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Moving towards Sustainable Mobility: A Comparative Analysis of Smart Urban Mobility in Croatian Cities

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Abstract: Most modern urban areas strive to realize a sustainable and smart urban mobility system. In the Republic of Croatia, no study has provided an analysis of the state of urban mobility therefore, the main purpose of this paper is to determine the level of smart urban mobility in the cities of the Republic of Croatia. Based on the indicators provided by ISO standards (ISO 37120:2018 and ISO 37122:2019), the state of smart urban mobility in the Republic of Croatia was evaluated and a comparative analysis of small, medium-sized, and large cities was conducted. Moreover, correlations were found between individual indicators, within the categories of small, medium, and large cities, to determine whether there is a connection between individual indicators. The obtained results show that the state of smart urban mobility in the territory of the Republic of Croatia is at a very low level. The highest level of smart urban mobility was achieved by large cities, but it was not significantly different from the level in small and medium-sized cities. The correlation between the indicators also highlights the strong links between individual elements in the city. Therefore, to achieve smart urban mobility, it is necessary to manage all elements in an integrated manner.

Keywords: urban mobility; sustainable mobility; smart mobility; smart cities; ISO 37120; ISO 37122

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1. Introduction

Urbanization, as well as other environmental factors that create negative effects on the environment, influence thinking on sustainable mobility. Although the concept of sustainable mobility appeared in 1992 [1], sustainable mobility systems are still underdeveloped in urban areas. Modern urban areas strive to achieve sustainability, which is in line with the concept of smart cities that modern cities strive to realize. Smart cities are cities which integrate all the necessary components to ensure a higher quality of life and to achieve economic, ecological, and social sustainability. One of the fundamental components of a smart city is sustainable urban mobility. Urban mobility is generally considered the basis of the economic development of an urban area, as it connects different areas of the city and ensures the normal functioning of citizens [2]. Unsustainable urban mobility can significantly impair quality of life in an economic and ecological sense, just as sustainable mobility can improve it. The importance of mobility in general has been especially emphasized by the COVID-19 pandemic. It was precisely because of the pandemic that there was a reduction in the use of certain forms of transportation, as well as a change in the habits of citizens [3]. The focus on the safety and health of citizens has triggered a new way of thinking with regard to mobility and the acceptance of new forms of sustainable mobility, which contributed to increasing the quality of the environment in which people live. This has been confirmed through the creation of Sustainable Urban Mobility Plans, which have been adopted by an increasing number of cities and which are becoming a priority for urban areas [4]; this is because the aforementioned plans ensure ecological and social sustainability.

Although sustainable forms of transportation are becoming increasingly prevalent, on the territory of the Republic of Croatia, most of the population still relies on cars for their daily trips [4]. Most of the previous research on sustainable urban mobility in the Republic of Croatia is based on the examination of residents' perceptions of urban systems [5–8]; no study has provided a comparison of cities in the territory of the Republic of Croatia with regard to the analysis of the state of urban mobility. This is precisely where a gap was noticed, as was the need to define a set of indicators for comparing the state of urban mobility in the cities of the Republic of Croatia; this serves as a basis for the further development of sustainable urban mobility (i.e., which provides an overview of the current analysis of the state of urban mobility). Cities in the Republic of Croatia started the process of implementing sustainable urban mobility by adopting the Transport Development Strategy for the period from 2017 to 2030 [9], which is why this topic is extremely important for further development of urban mobility in the Republic of Croatia. Services such as public city transport are part of a city's services, which is why the issue of urban mobility is in the interest of all decision-makers in the city, as well as citizens who are users of such services. In addition to the Transport Development Strategy, the aforementioned Sustainable Urban Mobility Plans and other documents which outline the aim to achieve sustainable mobility have a significant impact on the way urban mobility functions in order to achieve better quality of life in the area [10]. These plans also aim to ensure the greater safety of citizens, which is a priority of every city administration.

Given that sustainable urban mobility is an indispensable part of smart cities [2], indicators for evaluating the state of urban mobility can be found in the ISO standards for sustainable and smart cities. The International Organization for Standardization has issued a family of standards (ISO 37100—Sustainable cities and communities) [11]. This family of standards helps cities achieve goals concerning sustainable development, as well as define specific guidelines on how to achieve them. The most significant standard from this family of standards is ISO 37120 [12]. The ISO 37120:2018 [12] standard offers a set of indicators for measuring the quality of city services, as well as quality of life [13], which it defines through 19 areas, one of which is transport. In addition to the aforementioned standard, ISO 37122:2019 [14] is also often used, which offers a set of indicators for smart cities categorized into 19 areas. The use of the proposed indicators helps cities achieve greater safety and resilience [15], and ultimately greater overall sustainability of the urban system. Moreover, the mentioned indicators are a good starting point for the management of cities [16] as well as individual areas within the cities themselves. Taking all of the above into consideration, assessing the state of urban mobility in the cities of the Republic of Croatia based on the indicators proposed by ISO standards was the goal of this paper.

Based on all of the above, the goal of this study was to prove the possibility of using indicators proposed by the International Organization for Standardization using ISO 37120:2018 [12] and ISO 37122:2019 [14] standards to evaluate the state of urban mobility and to analyze the state of urban mobility in cities in the Republic of Croatia. To assess the state of urban mobility in the Republic of Croatia, indicators related to the field of transport were used, which include key elements of urban mobility with an emphasis on smart technologies. For this reason, the term smart urban mobility was used in this research. After conducting research on the current level of smart urban mobility in the Republic of Croatia, a statistical analysis was carried out, identifying the differences between small, medium, and large cities in the Republic of Croatia. The comparison was conducted using a Paired Difference t-test. In addition, one of the goals was to determine whether there is a correlation between individual indicators or, more precisely, whether a change in one indicator causes a change in one of the other indicators. Based on all of the above, the basic research questions which this research aimed to answer are as follows:

- What level of smart urban mobility are the cities of the Republic of Croatia at?
- Is there a correlation between the transport indicators presented in ISO 37120:2018 [12] and ISO 37122:2019 [14]?

This paper consists of five fundamental parts. In the first part, there is an introduction to the problem, and an attempt is made to explain the need for conducting this research. The second part of the paper describes the materials and methods used to conduct research and obtain results. The third part of the paper includes a discussion of the obtained research results, while the last part of the paper includes the derived research conclusions, as well as research limitations and recommendations for future investigations.

2. Materials and Methods

2.1. Research Methodology

The research begins by defining a sample of cities that were used to collect the data needed to analyze the current state of smart urban mobility. Then, based on the collected data, the level of measurement and use of each proposed indicator for urban mobility planning was assessed. Based on the obtained individual estimated levels, the total level of smart urban mobility for small, medium, and large cities was calculated. After the estimated total levels according to each category of cities, a comparative analysis of all indicators was performed using a Paired Difference *t*-test, and a correlation analysis was performed between individual indicators. The research methodology is shown in the Figure 1 below.

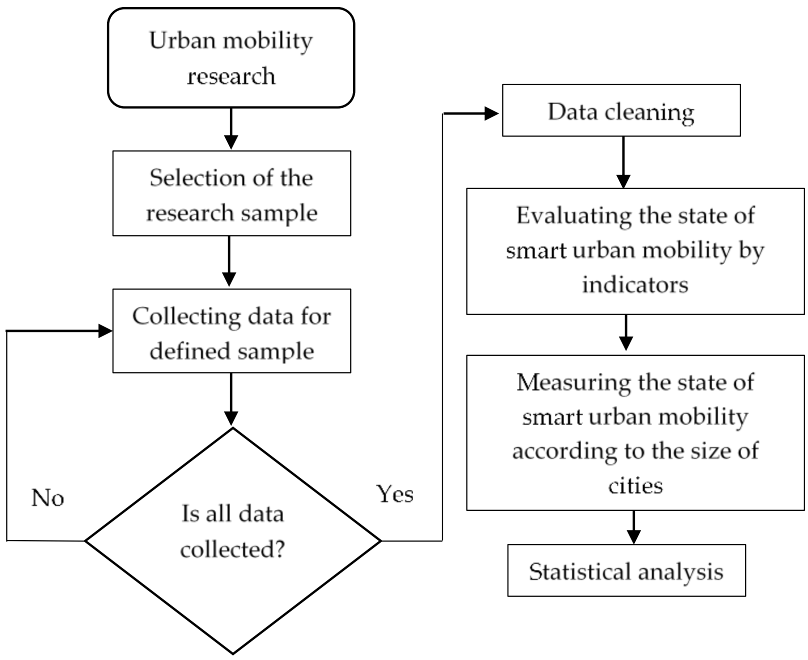

Figure 1. Research methodology flow chart.

Data were collected by responsible persons in cities conducting in-depth interviews according to defined indicators. The responsible persons were sent a questionnaire to their email addresses. In the questions, the indicators were defined, and based on them the responsible persons sent the requested data. All collected responses were then refined so that all incomplete responses were eliminated from the survey. Only complete responses were included in the survey.

The defined research sample is presented in Section 2.2. The method of data collection, as well as indicators for measuring the state of smart urban mobility, are presented in Section 2.3. The method of evaluating the state of smart urban mobility, as well as the method of statistical analysis, are presented in Section 2.4.

2.2. Study Area

Research into the state of smart urban mobility is conducted on a sample of cities in the Republic of Croatia. According to the Law on Local and Regional Self-Government of the Republic of Croatia, cities must have a minimum of 10,000 inhabitants, while in exceptional cases, where there is a special reason for this, cities can include fewer inhabitants. Also, cities with more than 35,000 inhabitants are considered large cities [17]. Currently, on the territory of the Republic of Croatia, there are 69 cities with less than 10,000 inhabitants, 43 cities with between 10,000 and 35,000 inhabitants, and 16 cities with more than 35,000 inhabitants. Based on the above, the cities of the Republic of Croatia can be categorized into small, medium, and large cities. Given that the Republic of Croatia is divided into counties in which there are different numbers of cities, a deliberate sample of cities is selected that includes the cities of the county headquarters and additional cities from those counties that contain the largest number of cities to obtain an even distribution of cities on the entire territory of the Republic of Croatia. The total sample of cities for the conducted research is 26, which makes up 20.31% of the total number of cities in the Republic of Croatia.

Table 1 shows the total sample of cities with the number of inhabitants of each individual city. The table contains the categorization of cities into small, medium, and large cities, as well as the index used in further analysis and statistical processing. It is possible to conclude from the table that there are cities of different sizes on the territory of the Republic of Croatia. According to the above table, the selected sample of cities includes 1,704,082 inhabitants, or 44% of the total population of the Republic of Croatia.

Table 1. A sample of selected cities for analysis.

City Size	City	Index	Population
Small cities	Pazin	C1	8306
	Zabok	C2	8678
	Glina	C3	7207
	Krk	C4	6846
	Belišće	C5	8884
	Hvar	C6	3998
	Novigrad	C7	3883
Middle-sized cities	Krapina	C8	11,553
	Koprivnica	C9	28,666
	Gospić	C10	11,464
	Virovitica	C11	19,366
	Požega	C12	22,364
	Vukovar	C13	23,536
	Čakovec	C14	27,266
Large cities	Zagreb	C15	769,944
	Sisak	C16	40,185
	Karlovac	C17	49,594
	Varaždin	C18	43,999
	Bjelovar	C19	36,433
	Rijeka	C20	108,622
	Slavonski Brod	C21	50,039
	Zadar	C22	70,829
	Osijek	C23	96,848
	Šibenik	C24	42,589
	Split	C25	161,312
	Dubrovnik	C26	41,671

2.3. Data Collection

For conducting the research, all the data needed to assess the state of smart urban mobility in the Republic of Croatia were collected. The assessment of smart urban mobility was based on the transport indicators presented through the standards ISO 37120:2018 [12] and ISO 37122:2019 [14]. The ISO 37120:2018 [12] standard defines a total of 7 different indicators, while the ISO 37122:2019 [14] standard defines a total of 13 different indicators. According to the above, a total of 21 indicators were used in the conducted research. All data were collected from relevant documents and sources presented by the cities and evaluated for each city individually on a scale from 1 to 5. The indicators used in the research, presented through ISO 37120:2018 [12] standards, are shown in Table 2. Considering that a statistical analysis was also carried out in the research, the corresponding index used in the further statistical analysis was added to each indicator.

Table 2. ISO 37120:2018 Transport indicators [12].

Indicators	Measure	Index
Kilometers of public transport system per 100,000 people	$x = \frac{\text{Total lenght (in kilometres) of the public transport system operating within the city}}{100{,}000}$	IN1
Annual number of public transport trips per capita	$x = \frac{\text{Total annual number of public transport trips originating in the city}}{\text{Total city population}}$	IN2
Percentage of commuters using a travel mode to work other than a personal vehicle	$x = \frac{\text{Number of commuters working in the city who use a mode of transportation other than a private Single Occupancy Vehicle (SOV) as their primary way to travel to work}}{\text{All trips to work, regardless of mode}} \times 100$	IN3
Kilometers of bicycle paths and lanes per 100,000 people	$x = \frac{\text{Total lenght (in kilometres) of bicycle paths and lanes}}{100{,}000}$	IN4
Transportation deaths per 100,000 people	$x = \frac{\text{The number of deaths related to transportation of any kind within the city's administrative boundary}}{100{,}000}$	IN5
Percentage of population living within 0.5 km of public transit running at least every 20 min during peak periods	$x = \frac{\text{Total number of inhabitants living within 0.5 km of public transit running at least every 20 min during peak periods}}{\text{Total city population}} \times 100$	IN6
Average commute travel	The average time in hours and minutes that it takes a working person to travel from home to place of employment. Average commute time is defined as a one-way commute (not round trip) and includes only travel from home to place of employment	IN7

To understand the individual indicators, it is also necessary to understand the basic terms used to calculate the individual indicator, which are also explained through standards ISO 37120:2018 [12] and ISO 37122:2019 [14]. The key terms and explanations needed to calculate the indicators presented through the ISO 37120:2018 [12] standard are presented in Table 3.

Table 3. Basic terms vital for understanding ISO 37120:2018 indicators [12].

Term	Explanation
Transport system types	System types are high-capacity systems (heavy rail metro, subway, commuter rail, other) and low-capacity systems (light rail, streetcar/tramway, bus and trolleybus, BRT and others).
Public transport trips	Public transport trips include trips via heavy rail metro or subway, commuter rail, light rail, streetcars and tramways, bus, trolleybus, and other public transport services.
Non-SOV modes	Modes other that non-SOV include carpools, bus, minibus, train, tram, light rail, ferry, non-motorized two-wheel vehicles such as bicycle and walking.
Bicycle lanes	Bicycle lanes refer to part of a carriageway designated for cycles and distinguished from the rest of the road by longitudinal road markings.
Bicycle paths	Bicycle paths refer to independent roads or parts of a road designated for cycles.
Peak periods	Peak periods are the two periods in the day when traffic volume is the highest. These two periods occur in the morning and once in the evening.

In addition to the indicators presented through the ISO 37120:2018 [12] standard, the indicators presented through ISO 37122:2019 [14] were also used. The selected indicators, as well as the method of their measurement and the corresponding index, are shown in Table 4.

Table 4. ISO 37122:2019 transport indicators [14].

Indicators	Measure	Index
Percentage of city streets and thoroughfares covered by real-time online traffic alerts and information	$x = \frac{\text{The number of street and thoroughfare kilometres within the city covered by real-time online traffic alerts and information}}{\text{Total number of street and thoroughfare kilometres within city limits}} \times 100$	IN8
Number of users of sharing economy transportation per 100,000 people	$x = \frac{\text{The total number of users actively using sharing economy transportation}}{100{,}000}$	IN9
Percentage of vehicles registered in the city that are low-emission vehicles	$x = \frac{\text{The total number of registered and approved low-emission vehicles registered in the city}}{\text{Total number of registered vehicles in the city}} \times 100$	IN10
Number of bicycles available through municipally provided bicycle-sharing services per 100,000 people	$x = \frac{\text{Total number of bicycles available through municipally provided bicycle-sharing services in the city}}{100{,}000}$	IN11
Percentage of public transport lines equipped with a publicly accessible real-time system	$x = \frac{\text{The number of public transport lines that are equipped with a publicly accessible real-time system to provide people with real-time operation information}}{\text{Total number of public transport lines within the city limits}} \times 100$	IN12
Percentage of the city's public transport services covered by a unified payment system	$x = \frac{\text{The number of city public transport services connected by a unified payment system}}{\text{The city's total number of public transport services}} \times 100$	IN13
Percentage of public parking spaces equipped with e-payment systems	$x = \frac{\text{The number of public parking spaces equipped with an e-payment system as payment method}}{\text{The total number of public parking spaces in the city}} \times 100$	IN14
Percentage of public parking spaces equipped with real-time availability systems	$x = \frac{\text{The number of public parking spaces that are equipped with real-time availability systems}}{\text{The total number of public parking spaces in the city}} \times 100$	IN15
Percentage of traffic lights that are intelligent/smart	$x = \frac{\text{The number of traffic lights in the city that are intelligent/smart}}{\text{The total number of traffic lights in the city}} \times 100$	IN16
City area mapped by real-time interactive street maps as a percentage of the city's total land area	$x = \frac{\text{The total city area mapped by real-time interactive street maps}}{\text{The city's total land area}} \times 100$	IN17
Percentage of vehicles registered in the city that are autonomous vehicles	$x = \frac{\text{The total number of autonomous vehicles registered in the city}}{\text{The total number of registered vehicles in the city}} \times 100$	IN18
Percentage of public transport routes with municipally provided and/or managed Internet connectivity for commuters	$x = \frac{\text{The number of kilometres of public transport routes in the city with municipally provided and managed Internet connectivity for commuters}}{\text{The total number of kilometres of public transport routes in the city}} \times 100$	IN19
Percentage of roads conforming with autonomous driving systems	$x = \frac{\text{The number of kilometres of road conforming with autonomous driving systems}}{\text{The total number of kilometres of road}} \times 100$	IN20
Percentage of the city's bus fleet that is motor-driven	$x = \frac{\text{The number of buses in the city's bus fleet that are motor-driven}}{\text{The total number of buses in the city's bus fleet}} \times 100$	IN21

In order to understand the indicators presented through the ISO 37122:2019 [14] standard, important basic terms are shown in Table 5 below.

Table 5. Basic terms vital for understanding ISO 37122:2019 indicators [14].

Term	Explanation
Streets and thoroughfares	Streets and thoroughfares refer to all local roads, streets and major and minor arterial roads of the city.
The sharing economy	The sharing economy refers to any form of economic activity where platforms enable providers and customers to exchange often underutilized goods and services using information technology.
Low-emission vehicles	Low-emission vehicles are vehicles that emit low levels of emissions and can include electric, hybrid and hydrogen-fuel-cell-driven vehicles.
Bicycle sharing systems	Bicycle sharing systems refer to bicycle sharing system with bicycles available through self-serve docking stations, or person-operated docking stations, located throughout the city, where bicycles can be rented as needed.
A public transport line	A public transport line refers to a portion of the public transport network where a public transport vehicle departs and arrives from two points of the public transport network in a single, continuous trip and follows a timetable with driving and stopping times.
Public transport services	Public transport services refer to travel services provided locally by the city that allow for several people to travel together along set routes.
Unified payment system	Unified payment system refers to an integrated mobility payment system that allows for transit users to plan, book and pay multiple modes of transit in order to transport them from point A to point B.
An e-payment system	An e-payment system refers to the way of making transactions or paying for goods and services through an electronic medium.
Real-time availability system	Real-time availability system for public parking spaces includes any form of technology that provides instantaneous information.
Intelligent/smart traffic lights	Intelligent/smart traffic lights refers to a traffic light system that utilizes a combination of lights, sensors and other information and communication technologies, along with algorithms, to control both vehicle and pedestrian traffic lights.
Interactive street maps	Interactive street maps refer to street maps generated by a geographic information system (GIS) and that contain location labels that respond digitally and immediately to a mouse, web-cursor or touchpad.
Autonomous vehicles	Autonomous vehicles refer to vehicles that are self-driving.
Municipally provided and/or managed Internet connectivity	Municipally provided and/or managed Internet connectivity refers to Internet connectivity services provided and/or managed by the city or third-party providers under license by the city to the public.
Motor-driven	Motor-driven refers to buses propelled by motorized systems and that use motors driven by electricity, air, hydraulic pressure, heat, photons, electrons or ultrasound.

2.4. Data Treatment and Statistical Analysis

All collected data are used to calculate the state of an individual indicator. For each of the cities previously defined by the sample, an assessment of the state of smart urban mobility is conducted based on a Likert scale from 1 to 5. A rating of 1 is assigned to those indicators that cities do not measure and do not use in planning their urban mobility, while a rating of 5 is assigned to those indicators which cities continuously measure and use for planning smart and sustainable urban mobility and also for decision-making. Based on the assigned scores, the overall level or overall state of smart urban mobility for each city is calculated. Also, in addition to the calculation of total smart mobility according to individual cities, the state of smart urban mobility is calculated according to categories of cities—small, medium, and large cities. The method of using the radar chart is used to calculate overall smart urban mobility. The method of using radar charts is recognized as a relevant method when conducting scientific research and recommended by numerous researchers [18–22]. The calculation of the area of the radar chart (SMOP or Surface Measure of Overall Performance) offers a mathematical expression of the achieved overall level of the measured dimensions [23].

Given that a total of 21 indicators are used in the research, the formula used to calculate the area of the radar chart is

$$SMOP = ((I1 \times I2) + (I2 \times I3) + (I3 \times I4) \ldots (I21 \times I1)) \times \frac{\sin\left(\frac{360}{21}\right)}{2} \quad (1)$$

where I1, I2 ... I21 are the estimated values of individual indicators.

The obtained SMOP values must then be compared with the maximum SMOP value. The maximum SMOP value is obtained using the same formula, where instead of values I1, I2 ... I21, the value of 5 is included as the highest possible realized value of an individual indicator. The total possible realized area or maximum SMOP value then amounts to 78,247. Therefore, the following formula is used to assess the overall state of smart urban mobility:

$$SUM_{level} = \frac{SMOP}{SMOP_{max}} \quad (2)$$

where SUM_{level} is the level or state of smart urban mobility, SMOP is the obtained area of the radar chart, and $SMOP_{max}$ is the maximum area of the radar chart.

Based on the obtained numerical values, it is possible to estimate the overall level of the state of smart urban mobility based on the table below.

In the same way, it is possible to evaluate the state of smart urban mobility according to the defined categories of cities—small, medium, and large. Then, the formula for calculating the overall state of smart urban mobility for small cities is as follows:

$$SMOP = ((C1 \times C2) + (C2 \times C3) + (C3 \times C4) \ldots (C7 \times C1)) \times \frac{\sin\left(\frac{360}{7}\right)}{2} \quad (3)$$

For medium-sized cities, the formula reads

$$SMOP = ((C8 \times C9) + (C9 \times C10) + (C10 \times C11) \ldots (C14 \times C8)) \times \frac{\sin\left(\frac{360}{7}\right)}{2} \quad (4)$$

The following formula is used to calculate the overall state of smart urban mobility for large cities:

$$SMOP = ((C15 \times C16) + (C16 \times C17) + (C17 \times C18) \ldots (C26 \times C15)) \times \frac{\sin\left(\frac{360}{12}\right)}{2} \quad (5)$$

where the values of C1, C2 ... C26 indicate the total achieved levels of smart urban mobility of individual cities.

The obtained SMOP values also need to be divided by the maximum possible SMOP values for the defined number of cities according to each category, and the obtained results should be interpreted according to the values shown in Table 6.

Table 6. Levels of smart urban mobility.

Level	Value
1	0–0.20
2	0.21–0.40
3	0.41–0.60
4	0.61–0.80
5	0.81–1

In the second part of data analysis, a statistical analysis is conducted. The first part of the statistical analysis includes the comparison of individual indicators using a Paired Difference *t*-test. Three comparisons (marked with letters a, b, c) are performed according to the model shown in the following figure.

According to the presented statistical model, the first comparative analysis includes the analysis of indicators of small and medium-sized cities, the second analysis includes medium-sized and large cities, and the third analysis includes large and small cities. Given that each of the small, medium, and large cities includes the same indicators, each indicator is assigned an index as indicated in the model (Figure 2). In the first analysis, a comparison is conducted of indicators (INS1–INS21) of small cities (C1 to C7) and indicators (INM1–INM21) of medium-sized cities (C8–C14)—marked (a) in Figure 2; in the second analysis, indicators (INM1–INM21) of medium-sized cities (C8–C14) and indicators (INL1–INL21) of large cities (C14–C26) are used—marked (b) in Figure 2; while in the third analysis, indicators(INL1–INL21) of large cities (C15–C26) and indicators (INS1–INS21) of small cities (C1–C7) are used—marked (c) in Figure 2.

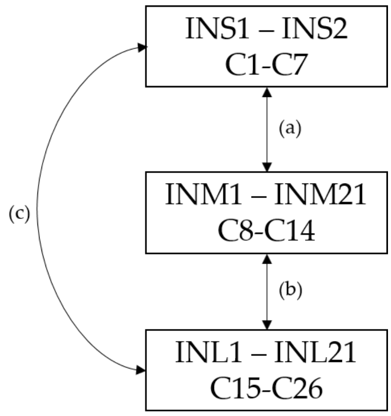

Figure 2. Statistical model of comparison of indicators by city category.

In the second part of the statistical analysis, a correlation is introduced between the indicators at the level of small, medium, and large cities. The resulting analysis determines whether a change in one variable affects one of the remaining variables, and thus the overall result obtained.

3. Results

According to the calculations, the total SMOP values obtained by dividing the achieved and maximum SMOP values are shown in the table. Each value is assigned a SUM level according to Table 6. The overall result is shown in Table 7.

Table 7. Total SUM levels by cities.

City	SMOP	SUM
C1	0.21	2
C2	0.17	1
C3	0.25	2
C4	0.20	1
C5	0.52	3
C6	0.25	2
C7	0.21	2
C8	0.17	1
C9	0.25	2
C10	0.22	2

Table 7. *Cont.*

City	SMOP	SUM
C11	0.19	1
C12	0.18	1
C13	0.20	1
C14	0.22	2
C15	0.29	2
C16	0.35	2
C17	0.18	1
C18	0.51	3
C19	0.45	3
C20	0.35	2
C21	0.28	2
C22	0.19	1
C23	0.27	2
C24	0.42	3
C25	0.41	3
C26	0.68	4

By calculating the total level of smart urban mobility according to the categories of small, medium, and large cities, the following results are obtained (Table 8).

Table 8. Total level of smart urban mobility by categories.

Category	Cities	SMOP	SUM
Small cities	C1–C7	0.13	1
Middle-sized cities	C8–C14	0.08	1
Large cities	C15–C26	0.22	2

The obtained levels are also shown on the radar chart in Figure 3.

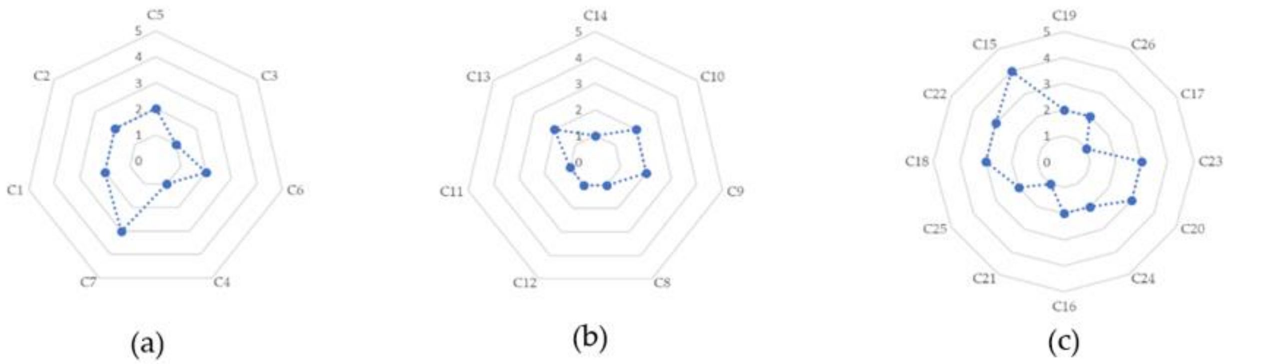

Figure 3. Radar charts of obtained smart urban mobility: (**a**) total level of obtained smart urban mobility of small cities in the Republic of Croatia; (**b**) total level of obtained smart urban mobility of middle-sized cities in the Republic of Croatia; (**c**) total level of obtained smart urban mobility of large cities in the Republic of Croatia.

The obtained results indicate the poor state of smart urban mobility in the Republic of Croatia, because the SUM value for small and medium-sized cities is at Level 1, while for large cities it is at Level 2. Based on the obtained results of individual cities, a comparison of small and medium-sized cities, medium-sized and large cities, and large and small cities is performed. The comparison aims to determine whether there are differences in the individual achieved values of the indicators between different categories of cities. The results of the comparison of small and medium-sized cities are shown in Table 9.

Table 9. Comparation between small and medium-sized cities.

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-Tailed)
Pair 1 INS1–INM1	1.429	2.440	0.922	−0.828	3.685	1.549	6	0.172
Pair 2 INS2–INM2	0.429	2.440	0.922	−1.828	2.685	0.465	6	0.658
Pair 3 INS3–INM3	0.714	1.254	0.474	−0.445	1.874	1.508	6	0.182
Pair 4 INS4–INM4	−0.571	1.902	0.719	−2.331	1.188	−0.795	6	0.457
Pair 5 INS5–INM5	−2.429	2.507	0.948	−4.747	−0.110	−2.563	6	0.043
Pair 6 INS6–INM6	−0.143	1.215	0.459	−1.267	0.981	−0.311	6	0.766
Pair 7 INS7–INM7	0.000	1.155	0.436	−1.068	1.068	0.000	6	1.000
Pair 8 INS8–INM8	−0.541	1.802	0.769	−2.421	1.248	−0.805	6	0.497
Pair 9 INS9–INM9	0.714	0.951	0.360	−0.165	1.594	1.987	6	0.044
Pair 10 INS10–INM10	−1.143	1.773	0.670	−2.782	0.497	−1.706	6	0.139
Pair 11 INS11–INM11	0.429	1.618	0.612	−1.068	1.925	0.701	6	0.510
Pair 12 INS12–INM12	0.571	2.225	0.841	−1.487	2.630	0.679	6	0.522
Pair 13 INS13–INM13	1.571	1.272	0.481	0.395	2.748	3.267	6	0.017
Pair 14 INS14–INM14	1.000	2.160	0.816	−0.998	2.998	1.225	6	0.267
Pair 15 INS15–INM15	0.286	1.890	0.714	−1.462	2.034	0.400	6	0.703
Pair 16 INS16–INM16	0.286	0.756	0.286	−0.413	0.985	1.000	6	0.356
Pair 17 INS17–INM17	0.286	0.756	0.286	−0.413	0.985	1.000	6	0.356
Pair 18 INS18–INM18	−0.143	2.545	0.962	−2.496	2.211	−0.149	6	0.887
Pair 19 INS19–INM19	1.857	1.676	0.634	0.307	3.407	2.931	6	0.026
Pair 20 INS20–INM20	0.286	1.799	0.680	−1.379	1.950	0.420	6	0.689
Pair 21 INS21–INM21	−2.286	1.890	0.714	−4.034	−0.538	−3.200	6	0.019

According to the analysis of small and medium-sized cities, it is determined that there is a difference in indicators INS5 and INM5 ($p = 0.043 < 0.05$), then in indicators INS9 and INM9 ($p = 0.044 < 0.05$), indicators INS13 and INM13 ($p = 0.017 < 0.05$), INS19 and INM19 ($p = 0.026 < 0.05$) and indicators INS21 and INM21 ($p = 0.019 < 0.05$). In the remaining pairs of indicators, $p > 0.05$ means that the results are not significant, that is, that there are no differences in the indicators.

The results of the comparison of medium-sized and large cities are shown in Table 10.

According to the conducted comparison of medium-sized and large cities, it is evident that there are almost no differences between the indicators, because in all indicators $p > 0.05$, except for indicators INM21 and INL21 ($p = 0.005 < 0.05$). In the last analysis, a comparison of large and small cities is conducted, which is shown in Table 11.

Table 10. Comparison between medium-sized and large cities.

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-Tailed)
Pair 1 INM1–INL1	0.429	1.272	0.481	−0.748	1.605	0.891	6	0.407
Pair 2 INM2–INL2	−0.714	2.628	0.993	−3.144	1.716	−0.719	6	0.499
Pair 3 INM3–INL3	−1.000	1.732	0.655	−2.602	0.602	−1.528	6	0.177
Pair 4 INM4–INL4	0.143	2.478	0.937	−2.149	2.435	0.152	6	0.884
Pair 5 INM5–INL5	−1.571	1.718	0.649	−3.161	0.018	−2.420	6	0.052
Pair 6 INM6–INL6	−0.571	1.512	0.571	−1.970	0.827	−1.000	6	0.356
Pair 7 INM7–INL7	−1.000	2.160	0.816	−2.998	0.998	−1.225	6	0.267
Pair 8 INM8–INL8	−0.571	0.787	0.297	−1.299	0.156	−1.922	6	0.103
Pair 9 INM9–INL9	0.143	1.676	0.634	−1.407	1.693	0.225	6	0.829
Pair 10 INM10–INL10	0.000	2.517	0.951	−2.327	2.327	0.000	6	1.000
Pair 11 INM11–INL11	−1.000	1.915	0.724	−2.771	0.771	−1.382	6	0.216
Pair 12 INM12–INL12	−0.714	2.928	1.107	−3.422	1.993	−0.645	6	0.542
Pair 13 INM13–INL13	−0.286	2.690	1.017	−2.774	2.202	−0.281	6	0.788
Pair 14 INM14–INL14	−0.286	1.799	0.680	−1.950	1.379	−0.420	6	0.689
Pair 15 INM15–INL15	−0.571	1.813	0.685	−2.248	1.105	−0.834	6	0.436
Pair 16 INM16–INL16	−0.571	1.618	0.612	−2.068	0.925	−0.934	6	0.386
Pair 17 INM17–INL17	0.000	1.000	0.378	−0.925	0.925	0.000	6	1.000
Pair 18 INM18–INL18	0.143	1.676	0.634	−1.407	1.693	0.225	6	0.829
Pair 19 INM19–INL19	0.571	2.370	0.896	−1.621	2.764	0.638	6	0.547
Pair 20 INM20–INL20	−0.714	1.799	0.680	−2.379	0.950	−1.050	6	0.334
Pair 21 INM21–INL21	−2.286	1.380	0.522	−3.562	−1.009	−4.382	6	0.005

Table 11. Comparison between small and large cities.

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-Tailed)
Pair 1 INS1–INL1	−1.000	2.309	0.873	−3.136	1.136	−1.146	6	0.296
Pair 2 INS2–INL2	−1.143	2.268	0.857	−3.240	0.954	−1.333	6	0.231
Pair 3 INS3–INL3	−1.714	1.799	0.680	−3.379	−0.050	−2.521	6	0.045
Pair 4 INS4–INL4	0.714	2.928	1.107	−1.993	3.422	0.645	6	0.542
Pair 5 INS5–INL5	0.857	2.478	0.937	−1.435	3.149	0.915	6	0.395

Table 11. *Cont.*

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-Tailed)
Pair 6 INS6–INL6	−0.429	1.272	0.481	−1.605	0.748	−0.891	6	0.407
Pair 7 INS7–INL7	−1.000	1.732	0.655	−2.602	0.602	−1.528	6	0.177
Pair 8 INS8–INL8	−0.571	0.787	0.297	−1.299	0.156	−1.922	6	0.103
Pair 9 INS9–INL9	−0.571	1.397	0.528	−1.864	0.721	−1.082	6	0.321
Pair 10 INS10–INL10	1.143	2.035	0.769	−0.740	3.025	1.486	6	0.188
Pair 11 INS11–INL11	−1.429	2.370	0.896	−3.621	0.764	−1.594	6	0.162
Pair 12 INS12–INL12	−1.286	2.498	0.944	−3.596	1.024	−1.362	6	0.222
Pair 13 INS13–INL13	−1.857	1.952	0.738	−3.662	−0.052	−2.517	6	0.045
Pair 14 INS14–INL14	−1.286	1.604	0.606	−2.769	0.197	−2.121	6	0.046
Pair 15 INS15–INL15	−0.857	1.773	0.670	−2.497	0.782	−1.279	6	0.248
Pair 16 INS16–INL16	−0.857	2.035	0.769	−2.740	1.025	−1.114	6	0.308
Pair 17 INS17–INL17	−0.286	0.488	0.184	−0.737	0.166	−1.549	6	0.172
Pair 18 INS18–INL18	0.286	1.799	0.680	−1.379	1.950	0.420	6	0.689
Pair 19 INS19–INL19	−1.286	1.380	0.522	−2.562	−0.009	−2.465	6	0.049
Pair 20 INS20–INL20	−1.000	1.826	0.690	−2.689	0.689	−1.449	6	0.197
Pair 21 INS21–INL21	0.000	2.309	0.873	−2.136	2.136	0.000	6	1.000

According to the performed analysis, differences are found between indicators INS3 and INL3 ($p = 0.045 < 0.05$), indicators INS13 and INL13 ($p = 0.045 < 0.05$), indicators INS14 and INL14 ($p = 0.046 < 0.05$) and indicators INS19 and INL19 ($p = 0.049 < 0.05$). Other indicators do not show differences or significance.

According to the conducted research, ten pairs of indicators that show differences are determined. To determine whether the identified differences are small, medium, or large, Cohen's D is used, as shown in Table 12.

Table 12. Cohen's D test for defined pairs of indicators.

Indicator Pairs	Mean	Std. Deviation	Cohen's D
INS5–INM5	−2.429	2.507	−0.968887
INS9–INM9	0.714	0.951	0.750789
INS13–INM13	1.571	1.272	1.235063
INS19–INM19	1.857	1.676	1.107995
INS21–INM21	−2.286	1.89	−1.209524
INM21–INL21	−2.286	1.38	−1.656522
INS3–INL3	−1.714	1.799	−0.952752
INS13–INL13	−1.857	1.952	−0.951332
INS14–INL14	−1.286	1.604	−0.801746
INS19–INL19	−1.286	1.38	−0.931884

According to the previously conducted analysis, it is possible to conclude that almost all differences are extremely large ($d > 0.80$), except for the pair of indicators INS9–INM9 in which the differences are medium (d = 0.75). The biggest differences are between INS13 and INM13 (d = 1.23), INS19 and INM19 (d = 1.10), INS21 and INM21 (d = −1.21) and INM21 and INL21 (d = −1.65).

In addition to the comparative analysis, a correlation is also conducted that answers the question of whether a change in one indicator affects a change in one of the remaining indicators. The results of the conducted correlation for small cities are shown in the following table. Table 13 includes those indicators for which a correlation is established.

Table 13. Correlation between urban mobility indicators in small cities. (Note: (*) = high correlation; (**) = very high correlation).

		Correlation							
		INS2	**INS3**	**INS4**	**INS5**	**INS6**	**INS9**	**INS12**	**INS13**
INS3	Correlation Coefficient	0.780 *	1.000						
	Sig. (2-tailed)	0.039							
INS7	Correlation Coefficient	0.829 *	0.857 *	−0.158	−0.692	0.683			
	Sig. (2-tailed)	0.021	0.014	0.735	0.085	0.091			
INS13	Correlation Coefficient	0.311	0.203	0.534	−0.759 *	0.525	0.734	0.584	1.000
	Sig. (2-tailed)	0.497	0.663	0.217	0.048	0.227	0.061	0.169	
INS14	Correlation Coefficient	0.356	0.299	0.495	−0.723	0.535	0.808 *	0.470	0.904 **
	Sig. (2-tailed)	0.433	0.514	0.259	0.067	0.216	0.028	0.288	0.005
INS15	Correlation Coefficient	0.385	0.392	0.099	−0.145	0.642	0.525	0.877 **	0.365
	Sig. (2-tailed)	0.394	0.384	0.833	0.757	0.120	0.226	0.010	0.420
INS16	Correlation Coefficient	−0.813 *	−0.523	0.000	0.698	−0.258	−0.342	0.000	−0.325
	Sig. (2-tailed)	0.026	0.228	1.000	0.081	0.576	0.453	1.000	0.477
INS18	Correlation Coefficient	−0.085	−0.557	0.971 **	−0.061	0.525	0.496	0.215	0.575
	Sig. (2-tailed)	0.856	0.194	0.000	0.897	0.227	0.258	0.643	0.176
INS19	Correlation Coefficient	−0.085	−0.557	0.971 **	−0.061	0.525	0.496	0.215	0.575
	Sig. (2-tailed)	0.856	0.194	0.000	0.897	0.227	0.258	0.643	0.176

According to the analysis, correlation is established between indicators INS3 and INS2 (p = 0.039 < 0.05), where the correlation coefficient is 0.780, which indicates a high level of correlation. There is also correlation between indicators INS7 and INS2 (p = 0.021 < 0.05) with a correlation coefficient of 0.829 and correlation between INS7 and INS3 (p = 0.014 < 0.05) with a correlation coefficient of 0.857. There is a connection between indicators INS13 and INS5 (p = 0.048 < 0.05) with a correlation coefficient of 0.759, then indicators INS14 and INS9 (p = 0.028 < 0.05) with a correlation coefficient of 0.808, as well as indicators INS14 and INS13 (p = 0.05) with a correlation coefficient of 0.904, which shows an extremely high level of correlation. A high level of correlation is also shown by indicators INS15 and INS13 (p = 0.010 < 0.05) with a correlation coefficient of 0.877. The INS16 indicator shows a correlation with the INS2 indicator (p = 0.026 < 0.05) with a coefficient of 0.813. The INS18 indicator shows a very significant and high correlation with the INS4 indicator (p = 0.000 < 0.01(5)) with a coefficient of 0.971. The same result is shown by the correlation of indicators INS19 and INS4 (p = 0.000 < 0.01(5)) with a coefficient of 0.971.

Significantly different results of the connection of individual indicators are shown by the results of the correlation conducted on medium-sized cities, which is shown in Table 14.

According to the conducted research, a correlation is established between indicators INM6 and INM3 (p = 0.031 < 0.05) with a coefficient of 0.801 and indicators INM6 and INM7, but considering that between the mentioned indicators p = 0.08, the result is not significant. A very strong correlation is established between indicators INM12 and INM9 (p = 0.04 < 0.05) with a coefficient of 0.916. Also, a high correlation is found between indicators INM13 and INM9 (p = 0.01 < 0.05), INM13 and INM10 (p = 0.029 < 0.05) and

INM13 and INM12 ($p = 0.01 < 0.05$). Extremely high correlation is also shown by indicators INM15 and INM14 ($p = 0.000 < 0.01(5)$) with a correlation coefficient of 0.968, indicators INM21 and INM10 ($p = 0.02 < 0.05$) with a coefficient of 0.941 and indicators INM21 and INM13 ($p = 0.022 < 0.05$) with a coefficient of 0.826.

Table 14. Correlation between urban mobility indicators in middle-sized cities. (Note: (*) = high correlation; (**) = very high correlation).

		Correlation								
		INM3	**INM4**	**INM6**	**INM7**	**INM9**	**INM10**	**INM12**	**INM13**	**INM14**
INM6	Correlation Coefficient	0.801 *	−0.899 **	1	0.885 **					
	Sig. (2-tailed)	0.031	0.006		0.008					
INM12	Correlation Coefficient	−0.415	0.291	−0.448	−0.598	0.916 **	−0.713	1		
	Sig. (2-tailed)	0.355	0.527	0.313	0.156	0.004	0.072			
INM13	Correlation Coefficient	−0.335	0.188	−0.362	−0.483	0.955 **	−0.806 *	0.954 **	1	
	Sig. (2-tailed)	0.463	0.686	0.425	0.272	0.001	0.029	0.001		
INM15	Correlation Coefficient	−0.309	0.473	−0.405	−0.303	−0.505	0.675	−0.341	−0.571	0.968 **
	Sig. (2-tailed)	0.500	0.284	0.368	0.508	0.247	0.096	0.455	0.180	0.000
INM21	Correlation Coefficient	0.228	−0.256	0.285	0.175	−0.730	0.941 **	−0.724	−0.826 *	.506
	Sig. (2-tailed)	0.623	0.579	0.536	0.707	0.062	0.002	0.066	0.022	0.246

Lastly, correlation results for large cities are shown in Table 15.

Table 15. Correlation between urban mobility indicators in large cities. (Note: (*) = high correlation; (**) = very high correlation).

		Correlation					
		INL1	**INL2**	**INL3**	**INL10**	**INL11**	**INL13**
INL4	Correlation Coefficient	0.621 *	0.277	−0.423			
	Sig. (2-tailed)	0.031	0.383	0.170			
INL5	Correlation Coefficient	−0.640 *	0.095	−0.227			
	Sig. (2-tailed)	0.025	0.769	0.479			
INL9	Correlation Coefficient	0.302	0.590 *	0.386			
	Sig. (2-tailed)	0.339	0.043	0.215			
INL10	Correlation Coefficient	−0.054	−0.012	0.790 **	1		
	Sig. (2-tailed)	0.867	0.970	0.002			
INL11	Correlation Coefficient	0.122	0.909 **	0.087	−0.096	1	
	Sig. (2-tailed)	0.707	0.000	0.788	0.766		
INL14	Correlation Coefficient	0.435	0.423	0.184	0.021	0.307	0.662 *
	Sig. (2-tailed)	0.158	0.171	0.567	0.948	0.332	0.019
INL17	Correlation Coefficient	0.265	−0.034	0.495	0.617 *	0.000	−0.081
	Sig. (2-tailed)	0.406	0.917	0.102	0.033	1.000	0.803
INL18	Correlation Coefficient	0.076	0.491	0.388	0.424	0.657 *	0.324
	Sig. (2-tailed)	0.815	0.105	0.213	0.170	0.020	0.305
INL20	Correlation Coefficient	0.083	0.120	0.599 *	0.197	0.282	0.088
	Sig. (2-tailed)	0.799	0.711	0.040	0.540	0.374	0.786
INL21	Correlation Coefficient	0.130	0.159	0.517	0.603 *	−0.115	−0.138
	Sig. (2-tailed)	0.688	0.621	0.085	0.038	0.722	0.668

The obtained results show correlation between indicators INL4 and INL1 ($p = 0.031 < 0.05$) with a correlation coefficient of 0.621, then between indicators INL5 and INL1 ($p = 0.025 < 0.05$) with a coefficient of 0.640 and between indicators INL9 and INL2 ($p = 0.043 < 0.05$) with a coefficient of 0.590. The above results indicate medium-level correlation. Medium-level correlation is also shown by indicators INL14 and INL13 ($p = 0.019 < 0.05$) with a coefficient of 0.662, indicators INL17 and INL10 ($p = 0.033 < 0.05$) with a coefficient of 0.617, indicators INL18 and INL11 ($p = 0.020 < 0{,}05$) with a correlation coefficient of 0.657, indicators INL20 and INL3 ($p = 0.040 < 0.05$) with a coefficient of 0.599 and indicators INL21 and INL10 ($p = 0.038 < 0.05$) with a correlation coefficient of 0.603. A somewhat higher level of correlation is shown by indicators INL10 and INL3 ($p = 0.002 < 0.05$) with a coefficient of 0.790, while an extremely high level of correlation is shown by indicators INL11 and INL2 ($p = 0.000 < 0.01(5)$) with a correlation coefficient of 0.909.

4. Discussion

According to the obtained results, as well as the graphic representation of the total achieved levels of smart urban mobility according to the defined categories, it is evident that the state of smart urban mobility in the Republic of Croatia is at an extremely low level. The worst result of SMOP values is achieved by medium-sized cities, while very similar results are achieved by small cities. Large cities in the Republic of Croatia achieve SUM Level 2 and show a shift compared to small and medium-sized cities, but they also have a very low SMOP value that is on the border between Levels 1 and 2.

If the obtained results were compared according to the indicators for small and medium-sized cities, then it is possible to conclude that there are significant differences in the values of some indicators. The biggest differences are recognized in the indicators of transportation deaths per 100,000 population, number of users of sharing economy transportation per 100,000 population, percentage of the city's public transport services covered by a unified payment system, percentage of public transport routes with municipally provided and/or managed Internet connectivity for commuters and percentage of the city's bus fleet that is motor-driven. On the other hand, when comparing medium-sized and large cities, there are almost no differences in the indicator values. The only indicator that differs in the values is the percentage of the city's bus fleet that is motor-driven. This shows that, although large cities achieve a higher level of smart urban mobility, according to the individual values of the indicator, there are no significant deviations from medium-sized cities. By comparing small and large cities in the Republic of Croatia, it was determined that the most significant differences are in the indicator percentage of commuters using a travel mode to work other than a personal vehicle, percentage of the city's public transport services covered by a unified payment system, percentage of public parking spaces equipped with e-payment systems, and percentage of public transport routes with municipally provided and/or managed Internet connectivity for commuters. The biggest differences between small and large cities are in the indicators mainly related to public transport. Most small cities in the Republic of Croatia do not have a public transport system in place, which may be the cause of the results obtained. According to the performed Cohen D's test, it is evident that all established differences between small, medium, and large cities are extremely large, which means that there are significant differences in the state of smart urban mobility in small, medium, and large cities.

Looking at the correlation between individual indicators in small cities, it was determined that there is a significant relationship between many indicators. The strongest connection was established between the indicator percentage of the city's public transport services covered by a unified payment system and percentage of public parking spaces equipped with e-payment systems, kilometers of bicycle paths and lanes per 100,000 people and percentage of vehicles registered in the city that are autonomous vehicles, kilometers of bicycle paths and lanes per 100,000 people, and percentage of public transport routes with municipally provided and/or managed Internet connectivity for commuters. The connection between these indicators is reflected in the payment method for public transport services and the use of public transport, as well as other modes of transport. In medium-sized cities, the strongest correlation was found between the indicator number of users of sharing economy transportation per 100,000 people and percentage of public transport lines equipped with a publicly accessible real-time system, number of users of sharing economy transportation per 100,000 people, and percentage of the city's public transport services covered by a unified payment system, percentage of public transport lines equipped with a publicly accessible real-time system and percentage of the city's public transport services covered by a unified payment system, percentage of public parking spaces equipped with e-payment systems and percentage of public parking spaces equipped with real-time availability systems, percentage of vehicles registered in the city that are low-emission vehicles and percentage of the city's bus fleet that is motor-driven. All of the mentioned indicators can be reduced to a common denominator, so the obtained results are not surprising. All indicators also refer to the method of payment, public transport, and the type of vehicle used for transport in the city. When it comes to large cities, the research shows that there is a significant correlation between the indicator annual number of public transport trips per capita and the number of bicycles available through municipally provided bicycle-sharing services per 100,000 people. This connection may indicate the fact that in large cities, in addition to cars, residents use bicycle-sharing systems for travel. A correlation was also established between some of the remaining indicators presented in the previous chapter, but the strength of the correlation is not high, as was the case in the mentioned two indicators.

The conducted research also supports the research conducted in [5], which confirms that the urban mobility system in the Republic of Croatia needs to be fundamentally redesigned and directed towards sustainability. Sustainable urban systems, as well as smart urban systems, are the focus of more and more research. In [24], a methodology was developed for carrying out a comparison of transport modes within an urban context; in [25], a tool was developed for strategic development of urban mobility; in [26], the use of new technologies such as artificial intelligence and blockchain in the development of smart mobility was studied; in [27], an analysis was conducted of the adoption of electric vehicles as one of the forms of smart urban mobility in the Republic of Croatia, which the authors based on previous research on sustainable urban mobility [28]. The research shows a good basis for further consideration of urban mobility, as well as the development of sustainable urban mobility, which can then be used for further development of urban systems on the territory of the Republic of Croatia.

The developed methodology, as well as the generally obtained research results, can serve as a basis for defining the direction of development of the city system, that is, mobility in cities. In other words, based on the obtained results, the city administration can define projects with which it can try to develop and additionally encourage urban mobility. Such projects can be related to encouraging the use of public city transport, the use of carpools, etc. By periodically assessing the situation using the developed methodology, the city administration can identify whether the implemented projects result in an increase in overall maturity or not, and based on that, they can define future plans.

Furthermore, it should be emphasized that additional electrification is expected in the future, as well as an emphasis on the use of electric vehicles in urban mobility, which means the need to adapt the existing infrastructure to new requirements in terms of the availability of charging stations for electric vehicles, sufficient capacity of electric charging stations, etc. Likewise, the need to regulate electric scooters in urban mobility should be emphasized given their large number and the risks of falling, injury, or other unwanted events such as traffic accidents. Emphasized should also be the possibility of using autonomous vehicles, which is especially important for taxis, the creation of carpools of electric vehicles that are available to residents of urban areas, etc.

5. Conclusions

In the conducted research, the state of urban mobility is determined with an emphasis on smart urban mobility on the territory of the Republic of Croatia. The research determines that smart urban mobility in the cities of the Republic of Croatia is at an extremely low level. In conducting a comparative analysis between small, medium, and large cities, the results indicate that there are certain indicators that show significant differences between certain categories of cities. The mentioned indicators mainly refer to the indicators of smart cities, more precisely indicators that concern the use of some of the new technologies. Looking at the relationship between the indicators, it is also determined that some of the indicators are in mutual correlation; more precisely, the change in one of the indicators affects the change in the other indicator. This certainly confirms the fact that the city is a system, which consists of subsystems that are, and should be, interconnected and interdependent. For this very reason, urban mobility should also be viewed as a separate system consisting of several elements, which need to be managed in an integrated manner to achieve the desired outcome.

The research identifies differences in the development of mobility in small, medium, and large cities. The fundamental reason for which the differences are identified is related to the ability of local self-government to implement projects financed from the funds of the European Union, as well as the complexity of the projects themselves. In other words, the condition of the infrastructure can be a significant factor that can determine the success of project implementation, which means that older infrastructure requires more investment and more systematic interventions that require significantly more money for their implementation.

The limitations of the conducted research are based on subjectivity in the assessment of individual levels of the state of urban mobility. Although the assessment is conducted based on the available data by the author, the use of the proposed research methodology by other researchers is prone to subjectivity. In future research, this potential issue can be overcome by introducing annual reports based on defined indicators, on the basis of which data can be systematically collected. However, despite the subjectivity, there is no bias given that the data collection was refined and quality-checked through additional research based on publicly available data.

Despite this, the proposed research methodology provides an overview of the state of urban mobility in the Republic of Croatia based on the indicators of ISO 37120:2018 [12] and ISO 37122:2019 [14] standards. In future research, it is suggested to supplement the presented indicators with additional indicators that will offer an additional dimension to considerations about smart urban mobility. In addition, it is recommended to inform the city administration about the indicators that will be analyzed and to send the indicators to the city administration with the aim of collecting data of the highest quality and preparing the city administration as well as possible.

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