



Smart City as a Mix of Technology, Sustainability and Well-Being: A Myth or Reality?

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Abstract. Smart city initiatives are often considered as solutions for overcoming several problems that modern cities are facing. Some of these problems refer to rapid urbanization, old infrastructure or the complexity of properly managing new technologies in cities. This complexity becomes even higher with the inclusion of sustainability and well-being. This paper examines the relationship between technology, sustainability, and well-being in the context of the smart city. The research methodology involves merging the IMD Smart City 2023 Index with the Happy City Index 2023 to identify the relation between “smartness” and “happiness”. The analysis reveals a correlation between smart city rankings and happiness rankings; however, with an important discrepancy between smart city performance and happiness when observing individual scores. Additionally, an analysis of scientific literature highlights the limited research emphasis on well-being and sustainability. The findings of the paper highlight the importance of further research in understanding the impact of technology on well-being and the need for a holistic approach that combines technology, sustainability, and well-being in the development of smart cities.

Keywords: Smart city · Adoption · Well-being · Smart City Index · Happy City Index · Attitude · Sustainability

1 Introduction

The world is facing with several issues like global warming, overpopulation, resource deficit, resource allocations, uneven economic development and many others. Many of these issues are not new in the contemporary world; however, several of them are becoming more and more difficult to manage. More than 50% of the global population lives in urban areas, and this number is expected to increase by 66% by the year 2050 [1]. Therefore, problems that are arising in large cities need to be prioritized. The

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primary challenge is to preserve the distinctive qualities of metropolitan areas without harming the environment or the standard of living, especially for the forthcoming generations. Therefore, considering the proper development of the technology, with a focus on sustainability and maintaining or even improving the well-being.

Smart cities as drivers of innovation in the digital age can leverage advanced technologies such as the Internet of Things to create sustainable, open and user-driven innovation ecosystems in order to improve environmental and communication technologies and enable community co-creation of innovative living and working situations [2]. The latter may be seen as a definition of smart cities focusing on the use of technology to promote innovation with the goal of improving the community in various areas [3]. The idea of a smart city is positioned on digital transformation, where the importance of adopting information and communication technology is crucial to achieving city smartness [4]. However, smartness as a main goal may not necessarily lead to the improved well-being of individuals or a sustainable future.

The smart city concept may present one of the ways for humanity to tackle these challenges. With the combination of developing technologies and intelligent management, cities can become significantly more efficient for both inhabitants and businesses. However, the success of smart city initiatives heavily depends on many factors that may hinder their development.

To ensure the successful development and implementation of smart city projects, it is vital for policymakers, businesses, and communities to work collaboratively towards a shared vision. This involves identifying and addressing potential obstacles, investing in the necessary infrastructure and resources, and fostering a culture of innovation and experimentation. By doing so, smart cities may harness their full potential to create sustainable, resilient, and prosperous urban environments that can effectively tackle the global challenges of the future.

The latter sounds like a perfect-case scenario, easily written on paper. Yet the reality is different. Cities are facing with the problems of too rapid urbanization, old infrastructure not being able to cope with the speed of urbanization, individuals reluctant to change their habits, managing the complexity of all interlacing technologies and many others.

A smart city relies on citizens assuming a crucial role in identifying innovation and actively gathering and sharing data, rather than solely reacting to provided information. The future hinges on empowered citizens who drive urban change. Thus, the significance of smart citizenship should be underscored. By leveraging technologies that enable self-expression, social interaction, and the sharing of assets and knowledge, smart citizens can become engaged, enthusiastic, and well-informed decision-makers [5].

However, this process is multifaceted, encompassing various aspects including technology adoption, change management, inclusiveness, and well-being, among others. Existing research on smart cities often fails to address many of these interconnected dimensions. Hence, the objective of this paper is to investigate the interplay of technology, sustainability, and well-being in smart cities, considering both the current state in the cities and relevant scientific research. In the first part, the concepts are briefly presented. The second part briefly presents the methodologies followed by the results section. Finally, a concluding remark is outlined.

2 Literature Review

2.1 Sustainability

The concept of sustainability initially focused primarily on environmental challenges, particularly the conservation of limited natural resources. Key considerations included climate change, clean energy, sustainable transport, sustainable consumption and production, conservation and management of natural resources, and public health. Gradually, attention shifted to include social and economic aspects, primarily in relation to demography, migration, global poverty, and sustainable development challenges [6].

When discussing sustainability in relation to organizations, the commonly employed Triple Bottom Line model [7] represents a balance between the environmental, social, and economic pillars. This model remains widely used as it emphasizes the need for socially and environmentally responsible behavior in organizations while also allowing for economic growth [8]. This holistic approach introduces a new concept of organizational sustainability, recognizing that organizations have a changed role in society and must make strategic decisions aligned with their new social context [9].

Cities, despite their unique challenges, are not exempt from the pursuit of sustainability. With urban environments rapidly expanding and over half of the world's population already residing in cities [10], their role in achieving global sustainability is crucial [6]. Digitalization can serve as a tool to foster sustainable development and enhance the quality of life for citizens, provided it offers practical solutions that benefit their daily lives [11]. Digitalization is therefore presenting an opportunity in organizations and society, and the concept of smart cities is just one of them.

2.2 Smart City

The concept of a smart city is a complex phenomenon that has been explored by numerous researchers, yet a unified definition has not been established. The prevailing understanding emphasizes the use of information technology as a fundamental requirement for a smart city, encompassing economic, managerial, and social aspects [12]. Thus, the concept of smart cities encompasses various crucial aspects of contemporary urban life, including smart mobility, smart living, smart environment, smart citizens, smart government, smart economics, smart architecture, and smart technology [13]. While technology plays a promising and valuable role in creating smart cities, its mere implementation alone is insufficient to generate benefits for society.

Smart cities are closely intertwined with the concepts of the Internet of Things and big data, as the availability of automatically collected data opens up new opportunities for developing and managing public information services. Extensive research has already been conducted from a technological perspective [14]; however, there is still a gap in understanding personal considerations and perceptions [13]. Additionally, recent research has focused on conceptualizing smart cities [15, 16], but there is a lack of comprehensive answers regarding the use of digital technologies to support a sustainable future in these cities.

After all, it is important to consider the elements that link technology adoption and personal characteristics [17], as well as to understand how individual behavior can be transformed to align with a more sustainable future-oriented mindset.

The rapid growth of urban areas in recent years has stimulated the adoption of diverse digital technologies within smart cities worldwide [18]. These technological advancements serve as the primary drivers of digital transformation and are important in shaping smart city initiatives [19]. Their integration, coupled with enhanced governance and the human capital of citizens, ensures that smart cities can bring the positive social change for society as a whole [20]. However, the global trends of urbanization and the pressing sustainability concerns pose significant challenges for smart cities [21] potentially affecting the well-being as well. The cities must address the social and environmental sustainability issues confronted by society, including sustainable economic growth, high quality of life, prudent utilization of natural resources, and smart governance [22].

Therefore, several definitions on smart cities can also be categorized as sustainability-oriented definitions and non-sustainability-oriented definitions [23]. An initial sustainability-oriented definition would be that smart cities leverage not only digital technology to improve traditional networks and services for residents and businesses, but go beyond it by reducing pollution and resource use. It implies better urban transit networks, updated water, and waste systems, and more efficient lighting and heating. It also implies a more responsive local government, safer public places, and accommodating an ageing population.

To attain a smart city, there is a need for increased community participation and to use the technology to accomplish positive community impacts. The technologies of a smart city should also raise residents' standard of living overall. Several activities and solutions in smart cities can enhance the quality of life [24]; however, residents need to perceive them as valuable for their quality of life as well.

3 Methodology

The research methodology in this paper consists of three parts. In the first part of the analysis, the IMD Smart City 2023 Index [25] was merged with the Happy City Index 2023 [26]. Cities that appeared in both indices were identified, resulting in a total of 97 cities worldwide for further analysis. SPSS software was used to analyze the relationships between the rankings and the individual scores of the cities in both indices.

The second part aimed to analyze existing papers on the adoption of smart technology, published in peer-reviewed scientific journals. A keyword search was conducted in the Web of Science (WOS) database. The search criteria included relevant words related to smart technology and either acceptance or adoption, appearing in the title, keywords, or abstract. Only research articles or review articles published in English-language journals indexed in SCI, SCI-expanded, or emerging SCI were included. Papers from WOS categories not relevant for our study such as surgery, orthopedics, veterinary science, art, radiology, and similar fields were excluded.

A total of 3,626 papers published between 1995 and 2023 were further analyzed using VOSviewer software and R Studio (biblioshiny tool). A co-occurrence analysis was performed in VOSviewer on 13,514 keywords with a minimum threshold of 50

occurrences. Additionally, a tree analysis was conducted in R Studio using unigram tokenization on the abstracts of the included papers.

In the third part, a web-based questionnaire was developed, focusing on technology interest, sustainability orientation, smart city-related services, and their impact on the quality of life. In the survey 315 millennials from Slovenia participated, and a total of 214 valid responses on all question sets were collected. The demographic characteristics of the respondents are presented below (Table 1).

Table 1. Profile of respondents

		Share
Gender	female	61%
	Male	39%
Education (highest completed)	high school	55%
	undergraduate	37%
	graduate	8%
Type of settlement	City	46%
	suburban settlement	21%
	a smaller compact settlement	26%
	scattered houses or secluded houses	7%

4 Results

4.1 Relation Between the Smart City and the Happiness

The initial analysis focused on examining the correlation between smart city rankings and happiness rankings. The correlation was found to be statistically significant (Pearson correlation 0.695, significant at the 0.01 level). Figure 1 illustrates a scatter plot of the two rankings. It is important to note that the scales on the axes are different due to the inclusion of several cities in both indices, while our analysis only included cities appearing in both indices, maintaining their original ranks. Lower rank numbers indicate better cities, implying that cities in the lower-left corner are considered the best cities from both the smart city and happiness perspectives.

However, as evident from the Fig. 1, there is a considerable dispersion among the cities. The green circles represent cities that perform well or poorly in terms of both indices. Interestingly, there are several cities that excel in terms of smart city ranking but have relatively low happiness rankings. Consequently, instead of solely examining the ranking positions, we conducted a further analysis of the individual scores received by each city in our sample (Fig. 2).

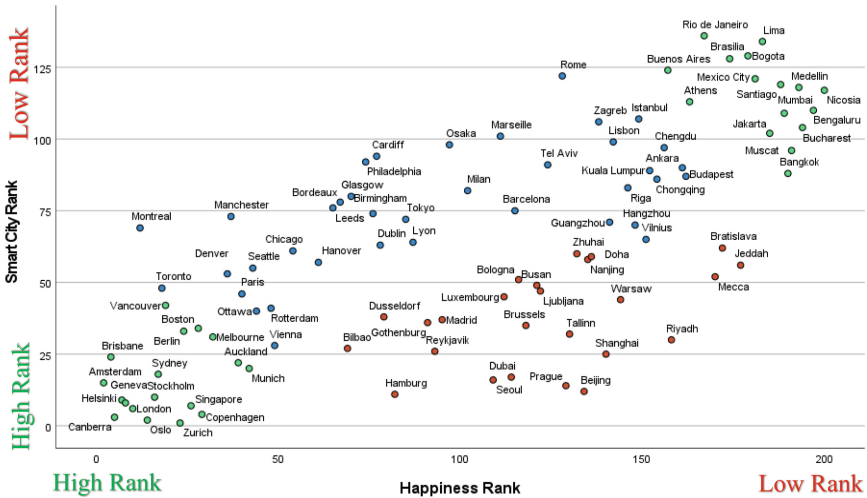


Fig. 1. Relation between smart city rank and happiness rank.

The maximum score for the happiness was 400, while for the smart city score it was 1.00. As a result, cities in the top-right corner of Fig. 2 are considered the best cities from both perspectives. An important observation derived from Fig. 2 is that the majority of cities received commendable scores for the smart city aspect. However, several of these cities performed poorly in terms of happiness.

This observation suggests that solely focusing on increasing smart city scores or enhancing the “smartness” of a city does not necessarily lead to increased happiness within that city. It implies that a holistic approach, considering factors beyond technological advancements, is crucial for achieving overall well-being and happiness in urban environments.

4.2 Bibliographic Analysis of Papers Dealing with Technology Adoption

Given the findings above, we wanted to deeply analyze the scientific literature and the focus of research dealing with smart technology adoption or acceptance. The first observation is that the topic is of interest globally despite some obvious clusters (Fig. 3). After all, it is not surprising due to the similar problems that cities are facing globally.

However, upon conducting a thorough analysis of the abstracts and keywords of the sampled journals within the field, we discovered that scientific papers can be categorized into four major clusters, with well-being being noticeably absent (Fig. 4). The predominant focus of research is primarily centered around (1) the adoption of existing and new technologies and the identification of associated factors, (2) the exploration of underlying technologies and concepts, (3) the consideration of smart technologies as emerging technologies, and (4) the examination of climate change-related issues.

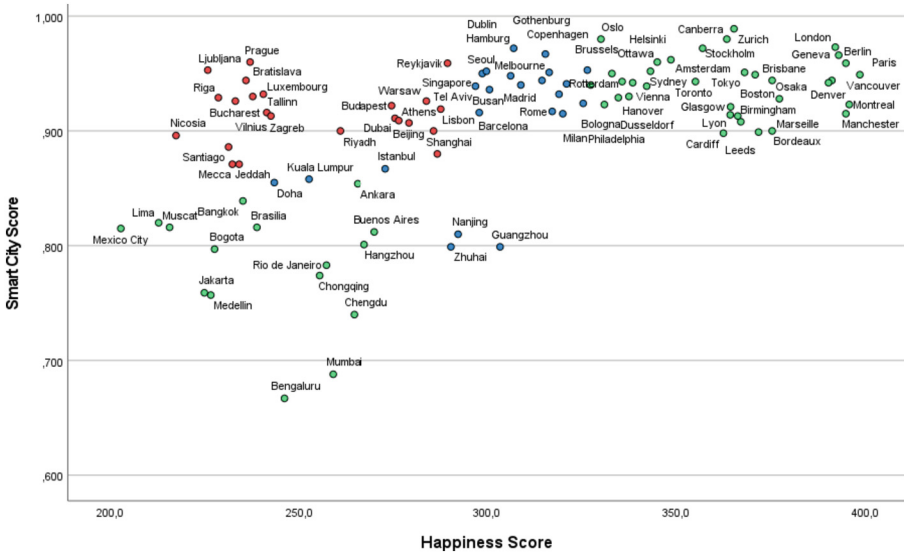


Fig. 2. Relation between smart city score and happiness score.

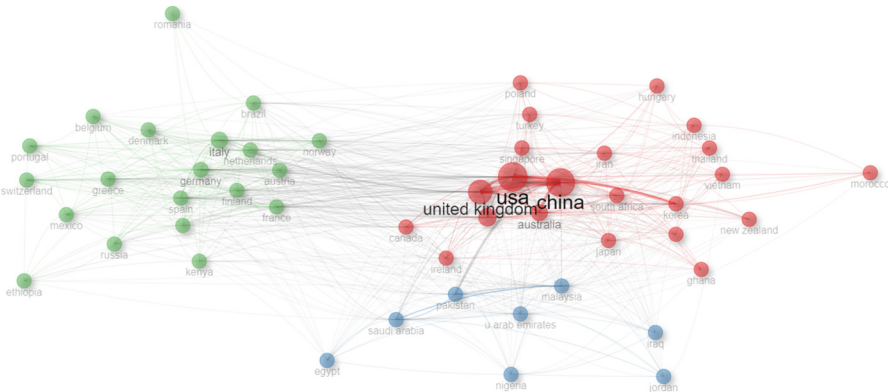


Fig. 3. Collaboration network for smart technology adoption.

Interestingly, the absence of a dedicated cluster for well-being, happiness, or sustainability indicates that the research primarily emphasizes facilitating the adoption process, with less emphasis placed on investigating the impact of smart technology on well-being. There are some rare papers dealing with well-being and smart technology, yet mostly focusing either on older adults only, learning performance or the impact of smart tourism technologies on the well-being of tourists.

4.3 Attitude of Millennials Towards Technology and Sustainability

We additionally wanted to examine the attitude of millennials towards the selected topic. Based on the initial data we received it is evident that additional focused research on areas combining technology, sustainability and well-being is needed. Individuals in our sample in the majority do not have any problems with using new technologies and are even not concerned about their future jobs or afraid that in the future they may not be able to follow new technologies.

Sustainability appears to be a high priority for the respondents; however, when examining their specific behaviors (such as choosing a mean of transport or active participation in reducing the negative impact on the environment), a discrepancy between awareness and action emerges. Despite their awareness of sustainability issues, their individual behaviors suggest less sustainable practices. This highlights the importance of bridging the gap between awareness and action to promote more sustainable behaviors among millennials.

Moreover, the respondents generally view smart cities as entities that enhance the quality of life (Table 2). However, they express less preparedness to live in such cities and show some hesitation in contributing to the community by providing the necessary data for the functioning of smart cities. Mostly they are prepared to share the data in case of some return benefit such as a direct reduction in the cost of living.

Table 2. Attitudes of millennials towards technology, sustainability and smart cities

	disagreement			agreement		Mean
	1	2	3	4	5	
I am excited by the possibilities offered by new technologies.	1%	4%	12%	51%	32%	4.1
Caring for the environment is very important to me.	1%	2%	10%	54%	33%	4.2
When choosing a means of transport, its impact on the environment is important to me.	10%	18%	33%	32%	8%	3.1
Smart cities can improve the quality of life.	2%	4%	18%	60%	17%	3.9
I look forward to living in a smart city.	3%	12%	28%	42%	15%	3.5
I would be willing to share a larger amount of my data without the immediate expected mutual benefits.	22%	34%	26%	16%	1%	2.4
I would be willing to share a larger amount of my data if it meant raising the quality of life of the whole community.	7%	18%	22%	44%	9%	3.3

These results highlight the need for further research in this area, particularly in examining the detailed relationship between technology and well-being. After all, a smart city is a complex combination of technologies aimed at creating better living environments for individuals. While individuals show a favorable attitude towards adopting new technologies and believe that smart cities can address various modern problems, they are less prepared to actively contribute to the environment necessary for the successful functioning of such cities. Therefore, additional research considering the elements of happiness,

well-being, and sustainability is required to gain a more comprehensive understanding of the relationship between technology and well-being in smart cities.

The limitation of the paper is that only the cities that have the data for both the IMD Smart City 2023 Index and the Happy City Index 2023 were included in the further analysis. Another limitation of the study is that it focused only on papers dealing with technology adoption or acceptance, while the keyword happiness or well-being was not included as the search criteria. However, this was the intention of the research to examine the papers dealing with technology adoption only and to study the focus of these papers. Lastly, in the web-based questionnaire, millennials on the voluntary basis participated not presenting a representative sample of the population.

Future research should be conducted on merging various indices to compare the relation between different categories and subitems within these indices in order to identify additional underlying structures among smartness and happiness. Further, additional research on analyzing relevant papers should be conducted by deeply analyzing the relevancy of each paper for inclusion and using text mining techniques to additionally identify focus areas of these papers. Lastly, a discussion regarding the suitability of existing technology acceptance models and involved factors in order to provide solutions that are leading to sustainability, well-being and happiness should be encouraged. A turbulent environment is already presenting a challenge for existing well-established technology acceptance models in order how to properly address and identify the crucial factors; while sustainability and achieving a state of suitable well-being are presenting additional challenges on how to incorporate these concepts into existing models.

5 Conclusion

Living in a city is becoming increasingly popular as people are attracted to the variety of employment, educational, and recreational opportunities that only diverse urban environments can provide. However, due to the high population density and increased work activity, there are several drawbacks related to pollution, traffic, and public health care problems. The smart city concept may present one of the ways for to tackle these challenges. However, the success of smart city initiatives depends not only on proper technology or technology implementations, but on considering wider complex aspects of intertwining the technology, sustainability and well-being.

This paper examines the smart city concept through the lenses of technology, sustainability, and well-being, considering the current state of cities and a substantial body of scientific literature on technology adoption. The findings highlight the strong need for future research that embraces a holistic perspective and reconsiders existing technology acceptance models to incorporate contemporary issues.

After all, the smart city can be both, a myth and reality. The result mostly depends on the ability to properly manage the technology, sustainability, and well-being. As evidenced in the paper, there are already numerous smart cities around the world facing challenges in achieving happiness and well-being for their inhabitants. Or written differently, there are already too many unhappy, yet smart cities in the world.

References

1. Hämäläinen, M.: A framework for a smart city design: digital transformation in the Helsinki smart city. *Entrepreneursh. Community Multidisc. Perspect. Create. Soc. Challenges Bus.* 63–86 (2020)
2. Schaffers, H., Komninos, N., Pallot, M., Trousse, B., Nilsson, M., Oliveira, A.: Smart cities and the future internet: towards cooperation frameworks for open innovation. In: Domingue, J., et al. (eds.) *FIA 2011. LNCS*, vol. 6656, pp. 431–446. Springer, Heidelberg (2011). https://doi.org/10.1007/978-3-642-20898-0_31
3. Scuotto, V., Ferraris, A., Bresciani, S.: Internet of things: applications and challenges in smart cities: a case study of IBM smart city projects. *Bus. Process. Manag. J.* **22**(2), 357–367 (2016)
4. Osman, A.M.S., Elragal, A.A., Ståhlbröst, A.: Data-driven decisions in smart cities: a digital transformation case study. *Appl. Sci.* **12**(3), 1732 (2022)
5. Zandbergen, D., Uitermark, J.: In search of the smart citizen: republican and cybernetic citizenship in the smart city. *Urban Stud.* **57**(8), 1733–1748 (2020)
6. Ahern, J.: From fail-safe to safe-to-fail: Sustainability and resilience in the new urban world. *Landsc. Urban Plan.* **100**(4), 341–343 (2011)
7. Elkington, J.: Towards the sustainable corporation: win-win-win business strategies for sustainable development. *Calif. Manag. Rev.* **36**(2), 90–100 (1994)
8. Agudelo, M.A.L., Jóhannsdóttir, L., Davídsdóttir, B.: A literature review of the history and evolution of corporate social responsibility. *Int. J. Corp. Soc. Responsib.* **4**(1), 1–23 (2019)
9. Van Marrewijk, M.: Concepts and definitions of CSR and corporate sustainability: between agency and communion. *J. Bus. Ethics* **44**(2), 95–105 (2003)
10. United Nations: 68% of the world population projected to live in urban areas by 2050 (2018)
11. Schaffers, H., Ratti, C., Komninos, N.: Special issue on smart applications for smart cities—new approaches to innovation: guest editors’ introduction. *J. Theor. Appl. Electron. Commer. Res.* **7**(3), 2–6 (2012)
12. Van den Bergh, J., Viaene, S.: Unveiling smart city implementation challenges: the case of Ghent. *Inf. Polity* **21**(1), 5–19 (2016)
13. Ismagilova, E., Hughes, L., Dwivedi, Y.K., Raman, K.R.: Smart cities: advances in research—an information systems perspective. *Int. J. Inf. Manag.* **47**, 88–100 (2019)
14. Chatterjee, S., Kar, A.K.: Effects of successful adoption of information technology enabled services in proposed smart cities of India: from user experience perspective. *J. Sci. Technol. Policy Manag.* (2017)
15. Duygan, M., Fischer, M., Pärli, R., Ingold, K.: Where do Smart Cities grow? The spatial and socio-economic configurations of smart city development. *Sustain. Cities Soc.* **77**, 103578 (2022)
16. Lom, M., Pribyl, O.: Smart city model based on systems theory. *Int. J. Inf. Manag.* **56**, 102092 (2021)
17. Shabanpour, R., Golshani, N., Shamshiripour, A., Mohammadian, A.K.: Eliciting preferences for adoption of fully automated vehicles using best-worst analysis. *Transport. Res. Part C: Emerg. Technol.* **93**, 463–478 (2018)
18. Chourabi, H., et al.: Understanding smart cities: an integrative framework. In: 2012 45th Hawaii International Conference on System Sciences, pp. 2289–2297. IEEE (2012)
19. Tomičić Pupek, K., Pihir, I., Tomičić Furjan, M.: Smart city initiatives in the context of digital transformation—scope, services and technologies. *Manag. J. Contemp. Manag. Issues* **24**(1), 39–54 (2019)
20. Kummitha, R.K.R., Crutzen, N.: How do we understand smart cities? An evolutionary perspective. *Cities* **67**, 43–52 (2017)

21. Colldahl, C., Frey, S., Kelemen, J.E.: Smart cities: strategic sustainable development for an urban world (2013)
22. Caragliu, A., Del Bo, C., Nijkamp, P.: Smart Cities in Europe. *J. Urban Technol.* **18**(2), 65–82 (2011)
23. Tura, N., Ojanen, V.: Sustainability-oriented innovations in smart cities: a systematic review and emerging themes. *Cities* **126**, 103716 (2022)
24. Nikitas, A., Michalakopoulou, K., Njoya, E.T., Karampatzakis, D.: Artificial intelligence, transport and the smart city: definitions and dimensions of a new mobility era. *Sustainability* **12**(7), 2789 (2020)
25. IMD World Competitiveness Center: IMD Smart City Index 2023 (2023)
26. Institute for Quality of Life: Happy City Index. Institute for Quality of Life (2023)