical, searchable catalogue that pilot leads and solution providers can consult while planning and running engagement activities. Its landing page, shown in Figure 10, routes the user to two complementary libraries.

- **Toolbox content**

The Toolbox is organised as two libraries. The **Pilot Toolbox** holds 30+ methods explicitly tagged to the NEXTLOGIC pilots and solutions, so that a pilot lead can see at a glance which methods are relevant to their city and their intervention. The **Method Library** holds 60+ general-purpose methods described without reference to any specific pilot or solution, so that the same knowledge can be reused in any participatory process and shared beyond the consortium. The two overlap by design: the Method Library restates the Pilot Toolbox's methods in neutral, project-independent terms — leaving aside a few that are specific to a NEXTLOGIC pilot or technology — and adds further methods covering evaluation, digital and remote formats, deliberation, qualitative research, and behavior change. Each method is presented as a single, self-contained sheet with a fixed structure — what it is, when to use it, the steps to run it, the materials required, the output it produces, what to watch out for, and its academic sources — and each sheet is formatted to be printed and used directly in a workshop.

²<https://butter-particle-c10.notion.site/NEXTLOGIC-Engagement-Toolbox-34bc6c4db4a881ebbc0ae8295e59ec38>

NEXTLOGIC: Engagement Toolbox

Methods for working with the people a project affects — finding out who they are, bringing them in, keeping them involved, working through disagreement, building things together, and checking whether any of it worked.

Each method has one sheet: what it is, when to use it, the steps, what you need, what you get out of it, what to watch for, and its sources. All of them are printable.

 [Open the Pilot Toolbox →](#)

 [NEXTLOGIC: Pilot Toolbox](#)

For a NEXTLOGIC pilot. 33 methods, tagged by pilot and by intervention type.

 [Open the Method Library →](#)

 [NEXTLOGIC: Method Library](#)

For any participatory process. 61 methods, filtered by what you want to achieve, the phase you are in, and the constraints you have — online or in person, group size, time available.

Figure 10. NEXTLOGIC: Engagement Toolbox Homepage

- **Selection options**

Every method is tagged along several dimensions, and the user narrows the catalogue by filtering on them, as seen in Figure 11. In the Pilot Toolbox the filters are the engagement goal, the pilot city, the solution (intervention) type, the format, and the effort required. The Method Library adds finer dimensions: the phase of the process, the participation level, the setting (in person, online, or hybrid), the group size, and the application domain. In this way a user moves from a broad question ("what am I trying to achieve?") down to the practical constraints of the moment ("which of these can I run online, with a small group, in under a day?").

Methods Toolbox

33 methods for stakeholder engagement and co-creation in NEXTLOGIC pilots. Filter by Goal, Pilot, Intervention.

 Default view  Quick scan  By Pilot  By Goal  By Intervention								  	
Aa Method	⌵ Effort	⌵ Format	⌵ Goal	⌵ Intervention fit	⌵ Pilot fit	⌵ When to use			
 Allies / Neutrals / Adversaries	Low (<1 day)	Framework	MAP	Microhubs SLZ	Aarhus Bergamo	After the 7-category in			
 Communication channels matrix	Low (<1 day)	Catalogue	ONBOARD ENG	Microhubs SLZ	Aarhus Bergamo	Step 5 of the 5-step str			
 Community of place / interest / pra...	Low (<1 day)	Framework	MAP	Microhubs SLZ	Aarhus Bergamo	After 7-cat inventory, a			
 Crazy 8	Low (<1 day)	Workshop	CO-CREATE	Microhubs SLZ	Aarhus Bergamo	Early co-creation to br			
 Design the Box	Low (<1 day)	Workshop	CO-CREATE	I&R Microhubs	Dublin Aarhus	Defining what the inter			
 Dot Voting	Low (<1 day)	Workshop	ALIGN	Microhubs SLZ	Aarhus Bergamo	Embedded in worksho			
 Emotion & mobility debrief	Low (<1 day)	Workshop	NEGOTIATE	Microhubs SLZ	Bergamo Dublin	When rational argumen			
 Empathy Map	Low (<1 day)	Workshop	MAP ALIGN	Microhubs SLZ	Aarhus Bergamo	On 2–3 critical stakehc			
 Large question cards	Low (<1 day)	Field activity	ALIGN	Microhubs SLZ	Aarhus Bergamo	Force focus on one iss			
 Motivation Matrix	Low (<1 day)	Workshop	MAP	Microhubs SLZ	Aarhus Bergamo	After basic mapping, b			

Figure 11. NEXTLOGIC: Engagement Toolbox filtering options

- **Grouping of methods and reasoning**

The primary organising principle is the engagement goal, mirroring the phases of the Stakeholder Engagement Framework — mapping, onboarding, engaging, aligning and

negotiating, and co-creating and monitoring. This goal-first structure is deliberate. A pilot lead does not begin from the name of a method but from a situation ("I need to bring reluctant operators on board"; "these two groups do not agree on the use of the curb"); grouping by goal keeps the catalogue aligned to that starting question and to the outcome sought, rather than to an abstract taxonomy of techniques. I.e. a single method frequently serves more than one goal, the same set of methods can be regrouped along any of the other dimensions — by pilot, by solution, by phase, by participation level, or by domain — so that the catalogue reorganises itself around whatever question the user brings to it.

- **Usage instructions**

A user enters through the landing page and chooses the appropriate library: pilot teams work from the **Pilot Toolbox**, while anyone working outside the pilots — or preparing material to share externally — works from the **Method Library**. From there, the workflow is consistent: select the goal to be achieved, filter down by the constraints that apply, open the chosen method sheet for its set-up and facilitation detail, and, where useful, print it for the session. The Toolbox is a recommendation resource rather than a prescriptive protocol: it remains up to the pilot leads to decide which method to use and when, with the Toolbox providing the structured guidance to make that choice well.

The following subsections discuss the Pilot Toolbox methods based on goal. Every subsection will mention the available methods and discuss their general build-up and intention. A full overview per implementation phase and per goal within each phase is provided in Figure 12. Although linked to pilots and solutions, it is up to the pilot leads to determine which method to use and when; this overview solely provides a recommendation.

10.2.1 Mapping

The goal of these methods is to get an overview of who the relevant stakeholders are and how they relate to each other. Their outputs may include a stakeholder matrix and an initial identification of roles, relationships, responsibilities and potential conflict points. Possible methods:

- **Categorical stakeholder framework**
- **Community of Place/Interest/Practice**
- **Allies/Neutrals/Adversaries**
- **Motivation Matrix**
- **Empathy Map**
- **Quick Survey**
- **Cultural Probes**
- **Walkshop**

These methods serve a variety of functions and can be planned in sequence. The functions and their associated methods are explained below.

Mapping and Relating Stakeholders

The first step is to ensure that the relevant stakeholders are identified and that their roles, interests and relationships are understood.

The **categorical stakeholder framework** identifies the key recurring stakeholders in city logistics projects. This first overview prepares the pilot for co-creation activities. Following the inventory comes the grouping, through the **Community of Place/Interest/Practice** method. This method maps the stakeholders according to what ties them together, recognising that the same stakeholder may belong to more than one community: are they connected by the same place; do they focus on a similar topic (e.g. Microhubs, emissions, liveability); are they involved in the same expertise or professional role? Having this overview will influence the communication strategy towards each group when onboarding.

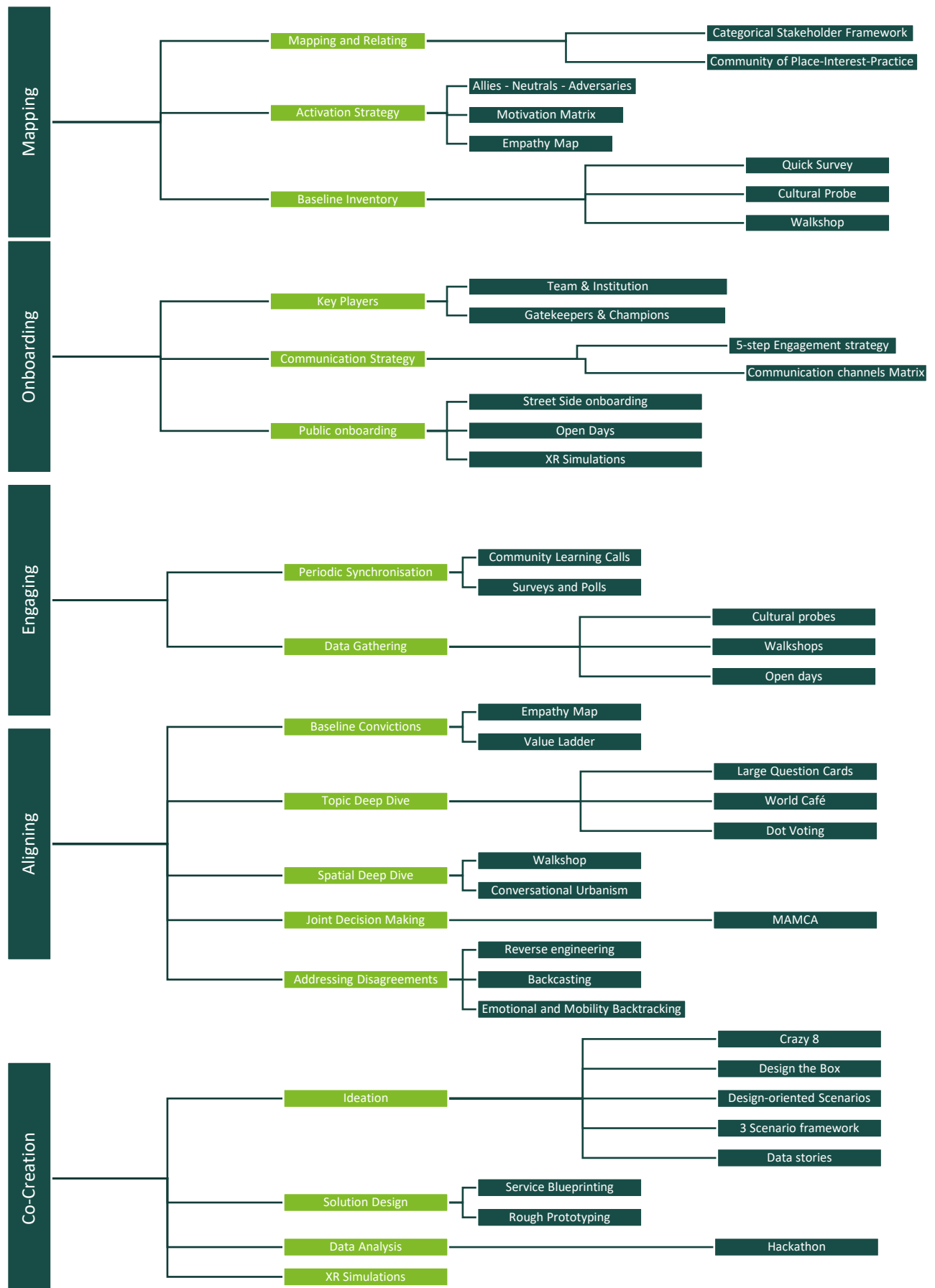


Figure 12. Co-Creation Methods in NEXTLOGIC

Determining Activation Strategy

With the stakeholders inventoried, their position with regards to the solution should be studied, to tailor their engagement. **Allies/Neutrals/Adversaries** further groups the stakeholders inventoried in their stance towards the solution and attributes an engagement form for them. Those favourable to the solution can be activated as supporters, while those who are neutral should be engaged to understand their expectations and information needs. Those opposed should remain involved so that their concerns, interests and potential exposure to negative impacts can be understood and addressed through adaptations or mitigation measures.

This is highly dependent on the ambitions and goals of the solutions. This overview is subsequently mapped in the **motivation matrix** method, which allows for a clear overview of what stakeholders gain or lose, what the project gains, whether stakeholders align, and what action is required for them. Should stakeholders be hard to understand, the **empathy map method** explores what they see, say, do and hear, as well as what they think and feel, including their pains and gains. This creates a clearer picture of stakeholders' perspectives and of how they can be approached and engaged in ways that respond to their experiences and concerns. These mapping activities require a dialogue with the core team and direct inputs from specific stakeholders.

Baseline Inventory

With stakeholders involved and mapped, it is important to understand what their current assessment of the challenge and solution is. For this, a **quick survey or a cultural probe** are straightforward methods. The quick survey provides a rapid and structured quantitative overview of stakeholder views on a chosen topic, while the representativeness of its findings depends on the sampling strategy, sample size and response rate. A cultural probe instead uses participant-led prompts and self-documentation activities, such as diaries, photographs or maps, to explore situated experiences and less immediately visible aspects of everyday life, including frustrations and minor effects. Together, these methods can provide complementary baseline evidence: quick surveys generate structured responses across a wider group, while cultural probes produce more situated and interpretive insights. The resulting materials may subsequently be explored through follow-up interviews. Should the baseline require stakeholder input on spatial situations, like the layout of the street or its use, the **walkshop** method allows for a walkalong interview with multiple stakeholders. Specific significations can then be mapped based on stakeholder preference or experience. This inventory is highly dependent on stakeholder participation, as it deals with lived experience. It can contribute to co-creation where stakeholders are also involved in interpreting the findings and translating them into design or implementation decisions. For the steps, timing, and output of each method, see the [NEXTLOGIC Engagement Toolbox](#).

10.2.2 Onboarding

With the stakeholders mapped, grouped, and specifically approached, the next co-creation step is to onboard them into the project. This involves both determining the core team, operational stakeholders and external stakeholders, and setting up communication strategies catered to the kind of stakeholder. Possible methods:

- **Onboarding - Team & Institutions**
- **Gatekeepers & Champions**
- **5-step engagement strategy**
- **Communication channels matrix**

- **Onboarding - Street Side**
- **Open Day**
- **XR Simulations**

These methods serve a variety of functions and can be planned in sequence. The functions and their associated methods are explained below.

Onboarding the Key Players

Before any pilot can start, an agreement and way of collaborating needs to be reached between the internal partners (project team and solution providers) and the external decision-makers (municipalities, logistics operators, and covenants). The **Onboarding - Team & Institution** method lets the internal team familiarise amongst themselves and the solutions first, in order to completely understand what is expected of who and how to communicate. External stakeholders expected to assume operational, institutional, decision-making or data-sharing responsibilities should be formally involved through an agreement specifying their role and level of commitment. Here municipalities may take the lead, but other external parties should be included as well, such as the local police where enforcement responsibilities are involved. This method allows for in-depth and shared discussions on goals and ambitions. **XR technology** may help in clarifying what the pilot will integrate.

Once the core team is onboarded, both internally and externally, the key stakeholders in the physical setting must be involved. Here **Gatekeepers & Champions** are a key consideration. These two actor categories are contact points to communities. Gatekeepers provide access (*transactional*) and Champions provide credibility (*relational*). Identifying both categories, often through the help of municipalities or covenants, allows the pilot to land in the chosen site or system better, as it is already endorsed and shaped by local actors. This exercise goes beyond merely identifying them, but also engaging them in a continuous onboarding and communication process.

Setting up the Communication Strategy

The mapping and first onboarding steps serve to get a clear idea of who should be involved, how to reach them, and how they regard the solution. Following this, tailored communication strategies should be determined. The **5-step engagement strategy** leading to the **Communication channels matrix** shapes the message per community focused on a call to action and clear expectation management. Here the realistic scale of required engagement must be specified, as well as the attainable goals. The key communication channels per community must be determined as well, depending on the type of engagement expectation. Selecting appropriate channels and messages for each stakeholder group can support continuous engagement and help limit participation fatigue.

Public Onboarding and Communication

When the pilot has something to show, or when it is starting its implementation in a physical setting, onboarding must branch out to external stakeholders like surrounding retailers, or even a passerby. Here **Street Side Onboarding** and **Open Days** can be strong methods of co-creation that may not strive for complete involvement of passing actors, but at least to get them on board with the idea and build understanding together. These events require physical presence with a clear message (set up in the previous methods) and visual character. These events can also incorporate quick polls to gather initial reactions and identify stakeholders interested in further involvement. Open days require initial results, or something to show, like a Microhub prototype or the I&R app, for visitors to share their ideas,

comments, and reservations. These events fall under onboarding as they 'onboard' the community or industry partners on the message and intentions.

Specific to NEXTLOGIC, this is an opportune moment to make use of the **XR simulations**. A virtual visualisation of what an SLZ will look like, or a digital, interactable prototype of a Microhub; these experiential understandings of the solutions and the effect have a strong onboarding function. Instead of solely communicating promises and ambitions, these XR simulations can support the onboarding of external stakeholders by making proposed solutions and their potential effects more tangible and easier to understand.

For the steps, timing, and output of each method, see the [NEXTLOGIC Engagement Toolbox](#).

10.2.3 Engaging

With core team stakeholders onboarded and committed, and targeted through a tailored **communication strategy**, the next co-creative task is to keep their attention, to maintain the momentum of the development, and the involvement and goodwill of the affected end-users.

These continuous activities should follow **long-term engagement principles**: each meeting should have a clear goal; the level of engagement should be tailored to participants and decisions concerned; progress and results should be communicated regularly; external participation should be appropriately recognised; schedule rest periods in between meetings; manage expectations, and always think of how to go beyond the pilot. With these general principles for each meeting, the following methods can be deployed.

- **Community Learning Calls**
- **Quick Survey**
- **Cultural Probes**
- **Walkshop**
- **Open Day**

Stakeholders that need to stay engaged should similarly be grouped and assessed through **Gatekeepers & Champions**, and through a **communication matrix**. With clear channels defined, different goals can be pursued in engagement.

Periodic synchronisation

The pilot, and especially a living lab, is a long running engagement, so stakeholders should be updated regularly about progress, results, and redirections. **Community Learning Calls** allow for a periodic moment of such an exchange. These meetings should primarily involve the core team, and at times operational stakeholders (specific solution providers for instance). Other external stakeholders may be invited when their knowledge, responsibilities or experience are directly relevant to the issues under discussion. Their involvement should be proportionate to the purpose and frequency of the meetings in order to avoid unnecessary participation demands and participation fatigue. These meetings ensure the project progress is logged, discussed, and attuned if blockers arise. These meetings can be combined with **quick surveys or polls** in order to gather input in advance or document participants' views on specific options. Decisions and their underlying rationale should, however, be recorded separately through the project's agreed decision-making and documentation procedures. Organising these meetings periodically and well prepared may ensure a longer engagement by relevant stakeholders.

Targeted data gathering

During the periodic meetings a need for specific information from the core team members can be necessary, or during the meetings, a need for operational knowledge or external experiences may be needed to properly engage different stakeholders. To this end **cultural probes, workshops, and open days** enable different forms of stakeholder participation and data gathering: cultural probes document situated experiences over time, workshops explore spatial experiences and uses in context, and open days gather reactions to pilot activities, prototypes or emerging results.

For the steps, timing, and output of each method, see the [NEXTLOGIC Engagement Toolbox](#).

10.2.4 Aligning/negotiating

With communication running fluently and consistently, co-creation shifts to confronting conflicts and finding common ground. For NEXTLOGIC core teams, adopting an impartial and transparent facilitation approach is an important precondition for these workshops. In NEXTLOGIC, stakeholders bring different interests, responsibilities and values, some of which may be in conflict. Impartial facilitation can help maintain the legitimacy of the process and support continued participation, but it does not remove underlying differences or guarantee agreement.

Being aware of power balance, the time dedicated to each actor, and separating the facilitator from the decision makers, can ensure equal proceedings. With this precondition in mind, the following methods can be used:

- **Value Ladder**
- **Empathy map**
- **World Café**
- **Large question cards**
- **Dot voting**
- **Workshop**
- **Conversational Urbanism**
- **MAMCA**
- **Backcasting**
- **Reverse engineering**
- **Emotion & Mobility debrief**

These methods vary in depth per topic, and at level of conflict.

Baseline convictions

An early step in the co-creation process, the convictions, values, and feelings of stakeholders need to be understood, so that alignment can be pursued. To this end **the empathy map or value ladder** methods will dive into the preferences and breaking points of specific actors. The empathy map focuses more on feelings or experiences about a topic, while the value ladder more fundamentally maps which values stakeholder stick to. The type of values will differ per type of stakeholder, but any layers of overlap are a strong basis for alignment. The personal experiences and feelings, as well as the key values followed allow the workshop to tailor communication to the stakeholder, ensuring their involvement feels right for them, and their needs can be met or at least discussed relevantly.

Topic deep dives

When it comes to specific decisions to be made about the solutions, co-creation can help gathering input in an organised setting. **Large Question Cards** let you gather brief input on specific issues by various stakeholders through a question posed on the wall, ensuring varied input. **World Cafés** discuss a variety of topics in a larger group through rotating table discussions that build on each other's findings. Both these methods generate cross cutting themes that are addressed by multiple stakeholders. **Dot Voting** subsequently allows for the quick prioritisation of the identified themes. This method provides a rapid indication of the preferences expressed by the participants present. The results should not be treated as representative of all stakeholders or as a final decision, and minority positions and differences between stakeholder groups should remain documented. These methods lay bare the shared interests and conflicting preferences. These form the basis for further alignment or negotiation.

Spatial deep dives

If the topic to align on is spatial or related to a physical context, like in the case of SLZs, Microhubs, and 15-minute Multimodal Hubs, specific spatial methods, like the **Walkshop** can be deployed. These methods gather opinions, ideas, and preferences for a spatial orchestration of multiple stakeholders through a walk. More specifically **Conversational Urbanism** places an informative artefact in the physical place to start discussions from people passing by. This evocation of responses is a quick way to gather many interpretations of new solutions. Similar to Large Question Cards, only now catered to a visual aspect, this functions primarily as a public engagement and consultation method.

Joint decision making

Multi Actor Multi-Criteria Analysis (MAMCA) is a co-creation method designed to facilitate the evaluation of alternatives when multiple stakeholders with different and conflicting priorities are involved [77], [78]. Compared to a singular MCA, this form allows for the inclusion of the needs and demands of different actors in the final evaluation. Especially when undertaken iteratively, results of the first (individual) multi-actor MCA are used as input for discussion, and as a basis to perform a new joint MCA, fostering the convergence of opinions [59]. MAMCA then provides a flexible co-creation method that can be applied in workshops, which lays bare the contributions of involved stakeholders.

Addressing disagreements

Disagreements can occur about a variety of topics, which can be addressed and identified through methods like the value ladder. There are however three particular disagreement types that merit a more specific approach:

- *The Need for the Solution*

The NEXTLOGIC solutions are implemented throughout the project, yet not all stakeholders may be convinced of the necessity thereof. Where stakeholders question the need for a solution, the **reverse engineering** method can be used to explore the conditions under which the solution might address their needs, as well as the adaptations or mitigation measures that may be required. The method does not presume agreement and should also allow participants to identify circumstances in which the proposed solution may remain unsuitable. This way the focus shifts from a yes/no debate to an exploration of possible adaptations to fit the solution within longer term goals. As a co-creation method, this step does imply that adaptations can be made to negotiate a shared vision.

- *The role of the solution for a future vision*

Stakeholders might disagree with the implemented solution but can be aligned on a future vision of where they want to be in 5-10 years. The **backcasting method** sets a shared future vision and then reconstructs which actions must be taken, and by whom in order to reach this goal. This method allows stakeholders to begin from a shared long-term vision and work backwards to identify the actions, responsibilities and intermediate conditions required to reach it. Through backcasting, a role for each stakeholder can be identified, without anyone being disadvantaged because of a ruined long-term goal.

- *Emotional Disagreements*

Disagreements are not always resolved through rational argument, especially when it comes to impacting livelihood or changing a lived environment. **The Emotional and Mobility Debrief** is a co-creation method that reflects on the emotional stress or reasoning behind disagreements. This method is a maintenance step in stakeholder engagement but ensures that the process and the solution improves in acceptability on the long run. Shifting to the emotional process can at time be required to ensure stakeholders remain onboard.

For the steps, timing, and output of each method, see the [NEXTLOGIC Engagement Toolbox](#).

10.2.5 Co-create and monitor

The last two stakeholder engagement phases concern the co-creation of solutions and the participatory monitoring of their use and effects. They are discussed together because monitoring evidence can be interpreted with stakeholders and used to inform subsequent adaptations. However, the methods may serve different functions within this iterative process: some support ideation and design, others facilitate the interpretation of evidence, and others help translate monitoring findings into revised solutions. The possible methods are:

- | | |
|------------------------------------|-------------------------------|
| • Crazy 8 | • Service Blueprinting |
| • Design the Box | • Rough Prototyping |
| • Design-Oriented Scenarios | • Hackathon/Datathon |
| • 3-scenario framework | • XR Simulations |

The methods differ in their purpose and expected outputs, which may include design ideas, scenarios, service models, prototypes, data analyses or stakeholder interpretations of monitoring evidence.

Ideation

Co-creation can mean tweaking an existing solution, or it can mean the development of original ideas together. To facilitate the exploration of possible design directions, several methods focus on the development of rough out-of-the-box ideas. The **Crazy 8** aims to break default thinking by making participants sketch eight solution uses/adaptations in 8 minutes. The most interesting ones are shared in order to spur more creative co-creation directions. Similarly, **Design the Box** lets participants design the box the solution would come in. This exercise highlights relevant features of the solutions and

provides useful communication means. Scenario building can similarly be used to direct the design process. **Design-oriented scenarios and the 3-scenario framework** are two methods to understand how a solution will work out in lived experience. The former lets participants create a narrative scenario to run through how the solution is used, while the latter presents three plausible scenarios that participants compare in terms of desirability, feasibility, potential impacts, risks and trade-offs. The exercise may lead to the selection of a preferred scenario or to the identification of elements to be combined or further developed. These methods let stakeholders gain a better understanding of how the solution should work and identify any missing everyday elements. Next to that, they provide insight into desirable directions the design has to follow. All these methods either spur creative thinking in co-creation or familiarise users more closely with the features and capabilities.

Especially scenario-based methods can be used for monitoring. Given the data visualisation possibilities of the Digital Twin, creating **data stories** that must be reflected upon by stakeholders allow for a clearer communication of results that are more understandable and invite discussion. Translating the gathered data into narratives or scenarios that stakeholders can relate to highlights the value of their participation and reveals gaps.

Concrete solution designs

After ideation, the actual design of solutions and their integration into the pilot site can be co-created. **Service Blueprinting** can support the co-creation of the service provided by a solution across different stages, actors and touchpoints, provided that the relevant users, operators and service stakeholders participate in developing and validating the blueprint. This reveals gaps, handoff breaks and user friction. As the solution is already imagined, this method designs the whole journey and identifies adaptations needed to make the solutions function live. **Rough Prototyping** instead explores the physical design. Building low-fidelity, intentionally rough prototypes of interventions or user experiences allows for the exploration of assumptions before any design is finalised. This allows both NEXTLOGIC core team members to present their ideal version but furthermore permits adaptations to be quickly made. This can be done with low-cost physical materials, but VR simulations could similarly generate an adaptable environment that allow participants to experiment, discuss and adapt proposed design.

Data analysis

Hackathons are time-boxed intensive sessions where mixed teams (*developers, data analysts, domain experts, stakeholders*) build working prototypes or analyse real pilot data. It can be understood as a more concentrated version of rough prototyping, condensing multiple sessions in a couple of days. Hackathons and datathons can support monitoring where they are used to analyse pilot data, test analytical approaches or develop prototypes in response to identified findings. Core team members, operational stakeholders and relevant technical experts may participate, while appropriate roles and accessible formats should be provided for non-technical stakeholders whose domain knowledge or lived experience is required. Linked with user stories, these day-events are usually informed by a challenge and a concrete story explanation at the end. This can generate design input for the project as well as prototypes, visualisations or other outputs that may support communication about the pilot.

Prototyping and simulated data

Next to the communication functions of XR during onboarding, XR can fulfil a strong design function. Virtual interactable designs which allow for adaptations and experience make XR a strong tool to

quickly generate multiple prototypes. Apart from the design function, the experiential role of XR simulations allows users to contribute to the gathering of data. Guided by a specific design or research question, participant behaviour within the simulated environment can be observed and analysed. Such observations should be treated as evidence of interaction under simulated conditions rather than as direct predictions of real-world behaviour. Apart from the design, the experience of the implemented solutions can also be monitored, before a final design is made. This makes XR a potentially valuable enabling tool for co-design, prototyping and participatory evaluation before, during and after solution development.

For the steps, timing, and output of each method, see the [NEXTLOGIC Engagement Toolbox](#).

10.3 Co-creation methods per pilot city

Different core challenges to pilot solutions have been defined, as shown in Table 22. The stakeholder mapping per pilot city, as well as their involvement per phase is also presented in section 9 and Annex A. These mappings are based on interviews undertaken in WP1, and in collaboration with WP4 leads. However, they should be understood as an initial mapping and analysis that serve as a starting point for the piloting process in WP4. As such, these overviews are living documents, expected to be adapted as the project continues.

Linked to concrete co-creation methods, a **stakeholder engagement plan** can be drawn up in each pilot city. These plans divide the pilot in different phases (pre-pilot, design, implementation, pilot, post-pilot) and distinguish the different solution tracks potentially running through the pilot.

In each phase, a suggestion is made on which co-creation methods to use in which order per solution, and with which stakeholders. Such stakeholder engagement planning are first suggestions based on a preliminary analysis of the local stakeholder engagement. The planning should be adapted during the actual pre-piloting phase of WP4 of NEXTLOGIC.

The different stakeholder engagement plans per pilot city can be found in Annex B.

11. Conclusions

11.1 Summary of the key findings

This deliverable has established the **methodological foundations that will guide the implementation, monitoring and assessment of the NEXTLOGIC project throughout its lifetime**. By combining a robust impact evaluation framework with a structured stakeholder engagement and co-creation framework, D1.2 provides a common methodological reference for all partners and pilot cities, ensuring that project activities are developed, monitored and evaluated in a consistent, transparent and comparable manner.

The **proposed Impact Evaluation Framework responds to the need for a comprehensive yet practical methodology capable of capturing the wide range of impacts expected from the NEXTLOGIC solutions**. Unlike conventional transport evaluations, which often focus primarily on operational or environmental performance, the framework adopts a holistic perspective that considers environmental, economic, social, governance and urban space dimensions simultaneously. This reflects the integrated nature of the project, where urban freight logistics, passenger mobility, public space allocation, digital technologies and stakeholder collaboration are intrinsically interconnected. A second major outcome of this deliverable is the **definition of an initial set of impact indicators and quantification methods**. Particular attention has been given to selecting indicators that are scientifically robust, operationally feasible, and compatible with the data expected to become available throughout the project. Rather than prescribing a rigid evaluation procedure, the framework has been conceived as sufficiently flexible to accommodate the different maturity levels of the pilot cities, variations in local data availability, and the specific characteristics of each demonstration. This balance between methodological consistency and local adaptability is one of the key strengths of the proposed approach.

Equally important is the **Stakeholder Engagement and Co-creation Framework** developed in the second part of the deliverable. Urban logistics interventions involve a broad range of actors whose interests, responsibilities and expectations frequently differ. Public authorities, logistics operators, retailers, infrastructure managers, citizens, mobility providers and many other stakeholders all influence the success of urban logistics policies and infrastructure interventions. Recognising this complexity, the deliverable proposes a **structured process for stakeholder identification, mapping, engagement and collaborative decision-making throughout the project lifecycle**. The proposed co-creation framework goes beyond consultation activities by promoting continuous stakeholder involvement from the early definition of local challenges through the design, implementation, monitoring and evaluation of the pilot activities. Drawing upon established participatory approaches, including Living Labs, Freight Quality Partnerships and collaborative planning methodologies, the framework offers **practical guidance for selecting the most appropriate engagement methods according to the objectives, stakeholders involved and stage of implementation**. The proposed stakeholder engagement toolbox further supports cities in tailoring these methods to their own governance structures and local conditions.

An important characteristic of both frameworks is their practical orientation. Rather than developing purely theoretical models, **D1.2 has focused on providing methodologies that can be directly applied during the implementation of the NEXTLOGIC pilots**. The evaluation framework establishes the basis for collecting comparable evidence across the cities, while the co-creation framework supports

inclusive and transparent decision-making processes capable of increasing the acceptance, effectiveness and long-term sustainability of the proposed solutions.

11.2 Next steps

The methodological frameworks presented in this deliverable provide the foundation for the implementation and assessment of the NEXTLOGIC project. During the next phases of the project, they will be progressively applied, refined and validated through the development and demonstration of the NEXTLOGIC digital tools and solutions.

The main next steps are:

- **Development of the data framework (D1.3):** define the data acquisition, management and interoperability framework supporting the implementation of the evaluation methodology. D1.3 will specify the data requirements, sources, collection procedures and governance mechanisms necessary to ensure that the selected indicators can be consistently measured across the NEXTLOGIC pilot cities while supporting the integration of data into the Digital Twin platform.
- **Operationalisation of the evaluation framework:** establish the baseline conditions in each pilot city, confirm data availability, and prepare the monitoring activities required to assess the impacts of the implemented solutions.
- **Integration with the NEXTLOGIC digital platform:** incorporate the proposed indicators and data requirements into the Digital Twin, geospatial analytics and data management components developed in **WP2**, enabling continuous monitoring and analysis.
- **Application during solution co-development:** use the evaluation framework and stakeholder engagement methods to support the design and refinement of the five NEXTLOGIC solution families developed in **WP3**.
- **Implementation in the pilot cities:** apply the common evaluation methodology and stakeholder engagement framework across all pilot and replication cities in **WP4**, while allowing adaptations to local priorities, governance structures and available data.
- **Continuous stakeholder engagement:** organise workshops, Living Labs and other co-creation activities throughout the project to ensure that public authorities, logistics operators, businesses, citizens and other relevant actors actively contribute to the design, implementation and assessment of the solutions (**WP4**).
- **Progressive refinement of the frameworks:** treat both the Impact Evaluation Framework and the Stakeholder Engagement Framework as living frameworks that will evolve based on implementation experience, stakeholder feedback and lessons learnt during the pilots.
- **Support for impact assessment and replication:** provide the methodological basis for the activities of **WP5**, including the comprehensive assessment of environmental, economic and social impacts, the development of governance and business models, and the preparation of recommendations to facilitate the replication of successful NEXTLOGIC solutions in other European cities.

12. Abbreviations

Term	Definition
ADAV	Advanced Data Analytics and Visualisation
D1.2	Deliverable 1.2
DALY	Disability Adjusted Life Year (DALY)
DEC	Websites, Patent Filings, Videos etc.
DEM	Demonstrator, Pilot, Prototype
DT	Digital Twin
FQP	Freight Quality Partnerships
JKP	Joint Knowledge Production
KPI	Key Performance Indicator
LCA	Life-Cycle Assessment
LL	Living Labs
MAMCA	Multi Actor Multi Criteria Analysis
PU	Public
R	Document, Report
SBPDT	Smart Bike Parking Digital Twin
SEN	Sensitive
SLZ	Smart Loading Zones
SME	Small and Medium-sized Enterprises
SSA	Shared Situational Awareness
VR	Virtual Reality
WP	Work Package
XR	eXtended Reality
ZE	Zero-Emission

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Annex A: Stakeholder mapping per pilot city

Aarhus

The overall aim of the Aarhus pilot is to design, implement, and assess scalable solutions for climate-neutral urban development by operationalising the **15-minute city concept through multimodal, digitally enabled urban hubs**, focussing on *Hjortshøj station square*. Within NEXTLOGIC, multimodal hub designs integrating transport encompass the combination of different public transport services, the use of private bicycles and cars alongside public transport for first- and last-mile connectivity, and shared mobility services when available. It also includes the co-location of logistics services (e.g. parcel lockers) and the promotion of their use through **Incentives and Rewards mechanisms (I&R)**, with the aim of supporting more sustainable mobility and logistics behaviours. The pilot will leverage **advanced Digital Twin (DT)** capabilities and **Advanced Data Analytics and Visualisation (ADAV)** to measure the impact of urban texture and urban design on the accessibility radius [76]. With this description, the stakeholders, their task, and inferred power and interest levels can be seen in Table 23. The higher the value, the higher the power and influence, with 3 being the highest and 1 the lowest.

Table 23. *arhus Stakeholder Categories and Matrix*

Stakeholder	Actors	Involvement	P	I
Government/Public Authorities	Municipality of Aarhus Transport Office	Strategic lead;	3	3
Logistics Operators	PostNord	Willing to test cargo bikes	2	2
Retailers/Shippers	Local Businesses	Travel surveys	1	1
Citizens/Residents	Citizens; Co-Design culture	Travel surveys	1	1
Academia	DTU, CBS, UniR1, MUV, LIST, FUAS, UniR3	Transport modelling; Lead;	3	3
		Freight insights;	2	2
		Incentive and rewards;	2	3
		Advanced Data Analytics & DT,	2	3
Industry Associations	Climate Neutral Logistics Network (CNLN) MOV	Existing informal collaboration, can be built upon	2	1
		Freight Stakeholder Engagement	2	2
Technology Providers	DTU (modelling), Trans, LIST	Modelling,	3	3
		Digital Twin	2	3
Infrastructure/ Transport provider	DSB CphM	Key land partner for hub locations	3	1
		Provide hub design expertise	2	2
Enforcement	Aarhus police, sensors	Monitor correct usage of the hub	3	1

This initial scoring, together with the outlined tasks, can now be used to assess the Influence, Legitimacy, and Urgency, depending on the phase of the Pilot, the darker the shade, the higher the value, as shown in Table 24.

Table 24. Aarhus Stakeholder Salience Model

		Pre-Pilot	Design	Implement	Pilot	Post-Pilot
		Baseline conditions, surveys, accessibility assessments, DT simulations, spatial location, mobility conditions		Evaluate performance of hubs, 15-minute city, and incentive and rewards, refining of simulation models		Assess effectiveness, scalability, and transferability
Municipality	Power	Regulation				
	Legitimacy	Policy	Mobility	Endorse		
	Urgency	Baseline	Mobility			
DTU	Power					
	Legitimacy					
	Urgency					
LIST	Power					
	Legitimacy	DT	DT			DT
	Urgency				Data	Data viz
PostNord	Power					
	Legitimacy		Willingness	Purchase	Testing	Experience
	Urgency	Onboard			Testing	
Retailers	Power					
	Legitimacy	Baseline			Affected	Opinion
	Urgency	Survey			Testing	
Citizens	Power					
	Legitimacy	Baseline			Affected	Opinion
	Urgency	Survey			Testing	
CBS	Power					
	Legitimacy	Experts	Experts		Evaluate	Experts
	Urgency	Consult			Consult	Consult
I&R	Power		Design			
	Legitimacy	Experts		Rollout		
	Urgency					
CNLN	Power					
	Legitimacy	Network	Baseline			Scaling
	Urgency	Mapping				
MOV	Power					
	Legitimacy		Engage	Engage		
	Urgency	Onboard				
DSB	Power	Space		Implement		
	Legitimacy	Space	Owner			
	Urgency	Location	Design			
CphM	Power					
	Legitimacy		Hub design	Hub design	Evaluate	
	Urgency					
Enforcement	Power			Familiarise		
	Legitimacy				Enforce	
	Urgency					Evaluate

The Stakeholder Salience Model of Aarhus shows that:

- The municipality, DTU, PostNord, and the I&R actors are involved throughout the pilot in different activities. They determine frameworks and provide the solution, which makes their contributions essential. These stakeholders should make up the core team, as their involvement and objectives are relevant throughout the formation of the pilot.
- DSB plays a role in the selection of the location and space of the intervention, next to the municipality. As such, their responsibility in the setup is considerable, and throughout the pilot they are still involved due to activities taking place on their property. As such, including DSB in the core team ensures a continuous check on the location of the pilot.
- LIST is intensely involved in specific phases for specific tasks. The DT requires setup in the early phases, and later visualisations put LIST on the forefront again. Yet once up and running, the DT should function without constant involvement. As LIST is essential at the start and the end, they can either be in the core team or join as operational stakeholder.
- CBS, MOV, CphM, and Enforcement each fulfil an important task in specific moments. Early stakeholder engagement by MOV, enforcement of SLZ once implemented, design input from experts; the contribution of these stakeholders is important, yet demarcated. These stakeholders make up the operational stakeholders, that are involved to be share their input in a particular part of the pilot.
- Finally, retailers, citizens, and CNLN are the external stakeholders, who are consulted when they experience effects of the solutions, or can help set the solution up. The inventory surveys to retailers and citizens put their impetus at the start, and later when they are confronted with the solution. CNLN can be a strong starting stakeholder to meet, in order to facilitate contact with others. If this is done however, their involvement is mostly over.

This creates the following Stakeholder division, as shown in Table 25.

Table 25. Aarhus Stakeholder Division

Core Team	Operational Stakeholders	External Stakeholders
Municipality	LIST	Residents
DTU	CBS	Retailers
PostNord	MOV	CNLN
UniR1	CphM	
MUV	Enforcement	
DSB		

Dublin

The Dublin pilot focuses on developing the **Smart Bike Parking Digital Twin (SBPDT)**, which will enable real-time monitoring, simulation, and optimisation of bike parking systems, with a particular focus on accommodating the growing use of e-bikes and e-cargo bikes. The pilot integrates sensor data and user-generated information within a Digital Twin environment. The **AR tool** will provide users with real-time information on parking guidance and **I&R** will offer incentives for responsible bike parking behaviour to improve parking availability and user experience. The overall aim of the Dublin pilot is to develop and validate a Digital Twin-based solution for smart bike parking management that enhances urban mobility, supports sustainable urban planning, and contributes to climate neutrality objectives

[76]. With this description, the stakeholders, their task, and inferred power and interest levels can be seen in Table 26. The higher the value, the higher the power and influence, with 3 being the highest and 1 the lowest.

Table 26. Dublin Stakeholder Categories and Matrix

Stakeholder	Actors	Involvement	P	I
Government/Public Authorities	Smart Dublin, Smart Docklands, Dún Laoghaire–Rathdown (DLR), DCC, SDCC, FCC	Policy and regulatory inputs	2	2
Retailers/Shippers	Local Businesses	Potential interest of using bikes Provides rewards for I&R	2	1
Citizens/Residents	Citizen groups, student associations, TCD staff organisations	Affected by congestion User group for pilot	3	3
Academia	TCD	Core team	3	3
	FUAS	DT	2	3
	TU Delft	XR	2	3
	UniR3	I&R	2	3
Industry Associations	Mobility Hubs	Potential parking locations	1	1
Technology Providers	TCD	Core Team	3	3
	MUV, MOV	I&R	3	3
	RealSim, EXE	DT	2	2
Transport provider	Bleeper; DublinBikes; Moby; Bolt	Consumes XR module, Provides bikes	2	1
Enforcement	TCD; sensors	Non-enforcement planned	1	1

This initial scoring, together with the outlined tasks, can now be used to assess the Influence, Legitimacy, and Urgency, depending on the phase of the Pilot, the darker the shade, the higher the value, as shown in Table 27.

The Stakeholder Salience Model of Dublin shows that:

- TCD, the DT partners, TU Delft, and the I&R actors, are involved throughout the pilot and provide different solutions. Their continuous involvement and steering therefore is essential and they should make up the core team, determining the course of the pilot.
- Citizens play a core role in this pilot, as source of general focus and requirements, as well as testing and feedback instance. Involving the citizens in a core team is complicated due to their disperse nature, yet even as operational stakeholders, these stakeholders should be involved in discussions more often than not.

Table 27. Dublin Stakeholder Salience Model

		Pre-Pilot	Design	Implement	Pilot	Post-Pilot
		Baseline conditions, parking demand, pressure and behaviour, user perceptions, identify key parking related challenges and needs		Continuous data collection through bike parking digital twin, sensors, user engagement, iteratively improve DT, AR and I&R		Assess effectiveness, scalability, and transferability
Public Authority	Power	Regulation				
	Legitimacy	Policy				
	Urgency	Baseline				
TCD	Power					
	Legitimacy					
	Urgency					
DT Team	Power				SBPDT	
	Legitimacy	DT	DT		DT	
	Urgency			Hook up the DT		
TU Delft	Power					
	Legitimacy		XR Design		XR Runtime	
	Urgency				Improvement	Improvement
Citizens	Power					
	Legitimacy	Parking Needs	Key Challenges	Tailoring	Engagement	Effectiveness
	Urgency	Consulted			I&R	
Retailers	Power					
	Legitimacy			Involvement		Opinion
	Urgency				Testing	Continuation
Industry Association	Power					
	Legitimacy	Experiences	Hubs	Location		
	Urgency	Consultation				
I&R	Power		Design			
	Legitimacy	Experts		Rollout		
	Urgency					
Transport Providers	Power			Bikes		
	Legitimacy				XR Module	
	Urgency					Continuation
Enforcement	Power					
	Legitimacy				Enforce	
	Urgency					

- The transport provider companies and public authorities are important framework, or tool providing actors, but are needed only at specific moments. These stakeholders make up the

operational stakeholders, that are involved to be share their input in a particular part of the pilot.

- The operational stakeholders include some DT actors, who are specifically required when designing and setting up the DT, but not the data integration.
- Finally, retailers, industry associations, and enforcement are the external stakeholders, who are consulted when they experience effects of the solutions, or can help set the solution up.
- *Logistics operators are not a part of this pilot* according to this first mapping. As key stakeholder in city logistics, the need for their inclusion should be considered throughout the pilot.

This creates the following Stakeholder division, as shown in Table 28.

Table 28. Dublin Stakeholder Division

Core Team	Operational Stakeholders	External Stakeholders
TCD FUAS UniR3 MUV MOV TU Delft	Smart Dublin, Smart Docklands (DCC), Dún Laoghaire–Rathdown (DLR) Citizens Transport Providers EXE	Retailers Enforcement

The Hague

The Hague pilot focuses on deploying and implementing smart, data-driven solutions for **curbside management for logistics activities**. The pilot aims to enhance the efficiency and sustainability of zero-emission zones extended towards coastal areas for urban freight operations and their implications for the grid network. The pilot integrates a **Digital Twin (DT)** to support real-time monitoring and optimisation of logistics activities. A key component is the deployment of **Smart Loading Zones (SLZ)**, which enable dynamic allocation and management of curbside space. An analysis will be carried out on the deployment of **electrification** strategies, with a particular emphasis on zero-emission zones and their integration into logistics operations. The pilot site location will be determined in the planning phase and will be in a central urban area with high logistics demand, mixed land use, and limited public space. The pilot area should present challenges such as congestion, competing uses of space, and environmental impacts, making it a suitable testbed for innovative logistics and curbside management solutions [76]. With this description, the stakeholders, their task, and inferred power and interest levels can be seen in Table 29. The higher the value, the higher the power and influence, with 3 being the highest and 1 the lowest.

Table 29. The Hague Stakeholder Categories and Matrix

Stakeholder	Actors	Involvement	P	I
Government/Public Authorities	Municipality of The Hague, Ministry I&W ACOR VOV	Responsible for ZE Zones and SLZs	3	3
		Road Authority, traffic design, Policymaker	3	1
		Committee for public space	2	1
		Committee for traffic	2	1
Logistics Operators	PostNL, DHL SME	Transitioning to Electric Vehicles Providing data and testing	2	2
Retailers/Shippers	Local Businesses	Affected by delivery operations Co-design and evaluation	1	2
Citizens/Residents	Local Residents	Affected by parking chaos Co-design and evaluation	1	2
Academia	BUas FUAS, LIST, UniR3 UniLU	Academic Support	2	3
		DT	2	3
		Expert on Electromobility	2	3
Industry Associations	Parcel Covenant Logistiek The Hague Business Improvement District Communication specialist	Delivery Companies	3	2
		Electrification and parcel lockers	3	2
		SLZ	3	2
		Communication strategy	2	2
Technology Providers	PKUN, Coding the Curbs NDW	Solution Provider SLZ	3	3
		Sensors	1	1
Enforcement	ANPR Enforcement Officer	Scan Car	2	1
		Parking Enforcement	2	2

This initial scoring, together with the outlined tasks, can now be used to assess the Influence, Legitimacy, and Urgency, depending on the phase of the Pilot, the darker the shade, the higher the value, as seen in Table 30.

The Stakeholder Salience Model of The Hague shows that:

- The pilot is very strongly represented by the municipality, the solution provider PKUN, and the digital support team. This is partially because the government represents several functions: road authority, traffic expert, property owners, and policymaker. These actors set the frames, but are often represented by university actors such as BUAS and UniLU. Together, these actors form a core team.
- The logistic covenants already provide an established collaboration or starting ground. Especially in earlier phases of the pilot, these stakeholders can provide a strong boost to the setup and networking. They also provide a strong basis for scaling of the pilot results. As such, they should be included in the core team, or at least involved more often than not as operational stakeholders.

Table 30. The Hague Stakeholder Salience Model

		Pre-Pilot	Design	Implement	Pilot	Post-Pilot
		Baseline assessment, analysis of loading/unloading zone usage, demand patterns, and regulatory constraints. Baseline traffic conditions through available data		Scenario-based simulations to test alternative policy configurations and compare impacts. Continuous data collection through the Digital Twin on curbside utilisation, parking turnover, and user behaviour		Assess effectiveness, scalability, and transferability
Municipality	Power		Localising			
	Legitimacy	Policy		Endorse		
	Urgency	ZE expansion				
ACOR	Power					
	Legitimacy	Feasibility		SLZ space		
	Urgency					
VOV	Power		Emergency			
	Legitimacy	Feasibility		Road design		
	Urgency					
Logistic Operators	Power					
	Legitimacy		Preferences	Purchase	Testing	Experience
	Urgency			Uptake	Testing	
Retailers	Power					
	Legitimacy		Co-design		Affected	Opinion
	Urgency	Location	Location		Testing	
Citizens	Power					
	Legitimacy		Co-design		Affected	Opinion
	Urgency	Location	Location		Testing	
BUAs	Power					
	Legitimacy	Setup	Facilitation		Neutral	Experts
	Urgency					Consult
DT Team	Power					
	Legitimacy	DT	DT		DT	
	Urgency	Traffic condition		Hook up the DT		
UniLu	Power					
	Legitimacy	Framework	Expertise	Facilitation		Learnings
	Urgency	Setup		Uptake		
Logistic Covenants	Power					
	Legitimacy	Network	Experiences	Rollout	Testing	Scaling
	Urgency	Onboard				
Communication Expert	Power					
	Legitimacy	Strategy		Communicate	Updates	
	Urgency					
PKUN	Power					
	Legitimacy	SLZ offer	SLZ design	SLZ design	Implement	Evaluate
	Urgency				Data	
Enforcement	Power			Familiarise		
	Legitimacy				Enforce	
	Urgency			Onboard		

- Logistic operators have to make use of the interventions, and as such, they should be treated as an operational stakeholder, that is consulted at moments of design, implementation, and

piloting. Yet their role is focused on operating the solutions, not so much the strategic planning.

- The communication expert functions as the adhesive between the strategic planning from the core team, the operation by operators, and the landing in a local spot. As such, they should be kept in the loop regularly, but involved as operational stakeholder with a specific task.
- Citizens, retailers, the committees and enforcement are external stakeholders. Their experience of the effects of the solutions are required during piloting, as well as their expert knowledge during setup or operation. However, beyond those moments of consultation, these stakeholders have a more validating role than a strategic one.

This creates the following Stakeholder division, as shown in Table 31.

Table 31. The Hague Stakeholder Division

Core Team	Operational Stakeholders	External Stakeholders
Municipality PKUN Covenants BUas LIST & FUAS UniLu	Logistics operators Communication Expert	Residents Retailers Enforcement ACOR VOV

Wrocław

The Wrocław pilot focuses on improving the efficiency and sustainability of last-mile urban logistics through the deployment of **Mobile Microhubs** combined with cargo bike operations, supported by advanced digital technologies. The pilot integrates the **NEXTLOGIC Digital Twin (DT) and eXtended Reality (XR)** tools to optimise planning, design, and operational performance of last-mile deliveries. The pilot addresses identified inefficiencies in urban deliveries, such as high levels of non-compliant delivery times and locations. Through a technology-driven and stakeholder-oriented approach that builds on the established FQP, the pilot aims to demonstrate scalable solutions for sustainable urban logistics. The pilot will be implemented in the wider Wrocław historic city in an area characterised by high delivery demand, spatial constraints, complex logistics operations, and challenges related to access restrictions. [76]. With this description, the stakeholders, their task, and inferred power and interest levels can be seen in Table 32. The higher the value, the higher the power and influence, with 3 being the highest and 1 the lowest.

Table 32. Wroclaw Stakeholder Categories and Matrix

Stakeholder	Actors	Involvement	P	I
Government/Public Authorities	City of Wroclaw	Pilot Lead Engage Stakeholders Feedback for policy development	3	2
Logistics Operators	Courier companies Food distributor	Grouped in FQP	2	2
Retailers/Shippers	Local Businesses	In FQP; delivery demand Co-creation	2	2
Citizens/Residents	Local Residents	Baseline survey; affected by	1	2
Academia	WUEB LIST, FUAS, UniR3	Facilitates; analysis support	3	3
		DT	2	3
Industry Associations	Freight Quality Partnership	Couriers, cargo bike manufacturers, retailers, university, city departments	3	2
	Architect	Design of Microhub	2	1
Technology Providers	Exe/Trans	DT	2	3
	WCG	Hub, Infra and Cargo bike provider	3	2
	TU Delft	XR and Hololens	2	2
	GPS Data provider	GPS Data	1	1
Infrastructure providers	Interparking	Manages existing underground microhub	2	1

This initial scoring, together with the outlined tasks, can now be used to assess the Influence, Legitimacy, and Urgency, depending on the phase of the Pilot, the darker the shade, the higher the value, as shown in Table 33.

The Stakeholder Salience Model of Wroclaw shows that:

- The pilot builds upon a strong FQP that incorporates many actors, the municipality, and is facilitated by WUEB. Another key player in this constellation is the solution provider WCG, who are essential in the initial design. Structured along a strong co-creation design in the earlier phases, the pilot is represented by a core team that is diverse and strongly incorporated from the start.
- The DT team, and XR development run alongside the hub development and as such should be integrated, but can be timed specifically. As such, these actors can be operational stakeholders.
- Architects, Interparking, and GPS data parties are called in for essential, but very momentary phases (e.g. the localisation, the design, or the data link). They can be considered external stakeholders (only contacted once) or treated as operational stakeholders as their input will have repercussions on the rest of the pilot and thus rely more on shared situational awareness.

Table 33. Wroclaw Stakeholder Salience Model

		Pre-Pilot	Design	Implement	Pilot	Post-Pilot
		Baseline assessment, courier selection, stakeholder needs, microhub location, microhub design and selection,		track implementation progress, operational performance, and stakeholder engagement, data collection through DT, GPS movement analytics		Assess governance arrangements, access rules, responsibilities, replication
Municipality	Power		Localising			
	Legitimacy	Policy				
	Urgency	Stakeholder				Governance
WUEB	Power	Facilitator	Facilitator			
	Legitimacy				Workshops	
	Urgency	Workshops	Workshops	Communication		Replicate
FQP	Power			Purchase		
	Legitimacy	Interest	Design			
	Urgency	Workshops	Workshops			
Logistic Operators	Power	Interest				
	Legitimacy	Needs	Preferences	Purchase	Testing	Experience
	Urgency			Uptake	Testing	
Retailers	Power					
	Legitimacy	Needs	Co-design		Use	Opinion
	Urgency	Location	Location		Testing	
Citizens	Power					
	Legitimacy	Baseline			Affected	Opinion
	Urgency				Testing	
Architect	Power					
	Legitimacy		Design			
	Urgency					
DT Team	Power					
	Legitimacy	DT	DT		DT	
	Urgency			Hook up the DT	GPS data	
TU Delft	Power					
	Legitimacy	XR design				Assessment
	Urgency	Purchase				
GPS data	Power					
	Legitimacy	Interest				
	Urgency	Onboarding		DT Integration	Data gathering	
WCG	Power					
	Legitimacy	Bike selection	Hub Design		Maintain	
	Urgency	Workshops	Workshops		Maintain	
Interparking	Power					
	Legitimacy	Localisation				
	Urgency	Workshop		Placing	On site	

- Citizens and retailers are external stakeholders. Their co-design or baseline input is formative for the pilot, but beyond those moments of consultation, these stakeholders have a more validating role than a strategic one.

This creates the following Stakeholder division, as shown in Table 34.

Table 34. Wroclaw Stakeholder Division

Core Team	Operational Stakeholders	External Stakeholders
<ul style="list-style-type: none"> • WUEB • Wroclaw • FQP • WCG • Logistic Operators 	<ul style="list-style-type: none"> • LIST • FUAS • TU Delft • Exe/Trans 	<ul style="list-style-type: none"> • Architects • Interparking • GPS Data • Citizens • Retailers

The stakeholder assessment of these four leading cities will replicate itself in the follower cities. Still, depending on the local context, different stakeholders will be involved. The stakeholder salience model of each follower city is relatively similar to their leading city.

Bergamo

The Bergamo pilot, follower of The Hague, focuses on deploying smart, data-driven solutions for the **dynamic management of loading and unloading zones (SLZ)** to enhance the efficiency, inclusivity, and sustainability of urban mobility and logistics. The pilot integrates smart curbside management with broader urban strategies, including **analysis of electric freight vehicles charging stations**. Building on existing measures, the pilot will leverage advanced **Digital Twin (DT)** capabilities and digitally enabled, flexible curbside solutions. The pilot site will be defined in the planning phase, with two urban contexts being considered: the Lower Town (central mixed use with spatial competition; focus on scalability, visibility, and replication) and the Upper Town (narrow with restricted vehicle access, lots of HORECA; focus on stakeholder engagement and adaptive solutions) [76]. With this description, the stakeholders, their task, and inferred power and interest levels can be seen in Table 35. The higher the value, the higher the power and influence, with 3 being the highest and 1 the lowest.

Table 35. Bergamo Stakeholder Categories and Matrix

Stakeholder	Actors	Involvement	P	I
Government/Public Authorities	Municipality of Bergamo	Pilot Co-owner Mobility Department, Urban Planning, Sustainability, relevant technical offices	3	3
Logistics Operators	Parcel and delivery operators DHL, GLS, BRT, SDA, Amazon Logistics, local couriers HORECA suppliers	Testing and validation	2	2
Retailers/Shippers	Shop owners, HORECA businesses, Confcommercio and Confesercenti	Structured consultation; permanent stakeholder table for feedback	2	3
Citizens/Residents	Residents, visitors, neighborhood associations, and vulnerable users of public space	Affected; consulted during design and evaluation	1	2
Academia	University of Bergamo LIST, FUAS, UniR3 BUAS UniLU	Facilitates; analysis support	3	3
		DT	2	3
		The Hague Insights	2	2
		Electrification	2	3
Industry Associations	Permanent Stakeholder table	To be instigated municipality, retailers, logistics operators, associations, and relevant service providers	2	3
Technology Providers	PKUN Trans	SLZ provider	3	3
		DT provider	3	3
Infrastructure providers	ATB Bergamo	Curbside competition; to be consulted	2	2
Grid Operator	Local Utilities	To be consulted for electrification	2	2
Enforcement	Polizia Locale di Bergamo	Enforce the SLZ implementation	3	3

This initial scoring, together with the outlined tasks, can now be used to assess the Influence, Legitimacy, and Urgency, depending on the phase of the Pilot, the darker the shade, the higher the value, as shown in Table 36.

Table 36. Bergamo Stakeholder Salience Model

		Pre-Pilot	Design	Implement	Pilot	Post-Pilot
		Baseline assessment, analysis of loading/unloading zone usage, demand patterns, and regulatory constraints. Baseline traffic conditions through available data		Scenario-based simulations to test alternative policy configurations and compare impacts. Continuous data collection through the Digital Twin on curbside utilisation, parking turnover, and user behaviour		Assess effectiveness, scalability, and transferability
Municipality	Power					
	Legitimacy	Policy		Endorse		
	Urgency	Localisation				
University of Bergamo	Power					
	Legitimacy	Facilitator	Co-Create	Facilitate	Validate	
	Urgency	Engagement	Workshop			
BUAS	Power					
	Legitimacy	Insights	Insights			Reflect
	Urgency	Sharing				
Logistic Operators	Power					
	Legitimacy			Purchase	Testing	Validation
	Urgency			Uptake	Testing	
Retailers	Power					
	Legitimacy			Location	Affected	Opinion
	Urgency	Consultation	Consultation		Testing	
Citizens	Power					
	Legitimacy		Affected		Affected	Opinion
	Urgency		Consulted		Testing	
DT Team	Power					
	Legitimacy	DT	DT		DT	
	Urgency	Traffic condition		Hook up the DT		
UniLU	Power					
	Legitimacy	Framework	Expertise	Facilitation		Learnings
	Urgency	Setup		Uptake		
Logistic Covenants	Power					
	Legitimacy		Experiences	Rollout	Testing	Scaling
	Urgency	Onboard				
Grid Operator	Power					
	Legitimacy		Best practice		Updates	
	Urgency	Consulted				
PKUN	Power					
	Legitimacy	SLZ offer	SLZ design	SLZ design	Implement	Evaluate
	Urgency				Data	
Enforcement	Power			Familiarise		
	Legitimacy				Enforce	
	Urgency			Onboard		
ATB Bergamo	Power					
	Legitimacy	Competition				
	Urgency		Compromise			

The Stakeholder Saliency Model of Bergamo shows that:

- The pilot is very strongly represented by the municipality, the solution provider PKUN, and the digital support team. The government represents several functions which may at times clash, so keeping them involved continuously is paramount. Enforcement is explicitly taken along throughout the pilot, and should be continuously involved for higher success. These actors set the frames, but are often represented by university actors such as the University of Bergamo and UniLu. Together, these actors form a core team.
- The stakeholder table holds a strong potential to keep multiple involved stakeholders on board, but it should be actively incorporated. This requires strong stakeholder engagement at the pre-pilot phase. Ideally, this table can be included in the core team, or at least involved more often than not as operational stakeholders.
- Retailers are continuously involved in the pilot, as main location, user, and co-designer. However, it is mostly their input that matters. As such, they should be included as operational stakeholder more than a core team member that guides activities.
- BUAS has insights from The Hague pilot, yet is also more focused on sharing and validating than forming. As such, their contribution to joint knowledge production puts them in operational category.
- Logistic operators have to make use of the interventions, and as such, they should be treated as an operational stakeholder, that is consulted at moments of design, implementation, and piloting. Yet their role is focused on operating the solutions, not so much the strategic planning.
- Citizens, grid operators, and infrastructure competition are external stakeholders. Their experience of the effects of the solutions are required during piloting, as well as their expert knowledge during setup or operation. However, beyond those moments of consultation, these stakeholders have a more validating role than a strategic one.

This creates the following Stakeholder division, as shown in Table 37.

Table 37. Bergamo Stakeholder Division

Core Team	Operational Stakeholders	External Stakeholders
Municipality of Bergamo University of Bergamo LIST & FUAS UniLU Enforcement Stakeholder Table PKUN	BUAS Logistics operators Retailers	Citizens Grid Operator ATB Bergamo

Differdange

The Differdange pilot, also following The Hague, focuses on the integration of urban mobility and logistics flows within an **enhanced Digital Twin (DT) and Advanced Data Analytics and Visualisation (ADAV) to support data-driven planning and the curbside management**. Building on existing digital capabilities, the pilot aims to expand the DT to include dynamic mobility and logistics data, enabling scenario analysis and evidence-based decision-making. A central component of the pilot is the deployment of **Smart Loading Zones (SLZ)**, which enable dynamic allocation and management of curbside space. These spaces will be dynamically managed to accommodate various uses, such as freight delivery, parking, and **electric freight vehicle charging**, depending on real-time demand. The pilot is implemented in Differdange's city centre, characterised by mixed-use urban functions, high demand for freight and passenger movement, and limited space availability [76]. With this description, the stakeholders, their task, and inferred power and interest levels can be seen in Table 38. The higher the value, the higher the power and influence, with 3 being the highest and 1 the lowest.

Table 38. Differdange Stakeholder Categories and Matrix

Stakeholder	Actors	Involvement	P	I
Government/Public Authorities	Municipality of Differdange	Regulations (SLZ), define the scope and location of the pilot	3	3
Logistics Operators	Delivery Trucks	Users of ParkUnload app	3	3
Retailers/Shippers	Shop owners and restaurants Union Commercial of Luxembourg	Qualitative input	1	2
Citizens/Residents	Residents, visitors,	Affected by illegal parking; consulted	1	1
Academia	MATSim Transport	Modelling	3	3
	LIST, FUAS, UniR3	DT	2	3
	BUAS	The Hague Insights	2	2
	UniLU	Electrification	3	3
Industry Associations	Cluster for logistics Luxembourg confederation	Represents the freight transporters and logistic stakeholders in Luxembourg	3	1
Technology Providers	PKUN	SLZ provider	3	3
	Trans	DT provider	3	3
Enforcement	Differdange Police	Enforce the SLZ implementation	3	3

This initial scoring, together with the outlined tasks, can now be used to assess the Influence, Legitimacy, and Urgency, depending on the phase of the Pilot, the darker the shade, the higher the value, as shown in Table 39.

Table 39. Differdange Stakeholder Salience Model

		Pre-Pilot	Design	Implement	Pilot	Post-Pilot
		Baseline assessment, analysis of loading/unloading zone usage, demand patterns, and regulatory constraints. Baseline traffic conditions through available data		Scenario-based simulations to test alternative policy configurations and compare impacts. Continuous data collection through the Digital Twin on curbside utilisation, parking turnover, and user behaviour		Assess effectiveness, scalability, and transferability
Municipality	Power					
	Legitimacy	Policy		Endorse		
	Urgency	Localisation				
UniLU	Power					
	Legitimacy	Facilitator	Co-Create	Facilitate	Facilitator	
	Urgency	Engagement	Workshop	Uptake		
BUAS	Power					
	Legitimacy	Insights	Insights			Reflect
	Urgency	Sharing				
Logistic Operators	Power					
	Legitimacy		Input?	Purchase	Testing	Validation
	Urgency			Uptake	Testing	
Retailers	Power					
	Legitimacy	Needs			Affected	Opinion
	Urgency	Input			Testing	
Citizens	Power					
	Legitimacy		Affected		Affected	Opinion
	Urgency		Consulted		Testing	
DT Team	Power					
	Legitimacy	DT	DT		DT	
	Urgency	Traffic condition		Hook up the DT		
MATSim	Power					
	Legitimacy	Framework	Modelling	Data Link	Adaptation	Learnings
	Urgency	Setup		Integration		
Logistic Covenants	Power					
	Legitimacy		Experiences	Rollout	Testing	Scaling
	Urgency	Onboard				
PKUN	Power					
	Legitimacy	SLZ offer	SLZ design	SLZ design	Implement	Evaluate
	Urgency				Data	
Enforcement	Power			Familiarise		
	Legitimacy				Enforce	
	Urgency			Onboard		

The Stakeholder Salience Model of Differdange shows that:

- The pilot is very strongly represented by the municipality, the solution provider PKUN, and the digital support team. Enforcement is explicitly taken along throughout the pilot, and should be continuously involved for higher success. These actors set the frames, but are often represented by university actors such as the UniLU. Together, these actors form a core team.

- The Logistics Covenant holds a strong potential to keep multiple involved stakeholders on board, but it should be actively incorporated. This requires strong stakeholder engagement at the pre-pilot phase. Ideally, this table can be included in the core team, or at least involved more often than not as operational stakeholders.
- MATSim Modelling is supporting the pilot, and the DT team throughout. Providing local data, they are an essential partner, yet function more operationally; supporting the pilot instead of steering it.
- BUAS has insights from The Hague pilot, yet is also more focused on sharing and validating than forming. As such, their contribution to joint knowledge production puts them in operational category.
- Logistic operators must make use of the interventions, and as such, they should be treated as an operational stakeholder, that is kept in the loop as they determine the running of the pilot. Yet their role is focused on operating the solutions, not so much the strategic planning.
- Citizens and retailers are external stakeholders. Their experience of the effects of the solutions is required before and during piloting. However, beyond those moments of consultation, these stakeholders have a more validating role than a strategic one.

This creates the following Stakeholder division, as shown in Table 40.

Table 40. Differdange Stakeholder Division

Core Team	Operational Stakeholders	External Stakeholders
Municipality of Differdange UniLu LIST & FUAS Enforcement Logistics Covenant PKUN	MATSim BUAS Logistics operators	Citizens Retailers

Frankfurt

The Frankfurt pilot, following Wroclaw, focuses on the implementation and validation of zero-emission last-mile logistics solutions through **Mobile and Modular Microhubs**. The pilot integrates the **NEXTLOGIC Digital Twin (DT)** to optimise planning, design, and operational performance of last-mile deliveries. The pilot adopts a phased implementation strategy, combining real-life testing of Microhub solutions with the progressive integration of digital tools and business models. It aims to address key urban challenges such as increasing delivery demand, limited public space, and environmental constraints, while contributing to climate neutrality objectives. The first Microhub will be deployed on Deutsche Bahn (DB) property, providing a strategic location with strong connectivity to transport networks. A location for a second Microhub will be identified during the project. The pilot areas reflect typical urban logistics challenges, including congestion, competing land uses, and environmental pressures. With this description, the stakeholders, their task, and inferred power and interest levels can be seen in Table 41. The higher the value, the higher the power and influence, with 3 being the highest and 1 the lowest.

Table 41. Frankfurt Stakeholder Categories and Matrix

Stakeholder	Actors	Involvement	P	I
Government/Public Authorities	City of Frankfurt	Pilot Lead Engage stakeholders Logistics vision and policy	3	2
Logistics Operators	Amazon, DHL, UPS	Involved in earlier Microhub	2	2
Retailers/Shippers	Local Businesses	Affected by congestion; no engagement	1	2
Citizens/Residents	Local Residents	Negative perception of logistics	1	2
Academia	WUEB	Insights from Wroclaw	2	3
	LIST, FUAS, UniR3	DT	2	3
Industry Associations	Logistics Dialogue Roundtable	City admin, DB, HOLM, logistics operators, businesses, researchers	3	2
	House of Logistics and Mobility	Pilot Lead; stakeholder involvement	3	3
Technology Providers	Exe/Trans	DT	2	3
	Urban Data Platform	Data support	2	2
	PTV	VISSIM/VISUM models	2	1
	WCG	Microhub Provider	3	2
Grid Operators	Grid operators	Congestion identified as barrier	1	2
Infrastructure providers	DB	Site provision	3	2

This initial scoring, together with the outlined tasks, can now be used to assess the Influence, Legitimacy, and Urgency, depending on the phase of the Pilot, the darker the shade, the higher the value, as shown in Table 42.

The Stakeholder Salience Model of Frankfurt shows that:

- The pilot builds upon a strong political commitment and support by HOLM to implement a hub with the help of WCG. Although lacking academic support, these two stakeholders have the best opportunity to engage other stakeholders.
- Engaging the Logistics Dialogue Roundtable is an essential first step in the pilot, which allows for the more coordinated engagement of stakeholders during workshops. As core team member, this roundtable is useful to keep everyone on board, and involve the influential logistics operators. Following Wroclaw, these should be involved early on in co-design.
- The DT team run alongside the hub development and as such should be integrated, but can be timed specifically. As such, these actors can be operational stakeholders.

Table 42. Frankfurt Stakeholder Salience Model

		Pre-Pilot	Design	Implement	Pilot	Post-Pilot
		Baseline assessment, courier selection, stakeholder needs, microhub location, microhub design and selection		Track implementation progress, operational performance, stakeholder engagement and feedback		Assess governance arrangements, access rules, responsibilities, replication
Municipality	Power		Localising			Feedback
	Legitimacy	Policy				Policy
	Urgency	Stakeholder				
WUEB	Power	Facilitator	Insights			
	Legitimacy	Insights				Reflect
	Urgency	Sharing				
HOLM	Power					
	Legitimacy	Engagement	Engagement			
	Urgency	Workshops	Support		Monitoring	
Logistic Operators	Power	Interest				
	Legitimacy	Needs	Preferences	Purchase	Feedback	Experience
	Urgency			Uptake	Testing	
Retailers	Power					
	Legitimacy				Consulted	Opinion
	Urgency				Affected	
Citizens	Power					
	Legitimacy	Baseline			Affected	Opinion
	Urgency				Testing	
Logistics Dialogue Roundtable	Power					
	Legitimacy	Covenant	Design	Uptake		Scalability
	Urgency	Onboard	Workshops			
DT Team	Power					
	Legitimacy	DT	DT		DT	
	Urgency			Hook up DT	GPS data	
Urban Data Platform	Power					
	Legitimacy		Local data	Local data		
	Urgency		Integrate DT	Integrate DT	Monitor	
PTV	Power					
	Legitimacy	Models				Model update
	Urgency	Baseline		DT Integration	Data gathering	
WCG	Power					
	Legitimacy	Bike selection	Hub Design			
	Urgency	Workshops	Workshops		Maintain	
Grid Operators	Power					
	Legitimacy	Challenge				Monitor
	Urgency					Results
DB	Power					
	Legitimacy	Localisation				
	Urgency	Workshop		Placing	On site	

- DB shares both insights from the previous hub and is determining for the new location. They should be involved in joint knowledge production. A similar role of insight provision is dedicated to WUEB, who provides shared situational awareness.

- The Data supporting partners of PTV and the Urban Data Platform are external stakeholders that enrich the DT. They are specifically needed during the setup process and piloting, but are represented through the DT actors.
- Citizens, grid operators, and retailers are external stakeholders. Their co-design or baseline input is formative for the pilot, but beyond those moments of consultation, these stakeholders have a more validating role than a strategic one.

This creates the following Stakeholder division, as shown in Table 43.

Table 43. Frankfurt Stakeholder Division

Core Team	Operational Stakeholders	External Stakeholders
Municipality of Frankfurt HOLM WCG Logistics Dialogue Roundtable	LIST FUAS Logistics Operators WUEB DB	PTV Urban Data Platform Citizens Retailers Grid Operator

Heidelberg

The Heidelberg pilot, following both The Hague and Wroclaw, focuses on the development and implementation of **Smart Loading Zones (SLZ)** and **Microhubs** with electric cargo bikes to improve urban logistics efficiency and reduce congestion, emissions, and safety risks. The pilot will leverage advanced **Digital Twin (DT) capabilities** and **Smart Loading Zones (SLZ)** to optimise the use of loading zones and reduce inefficiencies caused by illegal parking and delivery-related traffic. The pilot site will be defined in the planning phase, considering several districts with high logistics pressure and limited curbside space, including Bergheim, Neuenheim, Weststadt, and the Old Town, particularly its 2 km-long pedestrian zone [76]. With this description, the stakeholders, their task, and inferred power and interest levels can be seen in Table 44. The higher the value, the higher the power and influence, with 3 being the highest and 1 the lowest.

Table 44. Heidelberg Stakeholder Categories and Matrix

Stakeholder	Actors	Involvement	P	I
Government/Public Authorities	Municipality of Heidelberg Dept. of Economic Development and Mobility	Pilot Lead Engage local stakeholders Feedback on Policy	2	3
Logistics Operators	Operators and Shop owners	Ad hoc engagement; no commitment	2	2
Retailers/Shippers	Show owners	Compete for space; no engagement	1	2
Citizens/Residents	Residents, visitors,	Affected by illegal parking; consulted	1	1
Academia	LIST, FUAS, UniR3	DT	3	3
	BUAS	The Hague Insights	2	2
	UniR1, MUV, MOV	Incentives and Rewards	3	3
	WUEB	Wroclaw Insights	2	2
Technology Providers	PKUN	SLZ provider	3	3
	Trans	DT provider	3	3
	WCG	Hub Provider	3	3
Enforcement	Heidelberg Police	Parking tickets	3	1
Infrastructure providers	DB	Site provision	3	2

This initial scoring, together with the outlined tasks, can now be used to assess the Influence, Legitimacy, and Urgency, depending on the phase of the Pilot, the darker the shade, the higher the value, as shown in Table 45.

The Stakeholder Salience Model of Heidelberg shows that:

- The municipality, solution providers, and the DB make up the core team as they are continuously involved in the pilot. The implemented solutions form the main structure of the pilot, and this requires a spatial determination at the start.
- BUAS and WUEB form supporting actors with insights, but do not determine the design of the pilot. As such, they are operational actors, but an academic partner for the pilot is missing.
- Contrary to other pilots, the affected stakeholders and users are only onboarded later and miss a covenant engagement. Citizens, retailers, even logistics operators, are not envisioned to be involved earlier on. This requires a strong core team organisation, as stakeholder tailoring is kept to a minimum. *Following Wroclaw's pilot, it is advised to involve operators and enforcement earlier.*
- With the current stakeholder profile, the Heidelberg pilot aims at testing out an integrated solution, yet stakeholder engagement and co-creation is kept relatively low.

Table 45. Heidelberg Stakeholder Saliency Model

		Pre-Pilot	Design	Implement	Pilot	Post-Pilot
		Analysis of loading/unloading zone usage, demand patterns, traffic conditions, and regulatory constraints. DT traffic conditions		Track implementation, stakeholder engagement, business model, continuous data collection,		Assess governance arrangements, access rules, responsibilities, replication
Municipality	Power		Localising			Feedback
	Legitimacy	Policy				Policy
	Urgency	Stakeholder				
WUEB	Power	Facilitator	Insights			
	Legitimacy	Insights				Reflect
	Urgency	Sharing				
BUAS	Power	Facilitator				
	Legitimacy	Insights	Insights			Reflect
	Urgency	Sharing				
Logistic Operators	Power					
	Legitimacy			Purchase	Feedback	Experience
	Urgency			Ad hoc	Testing	
Retailers	Power					
	Legitimacy				Consulted	
	Urgency				Affected	
Citizens	Power					
	Legitimacy				Affected	Opinion
	Urgency				Testing	
DT Team	Power					
	Legitimacy	DT	DT		DT	
	Urgency			Hook up DT	GPS data	
I&R	Power		Design			
	Legitimacy	Experts		Rollout		
	Urgency					
Enforcement	Power			Familiarise		
	Legitimacy				Enforcement	
	Urgency			Onboard	SLZ use	
WCG	Power					
	Legitimacy	Bike selection	Hub Design			
	Urgency	Workshops	Workshops		Maintain	
PKUN	Power					
	Legitimacy	SLZ offer	SLZ design	SLZ design	Implement	Evaluate
	Urgency				Data	
DB	Power					
	Legitimacy	Localisation				
	Urgency	Workshop		Placing	On site	

This creates the following Stakeholder division, as shown in Table 46.

Table 46. Heidelberg Stakeholder Division

Core Team	Operational Stakeholders	External Stakeholders
Municipality PKUN WCG LIST & FUAS & Exe UniR1, MUV, MOV DB	BUAS WUEB	Residents Retailers Logistics Operators Police

Annex B: Stakeholder engagement planning per pilot city

Aarhus Stakeholder Engagement Planning

	Pre-Pilot	Design	Implementation	Pilot	Post-Pilot
General	<ul style="list-style-type: none"> Categorical Stakeholder Framework Community of Place/interest/practice Allies/Neutrals/Adversaries Motivation Matrix Onboarding internal 5-step engagement Core Team + CNLN		<ul style="list-style-type: none"> Community Learning Calls Core Team + Operational	<ul style="list-style-type: none"> Community Learning Calls Core Team + Operational	
15 min City	<ul style="list-style-type: none"> Walkshop Onboarding internal Community of Place/interest/practice Allies/Neutrals/Adversaries Municipality, DTU, PostNord, CphM, DSB, Enforcement	<ul style="list-style-type: none"> Design Oriented Scenarios XR Simulations Municipality, DTU, PostNord, CphM, DSB, Enforcement	<ul style="list-style-type: none"> Onboarding – Street side Open day Rough Prototyping Service Blueprint DTU, CphM, DSB, Enforcement, External Stakeholders	<ul style="list-style-type: none"> Conversational urbanism Walkshop Quick Surveys DTU, CphM, DSB, Enforcement, External Stakeholders	
I&R	<ul style="list-style-type: none"> Value ladder Empathy map Municipality, DTU, UniR1, MUV, MOV,	<ul style="list-style-type: none"> Crazy 8 Large question cards World Café Dot voting Cultural Probe Municipality, DTU, PostNord, UniR1, MUV, MOV, External Stakeholders	<ul style="list-style-type: none"> Onboarding – Street side Quick Surveys Cultural Probe DTU, MUV, UniR1 + External Stakeholders	<ul style="list-style-type: none"> Backcasting DTU, MUV, UniR1 + External Stakeholders	
Digital Twin	<ul style="list-style-type: none"> Onboarding Internal Municipality, DTU, LIST, CBS			<ul style="list-style-type: none"> Hackaton DTU, LIST, External Stakeholders	
ADAV			<ul style="list-style-type: none"> 3-scenario framework LIST, DTU, Municipality, PostNord, Residents, Retailers	<ul style="list-style-type: none"> Hackathon XR Simulations LIST, DTU, External Stakeholders	<ul style="list-style-type: none"> Hackathon XR Simulations LIST, DTU, Municipality

Dublin Stakeholder Engagement Planning

	Pre-Pilot	Design	Implementation	Pilot	Post-Pilot
General	<ul style="list-style-type: none"> Categorical Stakeholder Framework Community of Place/interest/practice Allies/Neutrals/Adversaries Motivation Matrix Onboarding internal 5-step engagement Core Team		<ul style="list-style-type: none"> Community Learning Calls Core Team + Operational	<ul style="list-style-type: none"> Community Learning Calls Core Team + Operational	
I&R	<ul style="list-style-type: none"> Value ladder Empathy map Municipality, TCD, UniR1, MUV, MOV,	<ul style="list-style-type: none"> Crazy 8 Large question cards World Café Dot voting Cultural Probe Municipality, TCD, Citizens, UniR1, MUV, MOV,	<ul style="list-style-type: none"> Quick Surveys Cultural Probe Onboarding – Street side TCD, MUV, UniR1 + External Stakeholders	<ul style="list-style-type: none"> Backcasting Cultural Probe TCD, MUV, UniR1 + External Stakeholders	
Digital Twin	<ul style="list-style-type: none"> Onboarding Internal Municipality, TCD, LIST, FUAS EXE	<ul style="list-style-type: none"> Onboarding internal Reverse Engineering TCD, LIST, FUAS, Transport Providers	<ul style="list-style-type: none"> Community Learning Calls Core Team + Operational	<ul style="list-style-type: none"> Hackaton TCD, LIST, External Stakeholders	
AR Tool	<ul style="list-style-type: none"> Onboarding internal Quick Survey TCD, TU Delft, Municipality	<ul style="list-style-type: none"> Design Oriented Scenarios Rough prototyping Quick Survey Cultural Probe TCD, TU Delft, Citizens	<ul style="list-style-type: none"> XR Simulation on bike parking TCD, TU Delft, Citizens	<ul style="list-style-type: none"> XR Simulation on bike parking TCD, TU Delft, Citizens	

The Hague Stakeholder Engagement Planning

	Pre-Pilot	Design	Implementation	Pilot	Post-Pilot
General	<ul style="list-style-type: none"> Categorical Stakeholder Framework Community of Place/interest/practice Allies/Neutrals/Adversaries Motivation Matrix Onboarding internal 5-step engagement Core Team + Covenants		<ul style="list-style-type: none"> Community Learning Calls Core Team + Communication Expert	<ul style="list-style-type: none"> Community Learning Calls Core Team + Communication Expert	
SLZs	<ul style="list-style-type: none"> Walkshop Onboarding internal Municipality, BUAS, PKUN,, Logistics Operators, Covenants	<ul style="list-style-type: none"> Design Oriented Scenarios Crazy 8 XR Simulations Large question cards World Café Dot voting Rough Prototyping Municipality, BUAS, PKUN Logistics Operators + External Stakeholders	<ul style="list-style-type: none"> Onboarding – Street side Open day Service Blueprint BUAS, PKUN, Enforcement, External Stakeholders, Logistics Operators	<ul style="list-style-type: none"> Conversational urbanism Walkshop Quick Surveys BUAS, PKUN, Municipality, Logistics Operators, External Stakeholders	
Electrification	<ul style="list-style-type: none"> Onboarding internal Allies/Neutrals/Adversaries Cultural Probes Reverse Engineering Backcasting MAMCA Municipality, UniLu, Logistics Operators		<ul style="list-style-type: none"> Service Blueprint UniLu, BUAS, Logistics Operators, Retailers, Municipality	<ul style="list-style-type: none"> Hackathon UniLu, BUAS	
Digital Twin	<ul style="list-style-type: none"> Onboarding Internal Municipality, BUAS, LIST, FUAS, Covenant, ANPR, SME			<ul style="list-style-type: none"> Hackaton BUAS, LIST, FUAS	

Wroclaw Stakeholder Engagement Planning

	Pre-Pilot	Design	Implementation	Pilot	Post-Pilot
General	<ul style="list-style-type: none"> Categorical Stakeholder Framework Community of Place/interest/practice Allies/Neutrals/Adversaries Motivation Matrix Onboarding internal 5-step engagement Core Team + FQP		<ul style="list-style-type: none"> Community Learning Calls Core Team + Operational	<ul style="list-style-type: none"> Community Learning Calls Core Team + Operational	
MicroHub	<ul style="list-style-type: none"> Walkshop Onboarding internal Community of Place/interest/practice Allies/Neutrals/Adversaries Municipality, WUEB, Interparking, WCG, FQP	<ul style="list-style-type: none"> Design Oriented Scenarios Crazy 8 XR Simulations Large question cards World Café Dot voting Rough Prototyping XR Simulations on hub design Municipality, WUEB, WCG, Architect, FQP, Logistics Operators, TU Delft	<ul style="list-style-type: none"> Onboarding – Street side Open day Service Blueprint WUEB, WCG, Retailers, Logistics Operators, Interparking	<ul style="list-style-type: none"> Conversational urbanism Walkshop Quick Surveys WUEB, WCG, Retailers, Logistics Operators, Interparking, Residents	<ul style="list-style-type: none"> Hackathon WUEB, Municipality, LIST
Digital Twin	<ul style="list-style-type: none"> Onboarding Internal Municipality, LIST, FUAS, Exe/Trans, GPS Data			<ul style="list-style-type: none"> Hackaton LIST, WUEB	
XR Tool	<ul style="list-style-type: none"> Onboarding internal Quick Survey WUEB, TU Delft, Municipality	<ul style="list-style-type: none"> Design Oriented Scenarios Rough prototyping Quick Survey Cultural Probe WUEB, WCG, TU Delft	<ul style="list-style-type: none"> XR Simulation on hub use WUEB, WCG, TU Delft, Citizens, retailers, logistics operators		

Bergamo Stakeholder Engagement Planning

	Pre-Pilot	Design	Implementation	Pilot	Post-Pilot
General	<ul style="list-style-type: none"> Categorical Stakeholder Framework Community of Place/interest/practice Allies/Neutrals/Adversaries Motivation Matrix Onboarding internal 5-step engagement Core Team + Stakeholder Table		<ul style="list-style-type: none"> Community Learning Calls Core Team	<ul style="list-style-type: none"> Community Learning Calls Core Team	
SLZs	<ul style="list-style-type: none"> Walkshop Onboarding internal Reverse Engineering Backcasting Empathy Map Municipality, UniBer, BUAS, PKUN, Logistics Operators, ATB Bergamo	<ul style="list-style-type: none"> Design Oriented Scenarios Crazy 8 Large question cards World Café Dot voting Rough Prototyping Municipality, UniBer, BUAS, PKUN, Logistics Operators + External Stakeholders, ATB	<ul style="list-style-type: none"> Onboarding – Street side Open day Service Blueprint UniBer, PKUN, Enforcement, Citizens, Retailers, Logistics Operators, ATB Bergamo	<ul style="list-style-type: none"> Conversational urbanism Walkshop Quick Surveys UniBer, PKUN, Municipality, Logistics Operators, External Stakeholders	
Electrification	<ul style="list-style-type: none"> Onboarding internal Allies/Neutrals/Adversaries Cultural Probes Reverse Engineering Backcasting MAMCA Municipality, UniLu, Logistics Operators, Stakeholder Table		<ul style="list-style-type: none"> Service Blueprint UniLu, UniBer, Logistics Operators, Retailers, Municipality, Grid operator	<ul style="list-style-type: none"> Hackathon UniLu, UniBer	
Digital Twin	<ul style="list-style-type: none"> Onboarding Internal Municipality, UniBer, LIST, FUAS, Grid Operator, ATB Bergamo, Retailer			<ul style="list-style-type: none"> Hackaton UniBer, LIST, FUAS	
ADAV			<ul style="list-style-type: none"> 3-scenario framework LIST, UniBer, Municipality, Logistics Operators, Retailers	<ul style="list-style-type: none"> Hackathon LIST, UniBer, External Stakeholders	<ul style="list-style-type: none"> Hackathon LIST, UniBer, Municipality

Differdange Stakeholder Engagement Planning

	Pre-Pilot	Design	Implementation	Pilot	Post-Pilot
General	<ul style="list-style-type: none"> Categorical Stakeholder Framework Community of Place/interest/practice Allies/Neutrals/Adversaries Motivation Matrix Onboarding internal 5-step engagement Core Team + Covenant		<ul style="list-style-type: none"> Community Learning Calls Core Team	<ul style="list-style-type: none"> Community Learning Calls Core Team	
SLZs	<ul style="list-style-type: none"> Walkshop Onboarding internal Reverse Engineering Backcasting Empathy Map Municipality, UniLu, BUAS, PKUN, Logistics Operators,	<ul style="list-style-type: none"> Design Oriented Scenarios Crazy 8 Large question cards World Café Dot voting Rough Prototyping Municipality, UniLu, BUAS, PKUN Logistics Operators + External Stakeholders	<ul style="list-style-type: none"> Onboarding – Street side Open day Service Blueprint UniLu, PKUN, Enforcement, External Stakeholders, Logistics Operators	<ul style="list-style-type: none"> Conversational urbanism Walkshop Quick Surveys UniLu, PKUN, Municipality, Logistics Operators, External Stakeholders	
Electrification	<ul style="list-style-type: none"> Onboarding internal Allies/Neutrals/Adversaries Cultural Probes Municipality, UniLu, Logistics Operators, Logistics Covenant		<ul style="list-style-type: none"> Service Blueprint UniLu, Logistics Operators, Retailers, Citizens, Municipality, Grid operator	<ul style="list-style-type: none"> Hackathon UniLu, Citizens, Retailers	
Digital Twin	<ul style="list-style-type: none"> Onboarding Internal Municipality, UniLu, LIST, FUAS, BUAS, MATSim			<ul style="list-style-type: none"> Hackaton UniLu, LIST, FUAS, MATSim	
ADAV			<ul style="list-style-type: none"> Data Stories LIST, UniLu, Municipality, Logistics Operators, Retailers	<ul style="list-style-type: none"> Hackathon LIST, UniLu, External Stakeholders	<ul style="list-style-type: none"> Hackathon LIST, UniLu, Municipality

Frankfurt Stakeholder Engagement Planning

	Pre-Pilot	Design	Implementation	Pilot	Post-Pilot
General	<ul style="list-style-type: none"> Categorical Stakeholder Framework Community of Place/interest/practice Allies/Neutrals/Adversaries Motivation Matrix Onboarding internal 5-step engagement Core Team + Logistics Dialogue Roundtable		<ul style="list-style-type: none"> Community Learning Calls Core Team + Operational	<ul style="list-style-type: none"> Community Learning Calls Core Team + Operational	
MicroHub	<ul style="list-style-type: none"> Walkshop Onboarding internal Community of Place/interest/practice Allies/Neutrals/Adversaries Municipality, HOLM, WCG, WUEB, DB	<ul style="list-style-type: none"> Design Oriented Scenarios Crazy 8 XR Simulations Large question cards World Café Dot voting Rough Prototyping XR Simulations on hub design Municipality, HOLM, WUEB, WCG, Logistics Operators, DB	<ul style="list-style-type: none"> Onboarding – Street side Open day Service Blueprint HOLM, WCG, Retailers, Logistics Operators, DB	<ul style="list-style-type: none"> Conversational urbanism Walkshop Quick Surveys HOLM, WCG, Retailers, Logistics Operators, DB, Residents	<ul style="list-style-type: none"> Hackathon HOLM, Municipality, LIST
Digital Twin	<ul style="list-style-type: none"> Onboarding Internal Municipality, LIST, FUAS, Exe/Trans, PTV, Urban Data Platform	<ul style="list-style-type: none"> Design Oriented Scenarios LIST, FUAS, Exe/Trans, Municipality, PTV, Urban Data Platform		<ul style="list-style-type: none"> Hackaton LIST, PTV, FUAS	

Heidelberg Stakeholder Engagement Planning

	Pre-Pilot	Design	Implementation	Pilot	Post-Pilot
General	<ul style="list-style-type: none"> Categorical Stakeholder Framework Community of Place/interest/practice Allies/Neutrals/Adversaries Motivation Matrix Onboarding internal 5-step engagement Core Team		<ul style="list-style-type: none"> Community Learning Calls Core Team	<ul style="list-style-type: none"> Community Learning Calls Core Team	
SLZs	<ul style="list-style-type: none"> Walkshop Onboarding internal Municipality, BUAS, PKUN, Logistics Operators, DB	<ul style="list-style-type: none"> Design Oriented Scenarios Crazy 8 XR Simulations Large question cards World Café Dot voting Rough Prototyping Municipality, BUAS, PKUN Logistics Operators, Police	<ul style="list-style-type: none"> Onboarding – Street side Open day Service Blueprint PKUN, Police, External Stakeholders, Logistics Operators	<ul style="list-style-type: none"> Conversational urbanism Walkshop Quick Surveys PKUN, Municipality, External Stakeholders	
Microhubs	<ul style="list-style-type: none"> Walkshop Onboarding internal Community of Place/interest/practice Allies/Neutrals/Adversaries Municipality, WUEB, DB, WCG	<ul style="list-style-type: none"> Design Oriented Scenarios Crazy 8 XR Simulations Large question cards World Café Dot voting Rough Prototyping XR Simulations on hub design Municipality, WUEB, WCG, Logistics Operators	<ul style="list-style-type: none"> Onboarding – Street side Open day Service Blueprint WUEB, WCG, Retailers, Logistics Operators, DB	<ul style="list-style-type: none"> Conversational urbanism Walkshop Quick Surveys WCG, Retailers, Logistics Operators, DB, Residents	
Digital Twin	<ul style="list-style-type: none"> Onboarding Internal Municipality, LIST, FUAS, EXE,			<ul style="list-style-type: none"> Hackaton BUAS, WUEB, LIST, FUAS	