SPINE
Smart Public
transport Initiatives
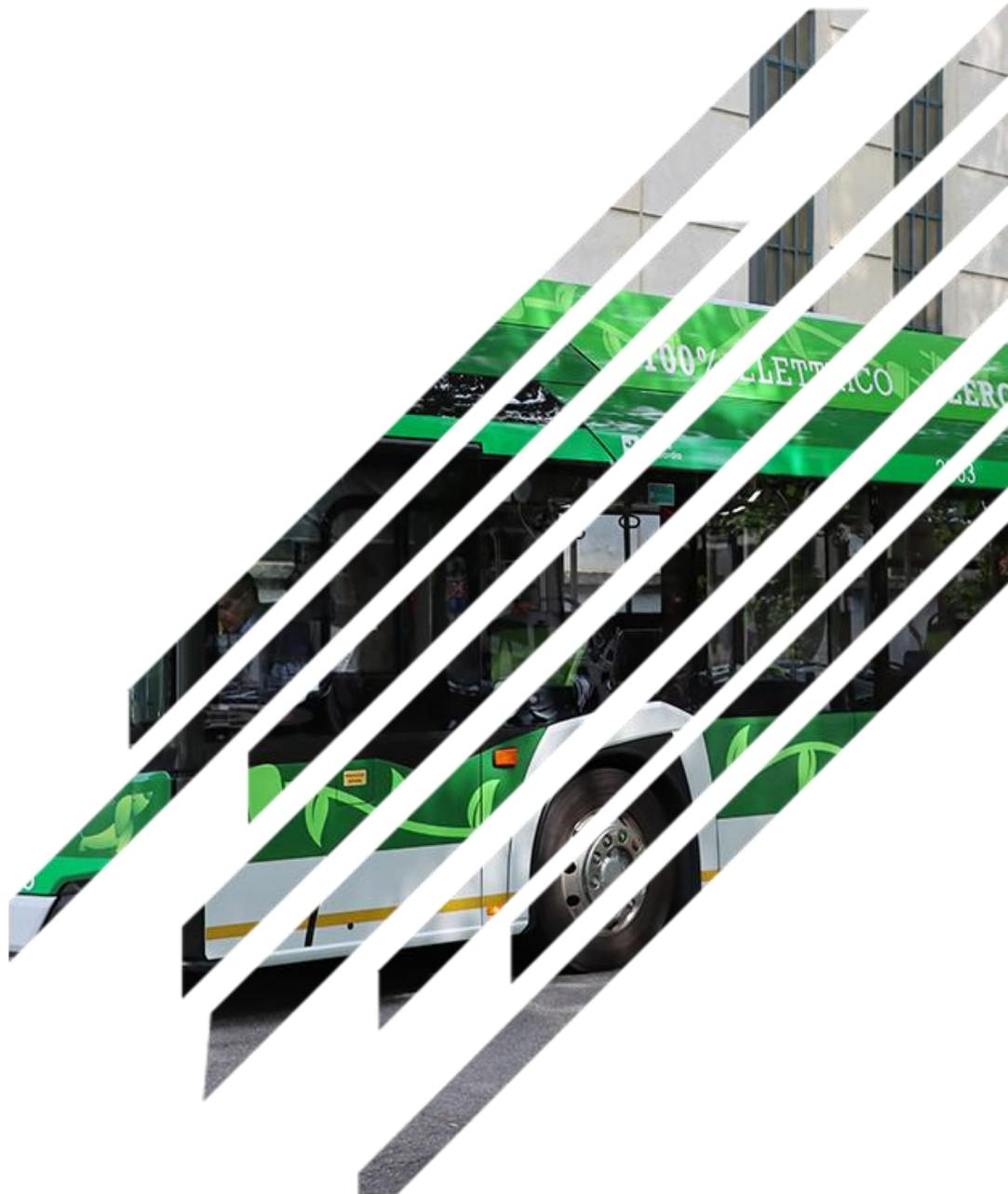for climate-Neutral
cities in Europe

Smart Public transport Initiatives for climate
Neutral cities in Europe

D2.1 Living Labs Report & Legacy Version 1

Document Summary Information

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V1.0	9/1/2023	5	Initial Deliverable Structure	Chris Van Maroey, Silvia Bartoloni
V2.0	14/2/2023	20	Updated Deliverable Structure and Population of some sections	Chris Van Maroey, Silvia Bartoloni, Chiara Lepori
V3.0	1/3/2024	90	First Complete version – for internal review	Chris Van Maroey, Silvia Bartoloni, Chiara Lepori
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Glossary of terms and abbreviations used

Abbreviation / Term	Description
API	Application Programming Interface (a software intermediary that allows two applications to talk to each other. API's are an accessible way to extract and share data within and across organisations)
EV	Electric Vehicle
GDPR	General Data Protection Regulation
KPI	Key Performance Indicator
LC	Lead City
LEZ	Low Emission Zone
LL	Living Lab
MaaS	Mobility-as-a-Service
Mobility HUB	A place that is central to a mobility network or a group of mobility services, for passengers and / or freight.
MS	Measure
NDA	Non Disclosure Agreement

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1 According to SPINE's Quality Assurance Process

P&R	Park and Ride
PT	Public Transport
SaaS	Software-as-a-Service
SCP	Smart City Platform
SIAF	The tracking method introduced in SPINE to manage and monitor project progress. The acronym SIAF stands for the 4 life cycle phases of the project (Start, Implementation, Activation and Finish).
TC	Twinning City

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1. Executive Summary

Deliverable 2.1 (D2.1) stands as a comprehensive report elucidating the knowledge, barriers, and challenges encountered during the implementation phase of the SPINE Lead cities' Living Labs. This document encapsulates the actions undertaken, articulates conclusions drawn at specific milestones, and accentuates the significance of knowledge exchange, acknowledging cultural and social disparities across various Living Lab contexts.

This report is a first consolidation of the Legacy originating from the Lead cities' LLs. This first version serves to establish the playground, therefore it details the approach, barriers, and challenges encountered during the implementation phase of the Lead Cities Living Labs until February 15, 2024. The final version will follow in the deliverable D2.2 that will be prepared at the end of the LL activities (foreseen in December 2025). The final version will provide more in-depth documentation on cities' actions and lessons learnt, also reporting justification in case of any changes in comparison to the initial deliverable. A simple yet effective methodology has been devised to orchestrate the operations of physical and digital spaces within the SPINE Living Labs. The SIAF tracking method, developed by the City of Antwerp, divides the project lifecycle into four distinct phases: Start, Implementation, Activation, and Finish, fostering clear communication and decision-making among stakeholders. Quarterly knowledge exchange sessions, spanning different Work Packages (WP2, WP3, and WP4), are organized to promote collaborative learning and synergy among project partners.

Furthermore, to consolidate the knowledge emanating from SPINE implementation in the cities, a comprehensive Logbook has been instituted. This Logbook, an excel document named "Event Logbook for SPINE cities", is intended as a living document, available to all cities in the SPINE shared project folder, and to be updated during the whole lifespan of the project to collect continuous input from the implementation processes in cities. The Logbook will therefore feed D2.1 LLs Report and Legacy Version 1 and D2.2 LLs Report and Legacy Final Version with knowledge by Lead cities, and D4.1 "Twinning Activities report and Legacy - Version 1" and D4.2 "Twinning Activities report and Legacy - Final Version" with experiences from Twinning cities.

An initial analysis of registered events and lessons learned from the logbook is compiled in the Living Lab catalogue provided in this first version of the deliverable. So far, three main themes emerge as basic elements to be reported: data, synergies and management issues.

Since this deliverable necessarily focuses on the preliminary stages of city activities, the knowledge generated mainly revolves around the preparation phases of measures and the early implementation stages. This mainly results in an increased awareness of technical requirements and open data, the imperative of translating theoretical approaches into practical solutions, and an enhanced readiness to navigate unforeseen complexities.

As the project progresses towards its culmination, efforts will be intensified to enhance the Logbook system, ensuring cities comprehend the value of their contributions. The forthcoming deliverable (D2.2 LLs report and legacy final version) envisages an expanded repository of lessons learned and knowledge exchange, culminating in a deeper impact of project actions.

2. Introduction

For the development of this deliverable, the following SPINE documents were taken into consideration:

- Grant Agreement (GA), Reference number: 101096664, to ensure that the agreed activities and outputs are delivered in this deliverable.

2.1 Mapping SPINE Outputs

The purpose of this section is to map SPINE's Grant Agreement commitments, both within the formal Deliverable and Task description, against the project's respective outputs and work performed.

SPINE GA Component Title	SPINE GA Component Outline	Respective Document Chapter(s)	Justification
DELIVERABLE			
D2.1 LLs Report and Legacy Version 1	Consolidated report with *generated knowledge, barriers and challenges faced during the LLs implementation phase*.	Chapter 4	Chapter 4 describes in detail how and when information about barriers, challenges and generated knowledge is collected during the implementation phase
	Production of a LL catalogue updated during the life of the project (re-reported in D4.1) to document experiences and learnings from the different LLs activities, *including contributions collected thanks to the "cross-pollination meetings"*, also *considering cultural and social differences in the different LL contexts*.	Chapter 5	Chapter 5 presents the LL catalogue, its structure, aim and timeline for updates through the project lifespan. It also describes the contribution of the LL catalogue to the twinning activities (WP4), highlighting cultural and social differences in the different LL context so to enable / facilitate the cross-fertilization among the cities.
TASKS			
T2.1. Lead Cities coordination and orchestration	*Undertakes the critical effort of managing, orchestrating and coordinating the activities across all LLs in the lead cities.* Specific steps towards achieving an optimal operation of the LLs	Chapter 3	Chapter 3 describes the overall LLs coordination, orchestration and exchange of knowledge through the use of a monitor, control and filter tool.
T2.6 Lessons learned and barriers' identification	Runs horizontally across all lead LLs and registers lessons learned,	Chapter 4	Chapter 4 outlines the connection of T2.6 with Tasks 2.2, 2.3, 2.4 and 2.5 and explains the importance to register lessons learned from the LL implementation in Lead cities for generated knowledge to support co-

			creation processes both among lead cities and among lead and twinning cities.
	Collects and organizes generated knowledge, *documenting the barriers to implementing non-qualified solutions and the challenges faced when implementing qualified innovations*.	Chapter 5	Chapter 5 outlines the steps followed into preparing a LL catalogue, outlining the process leading to its creation: from the analysis of the risk registry included in D7.1, through the drafting of a Logbook to collect best practices and lessons learned and its update at certain planned key moments (WP2 monthly meetings, cross-pollination activities, specific meetings with lead cities to follow the implementation process,…),

Table 1: Adherence to SPINE's GA Deliverable & Tasks Descriptions

2.2 Deliverable Overview and Report Structure

Chapter 1 and 2 consists of a general introduction and summary of this deliverable.

Chapter 3 builds on the collaboration with WP1 and aligns with the D1.1 "Inception Report" of the SPINE Living Labs. It provides a comprehensive overview of SPINE measures within Lead Cities, highlighting the strategic significance of collaborative efforts and the evolving role of SPINE solutions in urban development initiatives. Monitoring milestones from D1.1 are translated into an Excel timeline, facilitating filtering of specific measures and integrating delivery timelines for work packages WP2, WP3, and WP4. The SIAF tracking method is introduced to manage and monitor project progress, dividing the project lifecycle into *Start (S)*, *Implementation (I)*, *Activation (A)*, and *Finish (F)* phases. Quarterly knowledge exchange sessions per topic or measure are established to share experiences, pinpoint bottlenecks, and fine-tune milestones. Sessions, moderated by Halmstad University, include presentations by city representatives, expert panel discussions, and Q&A sessions, both online and physical.

Chapter 4 outlines the process of transitioning lead city experiences into a tool, the "catalogue," serving as the legacy of implementation processes for best practices and lessons learned. A Logbook is created to collect knowledge from SPINE implementation, involving COBO, SRM, UAEGEAN, and Halmstad University. The Logbook, accessible to all SPINE cities, is continuously updated to document input from city implementation processes. Internal and externally impacting events are registered, with 14 events registered till 15th of February 2024.

Chapter 5 details how information collected in Chapter 4 is systemized and organized into a real catalogue of best practices. Main lessons learned at this stage of the project, are generated by the implementation in the Lead Cities of Multimodal Hubs and by some technological solutions that are developed/implemented in collaboration with SPINE technical partners (MaaS, Smart City Platform, analytical activities around LEZ and PT prioritization services). Analyzing the events and lessons learned registered by SPINE cities, and going through the actions taken, three main themes emerge as basic elements to be reported: data, synergies and management issues (both internal and external to the project). As already stated, this deliverable necessarily focuses on the preliminary stages of city activities, the knowledge generated mainly revolves around the preparation phases of measures and the early implementation stages. This mainly results in an increased awareness of technical requirements and open data, the imperative of

translating theoretical approaches into practical solutions, and an enhanced readiness to navigate unforeseen complexities.

To conclude, the "Event Logbook for SPINE cities" has proven to be an effective tool to collect information from cities. In view of the final version of this deliverable (D2.2 "LLs Report and Legacy Final Version"), due at M36 (December 2025) and as potential future improvement of the Logbook system, even more effort will be made by the cities in order to capture the lessons learned and knowledge supporting implementation of SPINE solutions.

3. Consolidated Lead Cities Living Labs Schedule

3.1 Living Labs Implementation Monitor and Control system

3.1.1 Identified Lead Cities SPINE measures

This chapter builds upon the collaboration with WP1 and further shapes and aligns with the Inception Report D1.1 of the SPINE Living Labs. Additionally, D1.2 serves as a comprehensive presentation and description of the initial basket of SPINE solutions, effectively mapping them onto the diverse urban landscapes of the involved cities. This phase not only marks a significant point in the project but also establishes a foundation for the subsequent stages or milestones of implementation.

Within the context of lead cities, a comprehensive overview is provided in relation to the identified SPINE measures. This insight serves to underscore the strategic significance of the collaborative efforts and the evolving role of SPINE solutions in the urban development initiatives undertaken by the lead cities.

The following table gives an overview of the actual SPINE measures currently being implemented in the Lead Cities Living Labs.

Measure	Antwerp	Bologna	Tallinn	Las Palmas
MS1: Multimodal hubs	✓	✓	✓	✓
MS2: Real-time information for passengers	✓			
MS3: Multimodal journey planner app	✓			
MS4: EV charging stations		✓		
MS5: Inclusive mobility services		✓		
MS6: MaaS		✓	(✓)	
MS7: LEZ (Low Emission Zone)		✓		
MS8: Smart City Platform		✓	(✓)	
MS9: Citizen Mobility App / Micro-incentives program		✓	✓	
MS10: Logistics solutions		✓		
MS11: Bike Renting services			✓	✓
MS12: Smart Park and Ride Management			✓	
MS13: Traffic Management / PT prioritization services	✓	✓		✓
MS14: Mobility Management Software feature extension				✓
MS19: Environment Sensors			✓	

Table 2. SPINE Measures for Lead Cities

MS1 - Multimodal hubs

MS1 – Antwerp: The city will further develop and improve five mobility hubs within the SPINE project. These hubs are key nodes in the mobility network of Antwerp and its functional urban area. The measures to be made through the SPINE project are related to wayfinding, digital signs and improvements in real-time data. For each location, a redesign is done for the surrounding space. Based on this redesign, wayfinding locations are defined based on the existing infrastructure.

MS1 – Bologna: The city will focus on the implementation of collaborative mobility in three multimodal hubs located in the urban area of the city (within 5-6 kms from the historical center of the city. The aim of the city of Bologna within SPINE project is to integrate offered mobility services and equip multimodal hubs with innovative and inclusive facilities to improve passengers' experience and satisfaction such as (a) on-site interactive screens as well as speakers and braille displays to provide real-time information to passengers

regarding arrivals, delays, and possible crowding of buses and train carriages; (b) deployment of efficient color markings; (c) digital signages at the hubs to inform and entertain passengers while waiting.

MS1 – Tallinn: In Tallinn, SPINE will enhance one multimodal hub, with the installation of two-sided screens at the center of the hub to showcase all available mobility services, such as e-scooters, shared cars, and public transportation options. The screens will prominently display QR-Codes to enable users to download the city's MaaS app conveniently. To achieve this the city will collaborate with private companies since it does not own the land where the hub will be established.

MS1 - Las Palmas: Las Palmas will improve the user experience and promote multimodality at three bus stations ("7 Palmas", "La Ballena" and "Auditorio") The station "Auditorio" is a terminal stop while the other two are in the upper city, where accessibility is poorer and thus micromobility (e-bikes) will play a significant role. In the multimodal hubs, multimodality will be promoted with the provision of other mobility services than the bus, including bike-sharing, scooters and taxi in some cases. These multimodal hubs will also include: 1) implementation of wayfinding (color marking on the floor or bus stops) and signaling to facilitate the modal change or bus change, 2) installation of digital screens (for real time information, integrating the existing solutions for blind people, for information regarding the other transport modes available in the hub, for the publication of air quality parameters, etc. 3) simulation models of the mobility hubs by the technical partners of WP3 within SPINE

MS2 - Real-time information for passengers

MS2 – Antwerp: Real-time passenger information systems for PT provide accurate departure and arrival times, as well as timely updates on service disruptions and potential delays enabling passengers to plan their journeys and use their time efficiently. The ultimate goal of this measure is to increase PT usage by offering customers a better-quality service. In Antwerp, real-time information (e.g. updated PT information, route planners etc.) will be displayed on the digital screens of the multimodal hubs, (see also Section MS1) as well as integrated into the mobility app.

MS3 - Multimodal journey planner app

MS3 – Antwerp: Currently a functional route planner with navigational support is available in Antwerp. Within SPINE, MS3, Antwerp's main objective is to integrate and improve the real-time data integration in the existing route planner and mobility map of 'Smart Ways to Antwerp'.

MS4 - EV charging stations

.**MS4 - Bologna**: EV charging stations are stationary infrastructure that provide electric energy for the recharging of electric vehicles, such as cars, bicycles and scooter. Currently, Bologna's EV charging stations within a 250-meter radius of the train stations are limited. At present, the Mazzini hub, the one multimodal hub considered in SPINE, has only one charging station, while at Casteldebole and Corticella hubs (the other hubs of SPINE) EV charging stations will be installed in the next few years. Within SPINE, the city will utilise the public parking spaces surrounding the stations to deploy charging stations for EVs. The stations in Bologna will consider the provision of improved accessibility for users with special mobility needs. They will be equipped with accessibility interventions such as ramps and covered roofs, catering to individuals with unique mobility requirements. Special plugs accessible to wheelchair users will also be incorporated, fostering a user-friendly environment for all EV drivers.

MS5 - Inclusive mobility services

MS5 – Bologna: By providing transportation alternatives to all citizens, this measure endeavors to bridge the gaps in accessibility and ensure that mobility is equally accessible and available to everyone.

This is mainly linked with MS1 (Multimodal hubs) where a number of inclusive interventions will be employed to make mobility services in the city more equal. More specifically, MS5 in Bologna includes braille and audio communication for visually impaired users, visual instructions and efficient color marking for hearing impaired users included in digital signages and kiosks, information in different languages, etc.

MS6 - Mobility as a Service (MaaS)

MS6 - Bologna: The MaaS solution is aimed at improving smart mobility in the metropolitan area. An integrated multimodal travel planner will be developed. It will provide insights into mobility demand and the basis for further integration of mobility operators.

MS6 – Tallinn: The SPINE MaaS solution in Tallinn focuses mainly on the mobility operator's API development. This measure is currently on hold because of the lack of interest of the mobility providers to integrate, due to the absence of APIs in the technical solutions of mobility operators.

MS7 - Low Emission Zone (LEZ)

MS7 - Bologna: A low-emission zone (LEZ) is a designated geographic area where access to certain vehicles is restricted or discouraged as a deliberate measure to improve air quality within the LEZ's boundaries. Within SPINE, this measure will be explored in Bologna (covering the Green Area of the city while also introducing the city 30 km/h concept).

MS8 - Smart City Platform

MS8 – Bologna & Tallinn: Within SPINE, the Smart City Platform (SCP) aims to assist the city authorities and operators to efficiently manage their operations, assets, and monitor the SPINE-related mobility measures through targeted KPIs, aiming at an improved planning of mobility services. Quantitative KPIs will indicatively include indicators related to modal split, traffic conditions, user satisfaction and environmental aspects. The SCP serves as a Software as a Service (SaaS) application that can be integrated with a variety of data sources and pull and push information using APIs and data ingestion procedures. A set of different functionalities and dashboards are foreseen including Goal view, Modules view, KPIs & Analytics view.

MS9 - Citizen Mobility App

MS9 – Bologna & Tallinn: The Citizen App is a mobile application that empowers citizens to participate in the SPINE project, engage with the co-creation of solutions and "generate" the impact of the proposed measures. Citizen Mobility App is designed to act as an integrator of existing services and solutions developed in SPINE. Depending on the needs of the SPINE cities different features will be implemented.

In Tallinn, the plan is to integrate the Citizen Mobility App in Tallinn's MaaS platform. Unfortunately, due to the absence of APIs in the technical solutions of mobility operators, the MaaS platform was unable to launch. Therefore, there is a possibility that Tallinn may not be able to implement the Citizen Mobility app.

MS10 - Logistics solutions

MS10 – Bologna: As part of SPINE, this measure focuses on improving freight operations and their efficient transportation in urban environments. In SPINE, this measure will be implemented in Bologna with the aim to support the reduction of CO2 emissions and the presence of polluting vehicles within the city center adopting sustainable last-mile mobility services in the urban logistic chain. For this purpose, the city will advance the activities implemented as part of the URBANE project and undertake an analysis to explore innovative solutions for the optimization of PT in low congestion peak hours.

MS11 – (Cargo) Bike-renting service

MS11 – Tallinn: With the deployment of 10 new cargo-bikes and the use of a shared mobility software for renting, customer service, bike opening and money collection.

MS11 - Las Palmas: With the installation of 3 new electric bike stations in important nodes of the bus network, to support a modal change from car to bus and improve accessibility in the hilly parts of the city.

MS12: Smart Park and Ride management

MS12 - Tallinn: This measure will focus on the conversion of three existing parking lots (Gonsiori, Pirita and Kalev) into smart P+R facilities within the city of Tallinn. The parking areas will be equipped with digital signages/screens to display all available vehicles (e-scooters, shared cars, PT schedules) and if the car is parked there, the use of public transportation is free of charge.

MS13 - Traffic Management / PT prioritization services

MS13 – Antwerp, Bologna & Las Palmas: The primary objective is to enhance PT reliability, reduce travel times, and optimize green waves. In these cities, the measure will encompass several key features, including:

MS14 - Mobility Management Software feature extension

MS14 – Las Palmas: The aim to collect up-to-date information about citizens' mobility behavior. In this way, the city will be able to improve bike and scooter sharing schemes management, while improving user satisfaction. Software will be a useful decision-making tool for the implementation of the LEZs in the city.

MS19 - Environmental Sensors

MS19 – Tallinn: This measure concerns the installation of environmental l sensors, in order to monitor and collect environmental information for a city. Within SPINE, these data will be used to quantitatively assess the environmental impact of the project's planned interventions. These sensors are currently being discussed to be implemented in the city of Tallinn. Further locations may be assessed as the project progresses in future. They can be installed either on vehicles (e.g. installed on buses) or positioned at fixed locations across the city. The range of pollutants these sensors are capable of measuring encompasses CO2, CO, NO2, PM2.5, PM10, VOC, CH4, H2S, and SO2. The valuable results gleaned from these sensors will be displayed on the Smart City Platform, offering stakeholders and decision-makers a comprehensive overview of the city's environmental conditions.

3.1.2 Overall implementation Timeline

The monitoring milestones established in D1.1 "*SPINE Living Labs Inception Report*" have been turned to an Excel timeline, offering the capability to filter specific measures. This comprehensive timeline encompasses measures from both Lead and Twinning cities, and it integrates the delivery timelines for the respective work packages. Figure 1 illustrates the timeline for the measures of the Lead Cities. This structured approach ensures a systematic and accessible overview of the project's progress, facilitating effective monitoring and coordination of activities across the diverse tasks and work packages.

Figure 1. Delivery timeline WP2 with indication of monitoring Milestones Lead Cities, D1.1 Inception Report

3.1.3 Key Implementation Milestones, SIAF tracking method.

To follow-up and orchestrate planning of operations of physical and digital spaces of the SPINE Living Labs a simple and user-friendly methodology is developed in SPINE for managing and monitoring measure/project progress across various cities. The SIAF tracking method emerges as a strategic approach to project management, dividing the project lifecycle into four distinct phases: *Start (S)*, *Implementation (I)*, *Activation (A)*, and *Finish (F)*. This method is particularly tailored for the coordination of SPINE WP2-WP4 by the City of Antwerp to provide stakeholders with a clear, organized, and comprehensive overview of project milestones, thereby facilitating effective communication and decision-making.
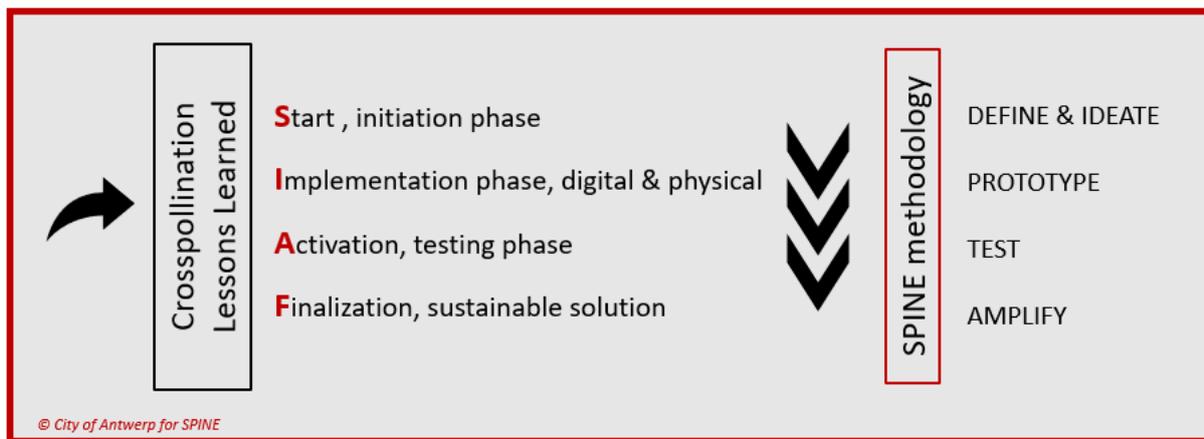
Figure 2. Scheme SIAF Implementation Milestones, developed by the project partner Stad Antwerpen for SPINE

<u>**S**tart (S):</u> The 'Start' phase marks the initiation of the project, signifying the commencement of planning, resource allocation, and initial groundwork, e.g. tendering process, budget planning, etc. This phase sets the foundation for subsequent actions and establishes a baseline for the project timeline.

<u>**I**mplementation (I):</u> Once planning is complete, the project transitions into the 'Implementation' phase, where the outlined strategies are put into action. This stage involves the execution of predefined measures, with a focus on adherence to timelines, resource utilization, and effective communication among project teams.

<u>**A**ctivation (A):</u> The 'Activation' phase denotes the point at which project (measures/LLs) components are operationalized. This could involve the launch of infrastructure, digital tools, initiation of community engagement programs, etc. The activation phase signifies a critical juncture where the project begins to yield **tangible outcomes.**

<u>**F**inish (F):</u> The 'Finish' phase represents the culmination of the project, emphasizing/evaluating the completion of all planned activities and the achievement of project objectives within the limits of the SPINE project. Evaluation and documentation are integral to this stage, Within the timeframe of the SPINE project the Finish is foreseen at the latest at month 36 and following the monitoring milestones of the KPI's allocated to the respective measures. The results should provide insights and lessons learned for the future projects, the continued existence of the measure/activities, ensuring accountability and a sustainable business model.

3.1.4 The SIAF Management tool to monitor & follow-up the status of the measures

The lead cities individually indicate the expected SIAF-milestones of their measures/LLs. During the monthly meetings of WP2 the further finetuning of the proposed milestones and expected outcomes are discussed.

Figure 4 illustrates the individual SIAF-milestones, highlighted in yellow, as indicated by the Lead Cities in February 2024. The SIAF letters in grey blocks are left from earlier prognoses. Most measures are in the Implementation phase. Activation will mostly start in summer 2024. This could involve the launch of infrastructure, digital tools, initiation of community engagement programs, etc. The activation phase signifies a critical juncture where the LLs begin to yield tangible outcomes. The blokes highlighted in red indicate the uncertainty of the estimated milestones due to certain events, such as the approval of amendments. Some measures have been erased or the characterization of the measure has been changed.

If measures are on hold or if changes in the initial proposed implementation milestones of the previous months take place, it's mandatory for the city to document this in the Logbook of occurred events during the implementation of the LLs. The community of Bologna, Task leader T2.6, took the lead in the development of this Logbook to register the lessons learned by collecting and documenting the barriers and challenges faced when implementing the qualified innovations or measures. This Logbook was developed by the Municipality of Bologna in co-creation with the corresponding task leaders of WP1 and WP4. The task runs horizontally across different WPs, lead- and twinning LLs, in order to map the lessons learned and barriers identification. (see Chapter 4)

A more detailed update of the cities LLs will be provided as part of the Lead Cities Implementation Report (version 1) by July 2024. Objective is the setup, operation and successful progress of the LLs developed in the four lead cities. Implementation Report Version 1 of the LLs will include a more detailed implementation plan, requirements, user stories and business model description.

Figure 3. SIAF-implementation milestones Lead Cities, February 2024

3.2 Process orchestration – Cross Living Labs Collaboration

There are three tiers of cross-living lab collaboration in SPINE to share knowledge and experiences between the 11 cities involved and between the WPs. The tiers are defined based on the level of engagement needed from the different partners:

- The first tier concerns webinars, best practice presentations and cross-project meetings.
- The second tier concerns SPINE workshops open to all cities and SPINE stakeholders. Common themes and topics are addressed in these cross-living lab settings, such as co-creation and living lab approaches, socially sustainable mobility solutions, and designing, evaluating, and monitoring SPINE measures from a user satisfaction perspective. In these workshops, SPINE partners work together over organizational borders to address particular SPINE challenges in an operative manner. For example, in the first cross-pollination workshop conducted at the General Assembly in Tallinn, all living labs worked and presented their co-creation plans to tailor, design and evaluate one SPINE measure.
- Finally, in the third tier of cross-living labs collaboration, WP2 and WP4 organize quarterly meetings of knowledge exchange group sessions per cluster of measures (horizontal over different WPs). The primary objectives of these sessions are to share and pinpoint bottlenecks, best practices, and use cases, as well as to finetune internal milestones and deadlines through collaborative efforts with relevant stakeholders.

The next chapter will explain more about the format and content of the first knowledge exchange session as part of the third tier of cross living labs collaboration. Objective hereby is to orchestrate and stimulate the knowledge exchange between the cities (as part of coordination task of WP2)

3.2.1 Knowledge exchange group sessions

A format has been created for quarterly meeting of knowledge exchange group sessions per cluster of measures (horizontal over different WPs, namely WP2, WP4 and with the support of the SPINE technical partners WP3

The knowledge exchange sessions can take place online or physical with the possibility of a site visit. The sessions will be jointly developed and moderated by Halmstad University, Task leader T5.2.

The group sessions take, at most, 90 minutes. They include a short presentation by the city representative with the most experience and practical knowledge concerning the chosen measures or topics. A heterogeneous panel of experts then exchanges and discusses best practices, followed by a Q&A with the participants. Challenges, bottlenecks, and opportunities are noted, and the next steps for further follow-up are planned. The knowledge exchange sessions can take place online or physically with the possibility of a site visit. The sessions are jointly developed and moderated by Halmstad University, task leader for T5.2.

The first session took place on the 26th of January. Emphasis was on the city's objectives, goals, business model of a city journey planner & MaaS with active participation from the lead cities and twinning cities with measures concerning this topic (MS3-MS6). Hence, it was mandatory for the city representatives of Antwerp, Bologna, Tallinn, Sibenik, Heraklion, Barreiro, Zilina and Rouen to join. The corresponding technical partners were also expected to participate (WP3).

The session facilitated invaluable networking opportunities. By fostering a community of practice, the session laid the groundwork for ongoing collaboration and mutual support beyond its confines, thereby amplifying its long-term impact.

A next session is planned in April 2024 to dig deeper into the issues raised during previous session, namely:

- How to convince private mobility operators to open their platforms for MaaS?

- Business models and how to create a win/win for both city and stakeholders
- Issue considering the future inclusion of the clearing / billing in the MaaS (currently, "horizontal" MaaS developed in Bologna)
- Routing logic used and nudging inside route planners (e.g. to nudge parking in P&R outside the city center.)
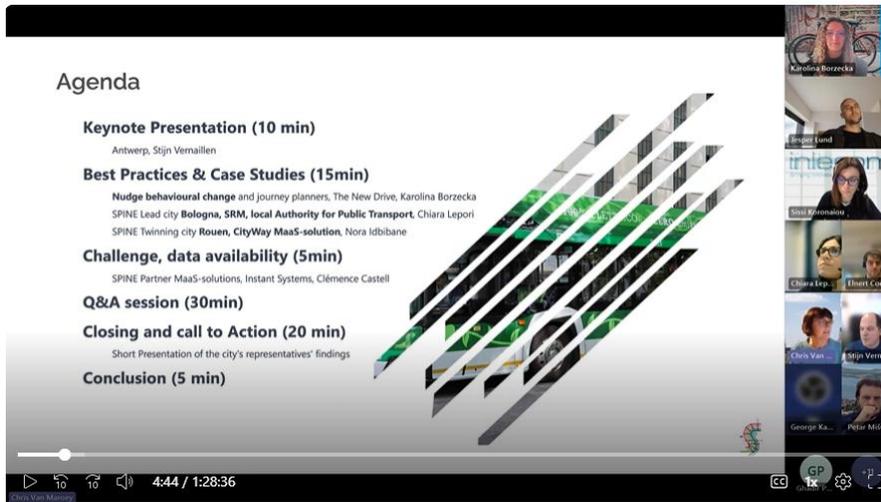
Figure 4. Knowledge exchange session 1, Agenda & Speakers

4. Creation of the SPINE legacy

This chapter explains the process used to go from the experiences of the lead cities to the building of a tool (the so-called "catalogue") which can be considered as the legacy of the implementation process for what concerns best practices and lessons learned and that can be used by Twinning cities / other Lead cities to ease their implementation processes.

4.1 From barriers to best practices to lessons learned

With 11 cities involved, the SPINE project has the very ambitious goal of supporting significant change in the field of European sustainable, inclusive and accessible mobility. Every city acts at its own local level, but continuously crosses paths with other project partners, both other cities and technical partners offering solutions that could support the achievement of the cities' objectives.

The Mobility scenario should also be taken into consideration when analyzing how complex it is for cities to work in a constantly changing environment: new regulations, new projects, new constraints represent an everyday challenge for cities which want to test new solutions and to innovate towards sustainable mobility development.

In this framework, all knowledge and understanding generated and gained by experience during the implementation of innovative processes in one city must be carefully treasured to make it available to other cities and their activities. There is a real need to drive lessons learned out from implementation processes in SPINE lead cities and constitute a legacy of experience that can help to prevent bottlenecks and to smooth processes avoiding duplication and / or loss of effort and time.

For this reason, Task 2.6 has the aim of running horizontally across all the lead Living Labs with the two-fold aim to:

- Identify and document barriers and challenges faced during implementation,
- Identify and collect the lessons learned.

All the generated knowledge collected through Task 2.6 and summarized in D2.1 will be used for two main purposes:

- Monitor and evaluate the implementation processes in the Lead Living Labs,
- Build a repository of documented experiences and learnings which will be the baseline to report on success and limitations of activities in the twinning cities.

Further on, building on the Lead Cities execution of SPINE activities in real time settings, D2.2 will report all reusable results for future adoption and scale up.
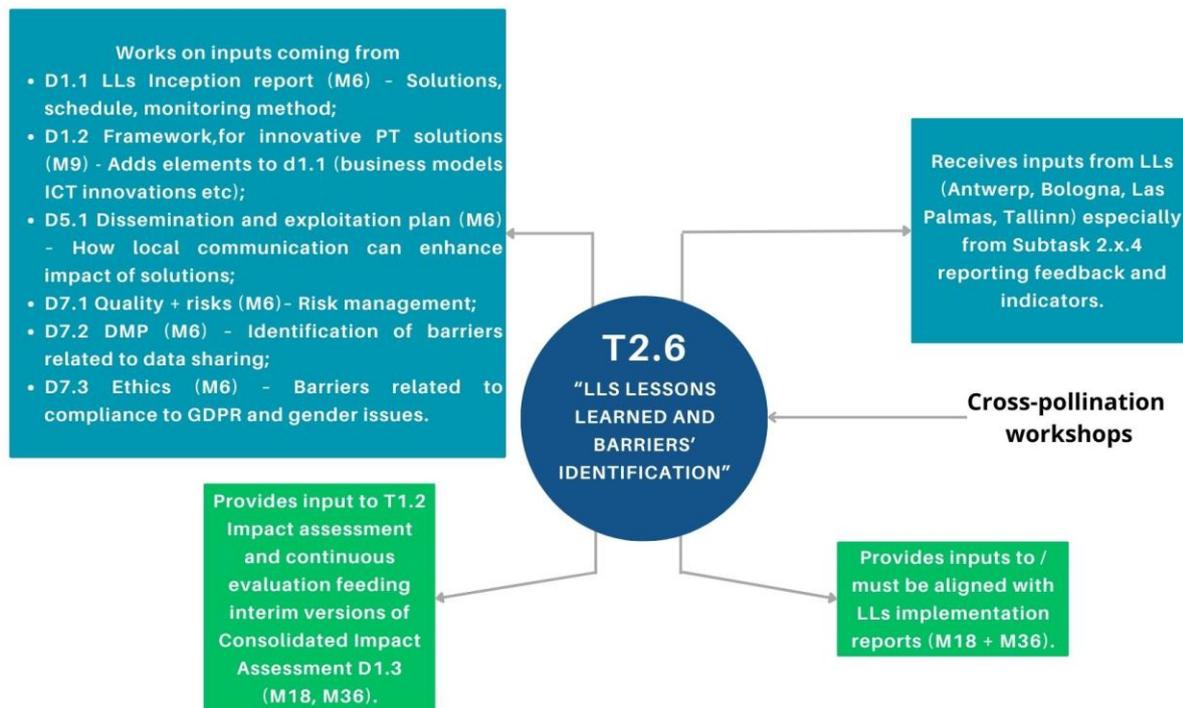
Figure 5. connections of T2.6 with other SPINE tasks and deliverables

To collect all generated knowledge deriving from SPINE implementation in the Lead and Twinning cities, a Logbook has been created by COBO, Task 2.6 leader, in collaboration with SRM, WP2 leader ANTW, UAEGEAN who oversees WP1 and project monitoring, and upon suggestions coming from Halmstad University, responsible for activities with Twinning cities.

The Logbook, an excel document named "Event Logbook for SPINE cities", is intended as a living document, available to all cities in the SPINE shared project folder, and to be updated during the whole lifespan of the project to collect continuous input from the implementation processes in cities.

The Logbook will therefore feed D2.1 LLs Report and Legacy Version 1 and D2.2 LLs Report and Legacy Final Version with knowledge by Lead cities, and D4.1 "*Twining Activities report and Legacy - Version 1*" and D4.2 "*Twining Activities report and Legacy - Final Version*" with experiences from Twinning cities.

Since events which need to be registered can have an impact on the monitoring of the project implementation that is carried out through the SIAF management tool, cities are invited to register the events as they occur, or at specific moments (usually before the monthly WP2 update meetings, or in occasion of cross-pollination meetings).

4.2 Generating the Event Logbook for SPINE cities

The development of the Logbook as a tool for cities went through different stages, resulting into different fields of information to be completed by cities:

4.2.1 Identification of internal / external events

WP1 delineates the "SPINE impact assessment framework", which is divided into two main activities: the impact evaluation process and the process evaluation activity.

The first one is related to the evaluation of the impacts of SPINE measures, and deals with the definition, measurement and monitoring of KPIs. The second refers to the evaluation of the processes of planning,

implementation & operation of measures; it acts during the operational stage of the project and deals with the identification of potential barriers & drivers for the implementation of each measure.

Considered that this second task has many connections with the identification of barriers and lessons learned required by Task 2.6, and that information and input would have been required by cities for both tasks, partners working on the Logbook decided to join efforts and maximize the data collection from cities by providing a single tool for collecting information. For this tool to feed both WP1, Task 1.2 and WP2, Task 2.6 with the needed information, it was decided to include a specific filter for internal / external events. Selecting this filter every time cities need to enter an event allows only the specific columns to appear, which cities must fill in, making work easier, quicker and more efficient.

Internal / external events are classified as follows:

- "*Internal events*" are all the events occurring during the implementation phase of the project directly impacting on SPINE solutions;
- "*External events*" are all the events that occur in cities in the mobility field, even the ones not directly impacting on SPINE solutions, but vital to understand the context in which the city operates.

4.2.2 Identification of risks and domain categorisation

Risks connected to SPINE implementation had already been identified by cities during the proposal phase. Then, also taking into consideration the different local social contexts and mobility scenarios with their strengths and weaknesses, a risk registry was refined and submitted within D7.1 "SPINE Quality Handbook and Risks Registry".

In D7.1, risks linked to the implementation of SPINE solutions are classified into 4 main categories, which have been coherently maintained in the following work around Task 2.6:

- <u>Technical risks</u>: all risks associated with work breakdowns in internal processes/procedures for the SPINE solutions development;
- <u>Management risks</u>: all risks related to the non-technical coordination of the project (planning, budget, resources, or communication) are classified as management risks;
- <u>Strategic risks</u>: all risk associated with changes to stakeholders and customers/citizens demands or expectations or the introduction of new products or services;
- <u>External risks</u>: risks that may occur due to political or regulatory changes, or any other force majeure risks that may affect the expected progress of the project.

Collection of barriers and lessons learned coherently follows the above categorization, in particular for the SPINE "internal events", elaborating under these groups different key situations which may occur during implementation of actions in cities. Some examples follow (non-exhaustive list), collected through the exchange with lead cities during WP2 monthly updates:

RISK CATEGORY	EXAMPLES OF RISKS
Technical risks	Risks related to data quality and accuracy, data access and type of data (open data vs. data subject to NDA agreements), comparability of data (data format and different calculation methods), data recentness and frequency of updating, granularity level of data; Operators not interested in joining the solution to be deployed; Reluctance of operators to offer access to their real-time data.
Management risks	Timing of interconnected actions, planning of actions vs administrative procedures (administrative and procurement procedures causing delays in the action); Difficulties in coordination among different initiatives and/or levels of government; Difficulties in getting the necessary approvals and

	permissions; Need to involve different departments due to the complexity of the solutions; Risk of accumulating delays in complex processes with multiple consequential steps.
Strategic risks	Lack of interest of citizens in changing their mobility habits, or resistance to behavior change; Stakeholder heterogeneity and difficulty of convergence in LLs; Difficulties in involving citizens (in particular fragile categories such as people with disabilities, elderly people, ...); Difficulties in coordination among stakeholders collaborating on the same solution; Social acceptance of the solutions (co-created solutions vs "imposed" solutions).
External (Exogenous) Risks	GDPR compliance or local data protection laws; Awareness raising and effective communication of project actions; Political factors, such as changes in government or shifts in public opinion; Physical damage to roads and/or transport vehicles and/or critical infrastructure due to dramatic climate-related events or malicious attacks.

Table 3. Categorization of non-exhaustive examples of potential risks that could occur during implementation of SPINE actions in cities

For every event registered in the Logbook, it is therefore required to select the domain (the main one Internal / External) under which the event can be classified. Additionally, for "Internal events" another column requires cities to state if the event was linked to an identified risk, or if it was an unforeseen event. Cities also must note if the event gave any early warning signs (useful to be picked up in the future), and the actions taken to deal with the event.

4.2.3 Connection to city measures and KPIs, start/end of the event and SIAF phases

The following step for cities to complete refers to the connection of the event with the implementation of specific measures and KPIs. This is of fundamental importance for WP1 and WP2 partners to understand and evaluate the impact of events on SPINE implementation. Social, cultural and geographical differences will also play an important role in the evaluation process.

To ease completion and evaluation, reference is made in the table to the lists of measures and to the list of KPIs already selected by the cities and officially provided in D1.1 and D1.2.

Following the introduction and use of the SIAF management tool (see section 3.1.4), a connection has also been created in the file, where the cities indicate at which implementation phase (with reference to the SIAF) the event occurred. Also, compilers of the Logbook are asked to indicate the start date of the event, as well as the end date (real or expected).

4.2.4 Action taken and lessons learned

To complete the scenario, cities are requested to report the action they took to face the reported challenge. Actions taken by cities to overcome the expected or unexpected barriers and bottlenecks can therefore turn into **best practices**, which can hopefully inspire other cities facing the same or similar challenges. A further step is then asked to cities to elaborate on the lesson learned that the occurred event has contributed to generate. This last step is the most demanding for cities because it implies to think how the solution applied to the local problem could be generalized, thus becoming generated knowledge supporting all cities in the SPINE Consortium (and beyond) officially being a **lesson learned** of the project.

4.3 Logbook of lessons learned during implementation

From 1st June 2023, starting day of T2.6, the first months were dedicated to the implementation of the Logbook, building on the mentioned discussion across WP2, WP1 and WP4.

For the following analysis, all internal events have been considered, plus all the external events with an impact on the implementation of SPINE measures in the Lead cities. Events analyzed in this deliverable are the ones collected from the beginning of the task until the end of M13 (January 2024), to allow the writing of this report. External events without direct impact on SPINE measures have not been included in the analysis but anyway registered to feed WP1, Task 1.2 evaluation of processes in cities.

Since the beginning of the task, a total number of 14 events have been registered in the Lead Cities.

In the timeframe June 2023 - February 2024 (9 months) the following number of events have been registered in connection with SPINE solutions thanks to the Logbook. It is noted that only the measures for which events have been reported are presented in the picture below.
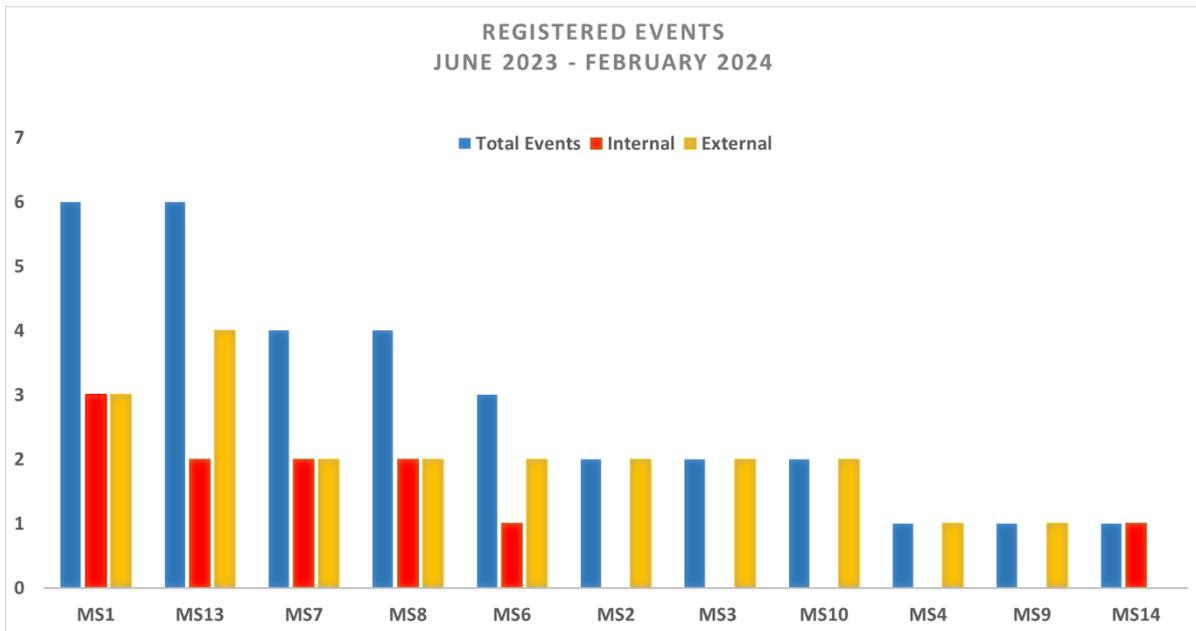
Figure 6. Registered events per SPINE measure

Measures MS15, MS16, MS17 and MS18 are not represented in this table nor in the following analysis since no SPINE lead city is implementing them.

At project month 14 (February 2024), the measures which are most impacted by internal and external events are MS1 Multimodal Hubs and MS13 Traffic Management / PT prioritization services (6 events), followed by MS7 LEZ and MS8 Smart City Platform (4 events), and MS6 Maas (3 events).

Details of registered events per measure follow (see section 3.1.1 for a description of specific implementation in lead cities). For easier reference, please see ANNEX A and ANNEX B for the list of measures and indicators from the Logbook. The annexes are located at the end of the document.

MS1 Multimodal Hubs

So far, all the four lead cities Antwerp, Bologna, Las Palmas and Tallin reported a total of 6 events.

Main events registered about MS1 concern data issues, essentially regarding data access and licenses, and availability of real time data to feed SPINE technologies.

Introduction of new services also have an impact on this measure: in Antwerp, the radical change of the transport plan for bus and tram and a new timetable in the Flanders region will also be an important point to consider when working on Multimodal Hubs.

Moreover, physical interventions already foreseen, or foreseen for the next few years to support the introduction of new services, could have a direct impact on SPINE planned actions when interventions are planned in the same urban areas (as in the Bologna case, the tram project individuated Mazzini hub as one of the terminals, which will be probably subject to infrastructural interventions).

City	Internal /External event	Event domain, categorization2 and description	Geographical area impacted	KPIs impacted	SIAF phase	Foreseen risk / unforeseen event
Las Palmas	Internal	TECHNICAL Access to data for modelling MS1 currently not available (license required)	Urban area (related with the impact of a model)	IND4	Implementation	Foreseen risk
Bologna	Internal	MANAGEMENT Integration of timing of co-creation activities and overall timeline of general interventions on multi-modal hubs (within and beyond SPINE)	Urban areas around the selected multimodal hubs	IND2, IND3	Implementation	Unforeseen event
Bologna	Internal	TECHNICAL Availability of real-time information to feed project technological solutions (mainly MaaS and infomobility tools at Multimodal Hubs)	Urban area (services linked to urban mobility)	IND2, IND3	Implementation	Foreseen risk
Bologna	External	Implementation of 4 new tram lines	Urban area	IND2		Unforeseen event
Antwerp	External	A radically changed transport plan for bus & tram in Flanders is introduced. Many bus stops have been cancelled and timetables changed	Flanders Region (including city of Antwerp)	IND21		Unforeseen event
Antwerp	External	New timetables for De Lijn	Flanders Region	IND21, IND23,		Unforeseen event

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2 It is noted that the categorization of internal events follows the risk categorization, ref. Table 4.

			(including city of Antwerp)	IND2, IND3		

Table 4. Events registered for Multimodal Hubs

MS2 Real-time information for passengers

Events linked to MS2 in Antwerp are linked to the radically changed transport plan for buses & trams in the Flanders region, including new timetables. This can have an impact on the average travelling time, and on user satisfaction both with public transport services and with the specific SPINE measure since it influences the Real-time information to passengers' measure.

MS3 Multimodal journey planner app

The same events registered for MS2 also impact MS3 Multimodal journey planner app. In Antwerp LL this measure is conceived as an upgrade of the exciting city Multimodal journey planner which will provide the passenger with real-time and scheduled information for several mobility services, therefore it is necessary that it is fed by the new timetable and data.

City	Internal /External event	Event domain, categorization3 and description	Geographical area impacted	KPIs impacted	SIAF phase	Foreseen risk / unforeseen event
Antwerp	External	A radically changed transport plan for bus & tram in Flanders is introduced. Many bus stops have been cancelled and timetables changed	Flanders Region (including city of Antwerp)	IND21		Unforeseen event
Antwerp	External	New timetables for De Lijn	Flanders Region (including city of Antwerp)	IND21, IND23, IND2, IND3,		Unforeseen event

Table 5. Events registered in Multimodal journey planner app

MS4 EV charging stations

In Bologna, 4 completely new tram lines will be implemented in the next few years, financed through the National Recovery and Resilience Plan and contributing to a radical change in urban mobility system and users' habits. Building works have already started for the first line and will start soon for the second one. For the second line, the selected terminal at one end will be Corticella hub, which is also one of the hubs selected for SPINE interventions. Specifically, EV charging station will be installed in the hub area, and special attention must be paid to interconnections between the two different activities and their timing, to avoid bottlenecks and delays.

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3 It is noted that the categorization of internal events follows the risk categorization, ref. Table 4.

City	Internal /External event	Event domain, categorization4 and description	Geographical area impacted	KPIs impacted	SIAF phase	Foreseen risk / unforeseen event
Bologna	External	Implementation of 4 new tram lines	Urban area	IND2	Implementation	Unforeseen event

Table 6. Event registered for EV charging stations

MS5 Inclusive mobility services

At the time when this deliverable was written, no event was registered regarding MS5 Inclusive mobility services.

MS6 MaaS

So far, Bologna has reported 2 Internal events and 2 External events. The Internal events register the foreseen issue of potential lack of real-time data for feeding the MaaS app, which has been proactively faced with the early involvement of the mobility operators, and the revision of the GANTT of the solution operated by the IT provider (and SPINE partner) Instant System, which considered useful to foresee more time for the data integration and – most important – to add one more release of beta testing versions of the MaaS App with its validation phase before the final release. As regards the External events, the first is the implementation of 4 new tram lines, which is common to all the Bologna solutions, and the collapsing risk of one of the medieval towers located in the city centre, which affects also solutions MS7, MS8, MS10, MS13. The respective actions taken to face those External events, which were totally unforeseen, are the same described for the other measures involved.

From the above, it is interesting to note that a general comment / lesson learned can be already drafted from the Bologna experience: a general indication valid for all the IT solutions to be developed in each city, is that there must be constant alignment between the city and the (IT) partner's timeframe, which needs a proactive approach from both the city and the IT provider itself.

City	Internal /External event	Event description, categorization5 and event domain	Geographical area impacted	KPIs impacted	SIAF phase	Foreseen risk / unforeseen event
Bologna	Internal	TECHNICAL Availability of real-time information to feed project technological solutions	Urban area (services linked to urban mobility)	IND2	Implementation	Foreseen risk
Bologna	External	Serious structural collapsing risk of one of the two medieval towers in the heart of the city center caused a sudden stop of mobility around the area. New mobility	City center	IND1, IND2, IND4 ,	Implementation	Unforeseen event

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4 It is noted that the categorization of internal events follows the risk categorization, ref. Table 4.
5 It is noted that the categorization of internal events follows the risk categorization, ref. Table 4.

		management plan elaborated, impacting on private mobility, PT, shared mobility services, pedestrianization of some central areas, logistic services, etc. Currently foreseen temporal extension of structural works in the tower area is about 10 years.				
Bologna	External	Implementation of 4 new tram lines	Urban area	IND2		Unforeseen event
Bologna	Internal	Delay in the original plan for the MaaS development in Bologna, in particular due to the time needed for integration of mobility data in the IT MaaS platform and to the opportunity of foreseeing at least 2 beta testing versions of the MaaS app, each of them followed by its validation phase, before its final release.	MaaS covered area (Bologna metropolitan area)	IND57, IND58	Implementation	Unforeseen event

Table 7. Events registered for MaaS

MS7 LEZ (Low Emission Zone)

In Las Palmas, SPINE should help designing the Low Emission Zone, but after the analysis conducted, the city decided that actions proposed in the LEZ draft are not interesting to model as the design process has not resulted in significant measures, but simply in a revision of those in place.

Therefore, the only city left to work on MS7 Low emission zone is Bologna. A first barrier here was linked to the possibility to access data needed by the modelling partner since the local traffic modelling system required a license for data to be extracted.

Other events impacting on the implementation of this measure are exogenous events connected to the urban mobility scenario at a general level: the introduction of four new tram lines in the next few years and the revision of the mobility plan due to extraordinary works in the very heart of the city center due to heritage conservation, which could influence the implementation of new regulations about the future extended LEZ. Someway, those events could also accelerate the process of reducing access to the urban area as in fact - on the one hand - new PT (trams) will be introduced and - on the other hand - the number of accesses will nevertheless be reduced due to heritage protection issues, at least in the historic center.

City	Internal / External event	Event domain, categorization6 and description	Geographical area impacted	KPIs impacted	SIAF phase	Foreseen risk / unforeseen event
Las Palmas	Internal	MANAGEMENT The actions proposed in the LEZ draft (outside of SPINE) are not interesting to model, as the design process has not resulted in significant measures, but a revision of those actually in place	Las Alcaravaneras	n.a.	Start	Unforeseen event
Bologna	External	Serious structural collapsing risk of one of the two medieval towers in the heart of the city center caused a sudden stop of mobility around the area. New mobility management plan elaborated, impacting on private mobility, PT, shared mobility services, pedestrianization of some central areas, logistic services, etc. Currently foreseen temporal extension of structural works in the tower area is about 10 years.	City center	IND1, IND2, IND4	Implementation	Unforeseen event
Bologna	Internal	TECHNICAL Both local partners COBO and SRM do not have access to VISUM traffic modelling tool since access is upon license only (need to access data came linked to technical requirements asked for WP3, task 3.2 Digital impact assessment models)	Urban area linked with LEZ emission zone	IND8	Start	Foreseen risk

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[6] It is noted that the categorization of internal events follows the risk categorization, ref. Table 4.

Bologna	External	Implementation of 4 new tram lines	Urban area	IND2		Unforeseen event

Table 8. Events registered for LEZ

MS8 Smart City Platform

Being implemented by Bologna and Tallinn, the SCP will integrate a variety of data sources and pull and push information using APIs and data ingestion procedures. Main bottlenecks can therefore concern the technical domain, especially regarding the availability of real time data to feed the solution; also, all events – external and internal - impacting on new datasets to be integrated in the SCP need to be considered and relevant stakeholders (e.g. new mobility services providers) need to be involved to keep the tool updated for an effective planning of future mobility.

Moreover, serious unexpected events causing temporary SPINE staff reduction – both at city (macro) and organization (micro) level – reflected on the respect of agreed timelines with project technological partners, causing some temporary delays in the implementation of the specific solution for Bologna - not on a general project level.

City	Internal /External event	Event domain, categorization7 and description	Geographical area impacted	KPIs impacted	SIAF phase	Foreseen risk / unforeseen event
Bologna	Internal	TECHNICAL Availability of real-time information to feed project technological solutions	Urban area (services linked to urban mobility)	IND2	Implementation	Foreseen risk
Bologna	External	Serious structural collapsing risk of one of the two medieval towers in the heart of the city center caused a sudden stop of mobility around the area. New mobility management plan elaborated, impacting on private mobility, PT, shared mobility services, pedestrianization of some central areas, logistic services, etc. Currently foreseen temporal extension of structural works in the tower area is about 10 years.	City center	IND1, IND2, IND4	Implementation	Unforeseen event

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7 It is noted that the categorization of internal events follows the risk categorization, ref. Table 4.

| Bologna | Internal | MANAGEMENT Temporary staff reduction in the SPINE local team, due to a combination of unforeseen internal and external events | Urban area linked to SPINE pilot actions | IND2 | Start | | Unforeseen event |
| Bologna | External | Implementation of 4 new tram lines | Urban area | IND2 | | | Unforeseen event |

Table 9. Event registered for Smart City Platform

MS9 Citizen Mobility App / Micro-incentives programme

So far, only Bologna reported an External event, i.e. the implementation of 4 new tram lines, which is common to all the Bologna solutions. The actions taken to face this External event, which was totally unforeseen, is the same described for the other measures involved.

City	Internal /External event	Event domain, categorization[8] and description	Geographical area impacted	KPIs impacted	SIAF phase	Foreseen risk / unforeseen event
Bologna	External	Implementation of 4 new tram lines	Urban area	IND2		Unforeseen event

Table 10. Event registered for Citizen Mobility App / Micro-incentives programme

MS10 Logistics solutions

Like mobility, logistics can also be heavily affected by changing conditions in the local context for what concerns new policies, new regulations, etc. This is particularly true in those European heritage cities where urban structure was not created to face nowadays high traffic and congestion levels.

Events impacting on roads restrictions, for example, can lead to the sudden need to re-plan mobility and logistics; sometimes, this could also have the power to accelerate processes since restrictions – especially long-term ones as in the Bologna case – can push towards the adoption of regulations to reduce congestion.

From another point of view, adoption of new mobility services (e.g. tram) can open scenarios that were not possible to foresee, such as an analysis of the peak hours aiming at the use of mobility services supporting innovative logistics models (cargo hitching).

City	Internal /External event	Event domain, categorization[9] and description	Geographical area impacted	KPIs impacted	SIAF phase	Foreseen risk / unforeseen event
Bologna	External	Serious structural collapsing risk of one of the two medieval towers in	City center	IND1, IND2, IND4	Implementation	Unforeseen event

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[8] It is noted that the categorization of internal events follows the risk categorization, ref. Table 4.
[9] It is noted that the categorization of internal events follows the risk categorization, ref. Table 4.

		the heart of the city center caused a sudden stop of mobility around the area. New mobility management plan elaborated, impacting on private mobility, PT, shared mobility services, pedestrianization of some central areas, logistic services, etc. Currently foreseen temporal extension of structural works in the tower area is about 10 years.				
Bologna	External	Implementation of 4 new tram lines	Urban area	IND2		Unforeseen event

Table 11. Events registered for Logistics solutions

MS11 Cargo-bikes renting service

At the time when this deliverable was written, no event was registered around MS11 Cargo-bikes renting service.

MS12 Smart park and Ride management

At the time when this deliverable was written, no event was registered around MS12 Smart Park and Ride management.

MS13 Traffic Management / PT prioritization services

Again, being MS13 a technological measure, main concerns and barriers have to do with access to data, their availability, and all new data generated by the city because of changes in the mobility system which will then need to be integrated to fulfill a complete analysis of the current situation and implementation of enhanced traffic management and prioritization services through SPINE.

Also, in the case of Bologna, serious unexpected events causing temporary SPINE staff reduction – both at city (macro) and organization (micro) level – reflected on the respect of agreed timelines with project technological partners, causing some temporary delays in the implementation of the specific solution for Bologna (not on a general project level).

City	Internal /External event	Event domain, categorization[10] and description	Geographical area impacted	KPIs impacted	SIAF phase	Foreseen risk / unforeseen event
Las Palmas	Internal	TECHNICAL Access to data for MS13 and modelling MS1 currently not available (license required)	Av. Escaleritas	IND3, IND4	Implementation	Foreseen risk
Bologna	External	Serious structural collapsing risk of one of the two medieval towers in the heart of the city center caused a sudden stop of mobility around the area. New mobility management plan elaborated, impacting on private mobility, PT, shared mobility services, pedestrianization of some central areas, logistic services, etc. Currently foreseen temporal extension of structural works in the tower area is about 10 years.	City center	IND1, IND2, IND4	Implementation	Unforeseen event
Bologna	Internal/ External	MANAGEMENT Temporary staff reduction in the SPINE local team, due to a combination of unforeseen internal and external events	Urban area linked to SPINE pilot actions	IND2	Start	Unforeseen event
Bologna	External	Implementation of 4 new tram lines	Urban area	IND2		Unforeseen event
Antwerp	External	A radically changed transport plan for bus & tram in Flanders is introduced. Many bus stops have	Flanders Region (including city of Antwerp)	IND21		Unforeseen event

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[10] It is noted that the categorization of internal events follows the risk categorization, ref. Table 4.

		been cancelled and timetables changed				
Antwerp	External	New timetables for De Lijn	Flanders Region (including city of Antwerp)	IND21 IND23 IND2 IND3		Unforeseen event

Table 12. Events registered for Traffic Management / PT prioritization services

MS14 Mobility Management Software feature extension

The requested project amendment is key to deploy SPINE activities as defined after the initial phase of measure revision and KPIs definition ended with the submission of D1.1 and D1.2. Administrative bottlenecks represent a high risk for delays in implementation.

City	Internal /External event	Event domain, categorization11 and description	Geographical area impacted	KPIs impacted	SIAF phase	Foreseen risk / unforeseen event
Las Palmas	Internal	MANAGEMENT Regarding MS14, one of the main subtasks is the tendering of the software. Without the budget amendment, the budget allocation makes it impossible to continue this measure	n.a.	IND31	Implementation	Foreseen

Table 13. Events registered for Mobility Management Software feature extension

MS19 Environmental Sensors

At the time when this deliverable was written, no event was registered around MS19 environmental sensors.

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[11] It is noted that the categorization of internal events follows the risk categorization, ref. Table 4.

5. SPINE Living Labs Catalogue

This chapter explains how the information collected through the process explained in chapter 4 is systemized and will be organized in a catalogue of best practices.

5.1 Lessons learned at this stage

5.1.1 Registered lessons learned through the Logbook

At this stage (end February 2024), the Logbook reports the following lessons learned, which categorization (theme) will be explained and further elaborated in section 5.2.

It is noted that the information in the table below is proposed with a double key: the measure and the city. The latter is introduced to link the lesson learned to the social and cultural (city) context. Such a reference is fundamental for the reader to understand if the specific lesson learned could apply to his/her city context.

Lesson learned or generated knowledge	Improve quality and availability of open data
ID	1
Theme(s) of lesson learned	Data
Measure(s)	MS1 Multimodal hubs (modelling) MS13 Traffic Management / PT prioritization services
City	Las Palmas
Event description	Access to data for MS13 and modelling MS1 currently not available (license required)
Early warning signs	--
Action taken	Delay phases Exploring other ways of generating the data Collaboration beyond the local project partners

Table 14. Lesson learned #1 "Improve quality and availability of open data"

Lesson learned or generated knowledge	Ensure updates and coordination among mobility projects in the city outside of SPINE
ID	2
Theme(s) of lesson learned	Synergies
Measure(s)	MS7 LEZ- Deleted
City	Las Palmas
Event description	The actions proposed in the LEZ draft (outside of SPINE) are not interesting to model, as the design process has not resulted in significant measures, but a revision of those actually in place
Early warning signs	Development of the LEZ design
Action taken	Tech. partners will participate in the modelling of other solutions implemented under SPINE (MS1) instead of the MS7

Table 15. Lesson learned #2 "Ensure updates and coordination among mobility projects in the city outside of SPINE"

Lesson learned or generated knowledge	Contextualize the measure to be applied
ID	3
Theme(s) of lesson learned	Management / Synergies
Measure(s)	MS1 Multimodal Hubs
City	Bologna
Event description	Integration of timing of co-creation activities and overall timeline of general interventions on multi-modal hubs (within and beyond SPINE). Close attention to the context in which the interventions are implemented (projects of other public and/or private actors, enabling factors as well as possible problems) allows to avoid clashing with other interventions already planned, and which may have a negative impact on the measure. Furthermore, with a view to synergy of actions, it is possible to avoid duplicating efforts and benefit from the context by identifying the enabling factors which can have a positive effect on the measure.
Early warning signs	News on active and future processes and projects in the hub areas coming from other departments and/or city actors (public works, mobility constraints, implementation of new services, etc.)
Action taken	Carefully planning of possible actions to be included in co-creation activities based on a deep analysis of the context where selected SPINE hubs are located

	including all city active and future processes and projects insisting on the same area

Table 16. Lesson learned #3 "Contextualize the measure to be applied"

Lesson learned or generated knowledge	Involve operators / stakeholders since the beginning
ID	4
Theme(s) of lesson learned	Synergies
Measure(s)	MS1 Multimodal Hubs MS6 MaaS MS8 Smart CIty Platform
City	Bologna
Event description	Availability of real-time information to feed project technological solutions (mainly MaaS, infomobility tools at Multimodal Hubs).
Early warning signs	Difficulty to access data which are not open could emerge already in the Start phase (planning)
Action taken	Early involvement of the operators asked to share real-time data. Recommendation is to put more effort in making operators understand the value of supporting the project (more data = better tools for the user = more satisfaction = increase in the use of PT).

Table 17. Lesson learned #4 "Involve operators / stakeholders since the beginning"

Lesson learned or generated knowledge	Ensure cooperation of mobility stakeholders (both institutional and private) to increase resilience of the mobility system
ID	5
Theme(s) of lesson learned	Management / Synergies
Measure(s)	MS6 MaaS MS7 LEZ MS8 Smart City Platform MS10 Logistic solutions MS13: Traffic Management / PT prioritization services
City	Bologna

Event description	Serious structural collapse risk of one of the two medieval towers in the heart of the city center caused a sudden stop of mobility around the area. A new mobility management plan has been elaborated in the last two months by the City Mobility Department which will impact on private mobility, PT, shared mobility services, pedestrianization of some central areas, logistic services, etc. The currently foreseen temporal extension of structural works in the tower area is about 10 years.
	The unexpected event made clear that - in order to cope with an unexpected event which is impacting heavily on mobility policies and regulations on the long term - mobility stakeholders (both institutional and private) have to cooperate in order to understand how to manage different possible scenarios which could include unforeseen barriers and challenges; more than new regulations, the need to elaborate a new management plan has emerged. In these cases, where historic cultural heritage is at risk, cooperation with other actors involved in the process (engineering company, superintendence for fine arts, cultural foundations and associations, etc) is also vital, as well as a high-quality communication with citizens to prevent unsatisfaction situations
Early warning signs	--
Action taken	Revision of mobility regulations in the area taking into consideration the possibility of having different future scenarios which are not totally under control at the moment.

Table 18. Lesson learned #5 "Ensure cooperation of mobility stakeholders to increase resilience"

Lesson learned or generated knowledge	Push the use of open data
ID	6
Theme of lesson learned	Data/ Synergies
Measure(s)	MS7 LEZ
City	Bologna
Event description	Both local partners COBO and SRM do not have access to VISUM traffic modelling tool since access is upon license only (need to access data came linked to technical requirements asked for WP3, task 3.2 Digital impact assessment models)
	This event has clarified the need for having open data. Cities have to push the use of open data, which are key for a good planning of mobility services. These cases make even more evident that collaboration with other local public and private mobility actors is of fundamental importance.
Early warning signs	--
Action taken	Collaboration beyond the local project partners with other mobility operators with access to the requested data

Table 19. Lesson learned #6 "Push the use of open data"

Lesson learned or generated knowledge	Adopt flexible timeplan
ID	7
Theme of lesson learned	Management
Measure(s)	MS8 Smart City Platform MS13: Traffic Management / PT prioritization services
City	Bologna
Event description	Temporary staff reduction in the SPINE local team, due to a combination of unforeseen internal and external events, made clear the need for adopting a flexible timeplan. Such an approach can help to face unforeseen events like temporary project staff reduction. Great attention must be paid to evaluating the consequences of stand-by actions on the overall project timeplan.
Early warning signs	-
Action taken	Priority has been given to urgent actions taking into consideration what could be temporarily put in a stand-by mode with minor repercussions on the project, in accordance with project partners involved.

Table 20. Lesson learned #7 "Adopt flexible time plan"

Lesson learned or generated knowledge	When planning an IT development / customization, foresee the releasing of at least 2 beta testing versions and constantly align with the IT developer
ID	8
Theme of lesson learned	Management
Measure(s)	MS6 MaaS
City	Bologna
Event description	Delay in the original plan for the MaaS development in Bologna, in particular due to the time needed for integration of mobility data in the IT MaaS platform and to the opportunity of foreseeing at least 2 beta testing versions of the MaaS app, each of them followed by its validation phase, before its final release. This event made clear that: (a) when developing a brand-new MaaS solution in a city context, delays can occur respect to the original plan, in particular due to (1 month) necessary for integration from the moment the IT developer / provider receives the data from the mobility operators involved in the MaaS;

	(b) it is good to foresee since the beginning the release of (at least) 2 beta testing versions of the MaaS app, each of them followed by its validation phase, before the final release;
	(c) the second and last beta-testing validation version validation phase should last at least 3 months before the final release;
	(d) as a general indication, there must be constant alignment between the city and the (IT) partner's timeframe.
Early warning signs	-
Action taken	Replanning of MaaS timeplan, in particular in the SIAF planning postponement of MaaS "Activation" from M19 to M21.
	Keeping MaaS 1st milestone at month 20, new M1 is "Instant System platform customization" (old was "Platform testing", now postponed)

Table 21. Lesson learned #8 "When planning an IT development / customization, foresee at least 2 beta versions and constantly align with the IT developer"

It is noted that the lessons learned at this stage of the project are generated by the implementation in the Lead Cities of Multimodal Hubs and by some technological solutions that are developed / implemented in collaboration with SPINE tech partners (ref. MaaS, Smart City Platform, and analytical activities around LEZ and PT prioritization services).

During this first implementation phase, cities were involved in different processes that this deliverable is trying to map and report. Its final version (D2.2) will also report results and degree of success of the actions undertaken to overcome barriers and will analyze how cities acted to face challenges and bottlenecks providing a detailed mapping of specific actions and steps taken.

At the moment, with reference to the measures that generated the lessons learned, cities have tried to elaborate some initial knowledge to be shared, based upon their experience when coping with challenges and bottlenecks faced during the first stages of the project (considering the SIAF management tool, first stages deal with Start and Implementation phases).

As already stated, the generated knowledge:

- Will be shared between Lead Cities and Twinning Cities during the whole lifespan of the project, with the aim of easing implementation processes running in Twinning Cities;
- Will also be a key element to share among Lead cities during project meetings and cross-pollination activities.
- Will work as a legacy of SPINE for future projects as an inspiration for other cities.

In the next section the reader can find a preliminary analysis of main themes and issues emerged during implementation.

5.1.2 Key knowledge coming from lessons learned

Analyzing events and lessons learned registered by SPINE cities, and going through the actions taken, three main themes emerge as basic elements to be reported: data, synergies and management issues (both internal and external to the project). Those elements are discussed in more detail here below.

1. Data

Main elements connected to data gravitate around some key aspects, which can be resumed as:

- Open vs. close/private data and data quality;
- Compatibility / integration;
- Collaborative approach.

Data which is not open represents a challenge for cities; public administrations have a key role to promote the use of open data, pushing on the fact that access to data is key for a good planning in different fields related to urban policies, including mobility. Open data do not cause access problems such as licenses etc. and can be easily shared and used by different stakeholders - both public and private - with the common aim of improving the quality of services offered to citizens.

Quality and availability of data also have an influence on qualification or non-qualification of the measures to be implemented by cities. If data does not allow the deployment of interesting solutions for the city due to lack of quality, or if the needed data is not available, the specific solution risks to be deleted from the city's activities.

A second issue reported by cities is related to compatibility and integration of data. Those aspects are of fundamental importance since SPINE technological partners supporting measures implementation need to integrate data coming from cities, with their different context and features, into their systems. Nevertheless, data have different formats. This implies that actions must be taken to turn data into compatible information that partners' system can read and transform into useful information for cities. For this reason, cities need to consider that some resources must be foreseen and allocated to integration activities.

A collaborative approach is also crucial to enable cities to maximize the impact of solutions implemented through the project. Beside open data, a lot of close and private data, owned by institutions or mobility stakeholders, are necessary to implement tools for best planning of services. Sensibilization and cooperation among mobility actors thus becomes a vital element to advance with project implementation in cities. Obviously, data sharing must comply with different requirements; data privacy and the need to sign Non-Disclosure Agreements (NDA) must be carefully taken into consideration.

2. Synergies

The last point of attention connected to data (see previous paragraph) leads the analysis towards the second of the main themes considered in the lessons learned approach for what concerns cities' experiences within SPINE, i.e. the importance of synergies.

In the framework of the project, the word "synergies" runs on different lines. Within the lessons learned reported by cities, two main meanings of "synergy" can be read: (i) collaboration and cooperation among stakeholders, (ii) link between SPINE project actions and ongoing and planned interventions in cities and city policies.

On the one hand, involving stakeholders around project actions is key to get vital insights, elements and data to make the work advance to the next steps in the most effective way towards the foreseen impact. Also, an extended exchange fosters creativity and allows the project team to develop better solutions.

Synergies are also a central point when it comes to include diverse population categories in different stages of the project.:

- In the implementation process, meaning the development of specific services for vulnerable users;
- Following SPINE Diversity, Gender and Inclusion approach[12], in the co-creation activities, with the involvement of all relevant population groups needed to maximize the impact of SPINE solutions.

Some effort should also be put into making stakeholders understand the value of supporting the project with their data. This is especially important for PT and sharing mobility operators, since more data available

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[12] D1.2 SPINE Framework for Innovative PT solutions, Section 2: Methodology

can turn through the equation more data available = better tools for the user = increased satisfaction = increase in the use of PT.

On the other hand, it is not possible to conceive project solutions as separate elements from all other actions the city is carrying out in terms of mobility policies and interventions. As SPINE supports urban policies on mobility and emissions reduction towards climate neutrality, it must be included in the general mobility scenario, which is very complex throughout Europe. When working in specific selected areas of the cities, it is therefore necessary to pay close attention to the context in which the interventions will be implemented (projects by other public and / or private actors can represent enabling factors as well as possible barriers) in order to avoid clashing with already planned interventions, with a negative impact on the solutions. Also, synergy of actions helps avoid duplication of efforts, and turns the city context into an enabling factor with a positive effect on project actions.

Another point which is favored by synergies among city actors and stakeholders is the capacity to cope with unexpected events impacting on mobility. European heritage cities must often deal with structural barriers linked to protection of cultural heritage, or with renovation works to make cities respondent to new mobility needs. In these cases, the capacity of mobility stakeholders (both public and private) to cooperate becomes a key asset for managing scenarios which could include unforeseen bottlenecks and challenges, and to facilitate fast replanning if needed.

3. Internal / external project management

Main challenges faced by cities in the project management field include internal (local) and external factors, mainly referring to unforeseen staff reduction in project teams and administrative issues causing delays in action development. One possible identified solution is a careful prioritization of solutions and relevant implementation steps aiming at pausing the critical elements, trying to keep delays at a minimum level.

Anyway, in case of both foreseen and unforeseen events, these situations can be important obstacles for the smooth implementation of project measures in cities, causing redefinition of the pathway to implementation or rescheduling of time plans, with possible repercussion on project impact at local and general level.

5.2 Main take aways for further rollout

At this stage of the project (Month 14, February 2024), main takeaways for knowledge exchange among SPINE cities have been elaborated as general principles, resumed in the following graphics.
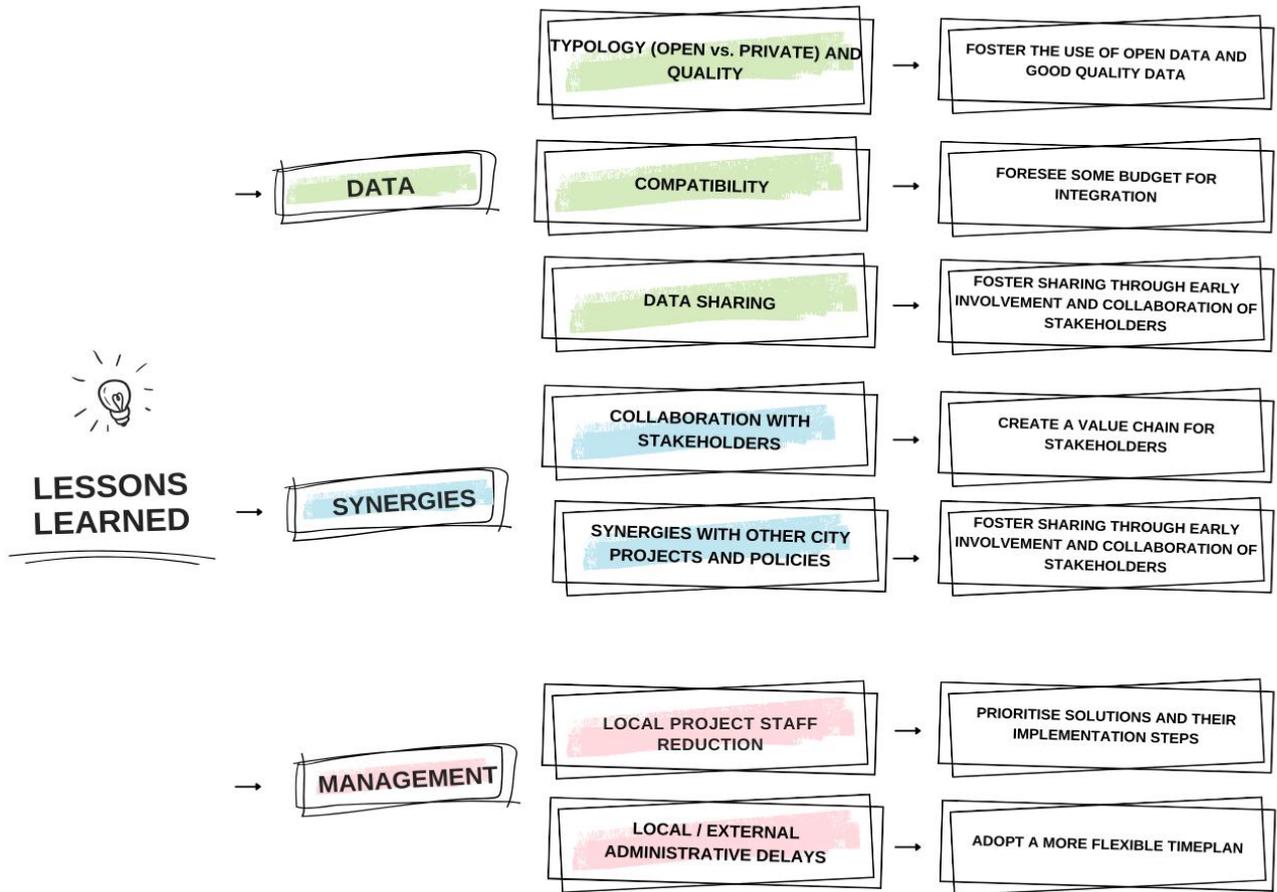
Figure 7. Reasoned map of lessons learned in SPINE Lead Cities until January 2024

Since the deliverable necessarily focuses on the preliminary stages of city activities, the knowledge generated mainly revolves around the preparation phases of measures and the early implementation stages. This mainly results in:

- An increased awareness of the technical requirements and resources (human and financial) needed for data work, including a strong push toward wider use of open data;
- The need of translating SPINE theoretical methodological approach into practice (Empathize, Define, Ideate, Prototype, Test and Amplify) thanks to the renewed understanding that SPINE cities are *real-world testbeds for exploring, co-creating, and evaluating new technologies, products, services, and policies*[13]
- An increased readiness to cope with unexpected events in a complex and rapidly changing scenario.

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[13] D1.2 SPINE Framework for Innovative PT solutions, Section 2: Methodology

6. Conclusion

This deliverable reports the current state of the art of collected lessons learned at the first stage of the project and the preliminary knowledge elaborated during the first implementation phases of SPINE solutions in Lead cities, detailing the approach, barriers, and challenges encountered until February 15, 2024.

So far, the "Event Logbook for SPINE cities" has proven to be an effective tool to collect information from cities also thanks to the regular monthly update meetings led by WP2 leader Antwerp. It set the outlines for a complete catalogue of lessons learned which will be provided with the final version of the deliverable at M36, together with a deeper insight on actions taken by cities to overcome barriers in the different local contexts; at an advanced state of implementation, an analysis of the success rate of reported actions will also be possible, The analysis will include reference to the specific contexts in which the Lead cities operate, meant as enabling factors that can influence the success of actions taken to cope with different kinds of issues. This will connect the lessons learned catalogue with all the elements already identified in D1.2 as maturity level and readiness of the SPINE cities, such as the city mobility status, city policies and planned interventions, existing digital enablers, digital media and communication channels, existing data, experience with co-creation activities.[14]

In view of the final version of this deliverable (D2.2 LLs report and legacy final version) due at M36 (December 2025) and as potential future improvement of the Logbook system, even more effort should be made to ensure that cities understand the value of their contributions, with the aim of expanding the collection of lessons learned and knowledge supporting a smoother implementation of SPINE solutions towards a deeper impact of project actions.

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[14] D1.2, section 3

ANNEX A

Measures

- MS1: Multimodal hubs
- MS2: Real-time information for passengers
- MS3: Multimodal journey planner app
- MS4: EV charging stations
- MS5: Inclusive mobility services
- MS6: MaaS
- MS7: LEZ (Low Emission Zone)
- MS8: Smart City Platform
- MS9: Citizen Mobility App / Micro-incentives programme
- MS10: Logistics solutions
- MS11: Cargo-bikes renting service
- MS12: Smart Park and Ride management
- MS13: Traffic Management / PT prioritization services
- MS14: Mobility Management Software feature extension
- MS15: On-demand mobility service
- MS16: Bus Passengers Analytics
- MS17: Cargo hitching
- MS18: Intersection Camera Recognition/ Dashboard for real-time traffic data
- MS19: Environmental Sensors

ANNEX B

Key Performance Indicators (KPIs)

- IND1: Average modal split of public transport
- IND2: Citizens satisfaction with public transport services
- IND3: User satisfaction with the SPINE solutions
- IND4: Demand for PT
- IND5: Number of cars entering the city centre
- IND6: CO_2 emissions
- IND7: PT congestion
- IND8: Air pollution
- IND9: Noise levels
- IND10: PT passengers by age
- IND11: PT passengers by gender
- IND12: PT vulnerable passengers
- IND13: Perception of the level of physical accessibility of a mobility service
- IND14: Stakeholder engagement
- IND15: Car congestion level
- IND16: Perceived waiting time at PT stops
- IND17: Average waiting time at PT stops
- IND18: Roads with restricted speed zone
- IND19: Traffic accidents
- IND20: Perceived safety/security in PT
- IND21: Perceived safety/security in shared mobility services
- IND22: Reliability of PT
- IND23: Average cycling time
- IND24: Number of bike-sharing users
- IND25: Distance travelled by bike-sharing
- IND25a: Number of trips conducted by bike-sharing
- IND26: Cycling conditions
- IND27: Average time of commuting with scooters
- IND28: Number of scooter-sharing users
- IND28a: Number of trips conducted by scooter-sharing
- IND29: Distance travelled by scooter-sharing
- IND30: Availability of shared bikes
- IND31: Availability of bike-sharing stations
- IND32: Availability of shared bikes at PT stations
- IND33: Availability of bike-sharing docks at PT stations
- IND34: Availability of bike-sharing docks at PT stations_2
- IND35: Cycling lanes
- IND36: Availability of shared scooters
- IND37: Availability of scooter-sharing stations
- IND38: Availability of shared scooters at PT stations
- IND39: Availability of scooter-sharing docks at PT stations
- IND40: Availability of scooter-sharing docks at PT stations_2
- IND41: Parking availability
- IND42: Occupancy rate of parking spaces
- IND43: Parking cost
- IND44: Use of space for parking

- IND45: Number of multimodal hubs improved
- IND46: Mobility services at multimodal hubs
- IND47: Demand in multimodal hubs
- IND48: Number of PT stations with more than one mobility services
- IND49: Perceived quality of the multimodal hub
- IND50: Demand of on-demand services
- IND51: Energy consumption at EV charging stations
- IND52: EV charging stations
- IND53: Coverage of Low emission zones
- IND53a: Design of Low emission zones
- IND54: Installation of digital signages/interactive screens etc.
- IND 55: PT stops with real-time passenger information
- IND56: Mobility integration in the multimodal app
- IND57: MaaS/multimodal journey planner app trips
- IND58: MaaS/multimodal journey planner app registered users
- IND59: Citizen app registered users
- IND60: Green wave
- IND61: Goods transported via cargo hitching
- IND62: Cargo hitching usage
- IND63: Demand for car-pooling
- IND64: Crowd level of PT

References

1) D1.1 - Living Labs Inception Report
2) D1.2 - Framework for Innovative PT Solutions
3) D7.1 - Quality Handbook and Risks Registry
4) D7.2 - Data Management Plan
5) D7.3 - Ethics Reports