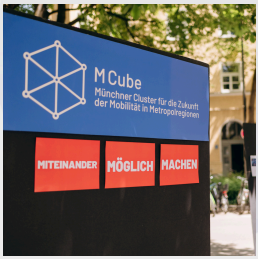
EPURA

MCube

MCube
Indicator Guide

Indicators for measuring the impact
of mobility innovations

MCube Phase II 2024 - 2027



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About MCube

MCube is led by the Technical University of Munich and brings together leading mobility experts from academia, industry, and society under the motto: making it possible together. Within MCube, research is conducted across the broad field of the future of mobility, prototypes are tested, and innovations are developed for Germany and the world. This includes topics ranging from autonomous driving and electric mobility to new legislation for mobility investments and the redesign of public space.
EPURA focuses on the evaluation, process evaluation, upscaling, replication, and application of project processes and results. In this way, exploitation and utilization strategies can be developed for the metropolitan region and implemented beyond the cluster. EPURA acts as an accompanying monitoring framework for the overall MCube strategy, improves internal processes, and promotes new implementation initiatives.

More information

https://www.mos.ed.tum.de/sv
www.mcube-cluster.de

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About the Indicator Guide

The Indicator Guide was developed as part of the Zukunftscluster MCube – Munich Cluster for the Future of Mobility in Metropolitan Regions, funded by the Federal Ministry for Research, Technology and Space (BMFTR). The guide was created during the first funding phase within the integration project MCube SUE (System Design and Evaluation) following the framework by Grundei et al. (2025b), and was revised in the second funding phase within the integration project MCube EPURA (Evaluation, Process Evaluation, Upscaling, Replication & Application).

The guide is aimed at all project staff involved in the MCube innovation projects, in particular the project leads and the respective evaluation officers.

The development of the indicators incorporated the following aspects

- Top-down: The MCube Strategy Paper and its defined missions to improve the quality of air, time, and space, as well as the guiding principle "Enable possibilities together".
- Bottom-up: The project goals defined in the descriptions of the individual innovation projects, along with input from various surveys and workshops with cluster members.
- A scientific analysis of academic literature and best-practice examples in the field of impact evaluation.
- Results from an indicator screening of relevant strategies, such as the Mobility Strategy 2035 of the City of Munich and development strategies of other MCube partners.

The guide provides a unified information base for possible indicators that can be represented within the innovation projects. It supports the MCube innovation projects in identifying suitable indicators for measuring the impact of their respective projects and, in addition to definitions, offers recommendations for appropriate data collection methods and references further reading. The guide is deliberately open and, in some cases, vague in its methodological recommendations to accommodate the diversity of projects within MCube. Depending on the available data in each project, both quantitative and qualitative methods may be applied.

Objectives of MCube's Impact Measurement

1. Making collective impact visible

How MCube as a whole contributes to the mobility transition and addresses the cluster goals (improving the quality of time, space, and air) and guiding principles ("Enable possibilities together").

2. Catalyst for consolidation and transfer

Making insights usable for other cities, regions, and municipalities, while providing a data basis for upscaling individual measures or innovations. Promoting knowledge transfer to education, administration, business, and society.

3. Cluster management and strategy development

Supporting cluster management in updating the strategy for the coming funding phase.

The following is explicitly not the goal

- Measuring/evaluating the success of individual projects in MCube
- Ranking or critically comparing projects

What is new?

This revised version of the indicator guide includes a significant change in the form of a distinction between core indicators and secondary indicators.

Core indicators should generally be addressed by all MCube innovation projects.

Secondary indicators are project-specific indicators that can only be collected under specific project conditions.

Relevance of system boundaries

System boundaries are important for evaluation. They help to classify impacts realistically, assign data and indicators correctly, create comparability between projects (where it makes sense) and enable the results to be combined at cluster level. System boundaries must be specified when evaluating indicators to enable a comprehensible interpretation of the findings.

Dimension	Exemplary project questions	Description
Spatially	In which geographical area does the project operate?	District, neighborhood, metropolitan area, campus, digital infrastructure
Subject matter	What is the subject matter of the project?	Passenger transport, freight transport, pedestrian traffic, public transport, sharing, etc.
Timely	What is the time frame of the project?	Test phase, continuation, only on site, subsequent use

Indicator Overview

	ID	Indicator	Dimension
Core Indicators	01	Proximity-Based Accessibility	Time
	02	System Usage	Time
	03	Perceived Safety	Space
	04	Perceived Quality of Public Spaces	Space
	05	Local Air Pollutants	Air
	06	Global Emissions	Air
	07	Acceptance	Enable possibilities together
	08	Inclusion	Enable possibilities together
	09	Participation	Enable possibilities together
	10	Collaboration	Enable possibilities together
	11	Influence on Planning and Decision-Making Process	Enable possibilities together
	12	Knowledge Gain	Enable possibilities together
Secondary Indicators	13	Travel Experience	Time
	14	Usability of Travel Time	Time
	15	Traffic Conflict Situations	Space
	16	Diversity of Activities in Public Space	Space
	17	Multifunctionality of Space	Space
	18	Land-Use Efficiency	Space
	19	Energy Efficiency	Air
	20	Noise Levels	Air
	21	Stress Levels	Space, Air
	22	Affordability	Enable possibilities together

Core Indicators

01 Proximity-Based Accessibility

Definition

The indicator measures the everyday accessibility of mobility and supply services, taking into account temporal proximity (travel time) and spatial proximity (walking distance). It combines two dimensions: (1) the average travel time using sustainable modes of transport or active mobility to destinations in everyday life (work, education, services, leisure), (2) the proportion of the population that has access to mobility services such as public transport stops, sharing services, or central points of interest (POIs) within a defined local area.

The focus is on everyday accessibility in the immediate vicinity of the home, especially in urban areas (10–15 minutes on foot or by bike).

Context and Relevance

Local accessibility is a key criterion for sustainable, equitable, and resilient mobility and urban development. It reflects people's ability to reach central areas of life with little time expenditure, low environmental impact, and without their own car. In the international expert debate (cf. Silva et al., 2020; Moreno et al., 2021; Büttner et al., 2022), this form of accessibility is increasingly understood as the basis for livable cities—for example, in the context of concepts such as the "15-minute city" or "proximity-oriented planning." A high value for this indicator indicates mobility equity, self-efficacy, health, and time savings—and thus supports the central goals of MCube.

Unit

Percentage of the population with walking/transport access to defined mobility services/destinations for everyday life [%]; travel time measured in hours [h] or minutes [min] (please specify the time frame and context/note system boundaries).

Methods

The survey can be conducted using GIS-based network analyses to calculate travel times and walking accessibility, supplemented by surveys, simulations, or on-board GPS data (e.g., in buses, (shared) vehicles) to map actual travel times and usage patterns.

Büttner et al. (2022); Silva et al. (2020); Moreno et al. (2021); Silva et al. (2023)

02 System Usage

Definition

Average system usage (bookings, rentals, users, passengers, etc.) in a specific time unit.

Context and Relevance

The system usage indicator measures the number of users in a fixed time unit and allows conclusions to be drawn about demand, mobility behavior, and utilization. It also covers the use of specific interventions, e.g., in real-world laboratories or newly available services, and can be used to evaluate their impact. In terms of vehicles, high system utilization can also improve efficiency and have a positive impact on travel times.

Unit

Absolute usage: e.g., number of bookings/trips/transports per hour or day; Relative utilization: e.g., [users] / [capacity] in %; Performance indicators: e.g., passenger kilometers, freight kilometers; Combination with time and space reference: e.g., utilization by time of day, location, line.

Methods

The survey can be conducted using household surveys, counts, on-site observations, operating logs, or technology-based system data. Typical units include passengers, bookings, or deliveries, which are usually recorded daily; in intervention-related analyses, they are also recorded hourly. This also allows the average utilization of a system to be determined.

Engels et al. (2020)

Definition

The perceived safety of a user of a mode of transport comprises two dimensions: (1) In traffic: The subjective perception of one's own safety in road traffic, i.e., how safe one feels and how high one estimates the risk of getting into conflicts with other road users. (2) In the environment: The perceived risk of becoming a victim of physical, psychological, or sexual violence—e.g., in vehicles, at stops, or in their vicinity. Factors such as lighting, design, and cleanliness influence this sense of safety.

Context and Relevance

Perceived safety is crucial for the use of sustainable modes of transport. Concerns about personal safety, health, or well-being can lead to people avoiding green mobility in particular.

The greatest danger for road users is accidents involving personal injury, which greatly contribute to feelings of insecurity. In 2024, 42,122 traffic accidents were recorded in Munich (+2.3% compared to 2023), 16 of which were fatal (+7). Cyclists and pedestrians, including many schoolchildren, are particularly at risk. That is why Munich, like many other cities, is committed to Vision Zero – the goal of zero deaths and serious injuries in road traffic.

Insecurity is perceived above all at night, in the dark, or in places that are perceived as dangerous, in public transport, or at stops. Since many incidents are not reported, it is difficult to obtain objective data. Subjective measurements are therefore important for gaining insights into safety. Greater perceived safety increases the attractiveness of eco-friendly transport and public spaces.

Unit

Preferred: Use a score of 1-5 (very uncertain – somewhat uncertain – neither certain nor uncertain – somewhat certain – very certain) or your own standard scheme with reference to project criteria.

Methods

At the locations within the study area, perceived safety can be assessed by means of a survey in the form of questionnaires, personal interviews, etc. Observations can also provide methodological support.

Engels et al. (2020); Polizeipräsidium München (2025); Landeshauptstadt München (2023)

04 Perceived Quality of Public Spaces

Definition

Perceived and observed comfort and perceived quality of public spaces, waiting areas at stations, or mobility hubs.

Context and Relevance

For public spaces to be used in a variety of ways, it is important that people perceive them as comfortable and high-quality. Comfort also includes the perception of safety, cleanliness, and the availability of seating and waiting areas at public transport stations. A good first impression, the gender distribution of users, the distribution and availability of seating, and cleanliness also play an important role here. This indicator is closely related to the secondary indicator of diversity of activities in public spaces.

Unit

Preferred: Use a score of 1-5 (very low – rather low – neither low nor high – rather high – very high) or your own standard scheme with reference to project criteria.

Methods

The quality of public spaces at locations and in areas can be assessed through observations or surveys in the form of questionnaires, personal interviews, telephone interviews, etc. Examples and further context for this can be found in The Place Diagram in the Comfort & Image section for evaluating successful public spaces from Project for Public Spaces (n.d.). In addition, user-centered methods, such as walk-along interviews, can be used to gain a deeper understanding of users.

Gehl Institute (n.d.); Project for Public Spaces (n.d.)

Definition

Local emissions caused, such as PM emissions or NOx emissions from system users. The indicator can be limited to trips made by residents of the area under consideration or target groups. In addition, measurements can be carried out in the street space in real-world laboratory projects.

Context and Relevance

Local emissions are an important indicator of air quality in urban areas. PM stands for particulate matter and refers to tiny particles suspended in the air that can originate from both natural and human activities. Nitrogen oxides (NOx) are a group of gases emitted mainly by combustion engines such as cars, trucks, and buses. Sources of these emissions include the combustion of fossil fuels in vehicles, industrial plants, and heating systems. Measuring local emissions is important for analyzing the impact of mobility on the environment and human health. High PM emissions can lead to respiratory diseases, cardiovascular diseases, and even cancer. NOx emissions can lead to respiratory diseases, smog formation, or acid rain. Measuring and monitoring this indicator is therefore important for improving air quality in urban areas and protecting the health of the population.

In addition to air pollution, local noise pollution can also be analyzed. It is listed as a separate secondary indicator due to different measurement parameters.

Unit

Prefer [t/year] or [g/passenger kilometer or freight kilometer]; for PM, a distinction should be made according to particle size (PM10, PM2.5).

Methods

Emissions can be measured using various methods, including calculations, field tests, simulations, or surveys. The decisive factors for a calculation could be the number of kilometers driven, the number of vehicles, the type of fuel, and the corresponding emission factors according to the Handbook of Emission Factors (HBEFA). The data can also be obtained from operating data. For real-world laboratory projects, before-and-after measurements could be carried out at designated locations in the selected area.

Engels et al. (2020); HBEFA (n.d.); Schröder et al. (2023)

Definition

Greenhouse gas emissions of system users. The indicator can be limited to residents of the area under consideration or target groups.

Context and Relevance

Even though mobility emissions have decreased in recent years, the transport sector continues to cause a drastic amount of greenhouse gases (GHG). The collection of GHG emissions data can help to develop and evaluate strategies and measures for reducing transport emissions. Examples include increasing the share of low-emission modes of transport such as electric vehicles or bicycles, expanding public transport, introducing traffic restrictions or diversions, or establishing innovative mobility solutions. By monitoring GHG emissions, the impact of these measures on the environment and society can be assessed and optimized.

The indicator can reflect both direct and indirect influences on GHG emissions. Direct influences can include, for example, the promotion of clean fuels or the switch to more environmentally friendly transport options. Indirect influences include reduced traffic congestion or access restrictions.

Unit

Preferred [t CO2e/year] or [g CO2e/passenger kilometer or freight kilometer].

Methods

GHG emissions can be measured using various methods, including calculations, field tests, simulations, or surveys. The decisive factors for a calculation can be the kilometers driven, the number of vehicles, the type of fuel, and the corresponding emission factors according to the Handbook of Emission Factors (HBEFA). The data can also be obtained from operating data. Electric vehicles, including emissions from the power source used, should be taken into account in the calculation. System boundaries and assumptions should be presented transparently.

Engels et al. (2020); HBEFA (n.d.); Schröder et al. (2023); Umweltbundesamt (2022)

Definition

Acceptance refers to citizens' willingness to embrace an innovative measure that is being tested as part of a project and to imagine integrating this measure into their everyday lives in the future. Acceptance is a decisive factor for the long-term success and sustainable implementation of new solutions in public spaces and mobility.

Context and Relevance

The acceptance survey records the percentage of respondents in the study area who agree with a project or its measures or have a positive attitude towards it. In addition, the actual use and response of citizens to the project or specific measures can also be a decisive measure of acceptance.

Analyzing the various forms of opposition is also crucial to obtaining a comprehensive picture of acceptance. It can be observed that resistance can manifest itself in different ways. Examples include negative attitudes, public protests, criticism expressed on social media, or low participation in information sessions and events.

The acceptance of a specific measure is determined by evaluating the positive and negative reactions of the target group. This enables an informed assessment of whether the measure represents a real solution for the people concerned and whether long-term implementation is possible.

Unit

Percentage [%] or number of users [n] with a positive/negative attitude or own standard scheme with reference to project criteria.

Methods

Acceptance can be measured through surveys, interviews, or feedback from actual use of the offers and services created (revealed preference). Locations where projects or sub-measures have a greater impact should be given preference as areas of investigation. If possible, the survey should be representative of the area under investigation.

Engels et al. (2020)

Definition

Inclusive mobility means creating an infrastructure in which all people, regardless of their individual abilities or needs, can participate equally and independently in mobility. In other words, individuals do not have to adapt to mobility structures or live with barriers. Barriers are obstacles that make access to various modes of mobility difficult or even impossible.

Context and Relevance

With the Basic Law (Article 3, Paragraph 3, Sentence 2) and the UN Convention on the Rights of Persons with Disabilities, Germany has committed itself to an inclusive society. This also includes inclusive mobility infrastructure and planning.

However, reality shows that certain groups of people, such as those with cognitive and/or physical disabilities, women, children, and seniors, are often insufficiently or hardly taken into account in conventional mobility planning. Therefore, inclusive infrastructure planning not only includes measures to ensure accessibility for citizens with limited mobility, but also aspects such as the provision of signage in easy-to-read language, the option to use analog payment systems, or sufficient space for strollers.

Where possible, the inclusion indicator should be considered in conjunction with the participation indicator. The participation of people with limited mobility plays a prominent role in all projects in the mobility sector in order to identify needs and ensure the acceptance and use of mobility options.

Unit

Preferred: Use a score of 1-5 (very exclusive – somewhat exclusive – neither exclusive nor inclusive – somewhat inclusive – very inclusive) or your own standard scheme with reference to project criteria.

Methods

Inclusion can be assessed at the locations within the study area by means of a survey in the form of questionnaires, personal interviews, etc. In addition, observations can provide methodological support, as can consideration of legal requirements and planning standards.

Bolz et al. (2022); Prem et al. (2024); Aktion Mensch e.V. (2025)

Definition

Participation means that people actively contribute to decisions that affect their lives. Participation enables those involved to contribute their experiences, interests, and values, strengthens personal responsibility, and enables co-creation. The degree and quality of involvement play a particularly important role in this context.

Context and Relevance

Civil society participation in mobility projects is essential for an inclusive and equitable planning and implementation process. Citizen participation makes it possible to take into account the values and interests of the (affected and disadvantaged) population in projects. It can also promote the acceptance, quality, and legitimacy of projects and the institutions involved in them. However, it can also cause mistrust if participants feel ignored or manipulated. At the individual level, participation can promote self-development and commitment to the common good.

Where possible, the participation indicator should be considered in conjunction with the inclusion indicator. The participation of people with reduced mobility plays a prominent role in all projects in the mobility sector in order to identify needs and ensure the acceptance and use of mobility options.

Unit

Qualitative description of a participation format and/or the overall process of participation activities. In addition, quantitative surveys, e.g., on the number of participation events, number of participants/participation rate, quality of results, and processes.

Methods

The process and results should be evaluated separately if possible. Ideally, both formal (e.g., surveys) and informal methods (e.g., discussions with project staff and participants) should be used. The Transdisciplinary Process Evaluation (TPE) method developed by Grundei et al. (2025a) is also suitable for embedding participation events in the overall process. The levels of participation described by Rube/Beilharz (2021) can be used as an example for further categorization of the depth of participation.

IAP2 (2018); Laurian and Shaw (2009); Rube/ Beilharz (2021); Grundei et al. (2025a)

Definition

Quality of the cooperation structures between all public and private project partners contributing to the development and implementation of the project. This may also describe networking between or within regions.

Context and Relevance

Transdisciplinary, interdisciplinary, and cross-sector research, the interlinking of sectors (science, business, society, and administration), strong networking within the region, and opportunities for diverse stakeholders to participate in decision-making are among the value-oriented guiding principles of the MCube cluster. However, the feasibility and efficiency of project implementation also depend heavily on the quality of the cooperation structures within the project and beyond. For this reason, this indicator is intended to qualitatively capture the change in the quality of these cooperation structures through the project and the entire cluster.

Unit

Qualitative description of the cooperation, number, and quality of the cooperations or cooperating partners.

Methods

Questionnaires and interviews with decision-makers and other project stakeholders. Optionally, the Transdisciplinary Process Evaluation (TPE) method developed by Grundei et al. (2025a) can also be used.

Engels et al. (2020); Grundei et al. (2025a)

11 Influence on Planning and Decision-Making Process

Definition

The indicator records whether and how a project feeds input into planning or decision-making processes — for example, through dialogue formats, publications, new routines, or collaborations — and thereby visibly influences processes. Even without direct implementation, any discernible effect is considered a relevant contribution to changing decision-making logic.

Context and Relevance

Projects can exert influence at different levels and in different formats. The following examples serve as a guide:

1. Project activities – **how can influence be exerted?**
   - Publications for target groups (e.g., policy briefs, innovation recommendations)
   - Participation in strategy and dialogue processes
   - Contributions to specialist events and knowledge transfer (e.g., MCube Phase II ReMIX dialogues, exchange with administration and politics)
2. Types of impact – **what can be achieved?**
   - Inclusion in strategies and planning
   - New routines or cooperation formats (e.g., changed responsibilities)
   - Dissemination and visibility of innovations (e.g., through programs or political discussions)
3. Embedding in a **temporal perspective**
   - Short term: Generating discussions, reactions, attention
   - Medium term: Integration into work routines, strategy processes, recommendations
   - Long term: Process or structural innovations, institutional anchoring, legislation

Unit

Qualitative description of the influence on planning and decision-making processes, supplemented by concrete evidence where applicable (event, quote, documentation, invitation, etc.).

Methods

Documentation and tracking of influence formats by the projects, e.g., through ReMIX participation (including ReMIX dialogues, advice on publications; contact ReMIX at https://mcube-cluster.de/projekt/remix/). Interviews with decision-makers are optional but can be coordinated by EPURA.

Engels et al. (2020); Laakso et al. (2017); BMBF - BeNaMo Begleitforschung (o. J.); MCube Phase I (s. Innovationsempfehlungen, Policy Brief, etc.)

12 Knowledge Gain

Definition

The knowledge gained describes the scientific and application-related contribution of the project to the analysis of current mobility challenges and the development of transferable solutions. This indicator addresses the relevance, depth, and connectivity of the knowledge gained in the project and the quality of the approaches for consolidation and transfer that can be derived from it.

Context and Relevance

The central objectives of the MCube cluster – embedded in the Clusters4Future funding line – are to create innovations, initiate social change, and promote economic exploitation. The transfer requirement for all MCube projects relates to knowledge gained from real-world laboratory processes, ongoing evaluations, and participatory formats. A fundamental component of this indicator is the development of basic knowledge, the development and implementation of innovative approaches, and the translation of findings into formats that are permanently effective. This work then enables, for example, the scaling of viable solution concepts, the establishment of start-ups and key technologies, or the creation of new planning processes.

Unit

Qualitative assessment based on a grid, optionally supplemented by a score of 1–5 (1 = no relevant scientific/application-related contribution; 5 = substantial, comprehensible findings with connectivity) or your own standard scheme with reference to project criteria.

Examples of evaluation dimensions: quality and innovative content of the approaches, scientific transferability, interdisciplinarity and transdisciplinarity, visibility and contribution to discourse, relevance for practice, and transferability.

Methods

Qualitative assessment through interviews with project partners, stakeholders, and decision-makers. Qualitative/quantitative survey using questionnaires with project partners, stakeholders, and decision-makers.

Engels et al. (2020)

Secondary Indicators

13 Travel Experience

Definition

Number and quality of factors per trip that influence the quality of the travel experience, such as: comfort, convenience, frequency, directness, safety, amenities, congestion/overcrowding, traffic jams, noise, views, weather, and reliability.

Context and Relevance

The factors of the travel experience can enable activities to be carried out during the trip and can thus have a direct influence on the use of travel time. The travel experience depends on the means of transport used.

Since a trip can be associated with both positive and negative experiences, both effects should be taken into account when evaluating travel time. The relationship between the indicators of travel experience and usability of travel time can be used to determine the perceived value of travel time and to distinguish between perceived worthwhile and wasted travel time. Accordingly, the two indicators can be considered together.

Unit

Travel experience best measured by [factors / trip]
Examples of factors: comfort, convenience, frequency, direct connection, safety, etc.

Methods

Several methods, such as interviews, focus groups, or questionnaires, can be used to collect data on factors. Relevant factors can be taken from the freely accessible data set on experience factors from the EU MoTiV project (Consonni et al., 2020, 2021). Cornet et al. (2022) can be used as an example of the theoretical framework.

Consonni et al. (2020); Consonni et al. (2021); Cornet et al. (2022)

14 Usability of Travel Time

Definition

Feasible and beneficial activities during a trip. Activities are generally divided into work-related and non-work-related activities, or productive and unproductive activities.

Context and Relevance

Meaningful activities contribute to the overall benefit of a trip. A distinction is usually made between work-related and non-work-related activities, or between productive and unproductive activities. A distinction can also be made between useful activities (e.g., working or making phone calls) and enjoyable activities (e.g., looking outside, reading, chatting). The relationship between the indicators of travel experience and usability of travel time allows the perceived value of travel time to be determined and a distinction to be made between perceived worthwhile and wasted travel time. Accordingly, the two indicators can be considered together.

Unit

Usability of travel time is best measured by [activities / travel]. In addition, a qualitative survey can provide a more in-depth assessment of the usability of travel time.

Methods

Several methods, such as interviews, focus groups, or questionnaires, can be used to record factors. Relevant activities can be found, for example, in the freely accessible dataset on activities from the EU MoTiV project (Consonni et al., 2020, 2021). Cornet et al. (2022) can be used as an example for the theoretical framework.

Consonni et al. (2020); Consonni et al. (2021); Cornet et al. (2022)

15 Traffic Conflict Situations

Definition

This refers to the objective risk of road users coming into conflict with other road users. Factors such as traffic volume, visibility of traffic situations, the design of roads and paths, and the behavior of other road users play a role here. Furthermore, it must be taken into account that the number of recorded or measurable incidents caused by any means of transport is defined. A recorded incident is defined as any event recorded by the police or scientifically that impairs the health of users or the usability or performance of the vehicle.

Context and Relevance

The quality of the mobility space can be measured by the risk of incidents and the number of incidents. Cycle paths that are too narrow and have poor visibility due to the infrastructure at intersections can increase the risk of incidents. Incidents themselves can reduce the efficiency and effectiveness of the transport system and thus negatively impact the user experience. If these two aspects are measured highly, the quality of the mobility space decreases accordingly.

The indicator, therefore, shows the important contribution of projects to reducing the risk of incidents and, as a result, the number of incidents in traffic. The focus is on analyzing the transport space to measure risk and on recording the number of incidents affecting travelers, regardless of their type or severity (e.g., collision, breakdown, failure, health impairment, etc.). The triggers for an incident can vary greatly and are not directly captured by this indicator.

Unit

Use a score of 1-5 (very low risk – low risk – moderate risk – high risk – very high risk). Or, at best, the number of incidents recorded in [incidents/time unit] over a period of three years. For better comparability, the type of accident should always be specified as well.

Methods

Figures and data can usually be provided by the police. Other scientifically recognized methods can also be used for data collection and analysis, e.g., conflict observation.

Engels et al. (2020)

16 Diversity of Activities in Public Space

Definition

The diversity of activities in public spaces considers the number, quality, and type of different uses and social interactions in public areas. The indicator considers functional and social dimensions and shows the diverse use of public spaces by people of different backgrounds, ages, genders, etc.

Context and Relevance

Diversity in a city is largely created by the use of public spaces. A high level of diversity in activities carried out by different groups of people demonstrates the vibrancy, inclusivity, and resilience of urban spaces. Where areas are easily accessible, people can make them their own and carry out a variety of activities, such as recreation, exercise, communication, work, or consumption. The quality of diversity of use is also reflected when people of different genders and ages use the space, when the space is used throughout the day, and when it can be used by both individuals and groups.

Unit

Preferred: Use a score of 1-5 (very one-sided – somewhat one-sided – neither one-sided nor diverse – somewhat diverse – very diverse) or a percentage for different types of use, optionally supplemented by a qualitative description (e.g., intensity of use).

Methods

At locations and in areas, the quality of public spaces can be assessed through observations or surveys in the form of questionnaires, personal interviews, telephone interviews, etc. Examples and further context for this can be found in The Place Diagram in the Uses & Activities section for evaluating successful public spaces from Project for Public Spaces (n.d.).

Project for Public Spaces (n.d.)

17 Multifunctionality of Space

Definition

Mix of different functions and types of use of the space in the study area.

Context and Relevance

Large monofunctional areas (residential, industrial, commercial) force people to travel in order to carry out other activities. Mixing several functions in one area creates spatial proximity and makes it possible to reach activities within a short distance. A greater mix of spatial functions also improves the quality of life in streets, neighborhoods, and cities. A mix of residential, commercial, and cultural facilities creates a more livable and diverse community where residents can live, work, and engage in leisure activities without having to travel long distances. Economic stability can also be achieved through increased spatial mixing. In addition, urban areas can be more adaptable and evolve over time to meet the changing needs of residents. A mix of uses can also create vibrant public spaces where people can come together and interact, fostering a sense of community and promoting social cohesion.

Unit

Preferred: Use a score of 1-5 (very monofunctional – rather monofunctional – neither monofunctional nor multifunctional – rather multifunctional – very multifunctional) or your own standard scheme with reference to project criteria.

Methods

The mix of spatial functions can be recorded using various methods. The study area and system boundaries should be defined when selecting the method.

Gillis et al. (2015); European Commission (2022); Zachary & Dobson (2020)

18 Land-Use Efficiency

Definition

Space required by a person or goods in motion. This usually takes into account the space required by different modes of transport.

Context and Relevance

The less space required, the greater the space efficiency. This means that the less space required per trip for a person or goods, the more people/goods can be transported in the same space. Examples of space-efficient modes of transport include well-utilized public transport, cycling, and walking. Cars, on the other hand, are space-intensive, especially when underutilized. In terms of spatial delimitation, the cluster approach refers to the transport network and/or selected routes.

Space efficiency is a key indicator in Munich's Mobility Strategy 2035. The aim here is to massively expand the range of eco-friendly transport options and to redistribute road space in favor of greater space efficiency.

Unit

Transport performance per area used in [passenger kilometers/m^2]. This refers to the route, not the footprint of the means of transport.

Methods

The ratio between transport performance and available space can be determined at the locations within the study area. This allows a comparison of passenger kilometers per year for different modes of transport.

Städtekonferenz Mobilität (2021); Städtekonferenz Mobilität (2022)

19 Energy Efficiency

Definition

Energy consumption per unit of transport performance.

Context and Relevance

As cities grow, so does the number of vehicles on the roads, posing a significant risk to air quality and sustainable urban mobility. The efficiency of a mode of transportation has a direct impact on the amount of pollutants it releases into the atmosphere.

In recent years, the importance of efficient mobility options has been highlighted by various organizations, governments, and interest groups around the world. The United Nations (UN) Sustainable Development Goals (SDGs) 7, 11, 12, and 13 aim to ensure access to affordable, reliable, and sustainable energy; make cities and human settlements inclusive, safe, resilient, and sustainable; ensure sustainable consumption and production patterns; and take urgent action to combat climate change and its impacts. Improving the energy efficiency of transportation is crucial to achieving these SDGs. In addition, more efficient vehicles also emit fewer pollutants such as nitrogen oxides, particulate matter, and sulfur dioxide, which have adverse effects on human health and the environment. Low energy consumption is also important for electric vehicles. It reduces the effort required for energy generation, distribution, and storage, and thus has a strong influence on infrastructure, investment, and operating costs.

Unit

Energy consumption per passenger or freight kilometer [kWh/km].

Methods

The number of vehicle kilometers is preferably collected using a traffic model. Alternative methods include field measurements (traffic counts at representative locations) or surveys (questionnaires on driving behavior). If vehicle kilometers are available in existing urban mobility databases, they can also be used.

Engels et al. (2020); European Commission (2022); Gillis et al. (2015); WBCSD (2020)

Definition

Noise level measured on site in the study area or at residents' homes. A distinction can be made between two values: (1) the measured sound level, measured in dB, (2) and the perceived sound level, measured in dB(A). A qualitative assessment of noise pollution is also possible.

Context and Relevance

Noise spreads widely through the air and therefore affects a large area around its source. When people are exposed to high noise levels over a long period of time, the likelihood of cardiovascular disease or high blood pressure increases. Animals can also be severely disturbed by traffic noise, which can have a particularly negative impact on their communication with each other. Switching to eco-friendly modes of transport often also reduces noise emissions. There is also potential for noise reduction in car traffic (e.g., traffic calming, road surfacing, drive systems).

Unit

Measurement: Preferably [dB(A)] (sound level adjusted to auditory perception). If possible, indicate the number of people affected.
Qualitative assessment: Preferably use a score of 1-5 (very unpleasant – somewhat unpleasant – neither unpleasant nor pleasant – somewhat pleasant – very pleasant).

Methods

The sound level alone can be determined through field tests. A variety of noises are recorded during on-site measurements. However, only traffic noise or noise levels affected by the project are relevant for the indicator. Sound level measurements should be taken continuously throughout the day and night and compared with permissible limit values. If measurements are not possible or unsuitable, the perceived or experienced noise can be assessed, for example, with the help of questionnaires or interviews.

The existing noise mapping of the respective study area should also be taken into account in order to be able to view and evaluate the results in the correct context.

Engels et al. (2020); Umweltbundesamt (2021); FGSV (2019)

21 Stress Levels

Definition

Extent of well-being among road users. This includes people using transportation and people who interact directly with them.

Context and Relevance

The stress level indicator refers to the degree of stress or strain that people are exposed to as a result of traffic situations or mobility problems. Measuring stress levels is important for improving individual health protection in the context of urban and rural mobility. High levels of tension due to traffic jams or traffic congestion can have a negative impact on health and lead to chronic stress, which in turn is associated with various health problems such as cardiovascular disease, sleep disorders, anxiety, and depression. By measuring stress levels, measures can be developed to improve mobility in urban and rural areas and reduce stress caused by traffic situations. This can contribute to promoting a healthier environment and make people feel safer and more comfortable when they are on the move. The indicator includes all forms of mobility.

Unit

Preferred: Use a score of 1-5 (very stressful – somewhat stressful – neither stressful nor relaxed – somewhat relaxed – very relaxed) or your own standard scheme with reference to project criteria.

Methods

On-site investigations in the area under consideration. Surveys or expert interviews can be used for this purpose. The use of aids such as heart rate monitors or other tracking methods can also provide data. The methodology of the Montgomery County Planning Department (2020) or the Level of Traffic Stress (LTS) (Furth, 2012) can be used as inspiration.

Furth (2012); Montgomery County Planning Department (2020)

22 Affordability

Definition

The indicator summarizes how affordable and accessible sustainable urban mobility services are for different user groups and, at the same time, how viable and financially viable they are for providers and operators—in terms of the ratio between mobility expenditure and disposable income, as well as cost recovery on the supply side.

Context and Relevance

The affordability of urban mobility has a significant impact on social participation, everyday life, innovation, and the long-term viability of urban mobility services. Relevant success factors include the percentage of their income that households actually spend on mobility and whether providers can cover all running costs with the available financing mechanisms. Taking absolute costs into account enables a transparent assessment that is relevant in terms of social and economic policy.

Unit

Users: Monthly mobility expenditure per household, in relation to disposable household net income [in %].

Providers: Proportion of services that cover their operating costs (including subsidies) [%].

Methods

Survey based on questionnaires and income statistics, analysis of operating costs and revenues among providers, analysis of subsidies. Additional information for the MCube context: integration of existing analyses and comparison with benchmarks from project reports, e.g., MCube Consulting "Value Creation in Public Transport" and Mobility (In)equity Atlas.

MCube (2024); Schröder et al. (2023); Litman, T. (2016), Rozynek et al. (2023)

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