SMART CITIES AND THE PANDEMIC: CHALLENGES, SOLUTIONS AND PROSPECTS

https://doi.org/10.47743/jopafl-2023-30-24

URSACHE Ioana-Maria
Alexandru Ioan Cuza University of Iași,
Doctoral School of Economics and Business Administration,
Iași, Romania

Abstract: As cities continue to evolve and face new challenges, the principles of smart cities - technology integration, data utilisation, sustainability, and community engagement - will remain vital in shaping the future of urban development. The COVID-19 pandemic has accelerated the adoption of these principles, highlighting their relevance and impact on enhancing the well-being of urban residents. This paper explores the evolving landscape of smart cities in the wake of the COVID-19 pandemic, delving into how cities are reimagining urban development to address the challenges they face. It examines the pivotal role of technology, data-driven decision-making, and sustainability in shaping the future of cities. Through a comprehensive analysis of key trends and best practices, this paper offers insights into how smart cities are navigating the post-pandemic era to create more resilient, sustainable, and inclusive urban environments that enhance the well-being of their residents.
Keywords: smart cities, pandemic, COVID-19, sustainability, resilience

This Article was presented as a paper at the 15th edition of the Annual International Conference Globalization and Higher Education in Economics and Business Administration (GEBA 2023), which was held at the Alexandru Ioan Cuza University, Faculty of Economics and Business Administration in Iasi, Romania from the 19-21 October 2023.

Introduction

Today's cities are complex systems, characterised by an increasing number of diverse and interconnected services and utilities, as well as extensive transport networks. They stand as the primary engines of economic development, concentrating more than half of the world's population and contributing over 80% of global GDP (UN, 2022). However, with this central role in global progress comes a stark reality: cities are also responsible for over 70% of global resource consumption and greenhouse gas emissions. These emissions are not only a result of urban density and the intensity of economic and social activities but also a consequence of inefficient urban planning (Bibri & Krogstie, 2017). As cities continue to grow and evolve, they grapple with multifaceted challenges that encompass various dimensions of life. These challenges span social issues, such as ensuring equitable access to education, healthcare, and housing, as well as environmental concerns related to pollution and ecosystem degradation. Furthermore, cities must address administrative challenges associated with citizen participation and the overall quality of life (Kirimtat et al., 2020; Zheng et al., 2020). In light of these complexities, the urbanisation process of the 21st century must be thoughtfully shaped and organised to allow cities to realise their

potential: not only to drive prosperity but also to enhance social cohesion, environmental quality, and the well-being of their residents.

The emergence of the COVID-19 pandemic has cast a unique spotlight on the inherent strengths and vulnerabilities of cities. While it has underscored the importance of adaptability and resilience in urban planning and governance, it has also accelerated trends in digital transformation, remote work, healthcare delivery, and sustainable mobility. The pandemic has prompted cities to reevaluate their priorities, with a newfound emphasis on public health, community engagement, and digital inclusion. This paper explores the evolving landscape of smart cities in the wake of the COVID-19 pandemic, delving into how cities are reimagining urban development to address the challenges they face. It examines the pivotal role of technology, data-driven decision-making, and sustainability in shaping the future of cities. Through a comprehensive analysis of key trends and best practices, this paper offers insights into how smart cities are navigating the post-pandemic era to create more resilient, sustainable and inclusive urban environments that enhance the well-being of their residents.

The Smart City Concept

The notion of the future of cities has been a subject of exploration across multiple disciplines, including urban planning, architecture, and research. In 1987, the Brundtland Report, titled "Our Common Future" and produced by the World Commission on Environment and Development, brought significant attention to the concept of a sustainable city. This report served as a pivotal moment, solidifying the sustainable city as the predominant vision for the urban landscapes of tomorrow. The sustainable city, grounded in a dynamic interplay of three fundamental pillars encompassing economic, social, and environmental dimensions, as articulated by Rogers (1998), strives to enhance the quality of life for urban populations while concurrently curbing resource consumption. It aspires to evolve into a self-sustaining ecosystem. In the pursuit of this ambition, various models of sustainable urban development have emerged in recent years, each contributing to the multifaceted goal of enhancing the prospects of urban inhabitants while navigating contemporary global challenges. Among these models are the "eco-city" (Bibri and Bardici, 2015), the "low-carbon city" (Gossop, 2011), the "compact city" (Neuman, 2005) and the "resilient city" (Jabareen, 2013). These models collectively represent the aspirations of cities to elevate the well-being of their residents and adapt to the complexities of the modern world.

The 1990s witnessed a remarkable period marked by technological advancements and the deep-seated integration of Information and Communication Technology (ICT) into urban services. This epoch gave rise to the concept of the digital city, which envisioned a comprehensive, internet-based representation of myriad city functions, designed to be accessible to all, irrespective of their technical expertise (Couclelis, 2004). Notably, the recognition of technology as an indispensable cornerstone in shaping the cities of the future dates back to the 1980s. During this time, various concepts emerged, such as the “wired city” (Dutton, 1987), the “information city” (Castells, 1996), the “cyber city” (Graham and Marvin, 1999), the “ubiquitous city” (Anthopoulos and Fitsilis, 2010), and the “'intelligent city” (Komninos, 2006). These conceptual frameworks provided diverse perspectives on the intricate relationship between the urban environment and ICT, thereby contributing significantly to the discourse on the evolution of cities in an increasingly digital age.

The latest concept at the forefront of discussions about the future of cities is the "smart city" (SC), representing an evolution of urban development practices informed by earlier models. The inception of the smart city concept has been the subject of extensive debate across various academic studies and fields. Today, the term "smart city" is in widespread use, encompassing a diverse array of actors, including universities, research institutes, governments, public administrations, and companies. However, despite its ubiquity, a universally accepted and comprehensive definition of the smart city concept remains elusive (Angelidou, 2015; Caragliu et al., 2009; Chourabi et al., 2012; Neirotti et al., 2014). Consequently, the notion of a smart city often appears vague and contingent upon the specific context in which it is examined, including factors like available resources, policy frameworks, administrative structures, or financial capabilities (Bibri & Krogstie, 2017).

Many of the prevailing definitions of smart cities are technology-centric, emphasising the role of technology in enabling cities to operate more intelligently and efficiently. This perspective is straightforward and revolves around the idea that technology can empower cities to work "smart" across various urban systems, which can be further segmented into technological domains (e.g., smart mobility, smart energy) and socio-economic aspects (e.g., smart population, smart economy). Another segment of the literature takes a more expansive view by highlighting the interplay between technology and human capital development. In this broader perspective, a smart city is not solely defined by its adoption of information and communication technology (ICT), but also by its capacity to empower citizens to innovate, participate in societal development, and collectively address common challenges for the greater good. This human-centric approach underscores the idea that the "smartness" of a city is intrinsically linked to the active engagement and agency of its residents in shaping their urban environment.

Numerous experts have conducted extensive research to understand the intricate factors that contribute to the success of smart cities. Given the multifaceted nature of urban systems and the dynamic concept of smart cities, a multitude of characteristics play pivotal roles in shaping their functionality and effectiveness. Lombardi et al. (2012) have proposed a holistic framework comprising six domains that collectively define the smart city. These domains encompass mobility and transport, environment, housing, people, economy, and governance. This comprehensive approach recognises that smart cities must excel in multiple dimensions, addressing various facets of urban life and development. Albino et al. (2015) claim that achieving sustainable urban development within the context of smart cities necessitates a framework that not only prioritises technological advancements but also fosters political competence and social development. Their perspective underscores the critical role of governance and community engagement in realising the full potential of smart city initiatives.

Giffinger et al. (2007) have contributed significantly to the discourse on smart cities by offering a comprehensive and intricate definition. Their framework serves as the foundation for the development of smart city rankings and assessments. Unlike simplistic approaches that rely on individual indicators, Giffinger et al.'s approach embraces a wide spectrum of characteristics and qualities. It is rooted in the concept of "future-oriented development" (Giffinger et al., 2007, p.10), acknowledging the influence of local conditions and the collective actions and decisions of local authorities, citizens, and private stakeholders. According to this framework, a city's smartness is assessed across six key

dimensions: economy, people, governance, mobility, environment, and living. Excellence in these dimensions collectively defines a city's status as "smart."

The COVID-19 Pandemic in Urban Environments

The COVID-19 pandemic had profound and far-reaching effects on cities around the world. It highlighted both the vulnerabilities and strengths of urban areas in responding to a global health crisis. Several studies have been conducted to understand the effects of the pandemic and explore potential strategies for resilience and sustainable development in the post-pandemic era (Sharifi and Khavarian-Garmsir, 2020; Sharifi, 2022). The concept of green recovery in urban areas has been explored, emphasising the importance of sustainable and environmentally friendly strategies in post-pandemic urban development (Moglia et al., 2021). Such strategies are essential for building resilient and eco-friendly cities. The importance of ensuring ample and equitable distribution of green spaces within urban areas has been a long-standing concern in urban planning. The COVID-19 pandemic has intensified this focus, as evidenced by a global analysis of urban park visitation trends conducted before and during the pandemic across numerous countries (Geng et al., 2021). As mobility restrictions elevated the risk of social isolation and increased anxiety-related issues, access to parks and green spaces emerged as crucial for individuals of all age groups to maintain their mental al physical well-being (Levinger et al., 2021; Pouso et al., 2021).

In addition to the issue of uneven access to green spaces and ecosystem services, the pandemic has drawn attention to vulnerabilities stemming from poverty and health disparities. Notably, certain North American cities have demonstrated a connection between unequal infrastructure distribution and heightened vulnerability to the pandemic within specific racial and low-income communities (Enright and Ward, 2021). Several significant factors contributing to these vulnerabilities include precarious livelihoods, which may lead individuals to disregard stay-at-home orders, and unfavourable living conditions, such as crowded slums, making it difficult to adhere to hygiene and social distancing guidelines (Sharifi and Khavarian-Garmsir, 2020; DeGroot and Lemanski, 2021).

Collectively, these vulnerabilities underscore the disproportionate impact of the pandemic on marginalised groups, especially during economic downturns and rising unemployment rates (Creţan and Light, 2020; Sharifi and Khavarian-Garmsir, 2020). There is a growing consensus that the pandemic has exacerbated existing urban inequalities (Turok and Visagie, 2021). One of the critical lessons learned is that societal inequalities act as barriers to effective pandemic response and control measures, potentially compromising the safety of more privileged groups (Moglia et al., 2021). One of the most prominently discussed effects in the literature has been the notable shift towards active transportation, encompassing walking and cycling (Buchel et al., 2022; Scorrano and Danielis, 2021). This shift, coupled with the evident environmental quality improvements resulting from substantial reductions in traffic, as previously explored, has opened unprecedented opportunities to reimagine the urban streetscape. Cities like Barcelona, New York and Melbourne have already embraced such transformations (Kakderi et al., 2021; Montero and Barcelo, 2020; Pase et al., 2020). The reallocation of underutilised public spaces to create cycling lanes and pedestrian areas has become a focal point of urban redesign.

This reshaping of the streetscape not only accommodates the rising trend of active transportation but also plays a pivotal role in averting the overburdening of public transit

systems, thus enhancing resilience against future pandemics (Barbarossa, 2020). Furthermore, these efforts to promote active transportation align with the broader goals of decarbonising urban transport and meeting urban climate change mitigation targets. To maximise these contributions, adopting integrated approaches is essential. For instance, integrating cycling and pedestrian corridors with urban green infrastructure networks not only enhances the appeal of the environment but also provides health and adaptation co-benefits (Valente et al., 2021). These integrated strategies are crucial for creating more sustainable, resilient, and liveable urban spaces in a post-pandemic world.

Smart city solutions and technologies present a unique opportunity to build upon the transformations spurred by the pandemic and sustain their momentum. For instance, teleworking can complement efforts to reduce travel demands, as some work-related trips that cannot be easily replaced by active modes may be cancelled (Sharifi, 2022). Automation, particularly through the deployment of autonomous vehicles, including public autonomous buses, has the potential to reduce the reliance on private cars and promote public transit and shared mobility (Ceder, 2020). Coupled with car-sharing and mobility-as-a-service schemes, autonomous vehicles can enhance accessibility for diverse social groups while offering cost-effective and comfortable mobility services (Mouratidis et al., 2021).

Shared mobility schemes, such as bike-sharing, have been the subject of extensive research (Kim et al., 2021). Notably, evidence from cities like New York City indicates a swift rebound in bike-sharing ridership to pre-pandemic levels following lockdown periods, demonstrating its resilience as a public transportation mode compared to subway ridership (Wang and Noland, 2021). When effectively integrated into the public transit system, bike-sharing systems offer a practical solution to the last-mile connection challenge and contribute to reducing automobile use (Pase et al., 2020).

Furthermore, the utility of smart city solutions and technologies extends beyond transportation, embracing areas like machine learning and artificial intelligence. These technologies have exhibited substantial potential in augmenting a city's ability to prepare for, recover from, and adapt to pandemic-related impacts. Their applications span predicting transmission patterns, contact tracing, ensuring uninterrupted city operations during lockdowns, mitigating disruptions in the supply chain, and facilitating optimised, integrated urban governance and management (Sharifi et al., 2020). For example, some countries, including South Korea, have harnessed web-based trading platforms to establish direct links between consumers and farmers in response to food supply chain disruptions (Blay-Palmer et al., 2021). Additionally, urban observatories have been deployed across diverse contexts, aiding in swift responses to evolving demands, engaging stakeholders, mitigating sectoral conflicts, and addressing intersectoral interactions across various scales through integrated multilevel governance systems (Moglia et al., 2021).

Nevertheless, it is crucial to acknowledge the raised concerns regarding data privacy and the dissemination of misinformation on social media platforms (Sharifi et al., 2020). These concerns underscore the necessity for further research to explore how smart solutions and technologies, underpinned by artificial intelligence, the Internet of Things, and machine learning, can effectively address privacy and data security issues, which hold paramount importance for urban residents. Furthermore, these technologies possess the potential not only to promote more sustainable urban development patterns but also to reform urban

economic structures, enhance integrated urban management, and fortify planning, absorption, recovery and adaptation capacities in the face of adverse events (Sharifi, 2020).

Methodology

The paper's methodology will involve a comprehensive review of best practices and case studies from smart cities worldwide that have demonstrated effective responses to the challenges posed by the COVID-19 pandemic. The research implied three levels of analysis, starting with an extensive review of academic literature and government reports detailing the initiatives and various practices adopted by cities during the pandemic. A central aspect of this study involves the identification and analysis of best practices adopted by the selected smart cities in response to the pandemic. Data was collected from official reports, case studies, government documents and academic research that provide insights into strategies, technological implementation and sustainability dimensions of these cities. In addition to best practices, this research implies a rigorous analysis of emerging trends that have surfaced as a result of the COVID-19 pandemic's impact on smart cities. The analysis of these trends contributes to a holistic understanding of how smart cities are navigating the post-pandemic landscape to create more resilient, sustainable, and inclusive urban environments for their residents.

The selection of the cities, Singapore, Barcelona, Bogota, Melbourne and Seoul was based on a combination of factors that made them notable examples of smart city responses to the COVID-19 pandemic. The chosen cities represent different regions of the world, offering a global perspective on how smart cities responded to the pandemic. This diversity allows for a comprehensive examination of practices across different cultural, economic, and urban contexts. These cities offer valuable lessons and insights for other urban centres facing similar challenges. Their experiences can serve as models for future urban development strategies in a post-pandemic world. It's worth noting that this study comes with certain limitations, including its reliance on secondary data sources as the accuracy and completeness of the collected documents are beyond the researcher’s control. Furthermore, this study focuses exclusively on Singapore, Barcelona, Bogota, Melbourne and Seoul and its findings may not be directly transferable to other cities.

Results and discussions

Amid the economic, social and political pressures, the pandemic prompted a swift and transformative response in urban policymaking and planning. Cities were compelled to adapt to the evolving landscape, fostering innovation and resilience. Examples abound of cities enacting policy changes and embarking on urban planning initiatives tailored to the new reality. The best practices observed in smart cities, including Singapore, Barcelona, Bogota, Melbourne and Seoul, offer valuable insights into how urban centres have responded to the challenges posed by the COVID-19 pandemic. These practices encompass a range of strategies, from digital health services to sustainable urban development and innovative approaches to mobility. The digital health services implemented by Singapore during the pandemic were instrumental in managing the virus’s spread. The “TraceTogether” App was a critical tool for contact tracing and controlling the spread of COVID-19 (Singapore Government Agency, n.d.). The app used Bluetooth signals to exchange anonymised proximity data with nearby phones. This allowed for the identification of close contacts of confirmed COVID-19 cases (Singapore Government

Developer Portal, 2023) When a user tested positive for COVID-19, the app helped authorities identify and notify individuals who had been in close contact with the infected person. This sped up contact tracing efforts and reduced potential transmission. The app prioritised user privacy by using temporary, anonymised IDs rather than collecting personal data. Data was stored locally on users' devices and automatically deleted after 25 days.

Seoul, the capital of South Korea, demonstrated exceptional pandemic response measures during the COVID-19 crisis, leveraging technology and innovation to enhance testing efficiency and healthcare access (Lee and Lee, 2020). These facilities allowed residents to get tested for COVID-19 quickly and conveniently while minimising the risk of virus transmission in crowded healthcare settings. By offering multiple testing options, Seoul ensured that individuals had access to testing resources tailored to their needs and preferences. Seoul prioritised transparent communication with the public (Seoul Metropolitan Government, 2020). The city regularly provided updates on COVID-19 cases, safety guidelines, and testing locations through various communication channels, including websites, mobile apps, and social media. This transparent communication strategy helped build public trust, encouraged compliance with safety measures, and promoted a sense of collective responsibility among residents.

Bogota's emphasis on active transportation emerged as a standout best practice during the COVID-19 pandemic (Bogota Government, 2021). One of Bogota's key initiatives was the expansion of dedicated bike lanes throughout the city. This strategic move not only encouraged residents to adopt cycling as a mode of transportation but also provided a safer and more accessible alternative to public transportation and private vehicles. By creating a network of bike lanes, Bogota facilitated a convenient and eco-friendly means of commuting, particularly during a time when social distancing and reduced vehicle occupancy were critical. In addition to bike lanes, Bogota also increased the availability of pedestrian zones in various parts of the city. These pedestrian-friendly areas allowed residents to walk safely while maintaining physical distance from others. These zones were often situated in busy urban areas, making it easier for people to access essential services and recreational spaces without relying on traditional forms of transportation.

Melbourne's "Reimagine the City" project was a remarkable initiative undertaken by the city to respond to the challenges posed by the COVID-19 pandemic (City of Melbourne, 2020). The administration prioritised community engagement as it sought input from residents, businesses, and community organisations to ensure that the project's interventions aligned with the needs and preferences of the local population. This collaborative approach fostered a sense of ownership and unity among locals. The city also introduced initiatives such as outdoor dining spaces (City of Melbourne, n.d.) and pop-up markets to enable businesses to operate safely while adhering to social distancing guidelines. These measures not only helped businesses stay afloat but also contributed to the vibrancy of Melbourne's urban spaces.

Barcelona's "Superblocks" project represents an innovative and sustainable urban planning initiative that significantly improved the quality of life for residents while addressing challenges posed by the COVID-19 pandemic. Barcelona's "Superblocks" project involved the transformation of traditional urban blocks into pedestrian-centric zones. The city identified nine-square-block areas and reimagined them as car-free or car-limited spaces. The primary goal was to reduce traffic congestion, improve air quality, and promote

sustainable mobility within these zones (Camerin and Fabris, 2021). The Superblocks project promoted sustainable mobility options such as walking and cycling. Wider sidewalks, dedicated bike lanes, and pedestrian-friendly infrastructure were introduced to encourage residents to choose active transportation modes (Benavides et al., 2022). This approach aligned with the need for safe and socially distanced means of getting around the city during the pandemic.

The analysis of the five cities reveals common features and valuable lessons in how they responded to the COVID-19 pandemic and embraced smart city principles to navigate through the crisis. All five cities prioritised data-driven decision-making during the pandemic. They leveraged advanced data analytics, real-time monitoring, and innovative technologies to track the virus's spread, identify hotspots, and allocate resources effectively.

Singapore, Seoul, Barcelona, Bogota, and Melbourne showcased their commitment to technological innovation. They employed various digital tools, mobile apps, and telemedicine to provide healthcare services, disseminate information, and engage with residents. These technologies not only supported pandemic response but also promoted efficiency and accessibility in urban services. Transparent communication was pivotal in managing the pandemic. These cities regularly provided updates on COVID-19 cases, safety guidelines, and testing locations through various communication channels. This transparency built public trust and ensured that residents were well-informed.

The pandemic has underscored the pressing need for cities to address disparities in access to green spaces, ensuring that all residents, regardless of their socioeconomic status or neighbourhood of residence, have the opportunity to benefit from these vital urban resources. The equitable provision of green spaces is not only a matter of urban planning but also a critical component of promoting public health and well-being, particularly during times of crisis. All five cities invested in resilient infrastructure. Whether it was Bogota's expanding bike lanes, Melbourne's street reimagining project, or Barcelona's Superblocks, they prioritised sustainable and adaptable urban environments. These investments not only improved mobility but also enhanced residents' well-being during the pandemic. The cities recognised the importance of green spaces for public health. Barcelona, Bogota, and Melbourne, in particular, preserved and expanded green areas, providing residents with opportunities for outdoor activities, exercise, and mental relaxation during lockdowns.

Conclusions

The COVID-19 pandemic has brought to the forefront the critical importance of smart city principles in urban development. Cities have faced multifaceted challenges during the pandemic, ranging from public health crises to economic disruptions and social inequalities. However, they have also demonstrated remarkable resilience, adaptability, and innovation in response to these challenges. This paper has explored the evolving landscape of smart cities in the post-pandemic era, focusing on key trends and best practices adopted by notable cities such as Singapore, Barcelona, Bogota, Melbourne, and Seoul. Drawing on the smart city conceptualisation and its dimensions, a few key lessons and features have been identified.

Smart cities prioritise data as a foundation for informed decision-making. The pandemic underscored the significance of data analytics, real-time monitoring, and predictive modelling in pandemic control and resource allocation. The adoption of innovative technologies, such as mobile apps, telemedicine, and digital platforms, has been

instrumental in delivering healthcare services, disseminating information, and engaging with residents during the pandemic. Furthermore, cities have recognised the importance of community engagement and transparent communication in fostering public trust, ensuring compliance with safety measures, and promoting collective responsibility.

Moreover, investments in resilient infrastructure, including green spaces, cycling infrastructure, and adaptable urban environments, have contributed to both pandemic response and long-term sustainability. Preserving and expanding green spaces has provided residents with outdoor recreational opportunities and improved mental well-being during lockdowns. At the same time, promoting active transportation modes like cycling and pedestrian zones has reduced reliance on public transportation and private cars, promoting both mobility and public health.

References

1. Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart cities: Definitions, dimensions, performance, and initiatives. Journal of urban technology, 22(1), 3-21. https://doi.org/10.1080/10630732.2014.942092
2. Angelidou, M. (2015). Smart cities: A conjuncture of four forces. Cities, 47, 95-106. https://doi.org/10.1016/j.cities.2015.05.004
3. Anthopoulos, L., & Fitsilis, P. (2010). From Digital to Ubiquitous Cities: Defining a Common Architecture for Urban Development. 2010 Sixth International Conference on Intelligent Environments. https://doi.org/10.1109/ie.2010.61
4. Barbarossa, L. (2019). The Post Pandemic City: Challenges and Opportunities for a Non-Motorized Urban Environment. An Overview of Italian Cases. Sustainability, 12(17), 7172. https://doi.org/10.3390/su12177172
5. Benavides, J., Usmani, S., & Kioumourtzoglou, M. A. (2022). Scaling the Superblock model to city level in Barcelona? Learning from recent policy impact evaluations. Contesti. Città, territori, progetti, (2), 79-94.
6. Bibri, S. E., & Bardici, V. (2015). The Sustainability of eco-city model of sustainable urban form: Green and energy efficiency technology-related framing and selectivity issues in eco-city projects in Stockholm. International Journal of Architectural and Environmental Engineering, 2(5), 1-20.
7. Bibri, S. E., & Krogstie, J. (2017). Smart sustainable cities of the future: An extensive interdisciplinary literature review. Sustainable Cities and Society, 31, 183-212. https://doi.org/10.1016/j.scs.2017.02.016
8. Blay-Palmer, A., Santini, G., Halliday, J., Malec, R., Carey, J., Keller, L., ... & van Veenhuizen, R. (2021). City region food systems: building resilience to COVID-19 and other shocks. Sustainability, 13(3), 1325.
9. Bogota Government. (2021, March). El coronavirus y nuestro reencuentro con la bicicleta [The coronavirus and our reunion with cycling]. https://bogota.gov.co/mi-ciudad/movilidad/el-uso-de-la-bicicleta-durante-la-pandemia
10. Büchel, B., Marra, A. D., & Corman, F. (2022). COVID-19 as a window of opportunity for cycling: Evidence from the first wave. Transport Policy, 116, 144-156. https://doi.org/10.1016/j.tranpol.2021.12.003
11. Camerin, F., & Fabris, L. M. F. (2021). Towards the Post-Pandemic (Healthy) City: Barcelona's Poblenou Superblock Challenges and Opportunities. Volume 2: Housing and Home, 65-74.
12. Castells, M. (1996). The rise of the network society: The Information Age (1st ed.). Cambridge: Blackwell.
13. Caragliu, A., & Del Bo, C. (2009, October). Nijkamp.: P. Smart cities in Europe. In Proceedings of the 3rd Central European Conference in Regional Science. Košice, Slovak Republic (pp. 7-9).
14. Ceder, A. (2021). Urban mobility and public transport: Future perspectives and review. International Journal of Urban Sciences, 25(4), 455-479.

15. Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., ... & Scholl, H. J. (2012, January). Understanding smart cities: An integrative framework. In 2012 45th Hawaii international conference on system sciences (pp. 2289-2297). IEEE.
16. City of Melbourne. (n.d.). Outdoor dining permits. https://www.melbourne.vic.gov.au/business/permits-and-approvals/hospitality-businesses/Pages/outdoor-cafe-dining-permits.aspx
17. City of Melbourne. (2020, September). COVID-19 Reactivation and Recovery Plan. https://www.melbourne.vic.gov.au/sitecollectiondocuments/covid-19-reactivation-recovery-plan.pdf
18. Couclelis, H. (2004). The construction of the digital city. Environment and Planning B: Planning and design, 31(1), 5-19.
19. Creţan, R., & Light, D. (2020). COVID-19 in Romania: Transnational labour, geopolitics, and the Roma 'outsiders'. Eurasian Geography and Economics, 61(4-5), 559-572. https://doi.org/10.1080/15387216.2020.1780929
20. De Groot, J., & Lemanski, C. (2020). COVID-19 responses: Infrastructure inequality and privileged capacity to transform everyday life in South Africa. Environment and Urbanization. https://doi.org/10.1177/0956247820970094
21. Dutton, W. (1987). Wired cities. Boston: Hall.
22. Geng, D., Innes, J., Wu, W., & Wang, G. (2021). Impacts of COVID-19 pandemic on urban park visitation: a global analysis. Journal of forestry research, 32, 553-567. https://doi.org/10.1007/s11676-020-01249-w
23. Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic, N., & Meijers, E. J. (2007). Smart cities. Ranking of European medium-sized cities. Final Report.
24. Gossop, C. (2011). Low carbon cities: An introduction to the special issue. Cities, 6(28), 495-497.
25. Graham, S., & Marvin, S. (1999). Planning cybercities: integrating telecommunications into urban planning. Town Planning Review, 70(1), 89. https://doi.org/10.3828/tpr.70.1.w34454x3475g2858
26. Jabareen, Y. (2013). Planning the resilient city: Concepts and strategies for coping with climate change and environmental risk. Cities, 31, 220-229. https://doi.org/10.1016/j.cities.2012.05.004
27. Kakderi, C., Oikonomaki, E., & Papadaki, I. (2021). Smart and resilient urban futures for sustainability in the post COVID-19 era: A review of policy responses on urban mobility. Sustainability, 13(11), 6486. https://doi.org/10.3390/su13116486
28. Kim, K. (2021). Impact of COVID-19 on usage patterns of a bike-sharing system: Case study of seoul. Journal of transportation engineering, Part A: Systems, 147(10), 05021006. https://doi.org/10.1061/JTEPBS.0000591
29. Kirimtat, A., Krejcar, O., Kertesz, A., & Tasgetiren, M. F. (2020). Future Trends and Current State of Smart City Concepts: A Survey. IEEE Access, 8, 86448-86467, https://doi.org/10.1109/ACCESS.2020.2992441
30. Komninos, N. (2006). The architecture of intelligent cities. Intelligent Environments, 6, 53-61.
31. Lee, D., & Lee, J. (2020). Testing on the move: South Korea's rapid response to the COVID-19 pandemic. Transportation Research Interdisciplinary Perspectives, 5, 100111. https://doi.org/10.1016/j.trip.2020.100111
32. Levinger, P., Cerin, E., Milner, C., & Hill, K. D. (2022). Older people and nature: the benefits of outdoors, parks and nature in light of COVID-19 and beyond–where to from here?. International Journal of Environmental Health Research, 32(6), 1329-1336. https://doi.org/10.1080/09603123.2021.1879739
33. Lombardi, P., Giordano, S., Farouh, H., & Yousef, W. (2012). Modelling the smart city performance. Innovation: The European Journal of Social Science Research, 25(2), 137-149. https://doi.org/10.1080/13511610.2012.660325
34. Lupu, D., & Tiganasu, R. (2024). Does education influence COVID-19 vaccination? A global view. Heliyon, 10(3).
35. Moglia, M., Frantzeskaki, N., Newton, P., Pineda-Pinto, M., Witheridge, J., Cook, S., & Glackin, S. (2021). Accelerating a green recovery of cities: Lessons from a scoping review and a proposal for mission-oriented recovery towards post-pandemic urban resilience. Developments in the Built Environment, 7, 100052. https://doi.org/10.1016/j.dibe.2021.100052

36. Montero, L., & Barceló, J. (2020). Mobility Trends before and after the Pandemic Outbreak: Analyzing the Metropolitan Area of Barcelona through the Lens of Equality and Sustainability. Sustainability, 13(14), 7908. https://doi.org/10.3390/su13147908
37. Mouratidis, K., Peters, S., & Van Wee, B. (2021). Transportation technologies, sharing economy, and teleactivities: Implications for built environment and travel. Transportation Research Part D: Transport and Environment, 92, 102716. https://doi.org/10.1016/j.trd.2021.102716
38. Neirotti, P., De Marco, A., Cagliano, A. C., Mangano, G., & Scorrano, F. (2014). Current trends in Smart City initiatives: Some stylised facts. Cities, 38, 25-36.
39. Neuman, M. (2005). The compact city fallacy. Journal of planning education and research, 25(1), 11-26.
40. Pase, F., Chiariotti, F., Zanella, A., & Zorzi, M. (2020). Bike sharing and urban mobility in a post-pandemic world. Ieee Access, 8, 187291-187306.
41. Pouso, S., Borja, Á., Fleming, L. E., Gómez-Baggethun, E., White, M. P., & Uyarra, M. C. (2021). Contact with blue-green spaces during the COVID-19 pandemic lockdown beneficial for mental health. Science of The Total Environment, 756, 143984. https://doi.org/10.1016/j.scitotenv.2020.143984
42. Seoul Metropolitan Government. (2020, March). https://english.seoul.go.kr/seoul-runs-drive-thru-coronavirus-testing-stations-for-faster-detection-of-the-infectors/
43. Sharifi, A., Reza, A., & Kummitha, R. K. (2020). Contributions of Smart City Solutions and Technologies to Resilience against the COVID-19 Pandemic: A Literature Review. Sustainability, 13(14), 8018. https://doi.org/10.3390/su13148018
44. Scorrano, M., & Danielis, R. (2021). Active mobility in an Italian city: Mode choice determinants and attitudes before and during the Covid-19 emergency. Research in Transportation Economics, 86, 101031. https://doi.org/10.1016/j.retrec.2021.101031
45. Sharifi, A., & Khavarian-Garmsir, A. R. (2020). The COVID-19 pandemic: Impacts on cities and major lessons for urban planning, design, and management. Science of The Total Environment, 749, 142391. https://doi.org/10.1016/j.scitotenv.2020.142391
46. Sharifi, A. (2022). An overview and thematic analysis of research on cities and the COVID-19 pandemic: Toward just, resilient, and sustainable urban planning and design. Iscience.
47. Singapore Government Agency - TraceTogether. (n.d.). https://www.tracetogether.gov.sg/
48. Singapore Government Developer Portal. (2023, January). TraceTogether – Community-driven Contact Tracing. https://www.developer.tech.gov.sg/products/categories/digital-solutions-to-address-covid-19/tracetogether/overview.html
49. Turok, I., & Visagie, J. (2021). COVID-19 amplifies urban inequalities. South African Journal of Science, 117(3-4), 1-4.
50. Valente, R., Mozingo, L., Bosco, R., Cappelli, E., & Donadio, C. (2020). Environmental Regeneration Integrating Soft Mobility and Green Street Networks: A Case Study in the Metropolitan Periphery of Naples. Sustainability, 13(15), 8195. https://doi.org/10.3390/su13158195
51. Wang, H., & Noland, R. B. (2021). Bikeshare and subway ridership changes during the COVID-19 pandemic in New York City. Transport Policy, 106, 262-270. https://doi.org/10.1016/j.tranpol.2021.04.004
52. Zheng, C., Yuan, J., Zhu, L., Zhang, Y., & Shao, Q. (2020). From digital to sustainable: A scientometric review of smart city literature between 1990 and 2019. Journal of Cleaner Production, 258, 120689. https://doi.org/10.1016/j.jclepro.2020.120689