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Sump Indicators in Focus – Investigating Modal Distribution in Urban Mobility Research

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ABSTRACT

These plans aim to strike a balance between the prevalent use of private cars and alternative modes of transport. A pivotal aspect of SUMP formulation lies in the identification of indicators, serving as tools for cities to assess their mobility systems and strategically address strengths and weaknesses. The European Commission provides a set of reliable indicators for standardized assessments, ensuring uniform data collection. Despite the importance of SUMPs, cities often lack consistent political and institutional support for their integration into urban development plans. Additionally, disparities exist in the application of methodologies for data collection in defining SUMP indicators. This paper thoroughly analyzes the indicator identification process within the SUMP creation framework. It highlights the need for continuous political backing and institutional support for SUMP projects within urban development plans. Furthermore, the paper addresses the variations in applying methodologies for data collection, emphasizing the importance of standardization. The focus is on the European Commission's indicators, providing practical insights into their application for a more uniform assessment of mobility systems. The research contributes by presenting a refined method for data collection, encompassing both basic and additional SUMP indicators. The study also introduces an in-depth analysis of modal distribution, offering a valuable resource for cities interested in formulating new SUMPs. By enhancing our understanding of these critical aspects, this paper contributes to the ongoing discourse on sustainable urban mobility and supports the development of more effective and harmonized transportation planning strategies.

1. Introduction

Integral to the Sustainable Urban Mobility Plans (SUMPs) is the implementation of proposed measures, a crucial phase involving the monitoring and evaluation of progress. This ongoing evaluation is pivotal to gauging the success of the entire SUMP planning procedure, offering valuable insights into the impact of implemented measures and highlighting their significance. To ensure objectivity and comprehensiveness, it is imperative that these processes are executed meticulously. The European Commission has played a pivotal role by providing a comprehensive set of urban mobility indicators for cities to employ in monitoring SUMP implementation. This initiative empowers cities to objectively assess the effectiveness of their policies and facilitates comparisons with the performance of other urban centers.

The paper categorizes indicators into basic and non-basic, offering clarity on data definitions and the parameters used for measurement. The primary objective is to showcase the utility of these indicators in evaluating the efficacy of measures, identifying strengths and weaknesses in city systems and mobility, and pinpointing areas for improvement through comprehensive indicators.

By employing these indicators, cities can undergo a standardized evaluation within the European Union, enabling meaningful comparisons among cities of similar sizes based on the collected data. Presently, various global and EU methodologies propose indicators for assessing mobility, sustainability, and traffic system efficiency in cities, with a discernible trend toward achieving standardization through benchmarking.

This paper aims to contribute to this evolving landscape by further elucidating the significance of SUMP indicators, their applications, and the potential for benchmarking in the context of contemporary urban mobility practices. Through an in-depth exploration of these aspects, we seek to enhance our understanding of how cities can harness standardized evaluations to foster more sustainable and efficient urban mobility solutions.

2. Set of SUMI indicators

The European Commission has therefore developed a comprehensive rally of practical and reliable indicators supported by cities to assess its mobility system and just improvements stemming from new practices or mobility policies. As part of the CIVITAS impact and process evaluation framework, a set of indicators was developed to capture and evaluate the changes triggered by mobility-related measures in six main impact categories: society – governance; society – people; the transport system; energy; economy; environment. Each indicator is defined, explained and comes with recommendations about data collection. These indicators are used already by many cities to keep transparent track of their mobility system and the links to other domains, to monitor their general mobility evolution and to evaluate the impact of mobility-related measures [1].

Indicators of sustainable urban mobility are useful tool for cities and urban areas to identify forces and weaknesses of the mobility system and focus on the areas for improvements. A standardised, methodically sound and practically feasible indicator set can enable public authorities to gain a better understanding of the current status of the city about sustainable urban mobility [2]. The set of SUMI indicators consists of two groups of indicators: basic and non-basic [4]. Indicators 1 to 13 are defined as basic indicators, while indicators 15 to 19 are considered non-basic indicators. The formulation of Sustainable Urban Mobility Indicators (SUMIs), capable of measuring and assessing potential solutions, is thus the key in addressing transport problems. SUMIs would prioritise people over cars establishing a new hierarchy where priority is given to sustainable transport modes such as walking, cycling and public transport [3].

A sustainable mobility system does not necessarily aim to completely “ban” cars, but it does seek to impose some barriers to their excessive usage. Simultaneously it should offer transport alternatives that will help people to cover their everyday mobility needs without having. private cars as a mono-solution but as another (hopefully secondary) option [3]. As Modal Split, constitutes an important parameter for the calculation of several of the indicator above, is developed a spreadsheet to calculate the modal split, counting as a 14th core indicator (modal split is not an indicator but parameter for several indicators).

2.1. Accessibility of public transport for the poorest groups

Definition: Proportion of the poorest household budget quartile required to own a public transport (PT) pass (unlimited monthly travel or equivalent) in an urban area of residence. Parameter: Rating = (Price of a monthly PT ticket * average household size) / income of the poorest 25% of urban residents [5].

2.2. Accessibility of public transport for groups with reduced mobility

Definition: This indicator determines the availability of public transport services for people with reduced mobility. Such vulnerable groups include those with visual and hearing impairments and those with physical limitations, such as pregnant women, wheelchairs and mobility devices, the elderly, parents and carers who use wheelchairs, and people with temporary injuries. Parameter: Proportion of total public transport services made accessible to individuals who would otherwise not be able to use them [5].

2.3. Emissions of air pollutants

Definition: Pollutant emissions into the air of all modes of passenger and cargo transport (exhaust and non-exhaust for PM2.5) in the urban area [5].

2.4. Noise disturbance

Definition: Disturbing the population with the noise generated by city traffic. Parameter: The percentage of the population disturbed by city traffic noise, based on the disturbance factor for data on the population's exposure to noise-by-noise range [5].

2.5. Deaths on the road

Definition: Deaths on the roads from all traffic accidents in the urban area on an annual basis. Parameter: The number of deaths in the period of 30 days after a traffic accident as a result of the annual ones caused by urban transport per 100,000 inhabitants of an urban area [5].

2.6. Access to mobility services

Definition: Share of the population with adequate access to mobility services (public transport). [5] Parameter: Percentage of population with adequate access to public transport (bus, tram, metro, train).

2.7. Greenhouse gas emissions

Definition: Well-to-wheel greenhouse gas emissions of all types of passengers and freight transport in urban areas [5].

2.8. Stoppages and delays

The focus of this study involves an in-depth examination of road traffic and public transport delays during peak hours in comparison to off-peak travel for private road traffic and optimal travel time for public transport. In the realm of private road traffic, the analysis revolves around the weighted sum of delays on 10 representative car travel corridors. This is calculated as the ratio of peak travel time to off-peak travel time. For public transport on the road, the examination considers the weighted sum of delays on 10 representative corridors for public transport journeys. This is evaluated as the ratio of peak travel times to the estimated optimal travel times [5]. Parameter: The parameter employed for this assessment is a weighted sum, ensuring a comprehensive evaluation of delays across various representative corridors. Specifically, for private road transport, this entails computing the sum of weighted averages for the 10 selected car travel corridors. This value is derived by considering the ratio of peak travel time to off-peak travel time for each corridor. On the other hand, for (road) public transport, the parameter involves calculating the sum of weighted averages for the 10 identified corridors for public transport journeys. This is determined by assessing the ratio of peak travel times to the estimated optimal travel times [5].

This meticulous definition and parameterization aim to provide clarity and precision in assessing road traffic and public transport delays, ensuring a robust methodology for evaluating the efficiency and effectiveness of urban mobility systems within the context of Sustainable Urban Mobility Plans (SUMPs).

2.9. Energy efficiency

Definition: Total energy consumption in urban transport per passenger km and ton km (annual average for all modes) [5].

2.10. Opportunity for active mobility

Definition: Infrastructure for active mobility, i.e., walking and cycling. Parameter: The length of roads and streets with sidewalks, bicycle paths, 30 km/h (20 mph) zones and pedestrian zones in relation to the total length of the city's road network (excluding highways) [5].

2.11. Multimodal integration

Definition: An interchange is any place where a passenger can change from one mode of travel to another, with a minimal/reasonable amount of walking or waiting. The more modes available at the exchange, the higher the level of multimodal integration. Note: This indicator is called "Multimodal integration", not "Intermodal integration", because the term "Intermodality" refers to freight transport (mainly container transport). Parameter: An index between 0 and 1 that shows the average level of multimodal connectivity of distribution points within the urban transport network [5].

2.12. Satisfaction with public transport

Definition: Perceived satisfaction with using public transport. Parameter: Average reported satisfaction with moving in the urban area by public transport [5].

2.13. Active modes of traffic safety

Definition: Fatalities of users of active modes in traffic accidents in the city in relation to their exposure to traffic. Parameter: Number of deaths within 30 days after a traffic accident as a result of an event per year caused by active modes of transport, per billion journeys per year (exposure) [5].

2.14. Quality of public spaces

Definition: Perceived satisfaction of public spaces. Parameter: The parameter is a successful result of survey responses on respondents' perception of satisfaction with green and non-green public areas [5].

2.15. Urban functional diversity

Definition: Functional diversity refers to the mix of spatial functions in an area, creating proximity to interrelated activities. Parameter: Average (value 1) or not (value presence 0) of 10 spatial functions related to daily activities other than work in 1 km x 1 km grids [5].

2.16. Travel time to work

Definition: Travel time to and from work or educational institution, using any type of mode [5].

2.17. Use of space for mobility

Definition: Proportion of land use taken by all modes of urban transport, including direct and indirect use. Parameter: Square meters of direct and indirect use of space for mobility per capita [5].

2.18. Safety

Definition: Perceived risk of crime and passenger safety in city traffic. Parameter: Reported perceptions of crime-related safety in the city's transport system (including freight and public transport, the public domain, cycle paths and roads for car traffic and other facilities such as car or bicycle parking) [5].

3. SUMP Indicators spotlight: Exploring modal distribution of urban mobility in cities

Problems in the implementation of SUMP often arise due to misunderstanding of the authorities and insufficient interest in starting the processes. A standardized, methodical and practically feasible set of indicators can also lead to the fact that the authorities better understand the current status of the city in terms of sustainable urban mobility and that they start implementing it more efficiently.

A definition is given for each of the indicators, as well as their parameter. The has given clear instructions on how to obtain data for calculating these parameters, which is a help for large and small cities when it comes to the problem of data collection, which is usually reflected in the lack of human and financial resources.

Definition modal split for passenger mobility: Modal division according to passenger kilometers travelled; Modal division according to vehicle kilometers travelled; Modal division according to the number of trips made; Modal division according to the number of vehicle kilometers travelled per trip. Definition modal split for cargo: Modal division according to kilometers travelled by goods vehicles; Modal division according to freight tons and kilometers travelled. Parameter: Modal breakdown by passenger kilometers travelled: the total number of passenger kilometers travelled for each mode of operation within an urban area compared to the total number of passenger kilometers travelled for all modes of travel within an urban area. Modal breakdown by vehicle kilometers travelled: the total number of vehicle kilometers travelled for each mode within an urban area compared to the total number of vehicle kilometers travelled for all modes within an urban area. Modal split by number of trips: the total number of trips for each mode within the urban area compared to the total number of trips for all modes in the urban area. Modal division by freight vehicle kilometers travelled: the total number of freight vehicle kilometers travelled for each mode of goods transport within the urban area compared to the total number of freight vehicle kilometers travelled for all types of freight vehicles within the urban area. Modal division according to vehicle tons travelled: the total number of ton kilometers of goods travelled for each type of goods transport within the urban area compared to the total number of ton kilometers travelled for all types of goods transported within the urban area [5].

$$\overline{SEC} = \frac{\sum_m \overline{SEC_m}}{m}$$

$$\overline{SEC_m} = \sum_h \overline{SEC_{h,m}}$$

$$\overline{SEC_{h,m}} = \frac{\#times\ agreement\ h\ was\ used\ in\ sample\ for\ aspect\ m}{\#people\ sampe\ of\ aspect\ m - \#\frac{DK}{NA}\ answers\ in\ sample\ m} x C_h$$

$$C_h = very\ safe = 10$$

$$C_h = safe = 6{,}66$$

$$C_h = unsafe = 3.33$$

$$C_h = very\ unsafe = 0$$

4. Conclusion

The integration of the Sustainable Urban Mobility Indicator (SUMI) framework emerges as a pivotal strategy for cities, offering a solution to challenges associated with efficient policy planning. Concurrently, it serves as a catalyst for the successful implementation of Sustainable Urban Mobility Plans (SUMPs) and the adoption of smart mobility strategies.

SUMI stands out as a crucial tool, facilitating the identification of deficiencies in sustainable urban mobility and pinpointing areas necessitating additional measures. Moreover, it plays a vital role in evaluating progress toward predetermined goals, fostering a culture of continuous improvement.

A significant advantage of embracing a standardized approach, such as SUMI, lies in its ability to foster city-to-city comparisons based on comprehensive databases. This facilitates the identification and application of exemplary practices across cities with similar characteristics. As European Union cities, urban areas, and individual cities in Bosnia and Herzegovina embark on the development of SUMPs, standardization becomes imperative. This ensures that the process is well-documented, transforming achievements and implementation into practical and efficient outcomes for cities and their residents.

Recognizing the importance of data collection, cities in Bosnia and Herzegovina need to be cognizant of the significance of systematically gathering and standardizing data. The establishment of a comprehensive database of indicators within the research domain, coupled with the continuous monitoring of EU development indicators in the mobility segment, becomes paramount. To achieve this, cities should commit to monitoring systemic innovations in mobility through the establishment of clear standards, guidelines, and databases for exchanging EU standards or proposed SUMI indicators, complete with defined initializers, protocols, and methods of data collection.

In essence, this study advocates for a harmonized and standardized approach to sustainable urban mobility planning, emphasizing the transformative potential of SUMI in shaping more resilient, efficient, and citizen-centric urban mobility systems across diverse European and Bosnian contexts.

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