SCALE-UP

User-Centric & Data Driven Solutions for Connected Urban Poles

The SCALE-UP evaluation framework Version 1.0

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0.4	10.12.2021	Version submitted to technical and project coordinator and to peer-reviewers
1.0	21.12.2021	Final version

List of Acronyms	
Acronym	**Meaning**
EC	European Commission
FUA	Functional Urban Area
GHG	Greenhouse Gas
GIS	Geographic Information System
LEM	Local Evaluation Manager
MER	Measure Evaluation Results
ML	Measure Leader
OECD	Organisation for Economic Co-operation and Development
PEM	Project Evaluation Manager
PER	Process Evaluation Report
PT	Public Transport
SC	Site Coordinator
SUMI	Sustainable Urban Mobility Indicators
UN	Urban node
WP	Work Package

Legal Disclaimer

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1. Introduction

1.1. Context and aim of this document

This document provides a first version of the SCALE-UP process and impact evaluation framework, which will be used to evaluate, in an efficient way, the evolution of the urban nodes into climate-resilient, well-connected, multimodal and multi-usage nodes for smart and clean mobility and the impact and process of the SCALE-UP measures implemented as part of the SCALE-UP project.

The long-term experience of the CIVITAS projects on evidence-based evaluation and monitoring of the implementation of sustainable mobility measures has been well-documented in the CIVITAS 2020 process and impact evaluation framework. It provides the building elements for a solid, transparent and consistent CIVITAS evaluation approach, with detailed guidelines and practical advice, reporting templates and examples from the CIVITAS projects.

The SCALE-UP project builds further on this experience by developing 'add-ons' to the CIVITAS 2020 evaluation framework, thereby responding to the specific needs for SCALE-UP-like cities in evaluating the effectiveness of their strategies and measures to become climate-resilient, well-connected, multimodal and multi-usage nodes for smart and clean mobility.

For this purpose, SCALE-UP proposes a layered evaluation approach encompassing 3 levels of evaluation:

- the level of the measures implemented within the project life span,
- the level of the Functional Urban Area, and
- the level of the strategy integration (TEN-T and multi-layered mobility system)

To this extent, the SCALE-UP framework will provide all elements to evaluate and understand whether the SCALE-UP project reaches its specific objectives and target.

In the course of the project this framework will be updated and finetuned based on further developments of the approach and the monitoring and evaluation experiences gained during the project. The final version of the SCALE-UP evaluation framework will be delivered at the end of the SCALE-UP project.

1.2. Structure of this document

This report presents the first version of the SCALE-UP evaluation framework.

Chapter 2 provides a recap of the CIVITAS 2020 process and impact evaluation framework, highlighting the main elements needed for a consistent and robust CIVITAS evaluation approach.

In Chapter 3, an overview is given of the overall SCALE-UP evaluation concept and specific elements of the framework which will be further developed in the course of the project.

In the next three chapters, the 3 different levels of evaluation are discussed. Chapter 4 discusses the building elements on how to successfully monitor, evaluate and understand the mobility evolution in the urban nodes including references to the relevant SUMI indicators and the definition of indicators on the innovation context inspired by the previous CREATE project. In chapter 5, the evaluation approach on the level of the SCALE-UP measures is discussed, hereby focusing on additional indicators defined in relation to the objectives of the SCALE-UP project. Chapter 6 outlines the basic elements of the SCALE-UP evaluation approach of the envisaged horizontal and vertical integration in SCALE-UP like cities.

Provisional conclusions and future actions are presented in Chapter 7.

2. The CIVITAS 2020 process and impact evaluation framework

In February 2021, CIVITAS SATELLITE published the CIVITAS 2020 process and impact evaluation framework (Engels 2021). Based on an intensive collaboration with the 2016-2020 Innovations Action projects – DESTINATIONS, ECCENTRIC and PORTIS – and a screening of the evaluation approaches in the Research and Innovation Action projects, the framework provides a basis for a solid, transparent and consistent evaluation of mobility related measures implemented in European urban environments. The CIVITAS 2020 process and impact evaluation framework provides detailed guidelines, practical advice, reporting templates and relevant examples from the CIVITAS project.

This chapter recapitulates the building stones of the CIVITAS 2020 process and impact evaluation framework.

2.1. Impact and process evaluation

The evaluation approach consists of an integrated evaluation approach (see Figure 2), including two complementary actions: impact evaluation and process evaluation, jointly providing a good understanding of how measures contribute to changes in the city.

The **impact evaluation** includes the evaluation of a wide range of technical, social, economic and other impacts of the measures being implemented by the cities. Based on measurements of selected indicators before and after the implementation of the measure(s), it quantifies the impact of a measure or an integrated package of measures in the six CIVITAS impact categories, as shown in Figure 1.

CIVITAS IMPACT CATEGORIES

1. Society-governance
2. Society-people
3. Transport system
4. Energy
5. Economy
6. Environment

Figure 1: The 6 CIVITAS impact categories.

Complementary to the impact evaluation, a **process evaluation** is performed. Process evaluation involves the evaluation of the processes of planning, implementation and operation and aims to understand why measures have succeeded or failed. Process evaluation analyses how the measure was implemented and identifies the barriers and drivers of the implementation process, and the important elements or activities that facilitated the implementation of that measure and increased the envisaged impact.

The integration and interpretation of the results from both the impact and process evaluation will provide the necessary comparative insights and understanding of the effectiveness and efficiency of the measures in the context of the urban area. Especially in the complex urban environment in which a range of factors influence changes, it is crucial to combine quantitative measurements (the traditional impact evaluation) with focused efforts to validate observations and put the figures in the correct context.

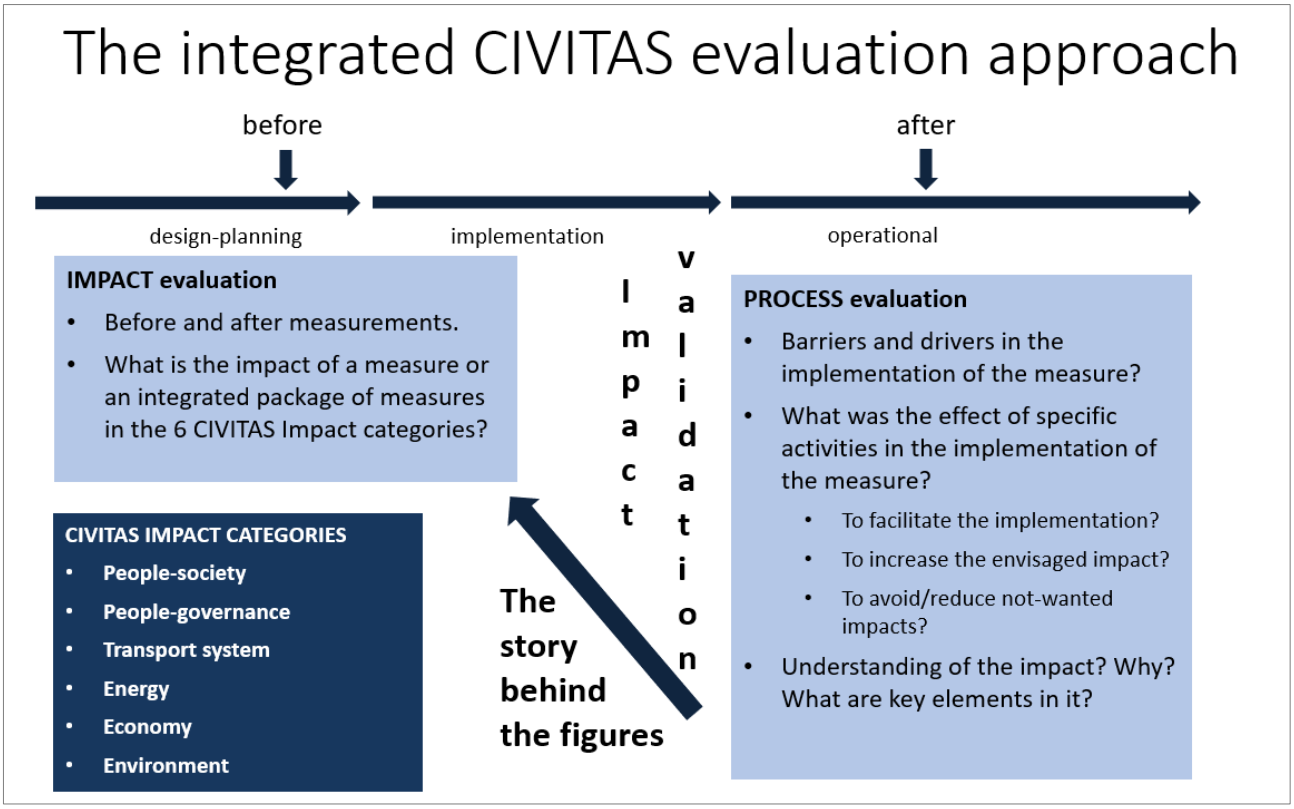

Figure 2: The integrated CIVITAS 2020 evaluation approach. Figure 2 from the CIVITAS 2020 process and impact evaluation framework.

2.2. Evaluation conclusions

To be able to draw evidence-based conclusions on the effectiveness of implemented sustainable mobility measures it is important to put the evaluation results in light of the urban context and mobility evolution of a city or site.

Therefore well-chosen evaluation activities should be organised, including consultation, expert group meetings, additional analyses, etc., to come to well-motivated conclusions and recommendations on different levels. Figure 3 gives an overview of how these activities can be structured combining direct measure related evaluation results with further analyses of the findings with different focusses

Bringing all these evaluation findings together in a structured way is an important task in each project aiming to contribute to our knowledge base of evidence-based solutions. Only with significant efforts to do this, the added value of good evaluation work on measure and city level will be clear and results of the evaluation will fully support decision making and optimisation, up-scaling and take-up of strategies.

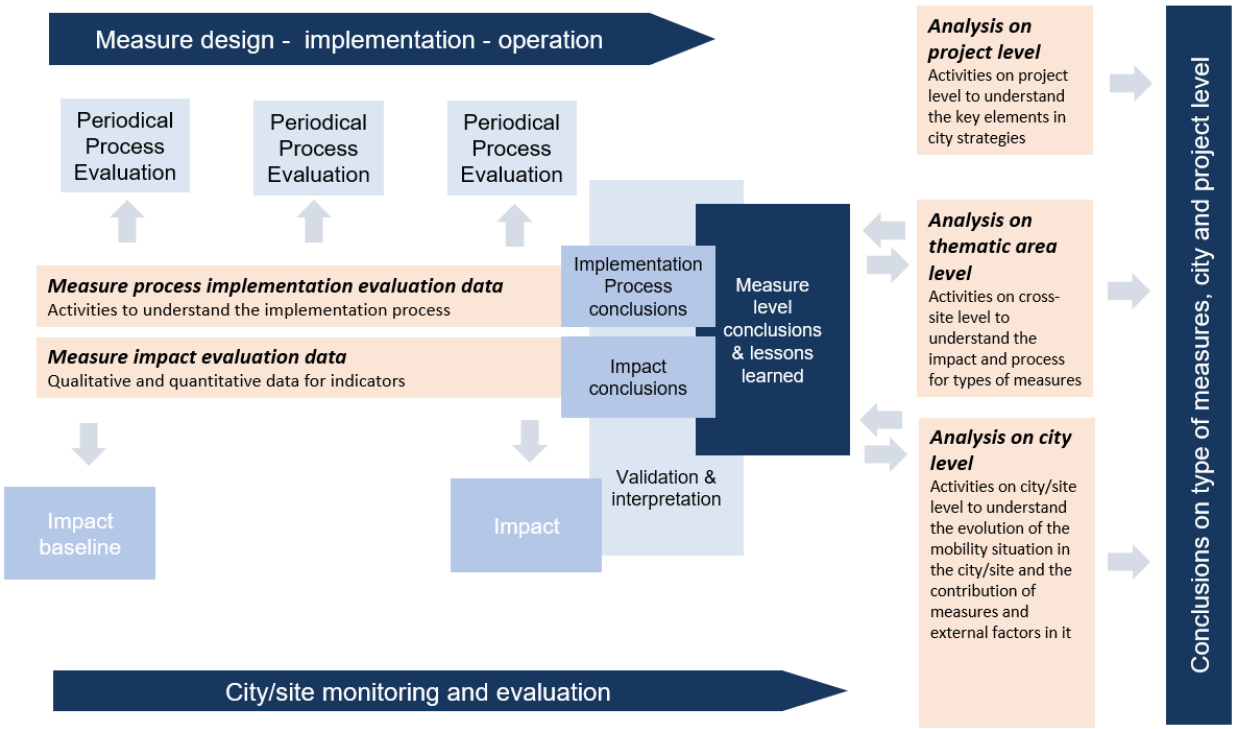

Figure 3: Bringing all knowledge together. Figure 12 from the CIVITAS 2020 process and impact evaluation framework.

2.3. Roles and reporting tools

An efficient evaluation approach resulting in useful findings and conclusions can only be achieved if the roles and responsibilities of the different actors involved in the evaluation process are clearly defined and agreed. The following typical **roles and responsibilities** should be assigned for a project with different cities or FUAs in which integrated mobility strategies and specific measures are implemented and need to be evaluated:

- A Project Evaluation Manager (PEM) coordinating the evaluation efforts in different sites and bringing the findings together in relevant overall conclusions.
- Local Evaluation Managers (LEM) responsible for the evaluation of all measures in a city or site.
- Measure Leaders (ML) responsible for organising the preparation, implementation and operation of a specific measure in his/her city. The ML also plays an important role in the data collection and gathering information on the implementation process.
- A Site Coordinator (SC) responsible for providing a general supervision of the implementation process of all measures in a city or site and providing support in evaluation where requested by the LEM and the ML.

Complementary to a good cooperation structure, efficient and feasible planning of the evaluation activities linked to the implementation of mobility measures is crucial. The CIVITAS framework provides a standard and easy-to-use Excel-based planning tool or **Gantt Chart** to monitor the progress of the measure implementation and to plan the evaluation activities, namely the data collection, the validation and reporting.

A consistent and well-structured reporting is crucial to increase the transparency and understanding of the findings on the implementation of a measure. As a basis for this the CIVITAS framework already makes a set of **reporting templates** available to synthesise the approach and findings on the impact and implementation process of mobility related measures:

- The Measure Evaluation Results template
- The Process Evaluation Report template

The **Measure Evaluation Results (MER) sheet** is the main basic report containing all the information related to the evaluation of the implemented measures.

Complementary to the MER, a **Process Evaluation Report (PER)** presents, on a regular basis, the key findings of the implementation process of the measure. It identifies the barriers and drivers and describes the main lessons learned. In the last phase of the

evaluation work (or also in an intermediate phase) these findings will be combined with the findings of the impact evaluation to arrive at a well-motivated understanding of the impact and implementation process of the measure(s). The conclusions of the process evaluation are also being included in the MER.

3. The SCALE-UP evaluation framework

3.1. The SCALE-UP add-ons

The SCALE-UP evaluation framework builds further on the CIVITAS 2020 evaluation approach using all its key elements in the existing framework. The SCALE-UP project aims to contribute to the knowledge base of innovative mobility solutions and identify effective integrated mobility strategies to reach the local and EU sustainable goals in the SCALE-UP urban nodes and in relation to the TEN-T dimension. In this light, the SCALE-UP evaluation approach develops a range of 'add-ons' to the CIVITAS 2020 process and impact evaluation framework in the following aspects:

- A layered and integrated evaluation approach encompassing **3 main focuses of evaluation**:
  - evaluation of the **SCALE-UP measures**,
  - evaluation of the **Functional Urban Area (FUA)**, and
  - evaluation of the **strategies for integration**, analysing the SCALE-UP concept of vertical (local – FUA – TEN-T) and horizontal (multi-layered mobility system) upscaling

  The TEN-T dimension is covered in the evaluation of vertical integration.

- **Definition of additional indicators** to the CIVITAS indicators for the 3 levels of evaluation. Dedicated attention will be given to indicators to monitor and evaluate the specific SCALE-UP mobility strategies (e.g. the level of horizontal and vertical integration) and the need to monitor the evolving mobility solutions in urban areas (e.g. micromobility).

- **Data collection opportunities** based on new approaches for data capturing, advanced data analytics, business intelligence and citizens science.

- **(Cost) effective analysis techniques** to identify the type of measures that really make a difference in changing the cities, with a focus on the EU climate and transport targets.

The proposed elements on these different aspects are presented in this document under the 3 main focuses of the SCALE-UP evaluation.

The SCALE-UP project has designed a combination of technical and non-technical measures around five intervention fields: governance, multimodal hubs, data, clean

safe and inclusive, and behaviour (see Figure 4). These intervention fields are directly linked to the first 5 strategic objectives of SCALE-UP.

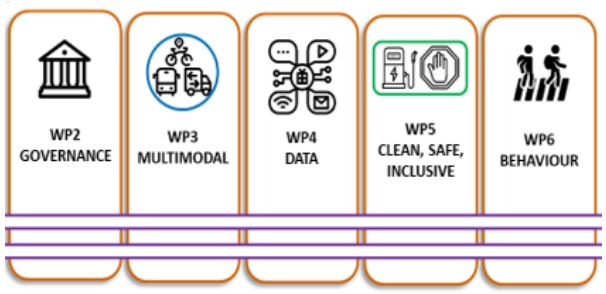

Figure 4: The 5 intervention fields of the SCALE-UP project.

The add-ons of the SCALE-UP evaluation framework will allow to make useful conclusions on **thematic challenges** of each of these intervention fields (e.g. data standardisation, digital experience of mobility hubs, public private cooperation models, etc.) and identify what approach is effective in reaching the objectives of each specific intervention field.

3.2. The 3 levels of evaluation

To provide evidence for the efficiency and effectiveness of the implementation of innovative measures and strategies, a layered evaluation approach is applied. This is illustrated in Figure 5.

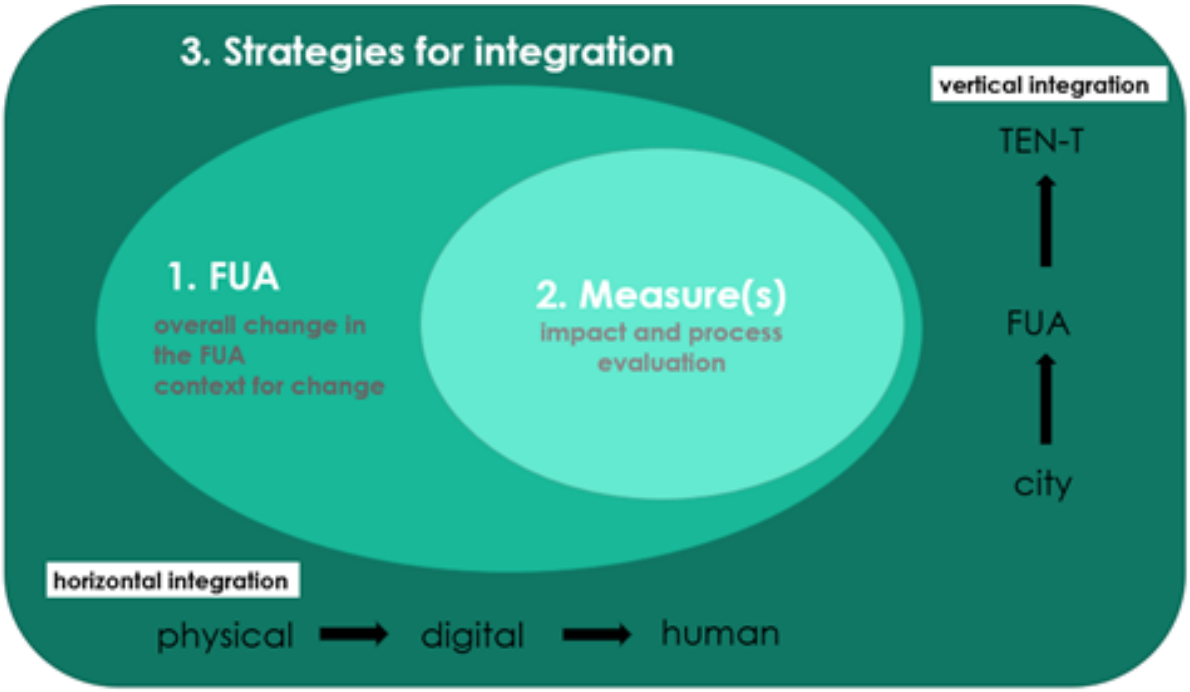

Figure 5: The 3 focuses of the SCALE-UP evaluation.

The first level of evaluation works on the **understanding of the overall changes**, **evolution and trends in the urban nodes**. Qualitative and quantitative indicators at city or FUA level are defined in each of the 6 CIVITAS impact categories (Figure 1) to understand the overall changes in governance-people, the transport system etc. For the selection of these indicators, inspiration is found in the indicators list of the CIVITAS 2020 process and impact evaluation framework and the Sustainable Urban Mobility Indicators (SUMI) indicator set. Furthermore, based on the approach developed in the CREATE project, the context for change in the different urban nodes is mapped. The overall aim is to identify the overall change in the different urban nodes in the different CIVITAS impact categories and understand why we observe this change. This change can be (fully or partly) attributed to a) the general evolution of the city/FUA, b) the implemented SCALE-UP measures or c) the implementation of other measures. Different techniques can be used to assess the level of influence of each

factor, such as stakeholder workshops with expert judgement or the City Level Evaluation tool, as developed by (Wright, et al. 2019).

The second level of evaluation consists of a **measure-oriented evaluation** applied to the measures implemented in the SCALE-UP urban areas. Building further on the CIVITAS 2020 process and impact framework, the most appropriate indicators are selected to monitor and evaluate the impact of the mobility related measures in the respective urban node. To complement this, for each measure, a detailed process evaluation is proposed identifying the barriers ad drivers in the implementation process. This will enable a good understanding of the impact and effectiveness of the proposed SCALE-UP solutions.

The third level of the SCALE-UP evaluation approach analyses the **overall effectiveness of the key SCALE-UP strategies as a basis for effective and efficient mobility strategies: the integration of all mobility related efforts in two directions:**

- the horizontal integration – physical, digital, human
- the vertical integration between the city, the FUA and the TEN-T network

To understand this the SCALE-UP evaluation framework proposes to evaluate the evolution of each urban node in the horizontal integration – physical, digital, human – and vertical integration – interaction between the city, FUA and the TEN-T network mapping the status of each UN at the start and the end of the project identifying the drivers and barriers for the observed evolution.

4. Evaluation on the level of the Functional Urban Area

4.1. Introduction

The aim of the first evaluation layer is to understand the overall changes on the level of the Functional Urban Area (FUA) of the urban node. To enable this, two sets of indicators are defined:

- FUA indicators to understand the overall changes in the FUA in each of the 6 CIVITAS impact categories: governance, people, transport, environment, economy and energy. These are qualitative and quantitative indicators.
- Indicators to evaluate the context for change in the FUA. The definition of and methodology to collect information on these quantitative indicators is inspired by the indicators and the approach developed in the CREATE project.

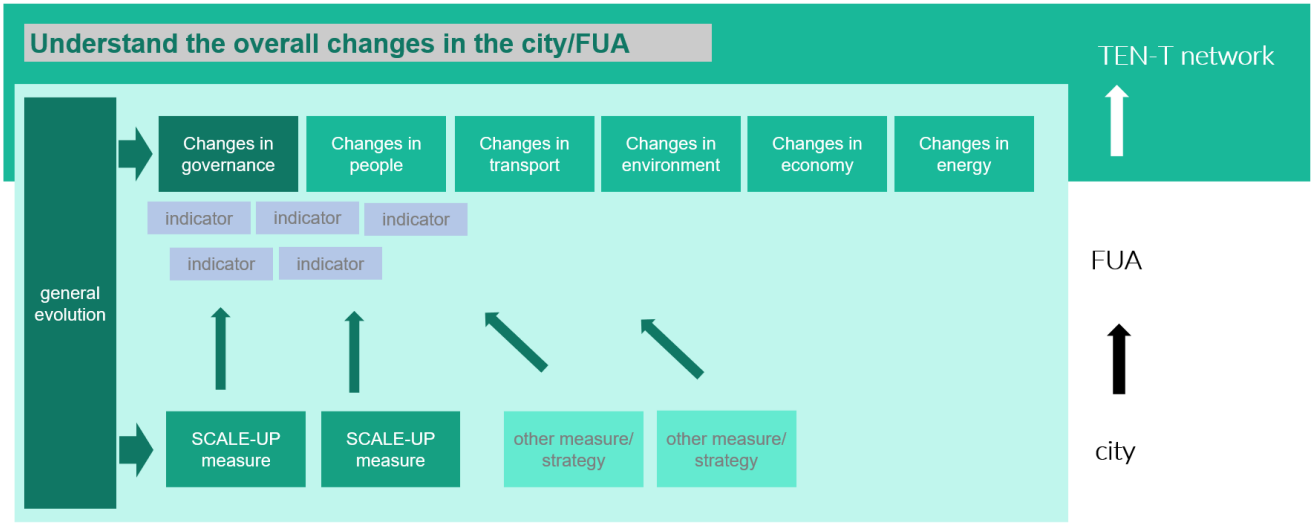

Figure 6: Illustration of the FUA level evaluation approach and the different elements contributing to the overall change at FUA level.

The objective is to identify the overall change in the different urban nodes and to understand this change. This is illustrated in Figure 6. The observed change can be either due to the general evolution in the FUA, or due to the implementation of one or multiple SCALE-UP measures or due to the implementation of other measures or strategies, or (most probably) due to a combination of these.

The basic goal is to collect all data on the level of the Functional Urban Area. However, data are not always available on this level. Therefore it is recommended to gather all data also on city level. For the most indicators data is available on city level since this is the basic administrative unit used for data collection campaigns. In this way we have a consistent basis and additional FUA values if available. The added-value of data on both level is a better understanding of the diversification between city and FUA.

The definition of a **Functional Urban Area** has been agreed upon by the Organisation for Economic Co-operation and Development (OECD), the European Commission's statistics office (Eurostat) and its Directorate General for Regional and Urban Policy (OECD 2013). It is based on "population density to identify urban cores, and on travel-to-work flows to identify the hinterlands whose labour market is highly integrated with the cores." In practice, the Functional Urban Area refers in this way to the larger urban zone composed of a city and its commuting zone.

However, this definition is not always applicable for smaller cities (e.g. part of the commuting area of larger neighbouring city).

4.2. The FUA indicators

At the start of the SCALE-UP project a dedicated selection of FUA indicators is made that can monitor the evolution at FUA level in the perspective of the SCALE-UP objectives. The selection of these FUA indicators is inspired by the indicators described in the CIVITAS 2020 process and impact evaluation framework in relation to the CIVITAS impact categories and by the Sustainable Urban Mobility Indicators (SUMI; see textbox below).

The aim of the FUA indicators is to capture the mobility related changes in the CIVITAS impact categories in each of the urban nodes at FUA level. It can also be opted to collect certain indicators only at city level if no other data would be available.

Since in most cities data are traditionally only collected at city level, SCALE-UP considers the project as an opportunity to engage the different stakeholders in starting to collect these types of data not only at city level, but (also) at the FUA level if possible.

The Sustainable urban mobility indicators or SUMI indicators were brought forward by the European Commission. It consists of a comprehensive set of 19 sustainable indicators to evaluate the mobility system and monitor improvements resulting from newly implemented mobility measures or policies. The main aim of the SUMI project was to provide a standardised methodology for the evaluation of important mobility indicators to allow benchmarking between cities. This benchmarking is not the objective in the CIVITAS inspired evaluation task, but the standardised methodology proposed in SUMI to calculate the underlying indicator values (not the final SUMI scores) is followed to define and calculate some of the FUA indicators by the SCALE-UP urban nodes in a consistent way.

Information on the SUMI indicators, including easy-to-use spreadsheets to calculate these indicators, is available on the EC website: https://transport.ec.europa.eu/transport-themes/clean-transport-urban-transport/sumi_en

In the following sub-sections, the FUA indicators of the SCALE-UP evaluation framework are presented and discussed for each CIVITAS impact category. For some indicators different definitions are presented. The selection of these indicators is a first result of an intensive process involving multiple discussions with the SCALE-UP urban nodes and those responsible for evaluation.

Since cities have to rely to a far extend on existing data sources not all indicators are feasible to be monitored on short term. However, these indicators are already listed in the SCALE-UP framework since they are useful to monitor the evolution of urban nodes in the perspective of effective integrated mobility strategies to reach the local and EU sustainable goals in the SCALE-UP urban nodes and in relation to the TEN-T dimension. Final decisions on the FUA indicators to be monitored and the definition to be used are taken during the development of the evaluation plans (see SCALE-UP D7.2) as a trade-off between the feasibility to collect the data and the importance to monitor key SCALE-UP goals.

The aim is to monitor these FUA indicators by collecting data at the start and during the end phase of the project.

4.2.1. Society-governance

Society-governance considers how society is organised both in terms of governance (which affects the way measures can be implemented and will be accepted) and in terms of land-use (which affects travel demand). Table 1 lists the possible indicators to be used to describe the impact aspects at FUA level in the category of society-governance.

Indicator	Definition	Method	QL/QT
Quality of cooperation structures	Quality of the cooperation between the different city/FUA departments and stakeholders	• Observations • Questionnaires • Discussions	QL
Quality of planning approaches	Quality of the SUMP/SULP/planning approaches in the FUA	• Observations • Questionnaires • Discussions	QL
Quality of the data layer	Quality and type of data collected on the FUA level, specifically data on active modes	• Observations • Questionnaires • Discussions	QL
Level of data driven	Availability and quality of mechanisms that are data driven	• Observations • Questionnaires • Discussions	QL

Table 1: FUA indicators identified in the society-governance impact area. QL: Qualitative indicators, QT: quantitative indicator.

Four qualitative (QL) indicators are proposed to measure the evolution in this impact area at the FUA level. Information on these indicators can be collected through observations (e.g., reports, websites...), questionnaires (e.g. to the administrations of different FUA departments, mobility experts, etc.) and/or discussions with local stakeholders (e.g. different administrations).

Here a possible approach to collect this information is proposed, by defining, for each indicator, a list of items to question. Based on the observations a score can be given to the indicator (low, medium, etc.) and its evolution can be monitored in the course of the project.

4.2.1.1 Quality of cooperation structures

Analysis and appraisal of the formal and informal cooperation structures and decision-making procedures

Items to question

- Internal cooperation between the mobility department and other city departments
  - e.g. environmental, special, economic, …
  - e.g. regular common meetings, internal advice, …
- Interaction city mobility department with mobility stakeholders
  - e.g. public transport companies, private mobility service providers,
  - e.g. formal mutual advice, regular meetings, common planning of actions, …
- Organisational body on the level of the Functional Urban Area
  - Participating actors?
  - Advisory body or decision body
  - Financial resources
  - Are the representatives of the participating actors in the daily functioning?
  - ..
- Interaction with other bodies responsibilities for parts of the mobility organisation
  - e.g. the region, national bodies, …
  - e.g. formal mutual advice, regular meetings, common planning of actions, …

Appraisal

Overall synthesis of the baseline situation on the quality of the cooperation structures in order to **push and facilitate** good planning and decisions.

- Main drivers
- Observed barriers or weak(er) aspects

4.2.1.2 Quality of planning approaches

Analysis and appraisal of the planning approaches in city and FUA and above.

Items to question

- Status and quality[1] of the SUMP of the city
  - e.g. current versions of 2xxx with a time vision to 2xxx
  - e.g. sustainable vision
  - e.g. sustainable modes, walking, cycling, public transport treated as a priority
  - e.g. action list with dedicated budgets to implement the strategy
  - e.g. supported by a strong participatory process involving stakeholders and citizens
  - e.g. integrated planning of freight transport (integrated SULP)
- Status and quality of the mobility planning on the FUA
  - e.g. existing of a full SUMP on FUA level
  - e.g. other mobility related planning on FUA level
  - e.g. formal mutual advice, regular meetings, common planning of actions
  - e.g. action list with dedicated budgets to implement the strategy
  - e.g. supported by a strong participatory process involving stakeholders and citizens
  - e.g. integrated planning of freight transport
- Other mobility related plans to implement a strong sustainable mobility strategy
  - e.g. operational action plans on cycling measures
  - e.g. integrated land-use mobility vision plan

Appraisal

Overall synthesis of the baseline situation on the quality of the planning in order to push the implementation of sustainable mobility strategies and measures.

- Main strong elements
- Observed weak(er) aspects

[1] See the SUMP self-assessment tool: https://www.sump-assessment.eu/English/start

4.2.1.3 Quality of the data layer

Analysis and appraisal of the quality of the data layers with an extra focus on active modes

Inventory of data

Describe which data are collected and made available on the level of the city, FUA or at higher levels.

- Existence of integrated data platforms on city or regional level
  - e.g. platforms managed by the city, stakeholders, private bodies, …
- Mobility related data collected on integrated platforms
  - which type of data is collected, on-line or off-line,
  - purpose of these data e.g. static and real-time information, for planning and optimisation and real-time management of the multi-modal transport system
  - e.g. safety data in general and specifically on active modes
  - e.g. traffic flows in the city, on the motorways, …
  - e.g. parking data
  - e.g. cycling flows, pedestrian flows, public transport passenger flows
  - e.g. air pollution

A template table for the analysis and appraisal of the quality of the data layers is given in Table 2.

Type of data	Collected on city level	Collected on regional level	On-line (real-time)	Off-line	Provided by	Made available to	Other comments

Table 2: Template table for the inventory of data

Appraisal

Synthesis of the current status of data management in the city and FUA to plan, monitor and optimise the functioning of the multi-modal mobility system and to inform its users (and more…).

4.2.1.4 Level of data driven

Analysis and appraisal of the level to which extent the multi-modal mobility system is planned, organised and used in a data driven way. Here not the quality of the data is assessed but an analysis is done on the extent to which elements of the multi-modal system are steered based on data that is collected. Some examples are given below.

Inventory of mechanisms

- Real-time mechanisms in the management of the multi-modal mobility system that are data driven, steered and pushed by the data we collect
  - e.g. parking guidance system guiding the cars to parking places and park&rides taking into account the occupancy rates of the parkings and the traffic flows e.g. congestion level and air quality levels in the city
- Operational planning mechanisms in the management of the multi-modal mobility system that are data driven
  - e.g. closing of the city centre for cars based on measurements and predictions of the air quality in the city

Appraisal

Synthesis of the current extent in which processes in the organisation of the multi-modal system are data driven.

4.2.2. Society-people

Society-people covers person-related aspects with a link to the mobility system. This includes characteristics of activities in the city and FUA), the accessibility to different levels of the transport system, as well as health aspects linked to mobility behaviour. Effects of the implemented SCALE-UP measures may have effects on society, which in turn, may have further effects on other factors such as employment opportunities, usage levels of the different modes, etc.

Indicator	Definition	Method	QL/QT
Awareness	Share of the target group aware of the key elements of the mobility approach in the city/FUA	• Survey	QT
Attitude and acceptance	Share of the target group favourably in receiving or approving the key elements of the mobility approach in the city/FUA	• Survey	QT
Operational accessibility to the transport network	How accessible is the PT network?	• GIS analysis of PT network and living areas • Survey	QT/QL
Operational accessibility to the transport network for mobility impaired people	How accessible is the PT network for mobility impaired people?	• Calculation	QT
Financial accessibility (related to social cohesion)	The cost of service relative to the average personal income	• Observation and calculation • Survey	QT/QL
Persons mobility demand	Average number of trips per person	• Survey	QT
Freight mobility demand	Number of goods movements, internal and to/from the city/FUA	• Simulation, surveys or observations on reference points	QT
Contribution of mobility on health	Average walking and cycling time per day/week	• Simulation of walking and cycling-kms (HEAT)	QT

Table 3: FUA indicators identified in the society-people impact area. QL: Qualitative indicators, QT: quantitative indicator.

4.2.2.1 Awareness level and attitude and acceptance

The awareness level and attitude and acceptance level are defined as the percentage of the target population (citizens, visitors, stakeholders ...) with **knowledge** or **favourably in receiving or approving the key elements of the mobility approach** in the FUA.

First, the key elements of the mobility approach in each urban node should be identified. Examples are a Low Emission Zone, priority of public transport and cyclists at junctions, parking optimisation, new cycling axes, …

This type of information can only be collected from a running survey. Findings are described (e.g. including figures, graphs, maps, ..) by presenting the share of citizens aware of / accepting a key element.

4.2.2.2 Operational accessibility to the transport network

The **operational accessibility to the transport network** indicator assesses how accessible the public transport (PT) network is. Possible methods to calculate this are:

- The number of citizens in areas with a maximum distance to a PT stop. This is a detailed geographic information system (GIS) exercise. Here the methodology of the SUMI indicator #6 Access to mobility services indicator can be followed.
- The perception of the operational accessibility of the PT network by the citizens can be assessed through a survey ("what do you think of the accessibility of the PT network?").

Eventually this indicator can be calculated in a simplified way, e.g. by the percentage of the population residing in an area with a radius smaller than 500 metres from a PT stop.

An additional focus is the **operational accessibility to the transport network for mobility impaired people**. The SUMI methodology (SUMI indicator #2 Accessibility of public transport for mobility-impaired groups indicator) can be followed to calculate this indicator.

4.2.2.3 Financial accessibility (related to social cohesion)

The Financial accessibility (related to social cohesion) can be estimated:

- By calculating the price of a normal subscription to PT in relation to the average income of the poorest quartile of the population. This corresponds to the SUMI approach of SUMI indicator #1 Affordability of public transport for the poorest group indicator.
- By estimating the perception of the affordability of the PT network for the poorest quartile of the population. This needs to be done through a survey.

4.2.2.4 Mobility demand

The **persons mobility demand** is calculated as the average number of trips per person. This type of data is collected from a travel survey.

The indicator **freight mobility demand** corresponds to the number of freight movements internal and to or from the city or FUA, and is more challenging to calculate. A possibility is to calculate the number of trucks that enter the city.

4.2.2.5 Contribution of mobility to health

The final indicator in the category society-people quantifies the contribution of mobility on health. The number of prevented premature deaths thanks to (increased) walking and cycling can be estimated with the WHO Health Economic Assessment Tool (HEAT) by providing a simulation of the walking and cycling-kilometres per day in a city. The walking and cycling-kilometres per day can be estimated from the modal split (see Section 4.2.3). The HEAT tool is a freely available online tool[2]. By providing input on the average amount of (increased) walking or cycling per person per day, and the number of people in a population to which the walking or cycling data refer, HEAT estimates the number of prevented premature deaths, as well as the reduced carbon emissions in tons of CO_2 equivalent and the economic valuation of the results.

[2] https://www.heatwalkingcycling.org/#start_tool

4.2.3. Transport system

The **transport system** focuses on the performance of the mobility system in terms of usage and its technical characteristics. The aim is to understand the evolution of the performance of the different modes of the mobility system.

Indicator	Definition	Method	QL/QT
Modal split persons	• Percentage of trips in the city/FUA for each mode during a day (overall or for a specific target group)	• Surveys • Traffic modelling	QT
Model split goods	• Percentage of goods using each mode during a day	• Surveys • Traffic modelling	QT
Road safety	• Number of accidents • Number of collisions with seriously injured and deaths per trip or distance driven for each mode or per inhabitant • Number of road deaths and seriously injured	• Statistics police • Statistics hospitals	QT
Multimodal integration of transport offer for persons	• Number and quality of multi-modal hubs in the city/FUA • Number of trips combining different modes	• Functional analysis of the hubs in the city/FUA (e.g. SUMI tables) • Mobility survey for citizens and commuters/visitors	QT

Multimodal integration of freight transport	• Number and quality of multi-modal freight hubs in the city/FUA • Number of freight movements combing different modes	• Functional analysis of the hubs in the city/FUA • Survey to logistics operators	QT
Congestion levels	• Delays in road traffic during peak hours versus free flow traffic	• Floating car data • Traffic modal data	QT
Quality of cycling network	• Quality score of the cycling infrastructure • User satisfaction of the cycling network	• GIS analysis of the network • Survey	QT

Table 4: FUA indicators identified in the transport system impact area. QL: Qualitative indicators, QT: quantitative indicator.

4.2.3.1 Modal split

The **modal split of persons** in the FUA can be calculated through different methods:

- The number of trips (of citizens and from/to the FUA) per mode. This data is collected through surveys and is often only available per specific target group (commuters, citizens, school children,...).
- The kilometres driven by the different modes (including cycling and walking). A traffic model is needed to calculate the vehicle-kilometres for each mode. However, the distances of pedestrians are often not available. Eventually this can be estimated with the data of a survey asking for the modes used and distances travelled. The SUMI indicator Modal split proposes a methodology to calculate this indicator, based on the vehicle-kms for each mode.

In the SCALE-UP project, the urban nodes will report on the split of the number of trips, overall in the city, from previous surveys and available reports. If this seems not possible, the modal split will be reported per target group.

The **model split of goods** corresponds to the percentage of goods using each mode during a day. This can be the split of the number of movements over de modes, the split of the kilometres driven by vehicles over the modes or the split of the ton-kilometres of goods moved. The modal split of goods is not easy to monitor, due to the complexity of calculating this indicator. Here logistic statistics can help to get a view on it.

4.2.3.2 Road safety

Based on statistics from the police department preferably completed with hospital records, road safety can be monitored by reporting on:

- The number of collisions
- The number of collisions with seriously injured and deaths per trip or distance driven, for each mode or per inhabitant
- The number of road deaths and seriously injured

It's essential to keep in mind that there is an underreporting of **active modes** in relation to collisions (however not on deaths). Also, special attention should be given to statistics on micromobility (e-scooters etc.).

4.2.3.3 Multi-modal integration

The **multimodal integration of transport offer for persons** can either be defined as:

- The number and quality (number and frequency of lines per (sub)mode) of multi-modal hubs in the city/FUA. The SUMI indicator #11 Multimodal integration indicator approach can be followed here, which is a functional analysis based on the number of transport modes available at a multi-modal hub and the number of changes possible.
- The number of trips combining different modes. This can be estimated through a mobility survey for citizens and commuters/visitors

The **multimodal integration of freight transport** can be defined in a similar way as:

- The number and quality of multi-modal freight hubs in the city/FUA. This can again be estimated through a functional analysis of the hubs in the city/FUA.
- The number of freight movements combining different modes. A survey to logistics operators can provide insight on this.

A simplified and more feasible way can be followed by analysing three to four freight hubs in the FUA and counting the type of modes that serve this hub and how they are linked e.g. train transport to truck transport, to lorries, cargo bikes etc.

4.2.3.4 Congestion levels

The congestion level indicator estimates how much congestion there is in the FUA. This can be calculated by comparing the road traffic journey time during peak hours with the free-flow journey time in the city or FUA. This can be calculated for all trips based on a traffic model. Another method is to use floating car data at reference corridors in the city or FUA. The difference between floating car measurements during day- and night-time can be used to estimate delays in traffic.

4.2.3.5 Quality of the cycling network

The quality of the cycling network indicator can be estimated by:

- An overall quality index (e.g. barometer) based on quality scores given to different elements of the cycling infrastructure (surface, wideness, ..) at certain sections and crossings
- A user satisfaction survey on the quality of the cycling network

Both methods are useful and can be used depending on the availability of data.

4.2.4. Energy

The impact category **energy** describes the consumption of energy.

In the perspective of SCALE-UP mission the SCALE-UP evaluation framework focuses here on the use of alternative fuels.

Indicator	Definition	Method	QL/QT
Share of renewables	Percentage of electric vehicles and hybrid vehicles in the car, bus and trucks fleet operating in the city/FUA	Car statistics for the city/FUA	QT

Table 5: FUA indicators identified in the energy impact area. QL: Qualitative indicators, QT: quantitative indicator.

This indicator monitors the evolution in the percentage of electric and hybrid vehicles replacing fossil fuel vehicles. Often this data is only available on national and not on regional level.

4.2.5. Economy

This impact category monitors economy related aspects in the city, such as the income of citizens or the creation of jobs.

Indicator	Definition	Method	QL/QT
Number of jobs	The number of jobs	Measurements	QT

Table 6: FUA indicators identified in the economy impact area. QL: Qualitative indicators, QT: quantitative indicator.

In this category the number of jobs is monitored. Starting from the idea that "good mobility helps our economy", a positive evolution in the number of jobs is expected. The overall number of jobs is monitored, not only transport related activities.

4.2.6. Environment

The impact category **environment** evaluates the improvement of the environment by using clean vehicles and alternative fuels and by reducing the modal share of private motorized transport by monitoring the pollution/nuisance and resource consumption.

The air quality and greenhouse gas (GHG) emissions are monitored in this impact category.

GHG emissions (i.e. CO_2 emissions) are calculated from a traffic model based on the number of vehicle-kilometres driven per vehicle type in the FUA.

Indicator	Definition	Method	QL/QT
Air pollutant emissions (NOx, PM2.5, PM10)	Emissions from transport modes based on the vehicle-km per vehicle type in the city/FUA	Post processing traffic model results	QT
GHG emissions (CO_2)	Emissions from transport modes based on the vehicle-km per vehicle type in the city/FUA	Post processing traffic model results	QT
Air quality	Air concentrations of NO_x, PM2.5 and PM10	Air quality measurements or simulation with an air quality model	QT

Table 7: FUA indicators identified in the environment impact area. QL: Qualitative indicators, QT: quantitative indicator.

Air quality can be estimated either from:

- Air quality measurements at monitoring stations at different locations in the city or FUA or simulations with an air quality model based on these air quality measurements.
- Air pollutant emissions calculated from a traffic model based on the number of vehicle-kilometres driven per vehicle type in the FUA;

4.3. Indicators for the context of change

A good insight into the **context for innovative change** is an important element in the overall understanding of why some cities are successful in the implementation of new strategies and measures and others are not. Only by clarifying the context to motivate change and by mapping the enabling conditions for innovative solutions a comprehensive understanding is build up on why and how strategies or measures can be implemented with a significant impact in a city.

To assess the context for change in the SCALE-UP cities, a selection of relevant indicators is defined, inspired by the results and approach of the CREATE project (VECTOS 2018). The CREATE project was a 3-year Horizon2020 CIVITAS project, which was completed in May 2018. It examined how 5 Western European capital cities have dealt with growing car use and congestion, over the past 50-60 years, to provide lessons for growing urban economies in Central and Eastern Europe and the EuroMed region.

The following indicators are assessed:

- **Mood and Motivation**: level of acceptance of a new type of transport policy and the quality of the governance and organisational structures that drive a change in transport policy
- **Mass**: capacity to make change happen
- **Momentum**: elements to speed up change
- **Mechanisms**: strong processes to control and manage change

In order to understand the status of the city in relation to a favourable context for change, the level of maturity for each of these aspects will be captured at the start of the project, and, in the end phase of the project. In this way possible evolutions can be observed and assessed.

The status on each of the four indicators is assessed from:

- **Questionnaires and focus groups** to/with cities and important stakeholders at the start and end of the project
- **Identification of what is happening and published** in the community and what is formulated in urban policy

In the following sub-sections, a range of questions are given to help assess the status for each indicator. These questions should be answered for each city in focus groups with local stakeholders (e.g. MLs, representatives of different society groups. The observations in the focus groups should be complemented by studying what is happening and published in the community and what is formulated in urban policy.

After each set of questions, examples are given from EU cities on their level of maturity for that specific aspect.

4.3.1.1 Mood and Motivation

Mood identifies the level of **acceptance** of a new type of transport policy, whether citizens are open to new ways of organising mobility and accepting new ways of living. Motivation identifies the **quality of the governance and organisational structures** that drive a change in transport policy. Both aspects are assessed together.

Possible questions to assess the level of maturity of Mood and Motivation:

- Do the existing transport or mobility policies specifically **address sustainable urban mobility**? e.g. in a SUMP
- Is there an **ongoing discussion** about the need for new or updated transport policy, to better meet mobility needs, to increase liveability?
- Are **citizens or community groups active participants** in the discussion about transport and mobility policy?
- Are the **local authorities/ agencies with responsibility** for urban mobility open to look at new types of mobility policy?
- Are **citizens (and lobby groups)** open to look at new types of mobility policy?
- Is **car traffic perceived to be a crucial problem** that requires active mitigation?

Examples
The city has an open mind to accept new transport concepts.
The transport and mobility responsible prefer trying things out, rather than studying them further. They dare to make errors and learn from those errors, "learning by doing and trial and error".
There are multiple articles on new mobility solutions in the city publications/press.
There is a generally accepted SUMP with strong sustainable goals & actions.

4.3.1.2 Mass

Even if there is a high acceptance to introduce some changes, it is crucial there is **capacity to make change happen**. E.g. are the appropriate organisational structures and people with sufficient capacity in place to design, organise and operate new mobility services?

Possible questions to assess the level of maturity of Mass:

- Is there existing **capacity** in the area to design, organise and operate new mobility services?
- Is there **any formal or ad hoc forum** that brings together stakeholders to discuss and consider new or amended transport policies?
- Are there **working arrangements** between the institutions/agencies and mobility service providers?
- Have any of the institutional, operator or community stakeholders **participated in European projects** (other than SCALE-UP) and have they experience in know-how exchange?
- Is there a **strategy for supporting activities** to be done for changing the mobility behaviour of the population of the region?

Examples
Decision makers are aware of the fact that the related deficits are an issue especially for the elderly generation.
Private and public agencies organizing knowledge-transfer and supporting local communities by developing similar initiatives.
Political and operational cooperation platforms between city and region.
There are research groups on sustainable mobility solutions.
The city department working on citizens awareness and behavioural change.

4.3.1.3 Momentum

This aspect identifies whether elements to speed up change are available in the city. If a city wants to have a change, it needs to 'grab the moment'. For that, momentum is needed.

Possible questions to assess the level of maturity of Momentum

- Are there any **incentives** (legislation, funding,…) of the regional, national or European level that pushes the change?
- Are there **any citizens initiatives game changers** in the mindsets on urban mobility and acceptance of urban traffic factors as safety and air quality?
- Is there a specific **political momentum** of changed visions and policy goals?
- Is there any **demographic or economic momentum** that requires new approaches on mobility?

Examples
At national level, laws have recently been voted that provide incentives for people who use alternative mobility (carpooling and cycling) at least 100 days a year for their commuting, accelerating the use of alternative mobility solutions.
The covid-19 period pushed the rethinking of mobility in the city.
The recently elected government wants to start a new direction in the mobility policy.

4.3.1.4 Mechanisms

Last but not least, strong processes or mechanisms are needed to develop new solutions, and to control and manage change.

Possible questions to assess the level of maturity of Mechanisms

- Are there specific **organisational structures** in the city and in between the city, region and national levels to **develop, monitor and manage** the implementation of new mobility strategies?
- How stable are **the working relationships and business agreements** among the city and other participating stakeholders?
- Is there a **participative process** for local communities and people **to shape the mobility solutions** in line with their needs and preferences?

Examples
City department with persons of the different city/regional sectors to manage new strategies in an integrated way.
Public-private partnerships to develop and implement integrated mobility solutions (infrastructure, management, services, promotion, ..).
Integrated monitoring and evaluation approach to optimise running policies towards the sustainable goals set.

4.3.1.5 Overall appraisal

The observations for each of the indicators are synthesised into an overall appraisal of the context for change in the urban node.

- Main drivers to push change
- Observed barriers or weak(er) aspects

5. Evaluation on the level of the mobility measures

5.1. Introduction

On this level the SCALE-UP add-on focuses on additional impact indicators and data collection methods in relation to the specific mobility related measures implemented to concretise the SCALE-UP vision.

For the process evaluation the existing CIVITAS 2020 approaches can be fully used to understand the implementation processes and story behind the figures.

The current overview of useful and feasible indicators and definition of the indicators with related data collection methods is based on a first analysis of the measures implemented in the SCALE-UP cities. The final choices will be made in the development of the evaluation plans.

5.2. Selection of impact indicators

As emphasized in the CIVITAS 2020 evaluation framework it is crucial that at the start of a project the description and output of each measure, as well as the objectives, targets and impact area, are (re)defined. This is usually already done in the proposal phase, but at the start of the project this needs to be redefined and verified, keeping the following questions in mind:

- What is exactly implemented with this measure and what is actually done?
- Which are the limitations of this measure?
- What is the output? E.g. a data collection tool, 3 mobile bike stations, etc.
- Which is the impact area and/or the target group?
- What are the (quantified) objectives or targets of this measure?
- Which indicators can monitor the effect of this measure in reaching the envisaged objectives?
- Are these indicators feasible to be monitored? Which data collection methods can be used or existing data sources can be consulted?

Answering these questions will also help to select the appropriate impact indicators. Table 8 gives an example of a table that can be used to define, select and monitor these elements.

Measure	Outputs	Objectives/Targets	Impact indicators	Target group	Impact area

Table 8: Measures monitoring table – part 1

Complementary to this, Table 9 presents a template table to define and describe the target group/ impact area, data units, method and frequency of data collection for each impact indicator.

Measure	Impact indicators	Target group	Impact area	Data units	Source/ Methodology	Frequency

Table 9: Measures monitoring table – part 2

The SCALE-UP urban nodes aim to be as consistent as possible in their selection and definition of the impact indicators. Nevertheless, different measures are implemented in each urban node, and therefore, different impact indicators are selected and, for common indicators, definitions and methods might differ slightly.

5.3. SCALE-UP impact indicators

For the selection of the impact indicators, inspiration is found in the CIVITAS 2020 process and impact evaluation framework and new innovative indicators and data collection methods are developed.

New data collection methods and citizens science methods are proposed/included such as a participatory approach to evaluate the implemented measures. Table 10 gives a first overview of new innovative impact indicators and new data collection methods in the 5 SCALE-UP intervention fields: governance, multimodal hubs, data, clean safe and inclusive, and behaviour. Additional innovate indicators and methods will be added based on further experiences gained during the project.

The impact indicators listed in Table 10 present only a small percentage of the overall list of impact indicators to be monitored in each urban node. A detailed list of the indicators selected to evaluate the impact of each measure in each urban node should be published in the evaluation plan of each urban node.

Impact indicators	Target group	Impact area	Data units	Source/ Methodology
Intervention field: Governance				
Number of incentives integrated in the MaaS offer	Business-to-business Business-to-consumer			Detailed info about incentives per MaaS project
Intervention field: Multimodal hubs				
Number of (near-) accidents on cycle highway crossings		FUA	Number of (near-) accidents on cycle highway crossings	Monitoring at 4 locations via technology
Bikeability index		FUA City		Cycle barometer

Increase in the number of sustainable vehicles used for last mile distribution during the project lifetime	Logistic company managing the hub	Delivery area	Number	Logistic company data
Intervention field: Data				
Number of PT operators and shared mobility services providers included in the MaaS ecosystem sharing their data	PT operators Mobility services providers	City FUA	Number	Number of PT operators and shared mobility services providers included in the MaaS ecosystem sharing their data
Intervention field: Clean, Safe & Inclusive				
Qualitative description of the roll-out of the Ring road plan				Dashboard/Scenario calculations
Number of collaborations with stakeholders from different logistics sectors			FUA City	Qualitative: via pilot projects
Biking skills	Daycare/school children of specific age			Testing at pilot daycares/schools
V2G energy use	e-vehicle owners	City	kW/h back to grid	Data from V2G
Intervention field: Behaviour				
Number of personal advice to unique users	Unique visitors of smart travel planner tool	FUA City		Monitoring tool of Google Analytics

Table 10: First selection of innovative impact indicators and data collection methods

6. Evaluation on the level of the strategies for integration

6.1. Introduction

The SCALE-UP concept relates to two ways of scaling up: a vertical upscaling (Y-axis) refers to integrating the mobility and transport strategies on multiple governance levels and beyond geographical boundaries (city, functional urban area (FUA), TEN-T) through collaboration with all stakeholders.

A horizontal upscaling (X-axis) refers to addressing, in a balanced way, the different layers that shape the multi-layered mobility system that we see today, being a physical or infrastructural layer, a digital layer, and the human layer referring to the central position of the end-user. To function as a data driven urban node all three layers need to be addressed in a balanced manner.

These concepts of integration are fairly new and will be developed further during the SCALE-UP project. Therefore, also the evaluation approach to measure and understand the level of vertical and horizontal integration of the SCALE-UP urban nodes, will be developed during the course of the project as a participatory evaluation effort in the further design and implementation of the integration concepts.

In this phase of the project **first elements of the evaluation of the integration concepts** are presented, indicating several basic indicators SCALE-UP is working on, as a further development of the knowledge build-up in previous projects, such as the Vital Nodes[3] framework.

Figure 7 presents the basic elements of the SCALE-UP integration concepts:

- Vertical integration: city/urban, FUA and TEN-T.
- Horizontal integration: the physical or infrastructural layer, a digital layer, and the human layer

[3] The Horizon2020 Vital Nodes project (2017-2019) aimed to enable efficient, sustainable freight delivery across the TEN-T urban nodes, by bringing together existing European, national and regional networks. https://vitalnodes.eu/

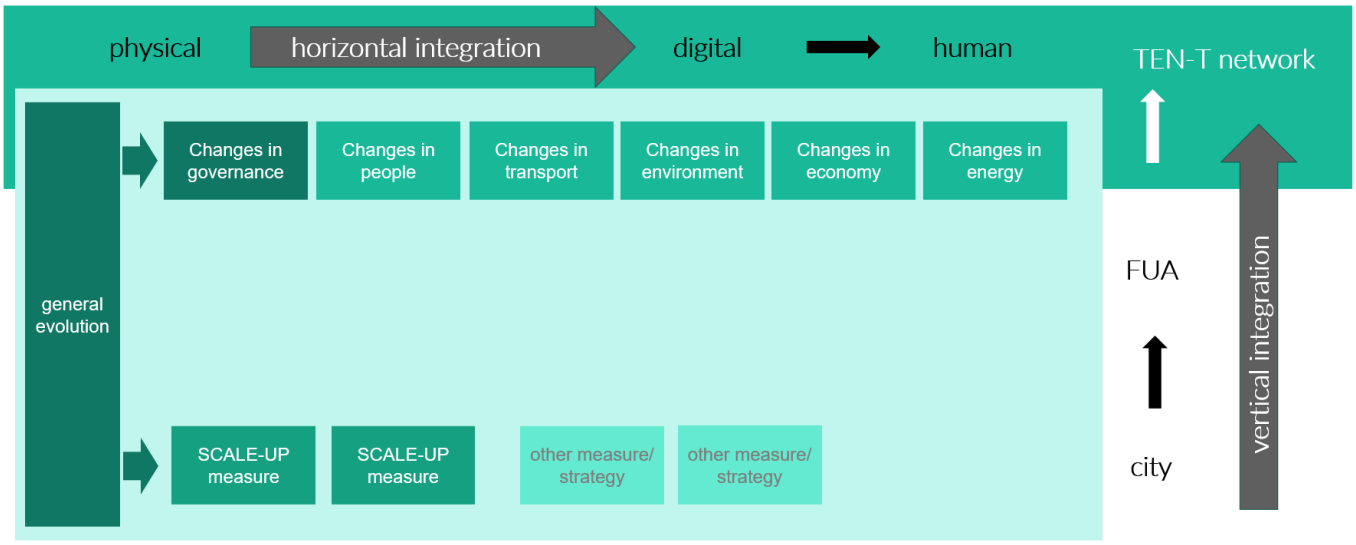

Figure 7: The vertical and horizonal integration concepts in SCALE-UP.

6.2. Vertical integration

Based on the findings in the Vital Nodes project and a first analysis of the SCALE-UP concepts for integration, the SCALE-UP experts propose the first key indicators to measure the level of integration between the city, FUA and TEN-T level:

- Governance: formal and informal cooperation, decision mechanism and planning including the city and FUA level and referring to the TEN-T perspective
- Awareness: awareness of the existence the other levels and the opportunities and barriers from the other levels (city, FUA, TEN-T)
- Connectivity: degree to which the urban node is connected to the wider region (FUA) and TEN-T corridor, existence of hubs linking city, FUA and TEN-T corridor
- Accessibility (closely linked to 'connectivity'): available capacity on the multi-modal transport network

To monitor these indicators, a detailed lists of items to discuss with policy makers and technicians from city, FUA and the TEN-T corridor is under development. Both the FUA indicators already developed for Governance (see Section 4.2.1) and Awareness (see Section 4.2.2)and the efforts to further develop the integration concept in practice for the SCALE-UP cities will be an inspiration for a feasible and efficient approach.

6.3. Horizontal integration

Indicators to monitor the level of integration of the physical or infrastructural layer, a digital layer, and the human layer in the SCALE-UP city will be developed starting with a structured analysis of these 3 layers identifying the key elements linking the layers in an efficient and balanced way. The following elements are important components of this:

- The exchange of input of one layer to another guaranteeing the good functioning of each layer
- Keeping the human layer as the main driver for any interaction

Indicators will focus on understanding the interaction between the 3 layers. For this the FUA indicators already defined on data (see Sections 4.2.1.3-4.2.1.4) will be an inspiration.

7. Provisional conclusions and future actions

This version of the SCALE-UP evaluation framework is the first reporting of the innovative evaluation approach SCALE-UP proposes to follow, to strengthen the existing CIVITAS 2020 process and impact evaluation framework in relation to the specific objectives of the SCALE-UP project.

Key add-ons are:

- the integrated monitoring and evaluation of the overall changes at the FUA level with an extra focus on the context for change,
- the additional indicators to evaluate the SCALE-UP measures and
- the evaluation of the vertical and horizontal integration

The evaluation approach on FUA level and the detailed indicators in relation to the SCALE-UP measures are already clearly defined and structured allowing further concretising in the SCALE-UP evaluation plans. The use of the developed concepts and elements of the SCALE-UP evaluation will validate the approaches and will allow further optimisation of the approach on these two layers in a final version of the SCALE-UP framework.

The evaluation of the vertical and horizontal integration will be further developed during the course of the project as a participatory evaluation effort in the further design and implementation of the integration concepts. This will also result in a strong understanding of the evolution of the SCALE-UP urban nodes and a validation of the evaluation approach.

In this way, this version of the SCALE-UP evaluation framework is a strong basis to come to a useful and validated evaluation framework that can be presented at the end of the SCALE-UP project.

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