

D7.1 Final cross-site evaluation handbook including main impact categories and assessment KPIs related to measures

WP7 Monitoring, evaluation and impact assessment



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EU-RES: Classified Information - restraint UE;

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List of abbreviations and acronyms

Abbreviation/Acronym	Meaning
AI	Artificial Intelligence
CINEA	European Climate, Infrastructure and Environment Executive Agency

CSA	Coordination and Support Action
EC	European Commission
ECF	European Cyclists' Federation
EIT UM	EIT Urban Mobility
EPF	European Passengers' Federation
IFP	International Federation of Pedestrians
FUA	Functional Urban Area
FWCI	Field Weighted Citation Impact
ITS	Intelligent Transport Systems
LUM	Local Evaluation Manager
KIP	Key Impact Pathways
MaaR	Mobility as a Right
MaaS	Mobility as a Service
MEL	Monitoring, Evaluation and Learning
PT	Public transport
PMB	Project Management Board
SECAP	Sustainable Energy and Climate Action Plan
SULP	Sustainable Urban Logistic Plan
SUMP	Sustainable Urban Mobility Plan
UITP	International Association of Public Transport
WP	Work package

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Abstract

This document presents the UPPER cross-site evaluation handbook including the main impact categories and assessment KPIs related to measures, consistent with the CIVITAS Evaluation Framework. The handbook starts from the assessment of the local impacts of the measures. This document includes information which will be used to assess impacts of individual measures as well as impacts of a combination of measures at the level of the functional urban area (FUA). In this document, the FUA baselines and targets are discussed for Public Transport (PT) modal share, User Satisfaction, and CO2 emissions.

The 8 impact categories are a selection of SUMI indicators, most relevant for assessing the impact of public transport. CO2 emissions, modal split i.e., share of public transport, and user satisfaction will be assessed at all UPPER sites. Eight cities have measures related to access to mobility services, seven cities have measures related to congestion; six cities have measures related to air pollution and two cities have measures related to improving road safety.

A new version of the handbook is planned in 2025 and will include the approach used to show the real impact of the measure if implemented on larger scale, a motivated indication of how the impact observed on short term will further evolve, and the validation of the impact assessment methods in the 10 UPPER sites, focusing on the reusability of the solutions in other urban areas. This is prepared by setting up an UPPER impact database. Gaps in this database will be analysed through setting up working groups for harmonisation of impact assessment of public transport improvements on specific impact categories: modal split, user satisfaction, access to mobility services and CO2 emissions. The current handbooks' last section gives a preliminary overview of expected use of UPPER tools for producing the 2025 UPPER cross-site evaluation handbook.

Keywords

UPPER measures, impact assessment, output indicators, impact indicators

Executive summary

UPPER strategic objectives are directly linked to the objectives of the Green Deal [1] and its prioritized actions focused on shifting the traditional way of travelling to sustainable and smart mobility. The UPPER project will contribute to boosting multimodal transport, deploying sustainable alternative transport fuels and reducing pollution from transport, especially in cities, according to air pollutants [2] and noise [3] regulations. Setting the PT modes at the centre of the mobility ecosystem will push the smooth coordination among the mobility and urban planning departments of the cities to fulfil the crucial principles of the Sustainable Urban Mobility Planning [4] of creating a sustainable mobility plan in the entire “functional city” by integrating the different transport modes. Another relevant contribution will be made to the Cohesion Policy 2021-2027 [5] by contributing to fulfilling its policy objectives of getting smarter, greener, more connected, more social, and closer to the European citizens.

This document presents the first version of the UPPER cross-site evaluation handbook. The handbook starts from the assessment of the local impacts of the measures in UPPER sites, including the measure outputs and KPIs.

The quantification of the measure contributions in line with SUMI indicators and aligned with the SPINE project is organized through 8 impact categories: CO2 emissions, modal split i.e., share of public transport, user satisfaction, access to mobility services, accidents and injuries, congestion, noise pollution, and air pollution. The measures address between four to six of these impact categories directly; connections to other impact categories for the measures will be explored as well.

How to read this document: Chapter 2 presents the methodology for developing the process and impact evaluation. Chapter 3 summarizes the FUA baselines. Chapter 4 looks at measure impact categories and the described for each measure. Chapter 5 describes the next steps for developing the evaluation protocol, monitoring of progress, and the link with U-tools. Chapter 6 summarizes the findings and presents the planning for future work towards the final UPPER evaluation Handbook.

KUL developed this document with contribution and support from Dirk Engels (Transport&Mobility Leuven) for the correct use of the CIVITAS 2020 process and impact evaluation handbook [6], ETRA (chapters 3 and 4) and the Local Evaluation Managers (LEM). Rupperecht Consult contributed to chapter 2 to ensure proper alignment of the output and impact indicators with U-SUMP. In each city, the designated horizontal partner from WP2 supported the LEM.

The lead authors would like to thank everybody who contributed to this cross-site evaluation handbook, in particular the LEMs and horizontal partners who participated to the indicator workshops and helped interpreting and processing the collected information. Lastly, the lead authors would like to thank everybody who provided input, insights and comments to this document.

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1. Introduction

The results brought by UPPER will be a cornerstone in the Climate-Neutral and Smart Cities Mission as well as in the EU Green Deal, proposing in 10 UPPER sites (Valencia, Rome, Versailles Grand Parc, Oslo, Mannheim, Lisbon, Budapest, Leuven, Thessaloniki, Hannover Region) large scale demonstrations of 80 push and pull measures, acting on 5 innovation axes that condition user's choices: mindset and culture, urban mobility planning, mobility services ecosystem, road network management, and democratic governance. The UPPER tools (U-NEED, U-SUMP, U-TWIN, U-SIM, U-GOV, U-KNOW, U-TRANSFER) will support the implementation of UPPER measures, contribute to the development and maximise the impact and transferability.

The overall goals in the 10 UPPER sites, as detailed in the initial proposal, consists of increasing the share of public transport (as part of total motorized transport) by at least 30 percent and increasing user satisfaction with public transport by 25 percent. As will be discussed later, in considering these targets, some cities have noted very high modal shares of public transport as well as user satisfaction as baselines, and thus targets have been customized to the local context. An additional aim of the UPPER project is inclusivity and leaving nobody behind in the development of transport systems; while accelerating the transition towards climate neutrality in cities. Different stakeholders will be impacted: citizens, local authorities, PT authorities, transport service providers, logistic service providers, PT employees, technology providers and innovators, researchers, end user organisations and civil society (cities, regions, passengers, pedestrians, cyclists, logistics, parking associations, among others). The UPPER Key Impact Pathways (KIP) cited in the grant agreement include:

- support the adoption of SUMP guidelines in EU cities and establish innovative public-private governance models centred on Mobility-as-a-Right (MaaS);
- support the uptake of co-created IT solutions to increase the reliability of PT,
- develop the next generation data analytics and big data visualisation tools.

Regarding societal and environmental impact, UPPER will foster capacity-building for upscaling the measures in the cities participating to the European Commission's Climate-Neutral and Smart Cities Mission. The new management services, policies and schemes developed in the project will support the replication of similar behavioural change measures in EU cities and the new MaaS schemes. Concerning economic impact, UPPER will support the deployment of sustainable urban mobility solutions in EU cities, contribute to the availability of relevant mobility data and support the replication of R&I initiatives.

2. Evaluation method development and application

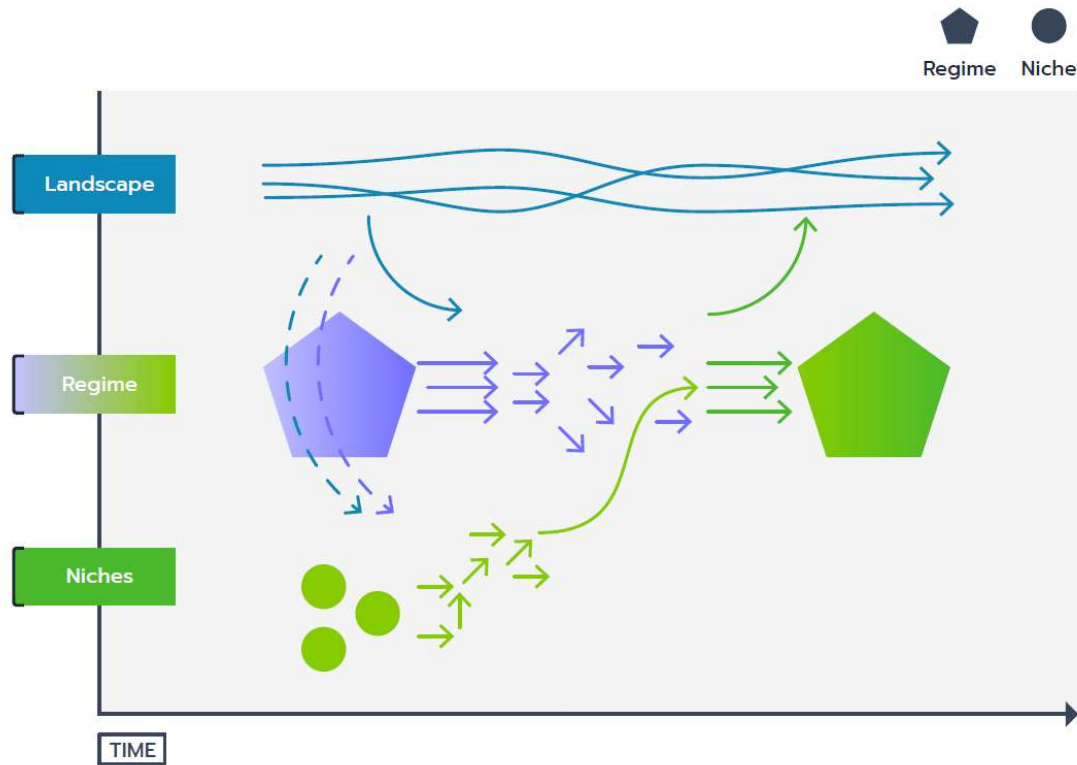
The following summarizes the theoretical framework upon which the UPPER impact assessment will be based, then presents the process and impact evaluation method, along with steps in developing the local evaluation. This highlights in particular the detailed measure descriptions, Indicator spreadsheet, and Local Evaluation Handbook components. The distinction between the functional urban area level evaluation and measure level evaluation is then elaborated.

2.1. Impact Assessment Theoretical Framework

Building from theories of transformative change, the UPPER evaluation will attempt to understand the various impacts of the measures, the scale of impact of the measures, how these measures interact with other measures as well as broader trends at the demo sites. Figure 1 shows an example of a multi-level perspective on transition, looking at niches, regimes, and landscapes. For the UPPER project, the measure-level area corresponds to "niches", the functional urban area impact corresponds to "regimes", and the broader context at the UPPER site corresponds to

“landscape”. This figure shows the variety of interactions that can take place. Measures can work synergistically together to impact the FUA; however, individual measures implemented in one location could also have effects on other measures. Similarly, measures implemented at the FUA level, or changes at city or regional level, can influence the effectiveness of individual measures. The evaluation process will look at transition pathways for the various measures and sites to understand these relationships. These chains of outputs, outcomes, and impacts will be identified for each of the UPPER measures.

FIGURE 1. - The multi-level perspective (MLP) on socio-technical transitions



Source: Motion Handbook: Developing A Transformative Theory Of Change (2022)

Similarly, Figure 2 emphasizes the different levers that can lead to particular outcomes, along with the chain of outcomes for these levers. It shows the timeframe of outcomes, and that outcomes in the short-term lead to longer term outcomes. Thus, impact pathways have to be reflected in impact indicators, acknowledging that urban transport is only one of the domains in a systemic approach. Therefore, the impact assessment of PT measures in UPPER is not addressed in isolation; new insights concerning impact assessment in other EU Mission projects will be followed up. This requires some flexibility, which is addressed by making the Cross-site evaluation handbook a “living document”.

FIGURE 2. - Concept for the integrated MEL indicator framework [7]

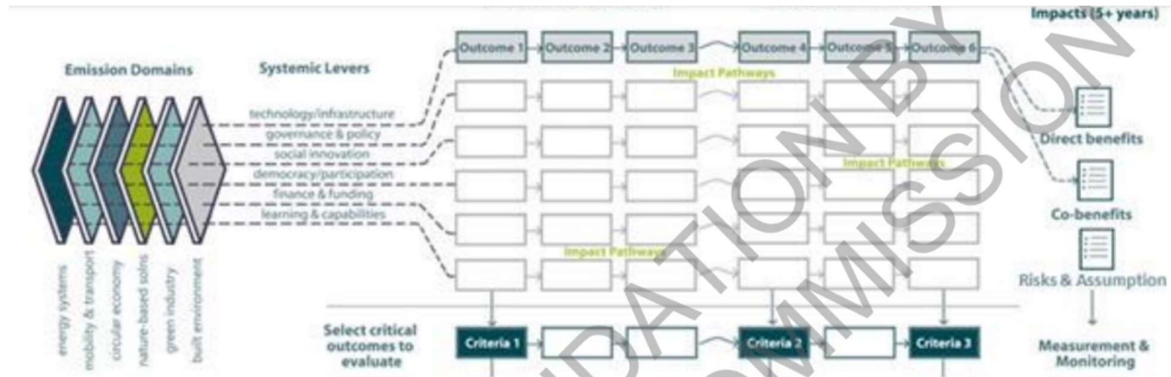


Figure 1: Schematic overview of impact pathways for Action Plans and Pilot Cities' reporting framework



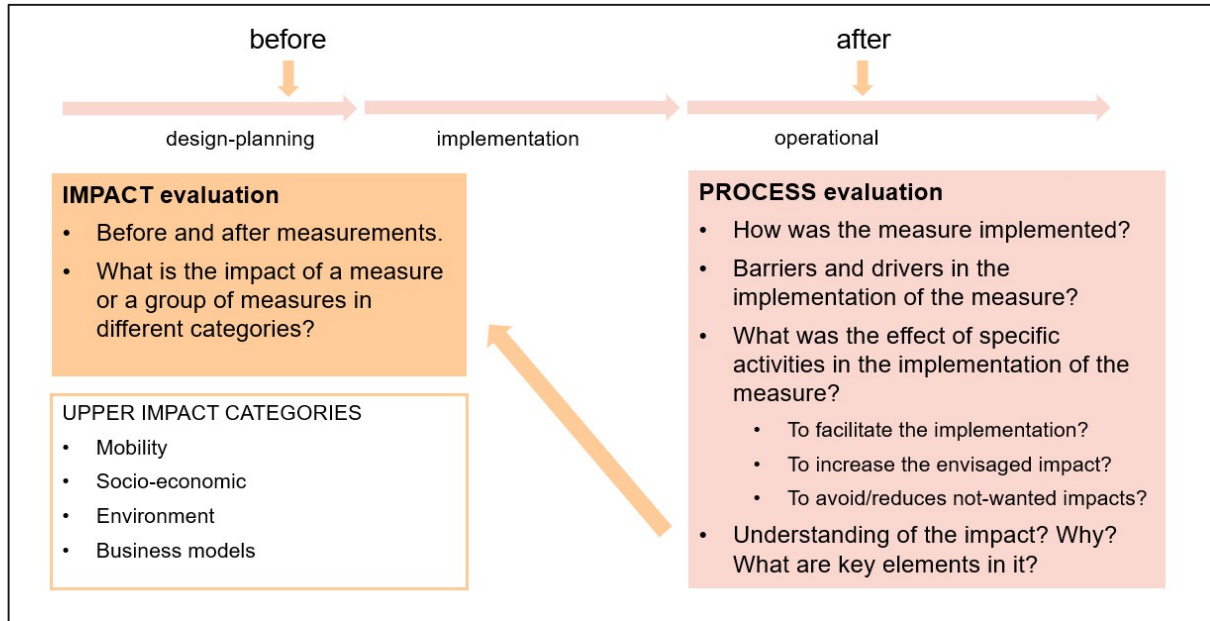
Source: NetZeroCities, D2.4-Comprehensive Indicator Framework (2022).

2.2. UPPER Process and Impact Evaluation method

While the full transition pathway for each measure and site will be developed in subsequent work, we have based the initial UPPER process and impact evaluation framework on the CIVITAS Evaluation Framework (Figure 1). This Evaluation Framework helps to sharpen measures and objectives of measures in order to gain more than a “before and after” understanding of the impact of the measure. It emphasises the context and steps involved in implementing measures which aid in analysing the results. An additional source for the development of the process and impact evaluation is the Inception Report Indicators spreadsheet provided by the European Climate, Infrastructure and Environment Executive Agency (CINEA).

It is important to highlight upfront the difference between measure evaluation and functional urban area (FUA) level evaluation. The measure evaluation is meant to evaluate quite clearly the impact of the measure, or a combination of measures, with a very clear objective. While similar principles of process and impact evaluation apply at both the measure and FUA level evaluation, the direct link of measures to impact at the FUA level may be less clear. This is where further understanding of the transition pathways at each site will be important and will be developed as part of the impact assessment.

FIGURE 3. - Key elements in the CIVITAS Evaluation Approach, applied to UPPER.



Source: (D. Engels, LEM meeting 5/4/2023)

The first aspect of the evaluation method is the process evaluation. This focuses on understanding if a measure:

1. Is implemented, by tracking various milestones and outputs,
2. Is implemented in a way that reflects the initial desired outcomes as defined in the planning stages,
3. Is implemented within the desired time frame.

What is important here is to identify what barriers and drivers had the largest influence on both quality and timing of implementation. This can help to provide lessons for other cities who are interested in implementing similar measures, as well as for future measures in the same city.

The impact evaluation uses before and after data to understand the results of various policies, programs, or infrastructure improvements that have been implemented. The main impact categories considered are from the CINEA spreadsheet: 1) Greenhouse gas emissions; 2) Congestion; 3) Accidents and injuries; 4) Modal share; 5) Access to mobility services; 6) Air pollution; 7) Noise pollution; 8) User satisfaction. In order to develop this evaluation, where possible the Business-As-Usual scenarios for different indicators are included, which can allow for better comprehension of the results. In understanding these impacts, it will also be necessary to reflect on the process evaluation, since if a measure was delayed or not implemented as designed for unforeseen reasons, this could impact the ability of the measure to achieve initial targets.

2.3 Process of developing local evaluation handbooks

Many activities took place within the UPPER consortium in order to select the indicators by which measure progress will be tracked. Many partners were involved in providing indicator recommendations for different types of measures and sub-measures as well as well as providing feedback to the demo sites specifically. The following table details the activities that have been carried out between January 2023 and September 2023. Section 2.2.1 and 2.2.2 provide more detail on developing the Measure Descriptions and the Indicator Spreadsheet and Local Evaluation Handbooks.

TABLE 1. - Indicator selection activities

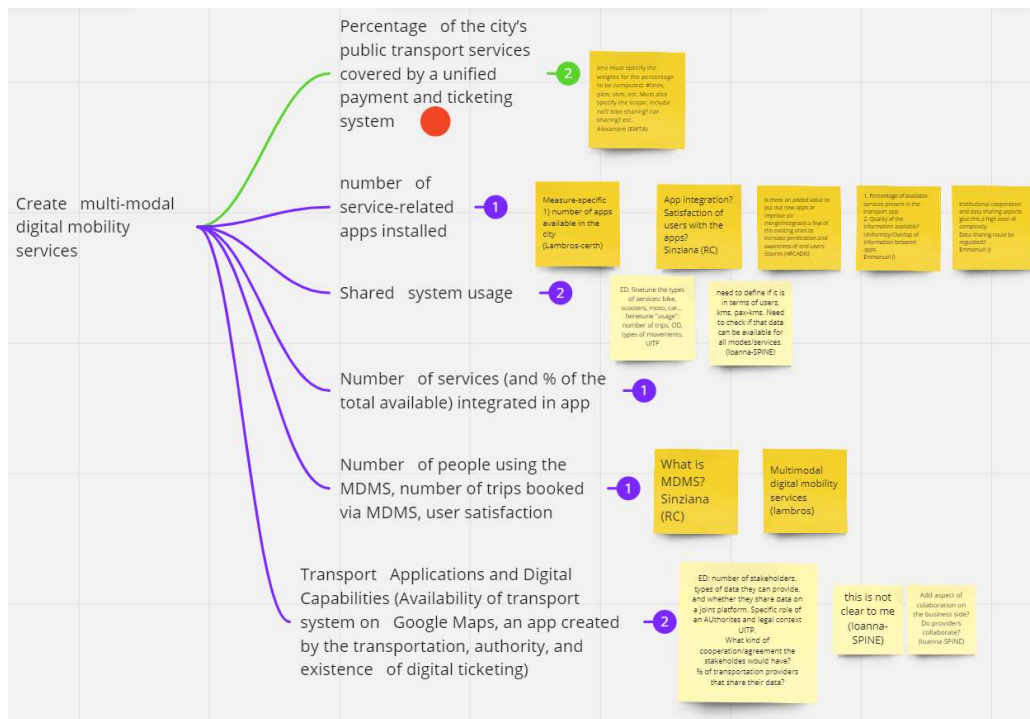
Activity and date	Content	Who
Preliminary impact indicators selected from CIVITAS evaluation handbook and SUMI ¹ . 18/1/2023	Outcome: selected indicators. “affordability of PT for the poorest group”, “accessibility of PT for mobility-impaired groups”, “access to mobility services”, “congestion and delays”, “multimodal integration”, “satisfaction with public transport”, “commuting travel time”, and “modal split”.	KUL and Dirk Engels
Workshop: Synergies, monitoring and evaluation of the living labs; Public Transport Thematic Cluster Meeting; Brussels, 24-25/1/2023.	First meeting of projects funded under topic ‘unleashing the innovation potential of public transport as backbone of urban mobility’ and WP7. Monitoring, evaluation and impact assessment. Outcome: clarification of the requirements concerning the impact assessment indicator table to be produced as annex to the Inception Report (IR).	All UPPER partners, project officer, SPINE, NetZeroCities and CIVITAS representatives
Preliminary compilation of all indicators, March 2023	Compilation of common indicators and methods based on SUMI, CIVITAS, and NetZeroCities	KUL
Initial measure-to-impact mapping, March 2023	Based on short measure descriptions in the project proposal, an initial mapping of measures, possible sub-measures, and impacts was developed.	KUL shared with demo sites
Input for Indicators spreadsheet started, April 2023	First, specific types of interventions being proposed in measures. Then, horizontal partners were asked for input on which indicators would be appropriate for these interventions. This was the basis for indicator workshops with horizontal partners.	KUL and horizontal partners
Develop Measure Description template, April 2023	Based on the CIVITAS evaluation framework, a Measure Description template was developed for measure refinement.	ETRA and KUL
Local Evaluation meeting Online 5/4/2023	Introduction on evaluation (Dirk Engels), Steps for completing UPPER Measure Descriptions and Measure Impacts (Erin Cooper), examples	KUL and Local Evaluation Managers from demo sites

¹ These indicators were listed in January 2023 on transport.ec.europa.eu/transport-themes/clean-transport-urban-transport/sumi_en and transport.ec.europa.eu/transport-themes/clean-transport-urban-transport/sumi/modal-split_en but are no longer up to date (August 2023)

	<p>Leuven and Valencia, Q&A and planning (Thérèse Steenberghen).</p> <p>Outcome: guidelines on how to fill in detailed measure descriptions in the 10 UPPER sites, including sub-measures and related impact indicators suggested from the UPPER sites.</p>	
<p>Bilateral ‘Measure Evaluation’ meetings with UPPER sites. Online 14/4/2023-2/6/2023.</p>	<p>Outcome: Annex of “D2.2 Diagnosis of PT in living labs, measure refinement and expected impact”, with detailed measure descriptions in the 10 UPPER sites, including sub-measures and impact indicators.</p>	<p>KUL and Local Evaluation Managers from demo sites</p>
<p>Impact indicator workshop 1: Measures related to improved data, incentives and pricing, outreach. 26/04/2023.</p>	<p>Outcomes (Figure 4) : suggested measure-specific indicators and their relation to core impact indicators for mobility, socio-economic environment, and business models linked to different types of measures; references for further information on specific indicators; identification of indicators requiring further research in Working Groups, and UPPER partners interest in joining these impact indicator working groups.</p>	<p>Organised by KU Leuven and Rupperecht Consulting in Miro. Participants: horizontal partners. Also attended by SPINE Project Evaluation Manager 28/04/2023.</p>
<p>Impact indicator workshop 2: Measures related to physical implementation and improved services. 28/04/2023</p>		
<p>Template for the impact assessment table of the IR received from CINEA. 12/5/2023. Meeting with PO and SPINE online 15/5/2023</p>	<p>Outcomes: 7 categories of indicators in line with the indicators categories considered as part of the simplification work under SUMIs: 1. greenhouse gas emissions; 2. congestion; 3. accidents and injuries; 4. modal share 5. access to mobility services; 6. air pollution; 7. User satisfaction, 8. noise pollution (with the option to use another pollution category); 9. Other.</p>	<p>UITP, ETRA, KUL, FIT, project officer, and SPINE</p>
<p>First test of assessment table, 12/5/2023 to 12/6/2023</p>	<p>Demo sites were asked to complete the table with indicators, definitions, and measure time frames, along with baseline and target information if possible.</p>	<p>KUL and demo site LEMs</p>
<p>WP7 Impact Assessment Plan 23/05/2023</p>	<p>Outcome: common understanding of Local Evaluation Handbooks vs Impact Assessment tasks in WP7.</p>	<p>WP7 task leaders</p>
<p>Impact indicator workshop at UPPER General Assembly</p>	<p>Outcomes: potential links between measures, measure outputs, measure impacts, and contribution of overall impact categories. As</p>	<p>All UPPER partners</p>

meeting in Versailles, 13/6/2023	illustrated in Figure 5, many measures contribute to more than one impact category, and this can be monitored through various impact indicators.	
Indicator Review, June and July 2023	Horizontal partners were asked to review the indicators associated with specific measures and provide feedback to sites.	Horizontal Partners
Local Evaluation Handbook drafts developed (July and August 2023)	Pre-filled Local Evaluation Handbooks based on D2.1, D2.2 and indicator workshops, are sent to LEMs for completion	KUL and Local Evaluation managers

FIGURE 4. - Examples of indicators proposed for UPPER measures on Multi-modal Digital Mobility Services



Sources: Impact indicator workshop 2: Measures related to physical implementation and improved services. 28/04/2023.

- Supporting activities
- Interaction with other city measures, both UPPER and non-UPPER measures
- Target groups
- Geographical coverage of the measure;
- Geographical coverage of the expected impact;
- Stakeholders
- U-tools support
- Process of implementation of the measure (including stages and intermediate milestones)
- Preliminary indicators

This evaluation framework was introduced with the activities for developing detailed measure descriptions (the template for which was also based on the CIVITAS Evaluation Framework), so that demo sites could consider the evaluation process when refining the measures.

2.3.2 INCEPTION REPORT INDICATOR SPREADSHEET AND LOCAL EVALUATION HANDBOOKS

While developing the measure descriptions, the indicator spreadsheet became available, which clarified the impacts which will be focused on throughout the UPPER. From this point, the evaluation team focused on further clarifying indicator definitions, for the purpose of understanding baselines and target potential as well as to begin harmonizing indicator names and definitions across project sites.

In this spreadsheet, the first sheet provides information about the pilot cities, including population and existing mobility services. This also includes baseline data at the functional urban area level for share of public transport in the modal split and user satisfaction. Some cities also provided baselines related to CO2 emissions, congestion, road safety, accessibility, and air pollution. The second tab looks at individual measures per city, including impact area, process, and estimated time frame of the measure. The third tab includes all the indicators per measure with a definition and baseline values where relevant. The indicators are also categorized into the 8 impact categories provided by CINEA. The indicator categories are reflected in the indicator ID numbers (i.e., Number of cyclists, since it is related to modal share (category 4), was given an ID that starts with 4). The ninth category 'Other' was used to capture output indicators, such as number of people reached by a campaign; these indicators are in many cases highly specific to individual measures.

At this stage, intended data collection and calculation methods are presented. This is an important aspect, again, for identifying whether certain indicators are possible for a city to track or if additional support from partners will be needed. Also, the attempt to collect baseline values was also necessary as it is a good judge of whether an indicator can be monitored (Dirk Engels, April 2023). An important note is that any baseline information that is not available is often because the surveys or modelling activities are part of the UPPER project and so may not yet exist.

3. Functional Urban Area Baselines and Targets

For the UPPER project, we will focus on three main areas of impact at the FUA level: greenhouse gas emissions, PT modal share and User Satisfaction, while other areas of impact will be considered at the FUA level based on site-

specific measures. An important distinction to make in the UPPER evaluation is that of functional urban area (FUA) level evaluation and measure level evaluation.

There are a variety of impacts expected from UPPER measures. Some measures may have a very direct influence on certain indicators, such as a bus priority corridor on commercial speed; others may have a more indirect influence, such as improved PT stations on PT modal share. Additionally, some measures or series of measures will be focused on a very specific part of the city, and therefore may only have a clear impact in that location, while the link to broader city objectives may be less direct. Understanding the synergies different combinations of measures will have that lead to impact, focused on a particular part of the city or the urban area overall, will be an important step to develop toward the final evaluation. This process is only in the initial stages as potential measure scope and impact areas were only defined by July 2023 as part of D2.2.

As we are tracking urban area indicators separately from measure-level indicators, it is also important to note that there are many ongoing trends within cities that will impact urban area level indicators. For example, many cities have a variety of policies in place aimed at promoting sustainable transport in addition to the UPPER measures. A significant part of the impact evaluation will be understanding how these trends or policies influence the achievement of FUA level goals at each site, as well as considering the contribution of UPPER measures towards FUA goals. In addition, the upscaling potential of various measures will be analysed in T7.2, to determine which measures could be replicated at other sites within the same urban area and estimating the combined impact of multiple measures. With the challenges of connecting individual measures to FUA targets in mind, baselines for the functional urban area were collected from the UPPER sites for the three major impact areas.

Regarding GHG emissions, it is important to note that this type of inventory does not take place every year in many sites, therefore data from the most recent year available is presented in Table 2. There is no general target laid out related to CO₂ emissions for UPPER sites, though many cities have developed targets through sustainable urban mobility plans. In general, further discussion is needed to understand how the combined impact of the UPPER measures on CO₂ emissions can be calculated at the urban area level and to what level of detail.

TABLE 2. - FUA baselines – CO₂ emissions

Site	Annual Mobility-related CO ₂ Emissions baseline	Estimated Mobility-related CO ₂ emissions per capita*	Year collected
Valencia	601,431 tonnes CO ₂ eq.	0,8	2021
Versailles Grand Parc	467,000 tonnes of CO ₂	1,8	2018
Rome	to be confirmed		
Oslo	541,976 tonnes of CO ₂ eq.	0,8	2021
Mannheim	582,344 tonnes CO ₂	1,8	2020
Lisbon	810,000 tonnes CO ₂	1,6	2020
Budapest	1,700,000 tonnes CO ₂	1	2015
Leuven	145,474 tonnes of CO ₂	1	2020
Thessaloniki	256,000 tonnes CO ₂ eq.	0,8	2019
Hannover Region	2,474,136 tonnes CO ₂	2	2020

*This were calculated for this report to give context to the data. They are not reported statistics.

Regarding PT modal share, there is an UPPER project target to increase the PT share of motorized transport by 30% in all sites. Considering the baselines, for cities with very low PT shares, this target may be ambitious but achievable; cities with already high modal shares of PT, would find this target much more difficult to achieve. In these cases, focuses will be on improving PT modal share for specific groups or areas with low PT use.

TABLE 3. - FUA baseline – Modal Shares

Site	PT trip%	Active trip %	Other motorised trip%	Year collected and scope
Valencia	21%	46%	32%	2018 - Metropolitan area of Valencia
Versailles Grand Parc	32%	6%	62%	2019 – Urban Community of Versailles Grand Parc
Rome	20%	22%	62%	City of Rome
Oslo	31%	38%	31%	2022 – City of Oslo
Mannheim	13%	54%	33%	2018 – City of Mannheim
Lisbon	16%	23%	61%	2017 – Lisbon Metropolitan Area
Budapest	47%	17%	35%	2018 – City of Budapest
Leuven	12%	25%	64%	2017 – City of Leuven
Thessaloniki	17%	26%	56%	2022 – City of Thessaloniki
Hannover	14%	41%	45%	2020 – Hannover Region

Similarly, there is a general project target to increase user satisfaction by 25%. In some cases, where user satisfaction is very high, the target will be to maintain the very high levels of user satisfaction. An initial look at the user satisfaction scores shows that many different monitoring scales are used, which could also show that many different criteria are used to monitor user satisfaction. Cities will not be asked to change their monitoring scale, though an initial review of how user satisfaction is monitored will be conducted.

TABLE 4. - FUA baselines – User Satisfaction

Site	User Satisfaction	Year collected
Valencia	<ul style="list-style-type: none"> Urban Bus (PTO): 7.5/10 Bike sharing: 7.7/10 	2023
Versailles Grand Parc	to be confirmed	
Rome	<ul style="list-style-type: none"> Surface PT: 56/100 (sufficient) Metro: 58/100 (sufficient) 	to be confirmed
Oslo	91%	Second half of 2022
Mannheim	2.6 (1-5 scale where 1 is best, aggregated value of numerous specific satisfaction values)	2020
Lisbon	2.85 (1-5 scale where 5 is the best) (PT included Bus, boat, tram, metro, taxi)	2022
Budapest	to be confirmed	
Leuven	62.3% scores 7/10 or higher (Buses)	2022
Thessaloniki	30%	2022
Hannover	90%	2022

For the additional impact categories, three cities have provided baseline numbers on accidents and injuries; however, many cities monitor this for traffic safety purposes. Thus, it may be possible to assess if the measures contribute to overall safety improvement. Four cities have provided baseline information on congestion; two cities on access to mobility services; two cities on noise pollution; and two cities on air pollution. We will continue to review if it is possible to assess urban area impacts in these categories at the UPPER sites based on site-specific measures.

4. Measures, Baselines, and Expected Impacts

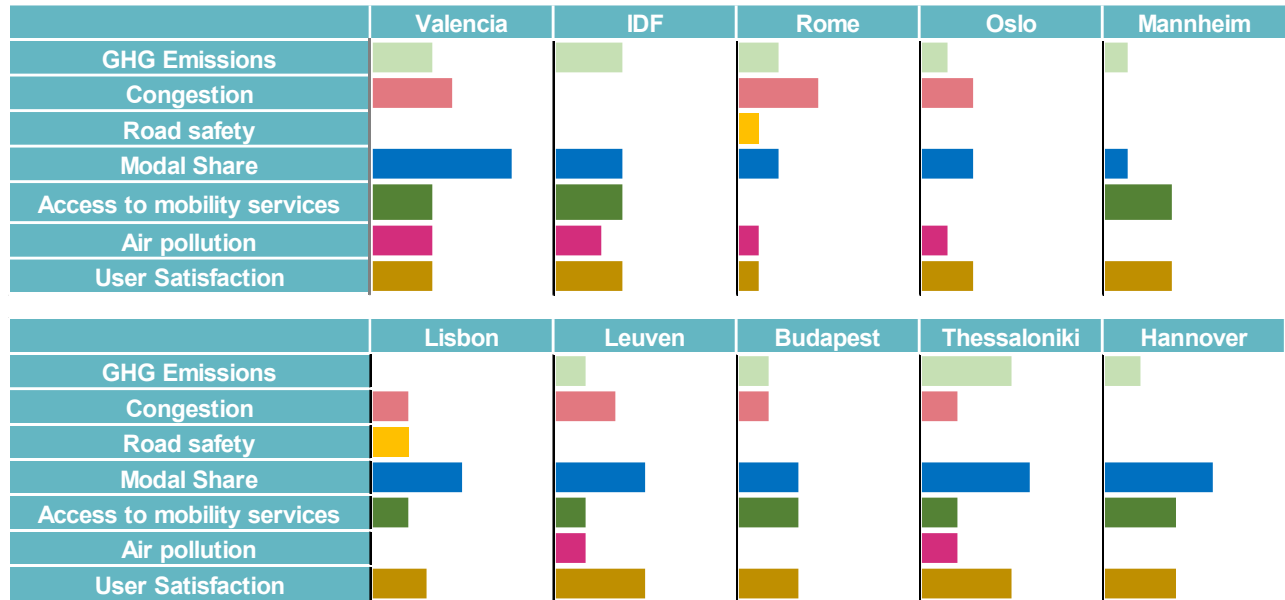
In this section, a summary measures and indicators is given based on the categories provided by CINEA. The number of measures contributing to the different impact areas is reflected in Table 5. This shows that there is a clear contribution expected to reduce GHG emissions, increasing sustainable modes, improving user satisfaction, as well as reducing congestion and increasing the reliability of PT. Access to mobility services and air pollution are also addressed in many measures.

TABLE 5. - Number of measures contributing to each impact category

Impact Category	Number of Measures	Number of Cities	Main Indicators tracked
GHG Emissions	17 measures	9 cities	<ul style="list-style-type: none"> • CO2 emissions • Energy used
Congestion	17 measures	7 cities	<ul style="list-style-type: none"> • Commercial speed • Travel time • PT frequency reliability • PT departure punctuality • PT regularity • Traffic flow
Road safety	3 measures	2 cities	<ul style="list-style-type: none"> • Accident rate • Number of accidents and injuries
Modal Share	34 measures	10 cities	<ul style="list-style-type: none"> • Modal split • Modal share of PT • Number of shared micromobility trips • PT ridership in peri-urban areas • % increase of intermodal trips • Number of cyclists within the city • PT ridership among vulnerable groups
Access to mobility services	18 measures	8 cities	<ul style="list-style-type: none"> • Access to mobility services • Percentage of population with a mobility option within walking distance • Coverage of area or travellers which is served by the measure
Air pollution	10 measures	6 cities	<ul style="list-style-type: none"> • PM emissions • NOx emissions • CO emissions • VOC emissions
User Satisfaction	27 measures	10 cities	<ul style="list-style-type: none"> • User satisfaction index • User satisfaction – safety • User satisfaction - accessibility

In Figure 6, there is further information by site which illustrates the priorities of the 10 UPPER sites. Between four and six impact categories are addressed by different measures at each site.

FIGURE 6. - Proportion of site measures which relate to different impact categories



4.1 Description of Measures to Achieve Impact

The following is a description of measures that aim to address the main impact categories: CO₂ emissions, modal split, and User Satisfaction.

4.1.1 CO₂ EMISSIONS

For CO₂ reduction measures, these are mostly related to specific areas or user groups. In Rome, there is planned implementation of a Low Emissions Zone and a pollution charge scheme. Leuven aims to reduce emissions through improved parking and PT connections. Mannheim aims to will focus on specific peri-urban tangential bus lines and the on-demand service. Thessaloniki will model CO₂ emissions reductions for PT use related to a Low Emissions Zone, parking pricing, PT corridor management, reducing PT travel times, and implementing electric buses. In Oslo, one measure to improve traffic flow aims to decrease CO₂ emissions in addition to other pollutants. In Valencia, CO₂ emissions will be measured related to improvements to a bus corridor as well as a creation of a network of multi-modal hubs. VGP aims to integrate PT and shared and active travel modes. VGP will also model the potential emissions reduction from a potential Low Emissions Zone. Budapest will reduce CO₂ emissions through increased use of shared micromobility and improved PT efficiency and convenience. Hannover will look at emissions reduction in the FUA as a result of the implementation of a digital tariff system throughout the region.

A significant contribution to reducing greenhouse gas emissions in UPPER will be achieved through measures for a modal shift towards more PT, in most cases along with active modes. It can be difficult to quantify these impacts directly and will be a subject to further develop in the evaluation process. Many partners have expertise in this domain, and a working group will be set up to refine calculation methods related to CO₂ emissions.

4.1.2 MODAL SPLIT; SHARE OF PUBLIC TRANSPORT

Increasing the PT share of motorized transport can be achieved through increasing PT ridership and reducing car use. This can reflect forgone trips or shifts from car trips to other modes. Budapest aims to increase the number of public transport users in dedicated areas by making PT more efficient and convenient. There is also a plan to increase micromobility trips. Leuven aims to increase PT use along a bus priority corridor and among specific target groups. Lisbon has many measures which together aim to increase the PT share of motorised transport. This includes various aspects of improving the PT systems as well as campaigns. Lisbon also aims to increase the number of cyclists in the city. Mannheim focuses on increasing the use of shared mobility. Rome aims to reduce car use through designing urban space for active modes. Thessaloniki will simulate modal shift for a variety of measures, mostly focused on defined areas where the measures will be implemented. In Valencia, improvements to a bus corridor, improving the PT offer, as well as a creation of a network of multi-modal hubs aim to increase the PT share, though targets are not yet available. In addition, there will be a focus on increasing use of PT by vulnerable groups and in peri-urban areas. Hannover will look at increased PT modal share in the FUA as a result of the implementation of a digital tariff system throughout the region; the target is yet to be defined. VGP plans to increase shared mobility trips through multiple measures. Oslo will aim to increase active mobility in accordance with national goals.

4.1.3 USER SATISFACTION

There are many existing systems and methods in cities used to track user satisfaction; we see a variety of user satisfaction scores put forth as targets. In Hannover, user satisfaction will be monitored for the digital tariff across the region. Hannover will also track user satisfaction with the Sprinti DRT service. In VGP, a user satisfaction study will be completed. Additionally, a measure to optimize the PT offer in the area aims to improve user satisfaction. In Leuven, two measures aimed at improving user information and digital tools for PT. Lisbon has measures which aim to increase user satisfaction in specific areas. Mannheim, through a campaign for sustainable transport, has a target to increase user satisfaction. They will also look at user satisfaction with digital sales channels. Thessaloniki will focus on measures related to user information, improved PT travel times, increased access to PT in low-demand areas, and implementation of electric buses. Oslo will monitor user satisfaction for two measures: the DRT service and improved road comfort. Valencia will focus on specific aspects of user satisfaction – safety and accessibility – related to improved PT stops. Additionally, it will look at overall user satisfaction with PT information. Budapest aims to improve user satisfaction through modifying PT lines. Rome will monitor user satisfaction for a measure related to multi-modal digital mobility services.

4.1.4 ACCESS TO MOBILITY SERVICES; ACCIDENTS AND INJURIES; CONGESTION; NOISE AND AIR POLLUTION

For the targets on access to mobility services, reducing the number of accidents and injuries, congestion reduction, and noise and air pollution, we refer to the Local Evaluation Handbooks. These are very specifically related to local conditions and priorities. These are impact areas where twinning will be most useful, to learn from each other and help develop the other technical tools, particularly U-SUMP, and U-TRANSFER.

5. Next steps For Evaluation Process

As indicators have been defined for all measures, the next section discusses monitoring and reporting and further development of the evaluation process and framework.

5.1 UPPER evaluation handbook: living document

The UPPER Cross-site evaluation handbook is considered as a “Living Document” that will be further refined. This first version is a summary of main impact areas and is a starting point for the monitoring of UPPER measures and mobility evolution in each functional urban area (T7.1). The anticipated revisions are as follows:

V2.0 – M12

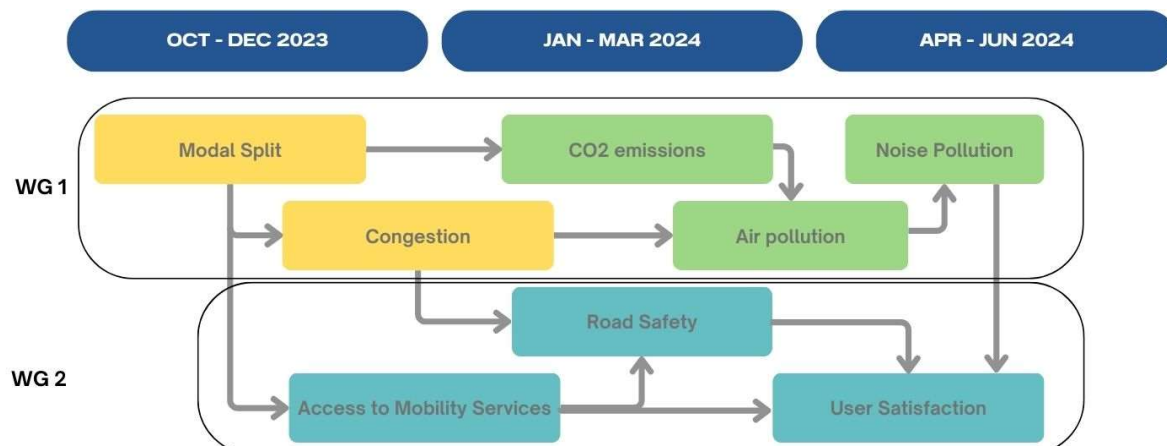
- Further harmonisation of indicators across sites
- Inclusion of additional baselines and targets where available
- Alignment with impact evaluation of other Mission Platform projects following Urban Mobility Days (3-6/10/23)

V3.0 – M18

- Results of thematic impact assessment working groups:

These are set up as a combination of horizontal partners and local partners having expertise on specific impact calculation methods. The main challenge to be resolved is to understand transition paths with different measures interacting towards impacts. We will use described in 2.1 which looks at systemic levers, outcomes in early stages and the link to long term changes, as well as direct and indirect benefits. The UPPER working groups will elaborate calculation methods, acknowledging currently missing data that will be produced by the UPPER tools, thereby avoiding gaps or double counts. These working groups will be organized over the next 6 to 8 months, considering which indicator methods are needed first to provide best practices and data for subsequent indicators (Figure 7).

FIGURE 7. - Proposed time frame for impact working groups



5.2 WP7 Assessments

The collected data by the cities, along with indicators produced using UPPER tools (WP3, WP4, WP5, WP6), will be used to assess the measures' upscaling potential (T7.2), the mobility impact (T7.3), the socio-economic and environmental impact (T7.4), and to evaluate business and operating models (T7.5).

5.2.1 UPSCALING POTENTIAL

This task aims at monitoring and quantifying/qualifying the multiplying effect of UPPER measures implementation at the level of the whole city, and involved Functional Urban Area (FUA), using as main parameters: the level of integration of the new services with existing services, the level of compliance of the services to the designed user needs (WP2) and the harmonized service specifications (WP4), the implemented rhythms of adoption by users and operators and finally the readiness of the mobility ecosystem in adopting innovation. Impact KPI Values will refer to the entire Functional Urban Area (FUA) of each demo-site. When this is not possible: indications of multiplying effect (figures of multipliers per impact category) will be provided to allow upscaling of impact. The outcome of this task is the repository of impact multipliers matrix per city measures verified by the city stakeholders.

5.2.2 MOBILITY IMPACT ASSESSMENT

For this assessment, the transport and mobility impact of the solutions implemented at UPPER sites are quantified. Various indicators will be used including, user satisfaction with PT assessment, effectiveness, and cost-effectiveness, PT accessibility and accessibility mapping. Additional elected indicators may be included in the evaluation to cover key representative impacts. The Multi Criteria Analysis (MCA) and/or Analytic Hierarchy Process (AHP) may be used in case of different options evaluated.

5.2.3 SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACT ASSESSMENT

The environmental impact assessment, will quantify direct transport emissions, including CO₂ and air pollution emissions, and associated energy consumption of UPPER measures. This will be further aligned with impact assessment methods of measures taken to address other issues in the Mission Cities. It will also consider cost and savings of interventions. The socio-economic impact analysis will be conducted through a social cost benefit analysis in each city. This will be based on indicator and survey data as well as results of accessibility mapping.

5.2.4 EVALUATION OF BUSINESS AND OPERATING MODELS

In this section, we will assess the collaboration model (analysed in WP4) for stimulating the conditions for innovative solutions development and adoption. The outcome will focus on the proposal of generic collaborative business models for uptake of innovative PT solutions.

5.3 Progress Monitoring

The Inception Report Indicator spreadsheet will be the basis of ongoing monitoring of measures During Y2 and Y3, monitoring activities will take place, with two intermediate reports:

- M18 - Progress monitoring #1,
- M36 - Progress monitoring #2,
- M48 - Final reporting

At these reporting periods, demo sites are expected to report progress on measures related primarily to process evaluation in the UPPER Impact Database.

- **Process Evaluation:** Tracking of completion of milestones and outputs, along with output indicators
- **Impact Evaluation:** As impact evaluation can only take place after implementation, the ongoing monitoring refers to identifying baselines for all impact indicators prior to implementation where these have not already been defined. Indicator reporting will only take place at intermediate reporting periods as needed or after implementation is complete.

Reporting responsibilities: The Demo Site leader and Local Evaluation Managers (LEM) are responsible for local evaluation activities, progress monitoring and the preparation and update of the evaluation handbook. The Project Evaluation Manager (PEM), KU Leuven, supported by an expert (Dirk Engels from Transport & Mobility Leuven) coordinates and assists the cities and LEMs in performing the evaluation in an efficient and consistent way and is responsible for the synthesis of the results of all the evaluations carried out in the project.

5.4 Measure timelines

Figure 8 and 9 show the measure timelines for all UPPER Sites, including implementation periods, reporting periods, and progress monitoring moments highlighted for measures where these are defined. Some project timelines are still under development and thus are not included in the timeline below. It is important to note that the timeframe indicates when a project is 'active,' including the implementation period, but also including times where studies or surveys, etc. have already begun for the measure. These timelines show that as of September 2023, 18 measures are already active, and by the end of 2023, 28 measures will be active. By M18, roughly 50 percent of the measures should be at least at the beginning stages of development. By the start of Year 3, almost all measures will have begun. This means that certain aspects of monitoring are already necessary.

FIGURE 8. - Living Lab timeline: Measure time frames, preliminary progress monitoring points per measure, and UPPER reporting and evaluation periods

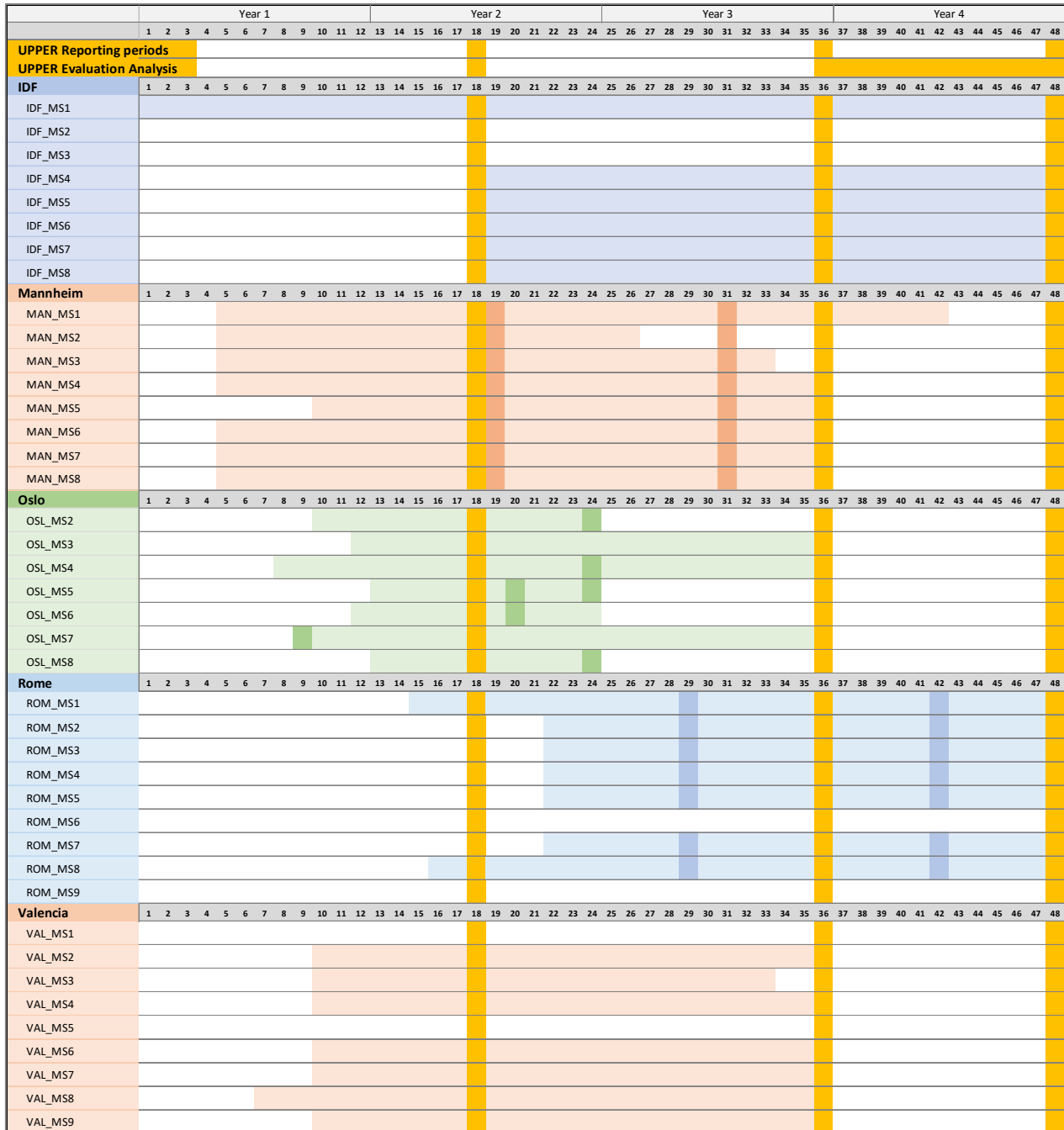
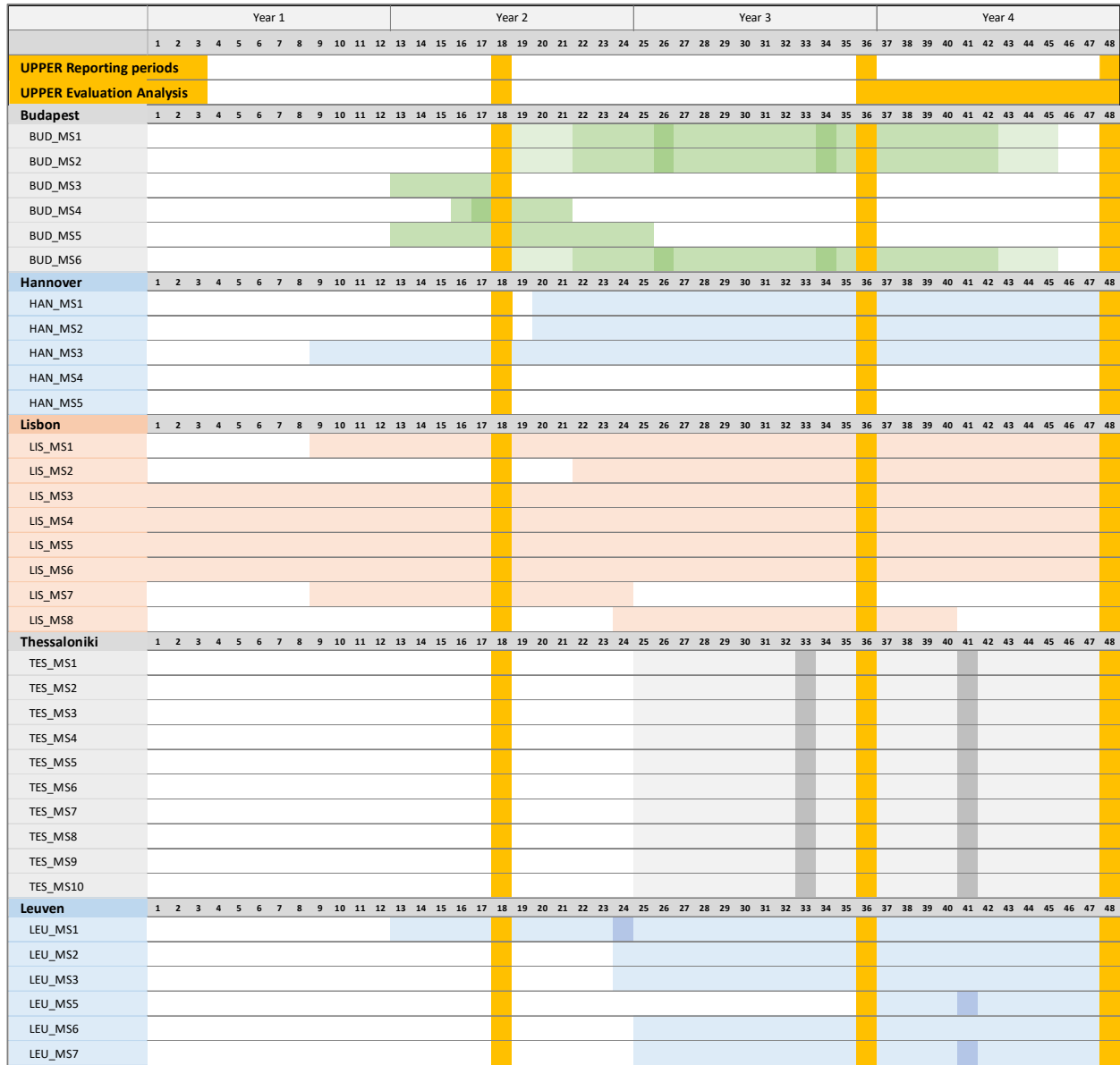


FIGURE 9. - Twinning site timeline: Measure time frames, preliminary progress monitoring points per measure, and UPPER reporting and evaluation periods



5.5 Database and U-Tools for Evaluation

The following describes how the Impact Database and U-Tools will be used throughout the evaluation process.

5.5.1 UPPER IMPACT DATABASE

The impact indicator table is the starting point for an UPPER impact database, which will facilitate the interaction between the impact assessment and the UPPER tools.

This database will also be the primary means of tracking 'process evaluation' – where sites will provide information about completed milestones and outputs, along with significant changes to these, including planned dates or scope. This will also be a place to report whether the timeframe of a measure overall has changed significantly. Sites will be able to provide any comments and explanations for any changes, focused on how this relates to process evaluation.

The UPPER impact database will collect data about:

- Cities
 - General city information (e.g. population)
 - Current indicator values
- Measures
 - Measure descriptions
 - Measure process and milestones
 - Indicators selected to monitor the measure
- Indicators
 - Indicator definitions and units
 - Indicator data collection and calculation methods
- Targets and process monitoring
 - Baseline, business as usual and target values
 - Timeline for progress monitoring
 - Calculated indicator values for intermediate progress monitoring and end evaluation

5.5.2 LINK WITH U-SUMP

U-SUMP will provide a data-driven platform that helps to guide and track the development, implementation and update of SUMPs. To accomplish this, U-SUMP will allow monitoring of UPPER measures, selecting and monitoring indicators and provide dashboards both for internal decision-making processes and transparent communication about the measures. Practically this implies that U-SUMP provides an interface to the UPPER impact database. Local and regional authorities will be able to define measures and milestones, select and link indicators for each measure and set baseline and target values a timeline for the monitoring. During the measure implementation, the authority will be able to update progress monitoring information. The U-SUMP dashboard will provide a comprehensive dashboard to visualise progress and support decision-making using the data in the UPPER impact database.

5.5.3 LINK WITH U-KNOW

U-KNOW will include information and resources on data collection and evaluation methodologies. With the U-KNOW development, inspiring practices will be available to help better formulate these targets, and anticipate user response to PT improvements.

5.5.4 LINK WITH OTHER U-TOOLS

U-SIM, U-NEED, U-TWIN and U-GOV can contribute to data collection and indicator calculation. Requirements related to evaluation were introduced for each tool during the T2.4 Volere process defining technical requirements. This will be further specified during the tool development planned in the next 6 months.

5.5.5 ALIGNMENT WITH OTHER CLIMATE-NEUTRAL AND SMART CITIES IMPACT ASSESSMENT DATABASES

Currently, the UPPER impact database is developed for the 10 UPPER sites, to help monitor their outputs and contributions to the project goals. Through cluster activities with the SPINE project, the impact indicators are aligned as much as possible. By using the CIVITAS evaluation framework and by aligning the theoretical framework with NetZeroCities, there is also possibility to extend this database later, for impact assessment and impact tool development in other urban sustainable and smart mobility projects.

6. Conclusions

This document is a first version of the cross-site evaluation handbook and impact assessment framework. It is considered a “living document”, that will be further elaborated throughout the project. The current conclusions reflect the expected impact of the UPPER detailed measure descriptions presented in the Annexes of D2.2, submitted to CINEA end of July 2023.

All the UPPER sites have measures contributing to speeding up greenhouse gas emission reduction. However, more research is needed to evaluate how modal shift contributes to the climate targets in each city. This will be conducted in working groups consisting of experts from UPPER core, horizontal and local partners, having expressed their interest to collaborate on the subject.

All the UPPER sites have measures to increase the use of PT by 30%. However, ranges of expected impacts are rather wide. This is linked to –mainly political and technical- uncertainties, that may affect the measure implementation and the urban mobility local context. More specific targets will be formulated by using the modelling tools and the policy support tools developed in WP3, WP4 and WP5.

UPPER sites having already high scores on user satisfaction, tend to focus more on other measures, such as increase access to mobility services. This is also the case in some cities having already a high share of PT, focusing more measures on e.g. congestion reduction (e.g. Valencia).

There are measures specifically targeting air (and noise) pollution reduction in 6 UPPER sites. These will also collaborate in the ‘environmental impact’ working group. This will allow sharing of experience and expertise among cities dealing with similar issues, thus changing ‘pilots’ into ‘followers’ (and vice versa) for specific issues.

Although only very few measures are explicitly targeting an improvement of traffic safety (e.g. Lisbon), it is monitored in all the UPPER sites, so the impact of the PT measures on safety can be considered as part of the mobility impact (Task 7.2).

The UPPER impact assessment framework builds upon current insights from 10 sites, considering the current resources from the EU Mission. The “living document” will be periodically supplemented based on new insights concerning SUMI indicators, the EU Mission, other relevant urban mobility projects, ... during the period of implementation.

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