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## Key Dimensions in Smart Cities' Rankings – Towards Enhancing the Quality of Life for Smart Cities' Inhabitants

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### Abstract

**Motivation:** Urbanization, demographic trends, globalization, and sustainable development contribute to the emergence of smart cities, which entail the intelligent integration of economy, governance, mobility, environment, daily life, and people. Smart city concept means a solution to support the growth of urban areas. One significant aspect discussed in the context of smart cities is the quality of life for their inhabitants. Smart cities are prevalent worldwide,



but there is no universally accepted index for accurate and reliable global rankings. Essential criteria for evaluation include livability, health, technology, mobility and transport, economy, environment, governance, and sustainability.

**Aim:** The primary objective of this paper is to address the following questions: How do smart cities enhance the quality of life for their inhabitants? Which ranking has the best performance and seems to be the best in the context of improving the quality of life for smart cities' inhabitants? The aims of the article are as follows: to explore the main dimensions and indicators in smart cities indexes and to present the first three smartest cities based on 2022 rankings and also to prove that CIMI indicators best correspond to the elements of the quality of life of inhabitants.

**Results:** There is currently no universally accepted index for accurately and reliably ranking smart cities worldwide, but taking into account key dimensions of smart cities' ranking it seems that the Cities in Motion Index from IESE Business School's has the greatest convergence with the quality of life for smart cities' inhabitants. This manuscript may prove valuable for researchers planning to assess the benefits and challenges associated with smart cities.

**Keywords:** quality of life; inhabitants; smart cities; economy; sustainable development

**JEL:** I15, I31, F63, H75, Q50

## 1. Introduction

The 21<sup>st</sup> century is characterized by globalization, new discoveries in science and technology, increasing competitiveness, and socio-economic changes. Amidst the opportunities and threats arising from these shifts, institutional changes are observed in regional cooperation, leading to increased digitalization in service provision to meet the needs of inhabitants and tourists (Masik et al., 2021). In September 2015, the United Nations General Assembly endorsed the 17 Sustainable Development Goals (SDGs)<sup>1</sup>, including Goal 11, which focuses on cities and urban areas. Smart cities play a pivotal role in this process through careful planning and effective management. Their goals include improving the quality of life for inhabitants, fostering favorable conditions for business, and attracting tourism with innovative technological and transportation solutions, as well as the application of new methodologies and streamlined processes.

<sup>1</sup> Goal 1: No Poverty, Goal 2: Zero hunger (No hunger), Goal 3: Good health and well-being, Goal 4: Quality education, Goal 5: Gender equality, Goal 6: Clean water and sanitation, Goal 7: Affordable and clean energy, Goal 8: Decent work and economic growth, Goal 9: Industry, Innovation and Infrastructure, Goal 10: Reduced inequality, Goal 11: Sustainable cities and communities, Goal 12: Responsible consumption and production, Goal 13: Climate action, Goal 14: Life below water, Goal 15: Life on land, Goal 16: Peace, justice and strong institutions, Goal 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development goals. – What are the Sustainable Development Goals?, <https://www.undp.org/sustainable-development-goals>, access 18.06.2024.



The smart city concept is seen as a solution to address challenges related to urban population growth and the transformation of cities into economically and socially efficient, sustainable areas that enhance the quality of life for their inhabitants. The United Nations predicts that nearly 70% of the world's population will reside in cities and urban areas by 2050 (United Nations, 2024), leading to increased emissions and ongoing energy usage. Therefore, modern solutions in cities should focus on finding both economic and environmentally friendly alternatives. Understanding how smart cities influence the quality of life for their inhabitants is an important goal in improving the well-being of smart cities' residents. In this context, attention is also given to identifying the smartest cities worldwide. For smart cities to develop efficiently, we need to know what determines their quality and the quality of their inhabitants' lives.

The first aim of the article is to explore the main dimensions and indicators in smart cities indexes and to present the first three smartest cities based on 2022 rankings. The second aim is to demonstrate that CIMI indicators best correspond to the elements of residents' quality of life (index includes all quality of life indicators). The paper is theoretical in nature, utilizing a method based on analyzing fundamental data from publications, reports, and research on the smart city concept. Relevant websites addressing the issues raised in the article serve as important sources.

## **2. Theoretical background – how smart cities can improve the quality of life of their inhabitants?**

Since the term 'smart city' was first coined in 1992, it has been used in various contexts. Today, it represents the commercialization of technology linked with effective collaboration between the public and private sectors to create new solutions in infrastructure for economic growth, diversification, and global competitiveness (Gibson et al., 1992). Simultaneously, there is no universally accepted definition of the smart city concept; however, it can be divided into several main aspects: social, economic, environmental, technological, and political. The social aspect encompasses considerations related to people, education, health and safety, social capital, mobility, and inclusion. The economic aspect focuses on growth, jobs, finance, and creating a business-friendly environment. The environmental aspect addresses energy, natural resources, and sustainability. The technological context covers ICT, communication, transport, infrastructure, and innovation. The political aspect should be understood in terms of good governance and civic participation (Džunić et al., 2022). Smart cities invest in smart technology and sustainable development but can emphasize various aspects, such as spatial planning to limit excessive building concentration in the city center or the use of information and communication technologies in energy management.

The aim of the smart city concept is to address challenges associated with rapid urbanization (Mazza et al., 2019). These challenges include issues such as traffic congestion, waste management, excessive energy use, shortages of supplies, and air pollution. The smart city is an innovative urban concept that brings both benefits and risks to its inhabitants (Chang, Smith, 2023). Through the introduction of modern solutions in the field of information and communication technologies, urban spaces are expected to become more welcoming for entrepreneurs and tourists in such cities.

Generally, quality of life is assessed through three key indicators: life satisfaction, frequency of happy emotions, and frequency of depressed emotions (Wang, Zhou, 2023). The quality of life for city inhabitants is influenced by numerous factors, and its assessment involves a combination of objective and subjective measures. The fundamental areas considered in evaluating residents' quality of life encompass material living conditions, primary occupational activities, health, education, free time and social relations, economic and physical security, state and basic rights and civic activity, environmental quality in the place of residence, and subjective well-being. Each of these categories comprises multiple sub-measures (Główny Urząd Statystyczny, 2017). The elements of quality of life of inhabitants and examples of indicators have been presented in Table 1. In the context of quality of life indexes, major themes highlight topics such as education, culture, energy, environment, health, housing, safety, ICT and infrastructure, recreation, and mobility (Teixeira et al., 2022).

The smart city concept is a holistic integration of a smart economy, smart governance, smart mobility, smart environment, smart living, and smart people. The quality of life for inhabitants in smart cities hinges on both smart living, encompassing cultural and leisure facilities, health conditions, individual security, housing quality, education facilities, touristic attractiveness, and social cohesion, and smart people – their education, lifelong learning, ethnic plurality, and open-mindedness (Europeansmartcities, 2024).

Smart cities provide tangible benefits, with the deployment of smart city applications potentially reducing commuting times by 15–20%. Intelligent synchronization of traffic signals has the potential to cut average commutes by over 5%, while applications may contribute to a 10–15% reduction in emissions. The tracking of water consumption through applications can encourage conservation and lead to a 15% reduction in consumption. Additionally, applications have the potential to decrease the volume of solid waste by 10–20% per capita. The implementation of public safety applications could result in an 8–10% reduction in fatalities, including those related to homicides, road accidents, and fires. Furthermore, incidents of assault, auto theft, burglary, and robbery could see a significant decrease of 30–40%. Beyond these specific benefits, smart cities have the capacity to save 25 to 80 liters of water per person daily and reduce unrecycled solid waste by 30 to 130 kilograms per person annually (Woetzel et al., 2018). Smart city initiatives,





in this way, are not only cost-saving and efficient but can also create new resources and generate revenue through creative initiatives. On a global scale, smart city initiatives could potentially save each citizen 125 hours per year (Stefanini Group, 2020). However, concerns arise from the gathering of big data through connected 'Internet of Things' sensors, prompting fears of potential misuse for social control or commercial exploitation. The IoT involves embedding objects with sensors for data exchange (Lai, 2023). It's crucial to note that while smart cities like Songdo in South Korea are frequently described as efficient, the key is for technology to serve as a tool rather than become the master (Watson, 2021).

The solutions introduced as part of the smart city concept undoubtedly enhance various aspects of inhabitants' lives; however, they are not without risks. While discussing the benefits, it is crucial to emphasize that the idea of a smart city should not be misconstrued as a blueprint for a utopian city. Otherwise, such a city could pose inherent dangers. The concept of smart cities also raises concerns about data collection, including access to data, surveillance of inhabitants, and others. Additionally, threats include the digital and technological exclusion of residents who may not have access to smartphones and the internet. An important aspect in threat analysis is the vulnerability of such a city to power failures, commonly known as blackouts (Sowa, 2024). Research findings by Wang and Zhou (2023) also indicate that the influence of smart city investments on subjective quality of life varies significantly based on the age and education level of inhabitants

Residents undoubtedly benefit from smart transportation, leading to reduced traffic jams and cleaner air. The green infrastructure in a smart city serves as a dust filter and sound attenuation tool, contributing to a temperature reduction of up to 4 degrees Celsius (Infrastructure Asia, 2024). The smart city is a collaborative process involving representatives from the public and private sectors, as well as residents. Public-private partnerships in a smart city foster long-term cooperation, aiming to provide services or implement projects typically managed by the public sector (Quan et al., 2023).

The essence of a smart city lies in optimizing existing infrastructure while promoting environmental sustainability (Sowa, 2024). Greening smart cities presents both benefits and challenges for air quality, ultimately impacting the health of inhabitants (Hui et al., 2023), while contributing to sustainable development. Ensuring the safety of residents is a top priority in a smart city. Centralizing services, such as police, fire brigade, and ambulance services, on a common platform enhances accessibility and coordination. A smart city's primary focus is to elevate the quality of life for residents, although measuring satisfaction can be challenging due to various contributing factors (Lewandowski, 2020). It is worth adding that apart from smart cities, there are concepts of slow city, green city and selected hybrid models (Farelnik, 2023). The effectiveness of implementing comprehensive solutions and hav-

ing a strategic approach is evident in the rankings of the highest-rated smart cities worldwide.

### 3. Methodology

The research is grounded in the analysis of indicators present in various smart cities' indexes, with the objective of comparing key dimensions and their corresponding indicators across different rankings. Utilizing data from the year 2022, the study aimed to identify the smartest cities globally and within Europe. The methodology employed in this study involved a systematic review of rankings published on websites.

Methodology diagram illustrating the division into successive five stages of the research process is included in Figure 1.

Smart cities are prevalent worldwide, but yet there is no universally accepted index for accurate and reliable global rankings. The selection of smart cities' indexes was based on their popularity in the literature and the availability of data on the Internet.

Several smart city indexes evaluate and compare performances, including the popular IMD Smart City Index (SCI) (Smart City Observatory, 2024), IESE Cities in Motion Ranking (CIMI) by IESE (Cities in Motion, 2024), AT Kearney Global Cities Index (GCI) (Global Cities Report, 2024), Cities of the Future Index (CFI) by EasyPark Inc. (The Cities of the Future Index, 2024), Mori-Foundation Global Power City Index (GPCI) (What is the GPCI, 2024), The SECI index by SmartEcoCity Ltd. (SmartEcoCity Index, 2024), Safe City Index (Safe Cities Index, 2024), Sustainable Cities Index (The Arcadis Sustainable Cities Index, 2024), Digital City Index (The Digital City Index, 2024), Innovation Cities Index (Innovation Cities, 2024), Liveability Ranking (Kopp, 2022), Global E-Government Survey (UN E-Government Survey, 2022), and Smart City Governments (Smart City Governments, 2024) (Toh, 2022). Each of these indexes offers unique insights into the strengths and dimensions of cities, providing opportunities for identification and improvement<sup>2</sup>.

<sup>2</sup> The above-mentioned indexes were considered for further analysis, and it's noteworthy to mention that there are additional indexes, such as the Smart City Strategy Index, Global Smart City Index, ICT Development Index, Smart Cities Prospects, IDC Smart Cities Awards, International Digital Economy and Society Index, Global Financial Centres Index, European Digital City Index, Global Cybersecurity Index, E-Government Development Index, Smart City Rankings (Lai, Cole, 2023). It's crucial to highlight the significance of smart cities' prospects and ProptechOS in creating the rank of future smart cities (Puttkamer, 2023). This ranking considers three key areas: tech infrastructure and connectivity, green infrastructure, and the tech-driven job market, incorporating various subcategories. The top 10 cities in this ranking are London, Amsterdam, Berlin, Paris, Lisbon, Oslo, Budapest, Dublin, Madrid, and Helsinki. Notably, Budapest, a member of the Visegrad Group (V4), secures the 7th position in the ranking of Europe's top 10 cities prepared for a 'smart city' future. Additionally, Budapest ranks 10th in European capitals with the highest EV charging density (McCann, 2023).



The above-mentioned rankings are synthetically presented below, with special attention being paid to criteria, indicators and measured aspects of smart cities. Additionally, for the six most popular indices, detailed tables containing key dimensions and their indicators have been presented.

The methodology of IMD Smart City Index (SCI) was improved in 2023, when the fourth edition of the index was published. IMD Smart City Index (SCI) includes 141 cities, distributed across the world. Previously 118 were measured and capture the economic, humane and technological aspects of smart cities, where the humane aspects referred to quality of life, environment, and inclusiveness. Nowadays each city is assigned to one of four groups, based upon its country HDI values. In methodology there are two pillars for which perceptions from inhabitants are solicited. The first pillar relates to the existing infrastructure of the cities, and the second describes the technological provisions and services available to the inhabitants. Each pillar is evaluated considering five key areas: health and safety, mobility, activities, opportunities, and governance (Table 2). Scoring is based on 5 criteria with 39 indicators. A total of 20 000 people is surveyed about aspects of living in their cities.

According to CIMI smart city means a way of city governance to maintain future sustainability and the quality of life of inhabitants, which generate business opportunities for collaboration between public and private sectors (Lai, Cole, 2023). CIMI aims to evaluate a smart city in relation to nine key dimensions: economy, human capital, technology, environment, international profile, social cohesion, mobility and transportation, governance and urban planning (Table 3). There are 183 cities included in the index with respect to the population of cities. CIMI divides cities into five groups: smallest cities (less than 600 000 population), small cities (600 000 to 1 000 000 population), medium-sized cities (1 to 5 million population), large cities (5 to 10 million population), megacities (over 10 million population). This index includes 9 smallest cities, 17 small cities, 98 medium-sized cities, 25 large cities and 34 megacities. Since the CIMI was introduced in 2020, it has emphasized the importance of putting people first. In addition, CIMI also takes into account: population, percentage of population employed, disposable income and expenditure on education, expenditure on medical and health services, expenditure on hotel and catering services, expenditure on housing – all per inhabitant (IECE, 2024). The top five cities for each of the smart city's categories are presented below in the Table 4.

AT Kearney Global Cities Index (GCI) measures the performance of 156 cities and belongs to one of the oldest smart city indices, because it was introduced in 2008. GCI measures globally engagement of cities by using 29 indicators across 5 criteria: business activity (30%), human capital (30%), information exchange (15%), cultural experience (15%), political engagement (10%) (Global Cities Report, 2024). The criteria are presented in Table 5.

The index Cities of the Future Index (CFI) is created by EasyPark Group, a company located in Stockholm, and reveals the most intelligent cities in the world (Cities of the Future). Index focusses on adopting new technologies by cities. The aim of this process is to create a more sustainable and livable city for inhabitants in cities – present and in the future. The cities are ranked by score and are divided into three categories: cities with more than 3 million inhabitants, cities with between 600,000 and 3 million inhabitants and cities with between 50,000 and 600,000 inhabitants. CFI include 50 best scoring cities in each size category. CFI is based on 4 aspects: digital life, mobility innovation, business technology infrastructure, sustainability and total of 50 indicators to be scored (The Cities of the Future Index, 2024). Criteria of CFI is presented in Table 6.

Mori-Foundation Global Power City Index (GPCI) was started in 2008 and rank global cities according to 6 criteria (urban functions): economy, R&D, cultural interaction, livability, environment, accessibility, which are broken down into 26 groups and total of 70 indicators. GPCI evaluates and ranks the major cities of the world taking into account their “magnetism,” or their comprehensive power to attract people, capital, and enterprises from around the world . Since early 2020, because of the COVID-19 pandemic and associated with this city lockdowns, travel restrictions, and changes in work styles there has been a change in various indicators (Global Power City Index 2021) (Table 7).

The SECI index by SmartEcoCity Ltd. is a private organization analyzing global and Asian cities. SECI is based on 7 categories: transport and mobility (22,5%), digitalization (17,5%), governance (15%), sustainability (12,5%), living standard (10%), cybersecurity (7.5%), innovation economy (5%) and experts’ perception (5%). The categories are based on smart, eco, and city criteria. Smart (equity) means improving the quality of life for citizens, social inclusion, public access, balanced development for all, making the city more attractive and fairer. Eco (environment) is related to reducing the environmental impact for better livability, sustainable city operations and activities, protecting the environment with minimal usage of energy, mobility, and water resources. City (economy) refers to involving citizens in bottom-up co-creation of growth initiatives, city-led government (instead of technology companies), clear vision, open innovation, resiliency plan to minimize impact of natural disasters, crime, virus pandemic, accidents and pollution. SECI research 100 cities in Asia with medium to high positions in the UN Human Development Index and the cities are also ranked on the China prosperity list and the Asia’s Digital City Index. The index consists of 24 factors (Table 8) and then ranked the top 20 smart cities (SmartEcoCity Index, 2024).

Safe Cities Index covers 60 major urban areas. The index consists of 76 sub indicators grouped under 5 domains: digital security, health security, infrastructure security, personal security, environmental security. Copenhagen had the highest score in the latest Safe Cities Index (2021).



In the Arcadis Sustainable Cities Index United States' cities lag behind despite having strong economies. The index evaluates overall the sustainability performances of 100 global cities, where delivering smart and sustainable urban outcomes improve quality of life of their inhabitants. The three individual pillars are taken into account in the ranking: planet, people, profit. The first pillar assesses the quality of the natural environment in a city. The second pillar measures the quality of social infrastructure in a city. The third pillar measures the quality of the economy in a city (The Arcadis Sustainable Cities Index, 2022).

Digital City Index covers 136 cities in the world and takes into account three dimensions: investment, tourism and talent. Investment concerns business environment, strategic sectors and socio-economic factors. Tourism is related to accommodation, generic information and touristic activities. Talent covers three areas: work, study and live (The DigitalCity Index, 2024).

The Innovation Cities Index, published since 2007, is the city ranking for innovation, based on quantitative method including 162 indicators. It measures and improves cities in all innovation areas. The aim of three main factors taken into account: cultural assets, human infrastructure and networked markets, is to map each cities development to the innovation process. The ranking is based on insights from 500 cities (City Rankings – Innovation Cities™ Index, 2024).

The Global Liveability Index concerns an individual's lifestyle and quality of life in 173 cities. The index reviews stability, healthcare, culture and environment, education and infrastructure factors to determine the quality of life of inhabitants in analyzed cities. Each city is assigned a score for over 30 qualitative and quantitative factors across five above mentioned broad categories. The index gives the opportunity to compare liveability trends and quality of life by city comparisons (Kopp, 2022).

Global E-Government Survey focuses on the websites of municipalities, taken as a viable assessment of smart government. Survey includes data analysis in global and regional contexts. Study of local e-government development is based on the United Nations Local Online Service Index (LOSI), that comprises 86 indicators relating to five criteria: institutional framework, content, provision, services provision, participation and engagement, and technology (Local E-Government Development, 2024).

Smart City Governments presented by Eden Strategy Institute ranks the top 50 smart city governments. The index aims to offer city leaders guidance on assessing the readiness of their governments to develop, facilitate, or track their smart city initiatives, and emphasizes the role of governments in smart cities. The 235 cities were ranked based on ten key factors: vision, leadership, budget, financial, support programmes, policies, ecosystems, people-centricity, talent-readiness, track record (Ranking Methodology).



The number and types of aspects measured in smart cities indexes vary, with some aspects recurring across different indexes. Generally, essential criteria include livability, health, technology, mobility and transport, economy, environment, governance, and sustainability.

#### 4. Results

Table 9 encompasses the most popular smart cities' indexes along with key dimensions and indicators, measuring various aspects of smart cities. It also includes the top three cities in the analyzed indexes in 2022, as this represents the latest available data in 2024. Based on the data presented in Table 1, London and New York emerge as top smart cities in the most popular rankings (Toh, 2022). Tokyo stands out as the smartest city in Asia, while the top European cities are predominantly Scandinavian capitals, including Oslo, Copenhagen, and Stockholm.

According to the methodological diagram (Figure 1) adopted in the study, a subsequent comparison was made between key dimensions in smart cities' rankings and key quality of life elements presented in Table 1. Only in the case of CIMI all elements of quality of life are included in the ranking. It means that CIMI shows the greatest convergence with quality of life areas (Table 10). In other words, the key elements of CIMI are most closely aligned with the indicators of inhabitants' quality of life.

According to the Cities in Motion Index (CIMI) from IESE Business School's smart city means a way of city governance to maintain future sustainability and the quality of life of inhabitants, which generate business opportunities for collaboration between public and private sectors. CIMI aims to evaluate a smart city in relation to nine key dimensions: economy, human capital, technology, environment, international profile, social cohesion, mobility and transportation, governance and urban planning (IESE Cities in Motion Index, 2024).

The top ten places in the general classification of CIMI were taken by the following cities in 2022: London, New York, Paris, Tokyo, Berlin, Washington, Singapore, Amsterdam, Oslo, Copenhagen. The first Polish city in CIMI is Warsaw – place 62. London has the London Datastore data platform, invests in the expansion of the transport network, has a lot of startups and human capital in the form of IT specialists, programmers and researchers. New York has thousands of new technology companies and an open WiFi network. Paris is home to nearly half of France's businesses and the Grand Paris Express project, and local authorities are encouraging the use of car sharing services. Tokyo is the most innovative city in the world. Berlin is committed to sustainable development in all areas (Lewandowski, 2024). Descriptions of smart solutions in the top three cities of the CIMI ranking,





which indicates that key dimensions in these cities are most consistent with the elements of quality of life for their inhabitants, are presented in Table 11.

In summary, smart cities indicators encompass a range of themes, including education, culture, economy, e-government, energy, environment, health, housing, safety, ICT and infrastructure, tourism, mobility, waste management, and water management. It's noteworthy that quality of life indicators, as identified by Teixeira et al. (2022), partially overlap with these themes but exclude e-government, tourism, waste management, and water management.

From the practical point of view, it is worth emphasizing in relation to the sustainable development goals signaled at the beginning of the article that the Basque Declaration, acclaimed during the 8th European Conference on Sustainable Cities & Towns in 2016, aims to inspire cities and towns to develop their own local transformative actions, fostering new pathways for European cities to become productive, sustainable, and resilient (Sustainable Cities Platform, 2024). Cities in Europe constitute a network of over 200 cities in 38 countries, with a collective population of 130 million. Their common objective is to ensure a good quality of life for all, with the largest number of these cities originating from Germany and France – 23 each. Notably, according to Juniper Research (2023), Berlin was recognized as the smartest city in Europe in 2023, credited to its transit infrastructure, including the Mobility-as-a-Service (MaaS) app Jelbi, micromobility, and renewable energy generation (Juniper Research, 2023). Poland boasts 10 Eurocities, namely Białystok, Bydgoszcz, Gdansk, Katowice, Lodz, Lublin, Poznan, Rzeszow, Warsaw and Wroclaw (Eurocities, 2024). However, this issue serves as a starting point for another article, showing that topic of interest and topicality for the academic environment but also the economic one.

## 5. Conclusions

To ensure the efficient development of smart cities, it is crucial to understand the factors that determine their quality and the well-being of their inhabitants. Smart cities contribute to enhancing the quality of life for their inhabitants through the utilization of innovative technology and data, fostering more efficient, cleaner, and healthier urban environments. The collaboration between the public and private sectors serves as a pivotal mechanism in driving urban transformation. The potential of smart city technology extends to reshaping city infrastructure and processes, aiming towards overall well-being and an improved quality of life. However, it is crucial to view the implementation of the smart cities concept through the dual lenses of opportunities and threats. The potential benefits of smart city technologies include the improvement of public safety, reduction of emissions for more sustainable environments, time-saving measures, enhancement of the dai-

ly commute, and advancements in public health through the use of digital devices, all contributing to increased social connectedness. Despite these advantages, it is essential to acknowledge the threats associated with issues such as surveillance and the potential leakage of data.

There is currently no universally accepted index for accurately and reliably ranking smart cities worldwide. Essential criteria for evaluation include livability, health, technology, mobility and transport, economy, environment, governance, and sustainability. Notably, London and New York emerge as top smart cities in popular rankings, with Tokyo standing out as the smartest city in Asia. Additionally, Scandinavian capitals are recognized among the smartest cities in the world among European counterparts.

Key dimensions and indicators in smart cities' rankings are part of the determinants of improving the quality of life of residents. The statistical measurement of quality of life takes into account its multidimensional nature. This approach aims to capture not only the objective conditions in which people live but also the subjective experience of life quality by individuals. The fundamental areas considered in evaluating residents' quality of life encompass material living conditions, primary occupational activities, health, education, free time and social relations, economic and physical security, state and basic rights, civic activity, environmental quality in the place of residence, and subjective well-being.

Not all indexes of smart cities' taken into account detailed elements related to quality of life, which is why cities on their podiums differ. Only one index among 13 analyzed includes all quality of life indicators – it is CIMI. According to CIMI, the smartest cities in the world are: London, New York and Paris. These cities are continually striving to conserve resources, minimize environmental impacts, and enhance the quality of life for their residents. We can therefore conclude that the quality of life of its inhabitants is the highest in these cities. There are practical and theoretical implications from the research. First of all, if we want to evaluate smart cities through the prism of the quality of life of residents, we should take the CIMI ranking into account.

It is worth to add that the analysis of smart cities' rankings reveals the crucial role of economic and environmental criteria, with environmental and sustainability issues occupying prominent positions across key dimensions and indicators. It becomes evident that solutions for environmental protection will play a pivotal role in accelerating the transition toward a greener future for smart cities. Implementing such solutions not only addresses environmental concerns but also fosters the creation of new jobs and productive investments, contributing to overall economic growth. One innovative proposal in this direction is the introduction of air taxis, an autonomous service aimed at alleviating traffic congestion. Paris is set to implement such a solution during the upcoming Olympic Games in 2024. However, legal challenges



surrounding air taxi services are expected to be a significant hurdle in the near future.

The article, constrained by its size, touches upon various threads without delving into detailed discussions. It serves as an introduction to potentially compelling issues that could be explored in future articles. Examples include delving into EU smart cities concerning innovation across countries and regions or focusing on the benefits and threats for inhabitants in smart cities within a specific country.

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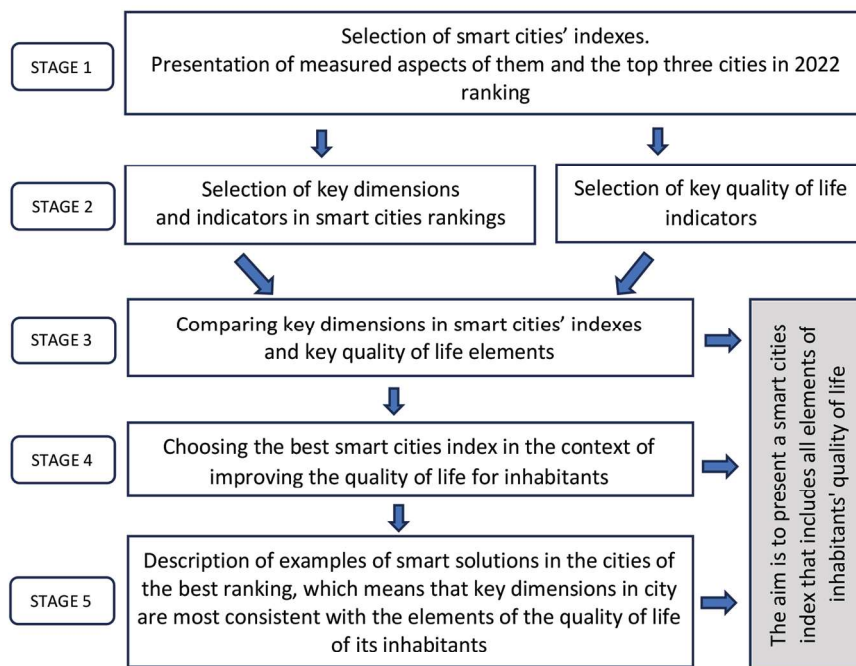
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## Appendix

Figure 1: Methodology diagram



Source: Authors' elaboration.

Table 1. Aspect of inhabitants' quality of life and examples of indicators

	Aspect of inhabitants' quality of life	Examples of indicators
1.	material living conditions	average monthly disposable income, share of expenditures on housing maintenance in total expenditures, poverty rate, inability to afford at least one week of vacation per year, lack of a car due to financial reasons, poor sanitary conditions index, inability to afford food, households living in overcrowded housing, households living in oversized housing
2.	primary occupational activities	employment rate, unemployment rate, youth not in employment, education, or training, employees working extended hours, employees on fixed-term contracts, median wage, job satisfaction
3.	health	self-rated health indicator, self-rated poor health indicator, individuals aged 15 or older who are overweight or obese, skipping a specialist doctor visit due to waiting lists or lack of a referral, skipping a specialist doctor visit due to financial reasons, people with limited ability to perform daily activities
4.	education	people who speak foreign languages, individuals aged 16–74 regularly using a computer, individuals aged 16–74 regularly using the Internet, individuals over 25 years old with higher education, individuals aged 15–64 participating in education or training, children aged 3–4 years enrolled in preschool education



	Aspect of inhabitants' quality of life	Examples of indicators
5.	free time and social relations	lack of free time for oneself, satisfaction with the amount of free time, satisfaction with the way leisure time is spent, ability to receive support from others, trust in other people, social isolation index
6.	economic and physical security	inability to cover unexpected expenses, arrears in payment, sense of security in the place of residence
7.	<ul style="list-style-type: none"> <li>state and basic rights</li> <li>and civic activity</li> </ul>	<ul style="list-style-type: none"> <li>trust in the government, trust in local authorities, trust in the courts, trust in the police, perception of the threat of discrimination, individuals volunteering in organizations, voter turnout</li> </ul>
8.	<ul style="list-style-type: none"> <li>environmental quality in the place of residence</li> </ul>	<ul style="list-style-type: none"> <li>exposure to excessive noise, exposure to pollution or other environmental issues in the area, satisfaction with recreational areas and green spaces</li> </ul>
9.	<ul style="list-style-type: none"> <li>subjective well-being</li> </ul>	<ul style="list-style-type: none"> <li>overall life satisfaction, sense of optimism, composite well-being index, composite ill-being index, sense of purpose in life</li> </ul>

Source: Author's elaboration based on Główny Urząd Statystyczny, 2017.

Table 2. Pillars of IMD SCI

PILLARS	
STRUCTURES	TECHNOLOGIES
health and safety	health and safety
<ul style="list-style-type: none"> <li>basic sanitation meets the needs of the poorest areas</li> <li>recycling services are satisfactory</li> <li>public safety is not a problem</li> <li>air pollution is not a problem</li> <li>medical services provision is satisfactory</li> <li>finding housing with rent equal to 30% or less of a monthly salary is not a problem</li> </ul>	<ul style="list-style-type: none"> <li>online reporting of city maintenance problems provides a speedy solution</li> <li>a website or app allows residents to easily give away unwanted items</li> <li>free public Wi-Fi has improved access to city services</li> <li>cctv cameras has made residents feel safe</li> <li>a website or app allows residents to effectively monitor air pollution</li> <li>arranging medical appointments online has improved access</li> </ul>
mobility	mobility
<ul style="list-style-type: none"> <li>traffic congestion is not a problem</li> <li>public transport is satisfactory</li> </ul>	<ul style="list-style-type: none"> <li>car-sharing apps have reduced congestion</li> <li>apps that direct you to an available parking space have reduced journey time</li> <li>bicycle hiring has reduced congestion</li> <li>online scheduling and ticket sales has made public transport easier to use</li> <li>the city provides information on traffic congestion through mobile phones</li> </ul>
activities	activities
<ul style="list-style-type: none"> <li>green spaces are satisfactory</li> <li>cultural activities (shows, bars, and museums) are satisfactory</li> </ul>	<ul style="list-style-type: none"> <li>online purchasing of tickets to shows and museums has made it easier to attend</li> </ul>
opportunities	opportunities
<ul style="list-style-type: none"> <li>employment finding services are readily available</li> <li>most children have access to a good school</li> <li>lifelong learning opportunities are provided by local institutions</li> <li>businesses are creating new jobs</li> <li>minorities feel welcome</li> </ul>	<ul style="list-style-type: none"> <li>online access to job listings has made it easier to find work</li> <li>it skills are taught well in schools</li> <li>online services provided by the city has made it easier to start a new business</li> <li>the current internet speed and reliability meet connectivity needs</li> </ul>
governance	governance



PILLARS	
STRUCTURES	TECHNOLOGIES
<ul style="list-style-type: none"> <li>information on local government decisions are easily accessible</li> <li>corruption of city officials is not an issue of concern</li> <li>residents contribute to decision making of local government</li> <li>residents provide feedback on local government projects</li> </ul>	<ul style="list-style-type: none"> <li>online public access to city finances has reduced corruption</li> <li>online voting has increased participation</li> <li>an online platform where residents can propose ideas has improved city life</li> <li>processing identification documents online has reduced waiting times</li> </ul>

Source: Smart City Index Report 2023, <https://www.imd.org/wp-content/uploads/2023/04/smartcityindex-2023-v7.pdf>, 18.06.2024.

Table 3. Key dimensions and their indicators in CIMI

Key dimensions	Indicator
economy	ease of starting a business, mortgage, motivation of individuals to undertake early-stage entrepreneurial activity, number of headquarters, GDP, estimated GDP, GDP per capita, purchasing power, productivity, hourly wage in USD, time required to start a business
human capital	secondary and higher education, schools, business schools, expenditure on education, expenditure on leisure and recreation, expenditure on leisure and recreation per capita, student mobility, museums and art galleries, number of universities, theaters
technology	mobile broadband, Innovation Cities Index, Internet, LTE/WiMAX, Computers/PCs, mobile phone penetration rate, social media, broadband subscriptions, telephony, internet speed, mobile speed, WiFi hotspots,
environment	CO <sub>2</sub> emissions, methane emissions, Environmental Performance Index, CO <sub>2</sub> Emission Index, Pollution Index, PM <sub>10</sub> , PM <sub>2.5</sub> , percentage of population with access to water supply, renewable water resources, solid waste, climate vulnerability
international profile	number of passengers per airport, hotels, Restaurant Price Index, McDonald's, number of congresses and meetings
social cohesion	female-friendly, hospitals, crime rate, Slavery Index, Happiness Index, Gini Index, Global Peace Index, Health Care Index, LGBT-friendly, price of property, female employment rate, death rate, unemployment rate, murder rate, suicide rate, terrorism, racial tolerance
mobility and transportation	bicycle rental, moped rental, scooter rental, bicycles per household, bike sharing, metro stations, Traffic Inefficiency Index, Traffic Commute Time Index, Exponential Traffic Index, Length of metro system, High-speed train, Vehicles in the city, Flights
governance	bitcoin legal, ISO 37120 certification, government buildings, embassies, public sector employment, E-Participation Index, Human Capital Index, Strength of Legal Rights Index, Telecommunication Infrastructure Index, Corruption Perceptions Index, Online Service Index, research offices, open data platform, Democracy Index, reserves, reserves per capita
urban planning	bike advance, buildings, bicycle stations, electric charging stations, number of people per household, percentage of the urban population with adequate sanitation services, artificial intelligence (AI) projects, high-rises buildings

Source: IESE Cities in Motion Index, pp. 83–89, <https://media.iese.edu/research/pdfs/ST-0633-E.pdf>, 18.06.2024.

Table 4. The top five cities in CIMI rank's groups

Cities groups	Top 5 cities in CIMI rank
smallest cities	Bern, Basel, Reykjavik, Canberra, Wellington
small cities	Edinburgh, Geneva, Eindhoven, Nottingham, Quebec
medium-sized cities	Amsterdam, Oslo, Copenhagen, Munich, Zurich



Cities groups	Top 5 cities in CIMI rank
large cities	Berlin, Washington, Singapore, Chicago, Toronto
megacities	London, New York, Paris, Tokyo, Seul

Source: IESE Cities in Motion Index, <https://media.iese.edu/research/pdfs/ST-0633-E.pdf>, 18.06.2024.

Table 5. Criteria and indicators of GCI

	Criteria				
	Business activity	Human Capital	Information exchange	Cultural experience	Political engagement
Indicators	<ul style="list-style-type: none"> <li>Fortune 500</li> <li>top global services firm</li> <li>capital markets</li> <li>air freight</li> <li>sea freight</li> <li>ICCA conferences</li> <li>unicorn companies</li> </ul>	<ul style="list-style-type: none"> <li>foreign born population</li> <li>top universities</li> <li>population with tertiary degree</li> <li>international student population</li> <li>number of international schools</li> <li>medical universities</li> </ul>	<ul style="list-style-type: none"> <li>access to tv news</li> <li>new agency bureau</li> <li>broadband subscribers</li> <li>freedom of expression</li> <li>online presence</li> </ul>	<ul style="list-style-type: none"> <li>museums</li> <li>visual and performing arts</li> <li>sporting events</li> <li>international travelers</li> <li>culinary offerings</li> <li>sister cities</li> </ul>	<ul style="list-style-type: none"> <li>embassies and consulates</li> <li>think tanks</li> <li>international organizations</li> <li>political conferences</li> <li>local institutions with global reach</li> </ul>

Source: Global Cities Report, <https://www.kearney.com/industry/public-sector/global-cities/2022>, 18.06.2024.

Table 6. Criteria of CFI

Digital Life	Mobility Innovation	Business Tech Infrastructure	Sustainability
Citizen Adoption	Parking Innovation	Business Innovation	Green Energy
<ul style="list-style-type: none"> <li>the number of startups in the healthcare, lifestyle and internet service sectors in each city, both in absolute terms and on a per population basis</li> </ul>	<ul style="list-style-type: none"> <li>the overall number of parking spaces per capita.</li> <li>the number of parking spaces capable of accepting digital payments.</li> <li>the number of parking technology providers operating in the city</li> </ul>	<ul style="list-style-type: none"> <li>healthcare.</li> <li>internet services.</li> <li>financial services.</li> <li>lifestyle services.</li> <li>media</li> </ul>	<ul style="list-style-type: none"> <li>share of nationwide energy consumed from renewable sources.</li> <li>share of electricity consumption from renewable sources</li> </ul>
Citizen Adoption	Parking Innovation	Business Innovation	Green Energy
<ul style="list-style-type: none"> <li>number of app downloads and ranking in food, navigation, travel, education and financial services categories, excluding reference and utility apps</li> </ul>	<ul style="list-style-type: none"> <li>civilian adoption of parking technology.</li> <li>the level of parking technology implementation</li> </ul>		



Digital Life	Mobility Innovation	Business Tech Infrastructure	Sustainability
Government Adoption	Traffic Management	ePayments	Green Buildings
<ul style="list-style-type: none"> <li>national digital infrastructure indices</li> <li>digital economy score</li> <li>development of e-government services</li> </ul>	<ul style="list-style-type: none"> <li>congestion levels</li> <li>time spent in traffic during a commute</li> <li>dissatisfaction due to long commute times</li> </ul>	<ul style="list-style-type: none"> <li>percentage of the population that is in favor of a cashless society</li> <li>percentage of the population that has been cashless since the beginning of the pandemic</li> <li>number of cashless retail transactions per 1,000 adults</li> <li>credit card ownership</li> <li>debit card ownership</li> <li>percentage of the population that paid bills or bought something online in the past year</li> </ul>	<ul style="list-style-type: none"> <li>number of certified green buildings</li> <li>building activities</li> <li>activities per square foot</li> <li>percentage of total buildings certified as green</li> </ul>
Healthcare Innovation	Clean Transport	Internet Connectivity	Waste Management
<ul style="list-style-type: none"> <li>Healthcare Quality and Access Index</li> <li>the number of startups in the healthcare sector in each city, both in absolute terms and on a per population basis</li> <li>number of app downloads and ranking in the healthcare and medical categories, excluding reference and utility apps</li> </ul>	<ul style="list-style-type: none"> <li>electric cars per capita and new electric car sales</li> <li>electric car charging stations per capita</li> <li>CO<sub>2</sub> emissions</li> </ul>	<ul style="list-style-type: none"> <li>median download and upload speeds</li> <li>5G deployment and government efforts to promote 5G</li> <li>5G availability in major cities</li> <li>number of 5G providers per city</li> </ul>	<ul style="list-style-type: none"> <li>waste generated per capita</li> <li>waste collection coverage</li> <li>the recycling rate in each country</li> </ul>
Tech Education			Climate Response
<ul style="list-style-type: none"> <li>highly ranked universities for computer science degrees</li> <li>highly ranked universities for engineering degrees</li> </ul>			<ul style="list-style-type: none"> <li>estimated percentage increase in greenhouse gas emissions</li> <li>total CO<sub>2</sub> emissions from fuel combustion</li> <li>expenditure on environment protection</li> <li>change in CO<sub>2</sub> emissions per capita over time</li> <li>number of climate laws, policies and targets in place</li> </ul>

Source: The Cities of the Future Index, <https://easyparkgroup.com/studies/cities-of-the-future/en/>, 18.06.2024.

Table 7. Criteria and indicators used in GPCI

Economy	R&D	Cultural Interaction
Market Size	Academic Resources	Trendsetting Potential
<ul style="list-style-type: none"> <li>nominal GDP</li> <li>GDP per Capita</li> </ul>	<ul style="list-style-type: none"> <li>number of researchers</li> <li>world's top universities</li> </ul>	<ul style="list-style-type: none"> <li>number of international conferences</li> <li>number of cultural events</li> <li>cultural content export value</li> <li>art market environment</li> </ul>



<b>Economy</b>	<b>R&amp;D</b>	<b>Cultural Interaction</b>
Market Attractiveness	Research Environment	Tourism Resources
<ul style="list-style-type: none"> <li>GDP growth rate</li> <li>economic freedom</li> </ul>	research and development expenditure number of international students academic performance	<ul style="list-style-type: none"> <li>tourist attractions</li> <li>proximity to world heritage sites</li> <li>nightlife option</li> </ul>
Economic Vitality	Innovation	Cultural Facilities
stock market capitalization world's top 500 companies	<ul style="list-style-type: none"> <li>number of patents</li> <li>winners of prizes in science and technology</li> <li>number of startups</li> </ul>	<ul style="list-style-type: none"> <li>number of theaters</li> <li>number of museums</li> <li>number of stadiums</li> </ul>
Human Capital		Visitor Amenities
<ul style="list-style-type: none"> <li>Total Employment</li> <li>Employees in Business Support Services</li> </ul>		<ul style="list-style-type: none"> <li>number of hotel rooms</li> <li>number of luxury hotel rooms</li> <li>attractiveness of shopping options</li> <li>attractiveness of dining options</li> </ul>
Business Environment		International Interaction
<ul style="list-style-type: none"> <li>wage level</li> <li>availability of skilled human resources</li> <li>variety of workplace options</li> </ul> Ease of Doing Business		<ul style="list-style-type: none"> <li>number of foreign residents</li> <li>number of foreign visitors</li> </ul>
<ul style="list-style-type: none"> <li>corporate tax rate</li> <li>political, economic and business risk</li> </ul>		
<b>Livability</b>	<b>Environment</b>	<b>Accessibility</b>
Working Environment	Sustainability	International Network
<ul style="list-style-type: none"> <li>total unemployment rate</li> <li>total working hours</li> <li>workstyle flexibility</li> </ul>	<ul style="list-style-type: none"> <li>commitment to climate action</li> <li>renewable energy rate</li> <li>waste recycle rate</li> </ul>	<ul style="list-style-type: none"> <li>cities with direct international flights</li> <li>international freight flows</li> </ul>
Cost of Living	Air Quality and Comfort	Air Transport Capacity
<ul style="list-style-type: none"> <li>housing rent</li> <li>price level</li> </ul>	<ul style="list-style-type: none"> <li>CO<sub>2</sub> emissions per capita</li> <li>air quality</li> <li>comfort level of temperature</li> </ul>	<ul style="list-style-type: none"> <li>number of air passengers</li> <li>number of arrivals and departures at airports</li> </ul>
Security and Safety	Urban Environment	Inner-City Transportation
<ul style="list-style-type: none"> <li>number of murders</li> <li>economic risk of natural disaster</li> </ul>	<ul style="list-style-type: none"> <li>water quality</li> <li>urban greenery</li> <li>satisfaction with urban cleanliness</li> </ul>	<ul style="list-style-type: none"> <li>station density</li> <li>public transportation use</li> <li>travel time to airports</li> </ul>
Well-Being		Transport Comfortability
<ul style="list-style-type: none"> <li>life expectancy</li> <li>social freedom and equality</li> <li>risk to mental health</li> </ul>		<ul style="list-style-type: none"> <li>commuting time</li> <li>traffic congestion</li> <li>ease of mobility by taxi or bicycle</li> </ul>
Ease of Living		
<ul style="list-style-type: none"> <li>number of medical doctors</li> <li>ICT readiness</li> <li>number of retail shops</li> <li>number of restaurants</li> </ul>		

Source: Global Power City Index 2021, pp. 2–3, [https://mori-m-foundation.or.jp/pdf/GPCI2021\\_summary.pdf](https://mori-m-foundation.or.jp/pdf/GPCI2021_summary.pdf), 18.06.2024.





Table 8. Factors of SECI

Smart (Equity)	Eco (Environment)	City (Economy)
<ul style="list-style-type: none"> <li>• smartphone penetration</li> <li>• internet penetration</li> <li>• cable tv penetration</li> <li>• smart parking</li> <li>• sharing services</li> <li>• traffic</li> <li>• public transport</li> <li>• smartness opinion</li> <li>• skyscrapers</li> </ul>	<ul style="list-style-type: none"> <li>• clean energy/ev incentives</li> <li>• smart building</li> <li>• waste disposal</li> <li>• environment protection</li> <li>• affordability</li> <li>• medical care</li> <li>• environmental exposure</li> </ul>	<ul style="list-style-type: none"> <li>• leadership</li> <li>• budget</li> <li>• urban planning</li> <li>• citizen participation</li> <li>• digitalization of government</li> <li>• industries</li> <li>• business eco-system</li> <li>• education</li> </ul>

Source: SmartEcoCity Index, <https://www.smartecocity.com/smartecocity-index/>, 18.06.2024.

Table 9. Smart cities indexes: key dimensions, indicators and top smart cities of 2022

Smart cities index	Key dimensions and indicators: measured aspects of smart cities	Top smart cities of 2022
IMD Smart City Index (SCI)	• health and safety, mobility, activities, opportunities, governance	1/ Zurich 2/ Oslo 3/ Canberra
IESE Cities in Motion Ranking (CIMI) by IESE	• economy, human capital, technology, environment, international profile, social cohesion, mobility and transportation, governance, urban planning	1/ London 2/ New York 3/ Paris
AT Kearney Global Cities Index (GCI)	• business activity, human capital, information exchange, cultural experience, political engagement	1/ New York 2/ London 3/ Paris
Cities of the Future Index (CFI) by EasyPark Inc <sup>o</sup>	• digital life, mobility innovation, business technology infrastructure, sustainability	I. 1/ London 2/ New York 3/ San Francisco II. 1/ Copenhagen 2/ Stockholm 3/ Oslo III. 1/ Lund 2/ Stavanger 3/ Espoo
Mori-Foundation Global Power City Index (GPCI)	• economy, R&D, cultural interaction, livability, environment, accessibility	1/ London 2/ New York 3/ Tokyo
The SECI index by SmartEcoCity Ltd	• smart (equity), eco (environment), city (economy)	1/ New York 2/ San Francisco 3/ Singapore
Safe City Index	• digital security, health security, infrastructure security, personal security, environmental security	1/ Copenhagen 2/ Toronto 3/ Singapore
Sustainable Cities Index	• planet, people, profit	1/ Oslo 2/ Stockholm 3/ Tokyo
Digital City Index	• investment, tourism, talent	1/ Dubai 2/ Singapore 3/ London
Innovation Cities Index	• cultural assets, human infrastructure, networked markets	1/ Tokyo 2/ London 3/ New York
Liveability Ranking	• stability, healthcare, culture, environment, education and infrastructure	1/ Vienna 2/ Copenhagen 3/ Zurich
Global E-Government Survey	• institutional framework, content, provision, services provision, participation and engagement, technology	1/ Berlin 2/ Madrid 3/ Tallinn



Smart cities index	Key dimensions and indicators: measured aspects of smart cities	Top smart cities of 2022
Smart City Governments	• vision, leadership, budget, financial, support programmes, policies, ecosystems, people-centricity, talent-readiness, track record	1/ Singapore 2/ Seoul 3/ London

\* The cities are divided into three categories: I/ cities with more than 3 million inhabitants, II/ cities between 600,000 and 3 million inhabitants, III/ cities between 50,000 and 600,000 inhabitants.

Source: Authors' elaboration based on the websites of the analyzed indexes (IMD Smart City Index (SCI), IESE Cities in Motion Ranking (CIMI) by IESE, AT Kearney Global Cities Index (GCI), Cities of the Future Index (CFI) by EasyPark Inc., Mori-Foundation Global Power City Index (GPCI), The SECI index by SmartEcoCity Ltd., Safe City Index, Sustainable Cities Index, Digital City Index, Innovation Cities Index, Liveability Ranking, Global E-Government Survey, Smart City Governments).

Table 10. CIMI versus quality of life indicators

Smart cities index	Element of quality of life appearing in a ranking'									
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
CIMI	x	x	x	x	x	x	x	x	x	x

\* 1. material living conditions, 2. primary occupational activities, 3. health, 4. education, 5. free time and social relations, 6. economic and physical security, 7. state and basic rights, 8. civic activity, 9. environmental quality in the place of residence, 10. subjective well-being.  
x – the quality of life indicator is included in the smart cities index.

Source: Authors' elaboration.

Table 11. Examples of smart solutions in the top three cities of the CIMI ranking towards enhancing the quality of life for their inhabitants

CIMI ranking place	Smart city	Smart solutions towards enhancing the quality of life for smart cities' inhabitants
1.	London	<ul style="list-style-type: none"> <li>• Digital Access for all including digital inclusion and digital skills programmes,</li> <li>• New city data platform to better use the city's collective data legally, ethically, and securely,</li> <li>• New Emerging Technology Quarter to guide and inform the trialing and deployment of new technologies,</li> <li>• Scaling Green Tech to ensure the widespread adoption of green innovation,</li> <li>• Open Innovation with the tech sector through high-value and status competitions around the Green New Deal,</li> <li>• Common digital platforms to serve Londoners better, such as Talk London and Make London.</li> </ul>
2.	New York	<ul style="list-style-type: none"> <li>• Accelerated Conservation and Efficiency (ACE) programme introducing LED lighting retrofits projects in buildings owned by city agencies,</li> <li>• Large-scale Automated Metre Reading (AMR) system to better understand how water is used, and warns customers of potential water leaks should the system detect abnormal spikes in consumption,</li> <li>• BigBelly – "smart" garbage and recycling bins,</li> <li>• The smart city pilot program involved installing hundreds of smart sensors and technologies across districts and boroughs, amassing data to help manage services,</li> <li>• Smart hubs with contactless technology and WiFi,</li> <li>• Urban Future Lab – growing community of climate tech incubators and accelerators.</li> </ul>



CIMI ranking place	Smart city	Smart solutions towards enhancing the quality of life for smart cities' inhabitants
3.	Paris	<ul style="list-style-type: none"><li>• Digital applications to help manage water, transport, energy and waste management systems.</li><li>• „Paris Respire” programme to enforce car-free areas in some parts of the city on weekends and public holidays,</li><li>• Paris2Connect – connected urban infrastructure project,</li><li>• High number of free public Wi-Fi hotspots,</li><li>• Smart park benches installed in city parks watch traffic and help officials manage crowds,</li><li>• Paris Smart City 2050 – buildings generating net positive renewable energy that sends excess energy back to the grid.</li></ul>

Source: Authors' elaboration based on L. Puttkamer, Smart City London: Europe's smartest city, <https://www.beesmart.city/en/smart-city-blog/london-europes-smartest-city>, access: 18.06.2024; O. Lai, How New York Smart City Projects are Leading the Way, <https://earth.org/new-york-smart-city/>, access: 18.06.2024; B. Buchholz, Top 10: Most Sustainable Smart Cities, <https://sustainabilitymag.com/articles/top-10-smart-cities-in-the-world-in-2023>, access: 18.06.2024; J. Locke, Top 10 Most Futuristic Smart Cities in the World (2023), <https://www.digi.com/blog/post/smart-cities-in-the-world#Paris>, <https://earth.org/new-york-smart-city/>, access: 18.06.2024.

