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COMPARATIVE CASE STUDIES ON THE DIFFERENT APPROACHES IN APPLYING ARTIFICIAL INTELLIGENCE IN SMART CITIES FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT

Urbanization is a prevailing trend globally. More than 50% of the world's population currently live in cities and the proportion is likely to grow to 70% by 2050 (World Bank Group, 2023). Amid this urbanization wave, smart cities have seen a noticeable rise since the 2010s (Almihat et al., 2022). Two other trends are picking up pace alongside the growth of smart cities. Firstly, there is greater focus on sustainable development since all United Nations (UN) member states adopted the seventeen global Sustainable Development Goals (SDGs) in 2015. Secondly, the advent of artificial intelligence (AI) transforms how people go about their daily lives and how cities function, including in pursuing the SDGs. Against this backdrop, there is value to study how AI could augment sustainability outcomes in smart cities. Specifically, this paper hypothesizes there are differences in how smart cities across regions apply AI to pursue sustainable development and seeks to uncover potential factors influencing such differences. The main methodology in this research is a set of comparative case studies involving three regions that have made notable progress in smart cities development – China, Singapore, and the United States. The findings from the comparative case studies validate the hypothesis that there are perceptible differences in how smart cities across regions deploy AI to pursue the SGDs. A potential factor for such differences could be regional sociocultural influences – an aspect that urban planners and policymakers should pay more attention to when applying AI in smart cities to improve sustainable development outcomes.

Keywords: Artificial Intelligence, Smart Cities, Sustainable Development Goals, Culture, Sustainable Development Policy

1. INTRODUCTION

1.1 Background

In 2015, all UN member states adopted the 2030 Agenda for Sustainable Development, advancing decades of efforts since discussions at the 1992 Earth Summit in Rio de Janeiro to build a global partnership for sustainable development. Central to the agenda are seventeen SDGs, per Figure 1 below, that strive to balance social, economic, and environmental sustainability priorities to protect the planet and ensure all people enjoy peace and prosperity by 2030 (United Nations, 2024).

Figure 1: The seventeen UN SDGs

Given the SDGs, this paper considers it paramount to address issues relating to the increasing number of urban areas in the world, especially cities, where more than half of the world's population reside, with the proportion possibly reaching 70% by 2050 (World Bank Group, 2023). Moreover, cities account for 60% to 80% of global energy consumption, 75% of carbon emissions, and up to half of the worldwide waste generation (Siemens, 2024). In view of these sustainable development considerations, it is pertinent to further examine relevant trends within the global urbanization wave, especially the rise of smart cities and their use of AI.

1.2 Hypothesis and Research Question

The number of publications on smart cities only picked up since 2010, in tandem with the growing number of smart city projects globally since that time (Jucevicius et al., 2014). Furthermore, according to a systematic literature review by Nikitas et al. (2020), more than 90% of the publications that investigate the interplay between smart cities, AI, and sustainable development only appeared from 2010 onwards. Thus, we can hypothesize that the research volume in this field is still relatively low compared to other topics. Correspondingly, there is a need for us to better address the question of how to sensibly support sustainable development using AI in smart cities. To do so, the research objective of this paper is to understand potential factors that could influence the application of AI in smart cities to support the SDGs. The awareness of these factors could help governments to be more mindful when designing smart cities, or propose interventions to address misperceptions due to influences by them.

1.3 Brief Review of the Literature

As this research pays particular attention to smart cities, it is essential to understand them clearly from the outset. However, despite the ubiquitous use of the term, practitioners and academia still do not have a clear and consistent definition of smart cities (Chourabi et al., 2012).

Having said that, since the emergence of the term in the early 1990s, there has been a common perception that smart cities employ diverse technologies representing the intersections between information communication technology, energy, and transport to remotely connect and command municipal systems to improve the cities' resilience, efficiency, connectivity, sustainability, and communication with stakeholders (Almihat et al., 2022). Kalenyuk et al. (2023) corroborated this viewpoint as they highlighted in their publication that smart cities use technologies like the internet

of things, energy efficiency systems, and communication infrastructure to improve the quality of life, ensure community safety, promote sustainable development, and increase the efficiency of the economy and infrastructure.

Ahad et al. (2020) further helped to provide a better picture of the major sub-systems typically present in smart city ecosystems per Figure 2 below. It is noteworthy that Ahad et al. featured sustainable development alongside nineteen other smart sub-systems in a smart city, underscoring the criticality of sustainable development in smart cities.

Smart Energy	Smart Security	Smart Governance	Smart Policies	Smart Agriculture
Smart Transportation	Smart Maintenance	Smart Feedbacks	Smart Users	Smart Services
Smart Environment	Smart Economy	Smart Communication	Smart Healthcare	Smart Education
Smart Living	Smart Industries	Smart Energy	Sustainable Development	Smart Well-being

Figure 2: Typical Sub-Systems of a Smart City

Another central concept to clarify in this research is AI. Since Alan Turing's founding work in the 1950s, AI has evolved to include various data analysis techniques, such as machine learning, robotics and automation, computer vision, neural networks, and other deep learning algorithms. Ecological economics researchers Inclezan and Pradamos (2017) suggested that AI could "help design a truly smart city, namely, a city that satisfies needs for most citizens through satisfactors that either minimize social or ecological externalities, or, even better, are socio-ecologically regenerative." Syed et al. (2021) also highlighted that a diverse range of AI applications could serve the needs of people living and working in smart cities, ranging from smart health to intelligent energy management.

However, AI is not a silver bullet to solve all the challenges in our society, including sustainable development. Research and studies that looked at the Strengths-Weaknesses-Opportunities-Threats analysis of AI applications' impact on society showed pros and cons to consider. For example, while AI can support SDG 8 in shaping decent work and economic growth by creating higher-value jobs, it could also exacerbate inequalities by replacing workers with lower qualifications (Palomares, 2021). Furthermore, although AI could enable smart technologies to optimize energy consumption, the energy needs for AI's supercomputing processes are widely known to be highly energy-intensive. Thus, AI could be a double-edged sword.

There is a noticeable lack of research on the nexus between AI and sustainable development. For instance, Chavarro et al. (2021) highlighted from their data analysis based on publications from the IEEE Xplore database that current engineering sciences research on AI only addresses "sustainable development to a small extent." Arguably, our understanding of the interplay between AI and sustainable development specifically in a smart city context would be similarly deficient. Hence, this research seeks to fill this gap in current literature by addressing the question on how to sensibly apply AI in smart cities to support the SDGs.

2. METHODOLOGY

The pertinence of AI in sustainable development is indisputable, with some even advocating that there should an eighteenth SDG on digital technologies to ensure guidelines and regulations for the beneficial application of AI to achieve sustainable development (Goh & Vinuesa, 2021). This suggestion echoes the view that AI solutions must consider the sustainability of the city's technical and socioeconomic systems (Becker et al., 2016). Hence, this research strives for a holistic approach in understanding how to apply AI in smart cities for sustainable development. A potentially well-rounded model to do so is a framework by Allam and Dhunny (2019) that integrates AI applications in smart cities for livability, as Figure 3 illustrates.

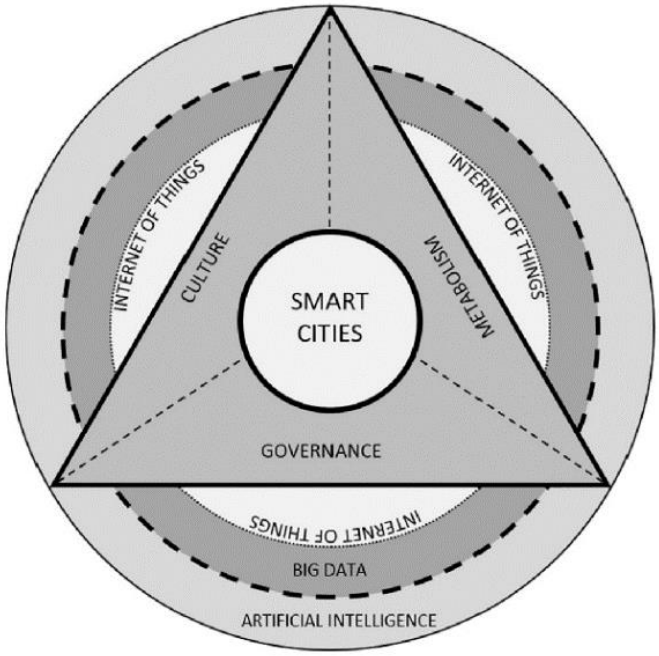

Figure 3: Allam and Dhunny's Framework for Integrating AI in Smart Cities

Allam and Dhunny's framework features a pillar on culture that studies how AI applications in smart cities account for the contexts of the cities' historical development and citizens' social sociocultural preferences. Besides that, the model also pays attention to the environmental aspect through the metabolism dimension, which considers resource flow and waste generation in the city (Allam & Newman, 2018). It is also helpful that the model has a focus on governance, which is central to the appropriate formulation and implementation of policies on leveraging technologies to drive sustainable development outcomes across the economic, social, and environmental dimensions. Thus, this research adopts this useful model as its core framework. In particular, this research plans to use the framework by Allam and Dhunny as three-prong analysis criteria to systematically conduct comparative case studies on smart cities across diverse geographical regions. Doing so should help to glean insights into the cities' varying approaches in applying AI for sustainable development.

In selecting the case studies, this research considered two major parameters. The first parameter is that the case studies should focus on examples reflecting regions with substantial track records in smart city development. This focus enables a fairer comparison of regions with similarly substantial track record in building smart cities and allows us to better appreciate how culture might have played a role in their respective smart city development journeys. The second parameter is that the

case studies should represent contrasting local cultures to test the hypothesis that sociocultural factors could influence how smart cities deploy AI for sustainable development.

Having established these two selection parameters, this research notes that AI applications are already rampant in various cities in Europe, North America, and Asia, particularly in world-class cities such as London, Toronto, and Singapore, which utilize AI to achieve sustainable outcomes in their smart city transformation objectives (Son et al., 2023). Thus, this research could develop the comparative case studies using examples in these regions, in line with considerations of the first selection parameter.

Within these geographies, this research also looked for case studies with distinct cultural differences, per the second selection parameter, to test the hypothesis that sociocultural differences could have an association with how smart cities apply AI differently for sustainable development. In this regard, Singapore is a suitable case study because the country has a unique cultural mix, predominantly from East Asia, while it embraces democratization to a certain extent (Cheang & Choy, 2024). The country also represents a small city-state that has a strong reputation for taking the lead with smart city technologies (Nature Portfolio, 2024). This research also focuses on North America, a region that – though far. from monolithic – generally has different sociocultural values from Asian countries, with a greater degree of democracy, equality, and freedom (Bell, 2024). Hence, San Francisco features in the comparative case studies since it also frequently ranks among the world's top smart and sustainable cities (World Economic Forum, 2024). In addition, the comparative case studies also include China because "new urbanization" is a national priority and the construction of smart cities across China has become a critical means to promote China's urbanization reform Wang, 2019). Chinese examples would also enrich the cultural diversity of this research since China is a region where the communist government shapes the social norms centrally (China Daily,. 2017).

Although this methodology includes sound selection parameters and a well-established framework to analyze the case studies, there are admittedly some limitations that could affect the results of this study. Notably, to manage the scope and focus of the research, this research only includes three examples for the comparative case studies. However, this limitation should not diminish the research's value and usefulness since the examples reflect rich sociocultural diversity. Furthermore, this research will distill insights on some approaches that vary across cultures in deploying AI in smart cities to support the SDGs, while identifying certain aspects that remain consistent regardless of sociocultural contexts. Accordingly. this paper seeks to develop actionable recommendations for governments to pay particular attention to specific facets that seem sensitive to sociocultural influences. The recommendations will also harmonize views across the comparative case studies into potential universal approaches for policymakers and urban planners. Hence, although the comparative case studies only involve three regions, the findings and learnings could apply in other regions, such as Africa and South America.

3. RESULTS

This section elaborates how Singapore, San Francisco, and China apply AI in smart cities to pursue the SDGs. The Allam and Dhunny framework serves as the backbone for the analysis of each example; the analyses then lay the foundation to synthesize learnings more holistically in the subsequent Section 4.

3.1 Singapore

Singapore has consistently developed solutions and implemented policies that built the nation into a leading smart city that promotes sustainability and enhances the quality of life for its citizens.

Examples include large-scale implementations of smart energy and water meters that empower citizens to access near real-time usage data to manage better and decide on their utilities consumption (SP Group, 2021).

Notably, the government launched "AI Singapore," an AI governance agency that brings together research institutions and the vibrant AI ecosystem, including start-ups and companies building AI products in Singapore, to grow the nation's digital economy and promote the development of AI technologies and innovation. AI Singapore also addresses the city's environmental metabolism, for instance, through the "Smart City Ideation Challenge" that sought proposals to utilize AI for the recovery of resources from Singapore's major waste streams – electronic, plastic, and food wastes (AI Singapore, 2022).

Singapore also paid attention to cultural considerations when leveraging AI to build a sustainable smart city. For instance, as Singapore has a multicultural and multiethnic society, its government ensured that the digital smart city services that citizens frequently utilize are also accessible in other languages Singaporeans may commonly use besides English, namely Malay, Mandarin, and Tamil (Smart Nation Singapore, 2024).

3.2 San Francisco

Although Singapore and San Francisco should have starkly different sociocultural backgrounds, they share numerous similarities as smart cities. For instance, on the environmental metabolism front, to combat climate change, San Francisco became the first city in the United States to mandate that new construction projects from 2017 must incorporate solar roofs (San Francisco Planning 2024).

However, San Francisco's local culture could create challenges that even AI might find difficult to resolve. For example, some argue that San Francisco's culture of liberal social support strategies has led to the severe homelessness problem that seems to be spiraling out of control; despite investing almost four billion dollars between 2018 and 2022, the number of homeless people in San Francisco failed to drop, but instead, ballooned from 7,800 to more than 20,000 (Ramos, 2023). Yet, one could also counterargue that San Francisco's other sociocultural values can also help resolve these problems. For instance, some believe that the current issues are just part of a cyclical occurrence and the strong spirit of innovation and entrepreneurship of the city in the Silicon Valley Bay Area would help attract talents who could rejuvenate the city economically and socially (Wiley, 2024). For instance, Google's continued presence in the area could sustain the city's deep-tech culture and attract AI talents who could contribute to its economy and social fabric.

To cite an example of the city's governance approach, after voters approved San Francisco Mayor Breed's Proposition in 2024, the city started to deploy drones and integrate other relevant AI technologies and public safety cameras to help the San Francisco Police Department respond to crimes more efficiently and effectively (SF.GOV, 2024). This example also demonstrates the governance and cultural norm in San Francisco to arrive at consensual decisions on municipal matters through a highly participatory voting and debate process.

3.3 China

In contrast, the development of smart cities in China exemplifies significant differences from Singapore and San Francisco. China's smart city development occurred over numerous phases since the early 2010s when its government set aside approximately two hundred billion dollars for its National Smart Cities Projects, comprising the first set of 277 smart cities in China (Sanseverino et al, 2018). Since then, China's central government has regularly updated its approach to

developing smart cities. For example, in May 2024, it unveiled a guideline to facilitate high-efficiency governance and high quality of life in urban areas by integrating digital technologies, such as AI, into their urban digital transformation (The State Council of the People's Republic of China, 2024).

Through observations on the evolution of the country's relevant policies over the years, one could argue that China uses a top-down governance approach towards smart cities. Researchers on China's smart cities development, Atha et al. (2020), held the same view finding that the central government's top-down approach to smart city programs and its shift away from city-led initiatives have led to the centralization of decision-making.

Another notable trend in Chinese smart cities is that with the proliferation of AI, the central government is adopting new technologies, which could help to improve the country's environmental metabolism. For instance, in Beijing, city-level systems leverage AI to monitor water usage and energy consumption to provide actionable insights to reduce environmental impact (AI Coalition Network, 2024).

However, the nationwide drive to implement smart technologies since the early 2010s to support economic growth might also have detrimental effects. A case in point is the Inner Mongolia Autonomous Region, which is home to the most extensive grassland in the world and houses indigenous populations who are preserving local heritage even as the government urbanizes the region through smart city initiatives. According to a study by Xie et al. (2022), the urban sustainability conditions in the region have worsened significantly since 2010, with a notable imbalance in the recovery of regional ecology. This phenomenon could be due to indiscriminate use of intelligent farming technologies. In this light, although intelligent technologies could boost livestock numbers and economic well-being of farmers, they might dramatically change the locals' traditional farming practices, which could lead to both sociocultural and environmental problems in Inner Mongolia.

4. DISCUSSION

Table 1 that follows summarizes the key pointers from the comparative case studies:

Table 1: Key Observations from the Comparative Case Studies on AI Applications in Smart Cities in China, San Francisco, and Singapore

	China	San Francisco	Singapore
Governance	China represents the model of a large country developing smart cities with a top-down approach from the central government. Scholars noted a growing centralization trend in decision-making and governance for Chinese smart cities.	San Francisco embodies a smart city in a large country that provides a high degree of democracy and autonomy in the development process. Citizens can actively participate in ground-up initiatives and play a role in deciding on the type of technologies the city could deploy.	Singapore's approach toward smart city development reflects a "middle ground" model that works for a small city-state. Although the government has a strong hand in shaping national policies and initiatives, there are strong efforts to involve citizens, such as through innovation challenges.
Metabolism	Smart cities in China, such as Beijing,	San Francisco deploys AI and intelligent	Singapore uses AI, such as through smart energy

	leverage AI to optimize energy management, waste reduction, and resource allocation efforts.	technologies to enhance the efficiency of building operations, reduce energy use, and streamline waste management systems.	and water meters, to improve environmental metabolism.
Culture	Due to the top-down approach by the central government, considerations of regional local culture do not feature strongly. In some instances, the government's actions could negatively impact local culture.	Local culture, such as the vibrant innovation spirit and strong pro-democracy sentiments, forms the hallmark of how San Francisco develops as a smart city and applies AI to support sustainable development.	Some aspects of the smart city reflect local sociocultural considerations. For example, the Singapore government develops solutions that meet local cultural needs, such as multilingual digital platforms for its multiethnic society.

From the results in the previous section and the summary in Table 1, it is evident that, as a smart city, Singapore has invested substantial efforts on the metabolism, cultural, and governance fronts to leverage AI for sustainable development. Its approach appears to lie in between that of San Francisco and Chinese smart cities. In particular, although the Singaporean government has a strong hand in shaping the development of the country as a smart city, there are notable efforts to involve citizens so that they can also raise concerns and ideas. The government is also culturally sensitive in its approach, such as providing multilingual digital platforms providing smart city services for a multiethnic society.

San Francisco is also a smart city that has made considerable progress in deploying intelligent technologies and AI to uphold its metabolism and support the environmental SDGs. Its governance approach incorporates strong local culture, including a tendency toward liberal social ideals and the tradition of giving all citizens a voice to debate issues that could impact the city's development. However, the liberal mindsets could contribute to social issues, such as homelessness. Notwithstanding, its culture of innovation might also pave the way for economic and social improvements – possibly through AI – to resolve the problems currently facing the smart city.

In contrast, China's central government seems to be adopting a predominantly top-down approach to develop nationwide policies and implement smart cities projects across the entire country since 2010. On the upside, Chinese smart cities are embracing technological advances and incorporating AI to achieve better environmental metabolic performance, such as optimizing energy, transportation, water, and waste management. Yet, on the downside, since China covers a vast region with a diverse population representing different ethnic, cultural, and socioeconomic backgrounds, it could be challenging to adopt the same approach on a broad-stroke basis. The government should customize their approaches for local sociocultural and environmental contexts, or it could risk thwarting sustainable development efforts.

Synthesizing the findings form the comparative case studies, this research proposes three major universal approaches in governance that urban planners and policymakers can adopt to apply AI more sensibly in smart cities for better sustainable development outcomes.

Table 2: Proposed Universal Approaches to Apply AI in Smart Cities for the SDGs

Findings from Case Studies	Proposed Universal Approach
In regions with a strong top-down culture, such as China, there could be limitations to the extent that citizens could participate in developing smart cities. In such regions, local culture considerations seem secondary in developing smart cities, which could lead to detrimental effects, such as the case in Inner Mongolia.	Engage citizens adequately to better understand local sociocultural norms so that the AI solutions the governments implement would not negatively impact local culture. This approach should be universally applicable regardless of whether the government practices top-down or bottom-up governance and it could help strike a balance between using AI for sustainable development and upholding local culture.
In regions with a local culture that strongly embraces democracy and human rights, such as the United States, citizens can have a strong say in how their government develop smart cities and adopt AI to support the SDGs.	Respect local preferences in applying AI solutions for sustainable development. However, if there are sociocultural considerations that might lead to misperceptions on AI, spend time to educate citizens and correct such inaccurate mindsets to facilitate appropriate adoption of relevant AI solutions.
On the environmental metabolism front, approaches across smart cities in different regions seem largely similar, for example, by applying AI to optimize energy, water, and waste management. Thus, it could be relatively more straightforward for smart cities to apply AI to improve their environmental metabolism since there seems to be less sociocultural influence in this aspect.	a) Governments can work with corporations and academic institutions objectively to develop AI solutions that address environmental issues their cities are grappling with. b) Smart cities from different geographies, regardless of sociocultural differences, could explore collaborations to co-develop innovative AI solutions to address common environmental challenges across regions. Doing so would harness synergies across smart cities.

5. CONCLUSION

This paper has made a significant contribution to academic research by plugging the gap in existing literature regarding the interplay between AI and sustainable development in smart cities. Although this paper admits its limitation of only comparing three regions in the comparative case studies, the research used robust examples with diverse sociocultural differences to validate the hypothesis that there are differences in how smart cities across varying geographical regions apply AI for sustainable development.

A major factor for the differences is the varying sociocultural values and norms in respective smart cities. For example, there seems to be differing governance approaches in regions with dissimilar sociocultural background, with China representing a top-down model and San Francisco representing a bottom-up model. Sociocultural considerations could also influence the design of AI solutions that would be the most appropriate for supporting the SDGs for respective cities. For instance, in a multiethnic smart city like Singapore, AI chatbots providing advice on sustainable development would likely need to be multilingual instead of just communicating in English.

Building on these insights, this research proposed three universal approaches that governments worldwide can adopt to apply AI more sensibly in their smart cities to support the SDGs. For instance, governments should engage their citizens adequately to better understand sociocultural

norms and implement AI solutions that would not undermine local cultures. Future research can further investigate relevant topics, such as potential sociocultural reasons behind preferences for certain AI technologies in specific regions' smart cities to pursue the SDGs. Such future studies could help governments build a deeper understanding of local sociocultural considerations and develop appropriate interventions to apply AI in smart cities more effectively for better sustainable development outcomes.

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REFERENCES

1) Ahad, M. A., Paiva, S., Tripathi, G., & Feroz, N. (2020). Enabling Technologies and Sustainable Smart Cities. Sustainable Cities and Society, 61, 102301. https://doi.org/10.1016/j.scs.2020.102301.
2) AI Coalition Network. (2024). The Role of AI in Advancing Smart City Initiatives in Beijing. https://ai-coalition.net/blog/role-ai-advancing-smart-city-initiatives-beijing.
3) AI Singapore. (2022). Smart City Ideation Challenge. https://aisingapore.org/technology/smartcity-ideation-challenge/.
4) Allam, Z., & Newman, P. (2018). Redefining the Smart City: Culture, Metabollism, and Governance. Smart Cities, 1(1), 4-25. https://doi.org/10.3390/smartcities1010002.
5) Almihat, M. G. M, Kahn, M. T. E., Aboalez, K., & Almaktoof, A. M. (2022). Energy and Sustainable Development in Smart Cities: An Overview. Smart Cities, 5, 1389-1408. https://doi.org/10.3390/smartcities5040071.
6) Atha, K, Callahan, J., Chen, J., Drun, J., Francis, E., Green, K.. Lafferty, B., McReynolds, J., Mulvenon, J., Rosen, B., & Walz, E. (2020). China's Smart Cities Development. SOSi. https://uscc.gov/sites/default/files/China_Smart_Cities_Development.pdf.
7) Becker, C., Betz, S., Chitchyan, R., Duboc, L., Easterbrook, S. M., Penzenstadler, B., Seyff, N., & Venters, C. C. (2016). Requirements: The Key to Sustainability. IEEE Software, 56-65.
8) Bell, D. A. (2024). Comparing Political Values in China and the West: What Can Be Learned and Why it Matters. Annual Reviews. https://www.annualreviews.org/content/journals/10.1146/annurev-polisci-051215-031821.
9) Chavarro, D., Perez-Toborda J. A., & Avila, A. (2021). Connecting Brain and Heart: Artificial Intelligence for Sustainable Development. Proceedings of the 2021 ISSI Conference, 1-12.
10) Cheang, B., & Choy, D. (2024). Culture of Meritocracy, Political Hegemony, and Singapore's Development. International Journa of Politics, Culture, and Society, 37, 265-290. https://doi.org/10.1007/s10767-023-09458-x.
11) China Daily. (2017). Core Socialist Values. https://chinadaily.com.cn/china/19thcpcnationalcongress/2017-10/12/content_33160115.htm.

12) Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., Pardo, T. A., & Scholl, H. J. (2012). Understanding Smart Cities: An Integrative Framework. Proceedings of the 45th Hawaii International Conference on System Science, 2289-2297.
13) Goh, H. H., & Vinuesa, R. (2021). Regulating Artificial Intelligence Applications to Achieve the Sustainable Development Goals. Discover Sustainability, 2, 52. https://doi.org/10.1007/s43621-021-00064-5.
14) Inclezan, D., & Pradamos, L. I. (2017). Viewpoint: A Critical View on Smart Cities and AI. Journal of Artificial Intelligence Research, 60, 681-686.
15) Jucevicius, R., Irena, P., & Patasius M. (2014). Digital Dimension of Smart City: Critical Analysis. Procedia - Social and Behavioral Sciences, 156, 146-150. https://doi.org/10.1016/j.sbspro.2014.11.137.
16) Kalenyuk, I., Bohun, M., & Djakona V. (2023). Investing in Intelligent Smart City Technologies. Baltic Journal of Economic Studies, 9(3), 41-48. https://doi.org/10.30525/2256-0742/2023-9-3-41-48.
17) Nature Portfolio. (2024). Intelligent Model for a Sustainable Singapore. https://nature.com/articles/d42473-022-00182-2.
18) Nikitas, A., Michalakopoulou, K., Njoya, E. T., & Karampatzakis, D. (2020). Artificial Intelligence, Transport and the Smart City: Definitions and Dimensions of a New Mobility Era. Sustainability, 12, 2789. https://doi.org/10.3390/su12072789.
19) Palomares, I., Martinez-Camara, E., Montes, R., Garcia-Moral, P., Chiachio, M., Chiachio, J., Alonso, S., Melero, F. J., Molina, D., Fernandez, B., Moral, C., Marchena, R., Vargas, J. P., & Herrera F. (2021). A Panoramic View and SWOT Analysis of Artificial Intelligence for Achiecving the Sustainable Development Goals by 2030: Progress and Prospects. Applied Intelligence, 51, 6497-6527. https://doi.org/10.1007/s10489-021-02264-y.
20) Ramos, J. (2023). Billions of Dollars Spent in Vain: Why Is San Francisco Unable to Stop Its Homelessness Problem. Tomorrow City. https://www.tomorrow.city/why-is-san-francisco-unable-to-stop-its-homelessness-problem/.
21) San Francisco Planning. (2024). Better Roofs. https://www.sfplanning.org/projects/better-roofs.
22) Sanseverino, E. R., Sanseverino, R. R., & Anello, E. (2018). A Cross-Reading Approach to Smart City: A European Perspective of Chinese Smart Cities. Smart Cities, 1(1), 26-52. https://doi.org/10.3390/smartcities1010003.
23) SF.GOV. (2024). San Francisco's New Public Safety Drone Program Leading to Arrests and Criminal Charges. https://www.sf.gov/news/san-franciscos-new-public-safety-drone-program-leading-arrests-and-criminal-charge.
24) Smart Nation Singapore. (2024). Multilingual Digital Services. https://www.smartnation.gov.sg/initiatives/multilingual-digital-services.
25) Son, T. H., Weedon, Z., Yigitcanlar, T., Sanchez, T., Corchado, J. M., & Mehmood R. (2023). Algorithmic Urban Planning for Smart and Sustainable Development: Systematic Review of the Literature. Sustainable Cities and Society, 94, 104562. https://doi.org/10.1016.scs.2023.104562.
26) SP Group. (2021). SP Group to Roll Out Singapore's First Large-Scale Smart Water Metering System. https://www.spgroup.com.sg/about-us/media-resources/energy-hub/innovation/sp-group-to-roll-out-singapore-s-first-large-scale-smart-water-metering-system.

27) Syed, A. S., Sierra-Sosa, D., Kumar, A., & Elmaghraby, A. (2021). IoT in Smart Cities: A Survey of Technologies, Practices and Challenges. Smart Cities, 4, 429-475. https://doi.org/10.3390/smartcities4020024.
28) The State Council of the People's Republic of China. (2024). China Unveils Guideline to Promote Development of Smart Cities. https://english.www.gov.cn/news/202405/21/content_WS664bdf37c6d0868f4e8e74ac.html.
29) United Nations. (2024). The 17 Goals. https://sdgs.un.org/goals.
30) Wang, Z. (2019). Discussing about Building Smart City in Inner Mongolia against the Background of New Urbanization. Advances in Social Sciences, 8(5), 818-825. https://doi.org/10.12677/ass.2019.85114.
31) Wiley, Hannah. (2024). All Is Lost in San Francisco? City Loyalists Take Issue with Naysayers. Data May Back Them Up. Los Angeles Times. https://www.latimes.com/california/story/2024-01-16/doom-loop-spirit-of-optimism-returns-to-san-francisco-tech.
32) World Bank Group. (2023). Urban Development. https://www.worldbank.org/en/topic/urbandevelopment/overview.
33) World Economic Forum. (2024). These Are Some of the World's Top Smart and Sustainable Cities. https://www.weforum.org/agenda/2024/03/top-cities-smart-technology-sustainability/.
34) Xie, Y., Liu, C., Chang, S., & Jiang, Bin. (2022). Urban Sustainability: Integrating Socioeconomic and Environmental Data for Multi-Objective Assessment. Sustainability, 14(15), 9142. https://doi.org/10.3390/su14159142.

