Responsible Artificial Intelligence For Sustainable Development

Evidences from Asia-Pacific cities

Charmaine Distor, Junior Research Assistant[1] (charmainedistor@unu.edu)
Inês Campos Ruas, Junior Research Assistant[1] (ruas@unu.edu)
Soumaya Ben Dhaou, Research Specialist[1] (bendhaou@unu.edu)

[1] Operating Unit on Policy-Driven Electronic Governance (UNU-EGOV)
United Nations University, Guimarães, Portugal

Abstract:

Artificial intelligence (AI) technologies demonstrated significant potential in the public sector both nationally and locally, addressing multiple urban challenges for sustainable development in cities. However, acknowledging and mitigating inherent technological challenges is critical. This paper explores how the "responsible" adoption, implementation, and governance of AI in cities address the risks and challenges of AI across various application areas, such as healthcare, public services, public safety, social welfare, transportation, environment, education, energy, and tourism. It examines how these AI applications contribute to urban sustainability and their role in achieving the Sustainable Development Goals (SDGs). Based on the study of thirty cases from the Asia-Pacific region, the findings reveal diverse AI landscapes, presenting advantages and challenges. The results will be illustrated using the example of the Philippines' KIRA Chatbot and Data Management Platform. Insights gleaned contribute to enhancing effective and ethical implementation, and fostering urban sustainability. The paper proposes key considerations and policies for responsible AI adoption in cities, offering actionable strategies for aligning AI initiatives with the SDGs.

Keywords: *Artificial intelligence, Smart Cities, Sustainability, Asia Pacific, Philippines, Sustainable Development Goals*

Introduction

Many cities worldwide face acute challenges in managing rapid urbanization, from ensuring adequate housing and infrastructure to support growing populations to confronting the environmental impact of urban sprawl and reducing vulnerability to disasters. The need for sustainable and inclusive urban development has never been more pressing. The aftermath of the global pandemic has accentuated socioeconomic inequalities, emphasizing the urgency for innovative solutions to build resilient and equitable urban environments. The United Nations' Sustainable Development Goals (SDGs), particularly Goal 11, focus on inclusive, safe, resilient, and sustainable cities, and stand as a comprehensive framework to guide cities toward a more sustainable future.

Artificial Intelligence (AI), an emerging technology with the capacity to exhibit intelligent behaviors and accomplish tasks traditionally associated with human intelligence (Misuraca & van Noordt, 2020), emerges as a transformative force capable of navigating the intricacies of urban challenges. Projections indicate that by 2025, AI will power over 30% of urban applications, presenting a significant opportunity to enhance resilience and sustainability globally. However, the adoption of AI in cities is not without its challenges. Concerns about algorithmic bias or the phenomenon when a technology unintentionally reflects the prejudices that exist in society leading to unfair or discriminating behavior against certain groups (Baker, Hawn, & Lee, 2023) and privacy violations necessitate a responsible and ethical approach. The concept of responsible AI, as defined by the United Nations Human Settlement Programme (UN-Habitat), becomes critical in ensuring the alignment of AI technologies with core values, including human rights and the SDGs.

This study is motivated by a dual imperative: to harness the transformative potential of responsible AI in cities for the SDGs and address the persistent risks and challenges accompanying its adoption. While AI holds promise in optimizing operational efficiency, enhancing service delivery, and fostering citizen engagement, it also introduces complexities related to security, data privacy, and the potential exacerbation of societal inequalities. As cities make efforts to become more inclusive, safe, resilient, and sustainable, they grapple with the need for standardized AI implementation processes and transparent regulatory frameworks. The challenges are multifaceted, from security and privacy concerns to a lack of municipal AI adoption resources.

The paper takes a comprehensive approach, aiming to describe the potentials and challenges of AI in cities in relation to the SDGs. Through a meticulous examination of 30 case studies from 14 countries (Figure 1) across the Asia-Pacific region captured through purposive geographic sampling, it seeks to address crucial research questions: *how AI facilitates sustainable development in cities,* and *how cities can mitigate the risks associated with AI to maximize its potential for achieving the SDGs*. The subsequent sections of this paper will systematically explore these dimensions, offering insights into the diverse AI landscape in Asia-Pacific by presenting a comprehensive illustration of the case of the KIRA chatbot

Figure 1: Distribution of AI in cities cases in Asia-Pacific (N=30)

in the Philippines. Finally, the paper proposes key considerations for the responsible deployment of AI in urban environments.

Artificial intelligence in Asia-Pacific cities

Rapid technological advancements have positioned the Asia-Pacific region as a dynamic and influential player in the global AI landscape. With diverse economies, cultures, and governance structures, countries in this region exhibit varying levels of AI readiness, ranging from the top leaders in AI to the least advanced countries in digital governance in general. The transformative potential of AI to address urban challenges and catalyze economic growth has led to a surge in adoption across Asia-Pacific cities.

The 2023 Government AI Readiness Index report by Oxford Insights, reveals the heterogeneous AI landscape in the Asia-Pacific region, highlighting a spectrum of capabilities marked by pronounced disparities. Notable frontrunners like Singapore, the Republic of Korea, Japan, Australia, and China showcase high government readiness. At the same time, a stark contrast emerges with islands such as Samoa, and Kiribati, and countries such as the Republic of Korea, reflecting significant discrepancies. Despite these divergent trajectories in government readiness for AI adoption, AI has a significant potential to act as a catalyst for bridging this gap. A study suggests that by 2030, leveraging AI could catalyze a 16% increase in the gross domestic product in the region, offering transformative solutions to regional challenges, including hunger alleviation and bolstered transportation safety (Haseeb et al., 2019).

This paper undertakes a comprehensive examination of 30 AI use cases from 14 nations within urban settings across the Asia-Pacific region, providing insights into the current landscape of AI implementation.

Figure 1 illustrates the study across 14 countries, with India, the Republic of Korea and Australia prominently featured. The Philippines and the United Arab Emirates contribute two cases each, while other nations each present one use case, showcasing the breadth and depth of AI utilization within diverse urban contexts across the region.

Within the dataset, a prevalent form of AI technology emerges through its integration with other emerging technologies, particularly IoT and blockchain, encompassing 13 cases. A summary of the diverse AI typologies and corresponding example cases is provided in Table 1.

Seoul, the Republic of Korea's implementation of smart poles equipped with a suite of technologies is a notable example. Similarly, the sowing advisory app and commodity price forecasting tool deployed in Andhra Pradesh and Karnataka (India) aimed to enhance smallholder farmer incomes (Smart City Korea, 2021; UNESCAP, 2019).

Furthermore, 9 cases are identified as chatbots and virtual assistants programmed to deliver automated assistance to users, exemplified by Da Nang, Vietnam's *Fantasticity* for tourism, Quezon City, Philippines' *KIRA* for COVID-19 information dissemination, and Jakarta, Indonesia's *PetaBencana* for disaster response (Da Nang Department of Tourism, 2018; Distor & Moon, 2022; Diwakar, 2021).

Six cases are categorized as predictive analytics, simulations, and pattern matching, representing AI's utilization in learning from vast datasets to discern data patterns for visualization, simulation, or prediction purposes. Noteworthy examples include Saitama, Japan's utilization of AI to match children with daycare centers, considering familial preferences such as siblings attending the same facility (Kyushu University, 2017), and New South Wales, Australia's *LandiQ*, facilitating land use analysis encompassing social, economic, environmental, and financial considerations (New South Wales Government, 2022).

Additionally, 2 cases are identified as examples of robotics and process automation, exemplified by the autonomous shuttle buses at the King

Table 1: AI typologies and examples from the Asia-Pacific region

AI Typology	Description	Examples
Integration with IoT and other emerging technologies	AI technologies are integrated or complemented with other emerging technologies like IoT, blockchain, cloud computing, and digital twin in the deployment stage	*Example: Seoul, South Korea's smart poles equipped with traffic lights, intelligent CCTV, public Wi-Fi, and charging ports for electric vehicles*
Chatbots and virtual assistants*	Includes virtualized assistants or online "bots" currently used in not only to provide generic advice but also behavior-related recommendations to users	*Example: Da Nang, Vietnam's Fantasticity chatbot for tourism information*
Predictive analytics, simulations, pattern matching*	Learns from large datasets to identify patterns in the data that are consequently used to visualize, simulate, or predict new configurations	*Example: Saitama, Japan's Children-Daycare Centre Matching*
Robotics and process automation*	The common trait of these AI technologies is process automation, which can be achieved through robotized hardware or software	*Example: Thuwal, Saudi Arabia's KAUST autonomous shuttle buses*
Machine learning**	Enables computers to think and learn on their own	*Example: Queensland, Australia's Land Use Mapping Program for disaster and biosecurity response*
Natural language processing*	Capable of recognizing and analyzing speech, and written text, and communicating back	*Example: Manila, Philippines' Public Information Office Complaints Desk for analyzing citizen complaints*

**Definition adopted from Misuraca & Van Noordt, 2020;*

***Definition adopted from Alzubi, Nayyar, & Kumar, 2018*

Abdullah University of Science and Technology (KAUST) in Thuwal, Saudi Arabia, and the AI-enabled Administrative Approval Bureau (AAB) system in Wuhou, China (Bashraheel, 2019; Chen, Ran, & Gao, 2019).

While most AI typologies incorporate machine learning, defined as enabling computers to think and learn autonomously (Alzubi, Nayyar, & Kumar, 2018), notable applications include Queensland, Australia's utilization of machine learning alongside computer vision for land use mapping, aiding in disaster response efforts (OECD-OPSI, 2018). Moreover, natural language processing emerges as a critical AI typology capable of recognizing and analyzing written or spoken content, as exemplified by the Public Information Office in Manila, Philippines, utilizing this technology for analyzing citizen complaints (Newsbytes, 2020).

The diverse AI landscape across the Asia-Pacific region provides a picture of both challenges and opportunities, with AI leaders showcasing remarkable government readiness. At the same time, important disparities persist in the region. As we observe AI implementation in urban settings, it becomes evident that the transformative power of AI extends beyond technological advancements, offering solutions to multifaceted challenges. In some cases, these technological innovations are also harnessed to create meaningful impact and steer urban development towards a more sustainable and equitable future.

The potential of AI in achieving the sustainable development goals

The potential of responsible AI in urban contexts, as evidenced by the Global Assessment of Responsible AI in Cities (UN-Habitat, 2024), is far-reaching and transformative. The adoption of AI technologies presents significant positive impacts on various facets of urban life, ranging from enhanced public services to societal well-being (UN-Habitat, 2024). Cities can leverage AI to optimize operational costs and resources, fostering proactive citizen engagement and creating more equitable and livable urban environments (Islam et al., 2022). The efficiency gains, productivity enhancements, and tailored digital platforms promise faster, better, and more cost-effective services. However, cities must navigate critical capacity gaps to harness these benefits fully. Addressing these needs requires substantial investments in infrastructure, comprehensive training programs, and robust regulatory frameworks (Birkstedt et al., 2023). This proactive approach is essential to unlock

the full potential of AI, contributing to operational efficiency, equitable service delivery, and overall urban livability. The motivation to harness responsible AI aligns with the shared vision of creating sustainable urban environments with the potential to contribute to achieving 134 targets of the SDGs. It can also hinder progress on 59 targets, including addressing issues on gender, labor, and carbon emissions (Vinuesa et al., 2020), ushering in a future where technology catalyzes positive change and collective prosperity.

This study enquired into 30 AI use cases across various sectors in the Asia-Pacific region, categorized in Figure 2. Environmental applications accounted for 21%, with notable examples, such as Melbourne's laneway waste management system, and Yokohama City's *Iio* waste management chatbot (Murphy, 2021; Aoki, 2020). Transportation and public service sectors each constituted 18% of the cases, featuring notable implementations such as Hangzhou, China's *City Brain* addressing traffic congestion, and Hamilton, New Zealand's *Frankly* chatbot for citizen feedback (Marvin et al., 2022; Inside Government, 2021). Social welfare accounted for 13% of cases, including Seoul, the Republic of Korea's utilization of AI speakers to aid senior citizens in caregiving (OECD-OPSI, 2017).

Health and public safety sectors comprised 9% each, such as Singapore's *BotMD* chatbot providing clinical information for medical practitioners, and the City of Port Phillip in Australia employing *AI Road Surveys* for sustainable transportation initiatives (World Bank, 2020; Powell, 2021). The energy sector represented 6%, exemplified by Taoyuan, Taiwan's AI-powered energy-saving streetlamps (Gan, 2020). Additionally, the tourism and education sectors each contributed a case study (3% each), with Da Nang, Vietnam's *Fantasticity* tourism chatbot, and the deployment of the *Class Saathi* edtech solution in India's Madhya Pradesh and Uttar Pradesh regions (Da Nang Department of Tourism, 2018; India AI, 2021).

Analyzing AI use cases in the Asia-Pacific region reveals a diverse landscape contributing to several SDGs (summarized in Figure 3). The study showcases significant contributions to SDG 9 (Industry, Innovation, and Infrastructure), with 21% of cases exemplifying advancements in this domain. Additionally, SDG 11 (Sustainable Cities and

Figure 2: Distribution of AI in cities cases in the Asia-Pacific region based on sectors

Figure 3: Distribution of AI in cities cases in the Asia-Pacific region in relation to the SDGs

Communities) emerges prominently, with 24% of cases demonstrating the role of AI in fostering urban sustainability and development.

Furthermore, AI applications are aligned with SDG 16 (Peace, Justice, and Strong Institutions), evidenced by 22% of cases illustrating the potential of AI to enhance governance and institutional capacities. Other notable contributions include SDG 13 (Climate Action), with 7% of cases addressing environmental challenges. SDG 15 (Life on Land), with 8% of cases focusing on land conservation and biodiversity, and SDG 3 (Good Health and Well-being), with 5% highlighting AI's impact on healthcare services. While some SDGs, such as SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 5 (Gender Equality), are represented by fewer cases, the comprehensive analysis underscores AI's multifaceted role in advancing sustainable development across the Asia-Pacific region. As specific applications of AI in achieving Sustainable Development Goals are explored in this paper, the next section will focus on the specific case of the Philippines, examining the KIRA chatbot as a case study that provides valuable insights into the practical implementation of AI technologies at the local level for better sustainability and resilience.

Despite the potential benefits and opportunities associated with AI applications, cities aiming to become more inclusive, safe, resilient, and sustainable are confronted with persistent risks and challenges in adopting AI technology. Security complexities and data privacy concerns are real. Thus, introducing AI into urban environments, especially when combined with technologies such as the Internet of Things (IoT) or blockchain, adds layers of complexity to security measures. Moreover, citizens are constantly required to share sensitive and personal data or be under constant surveillance due to the prevalence of cameras on city streets. These findings are supported by literature, exemplified by Ghallab (2019). To further understand the nuances of the potentials and challenges brought by AI implementation in cities, the next section shall delve into this through a use case from the Philippines.

Insights from the Philippines' KIRA Chatbot

The case of Knowledge Informs Responsible Action (*Katuwang na Impormasyon para sa Responsableng Aksyon in Filipino*) or KIRA in the Philippines is a concrete manifestation of AI contributing to the SDGs, particularly in public health and disaster management. Initially conceived by AI4GOV, one of the start-ups and tech partners of the Department of Health – Philippines (DOH), for disaster management during a volcanic eruption, KIRA swiftly adapted to address the pressing challenges posed by the COVID-19 pandemic. This dual-purpose application underscores the agility and replicability of AI models and algorithms for diverse use cases.

KIRA was launched in 2020 to help address the COVID-19 pandemic. KIRA's primary focus is on providing verified information, combating misinformation, and connecting citizens with local health units. This helps to address SDG3 (Good Health and Well-being) and extend its contribution to SDG 16 (Peace, Justice, and Strong Institutions) by enhancing governance capacities through efficient data processing and contact tracing. The chatbot's extensive reach, with over 1 million users and engagement with 1,400 local health units, yielding nearly 35 million interactions demonstrates its significant impact on enhancing pandemic response and citizen awareness. Data processing speed also increased 12-fold, whereas contact tracing speed increased six times. Since 2021, the focus of KIRA has shifted towards vaccination, leading to additional features, including educational information about vaccines, crowdsourced vaccine demand, hesitancy data, and citizen satisfaction.

KIRA is composed of a chatbot deployed on several platforms, such as the DOH's website and its official pages on Viber and Facebook Messenger (Figure 4), as well as a real-time dashboard that can help national and local governments make a data-driven decision. Citizens submit their information, which undergoes classification based on the current policy framework, utilizing natural language processing and understanding techniques. To cater to citizens who cannot access the web version of KIRA, a free short messaging service or SMS version was also launched linked to the same dashboard.

Several partners collaborated with the DOH in the development and deployment of KIRA. Their technology partners include start-ups such as AI4GOV, Aiah, and Senti. Big tech companies like Google, Facebook, and Viber also provided advertising and platform support. Implementation was also aided by development support from various organizations such as Plan International, the United Nations Development Programme, and the World Health Organization.

KIRA's design and implementation abide by national policies such as the country's 2021 National AI Roadmap, the 2012 Data Privacy Law, and the 2018 Mandatory Reporting of Diseases Law. DOH also provided technology partners internally with specific guidelines on how to use the data for KIRA.

The technical implementation of KIRA has several challenges, particularly in adapting to citizens' evolving concerns during the COVID-19 pandemic. The shifts in public priorities lead to promptly adjusting the topic modelling behind KIRA while maintaining an accurate representation of the unfolding health crisis. This balancing act between responsiveness and precision imposed internal pressures, reflecting the intricate nature of aligning AI technologies with real-time public needs.

Moreover, KIRA encountered challenges in managing human resources. Despite knowledge and skills transfer initiatives between technology partners and focal persons from national and local governments, a significant difficulty emerged due to a repetitive cycle caused by the resignation or reassignment of trained focal persons. This turnover, attributed to the demanding workload, impeded the continuity of knowledge and skills within the project team. Particularly, the departure of trained personnel created a gap in maintaining the designed approach to verify symptoms reported by citizens, which relies heavily on the availability and capacity of focal persons, predominantly healthcare workers already

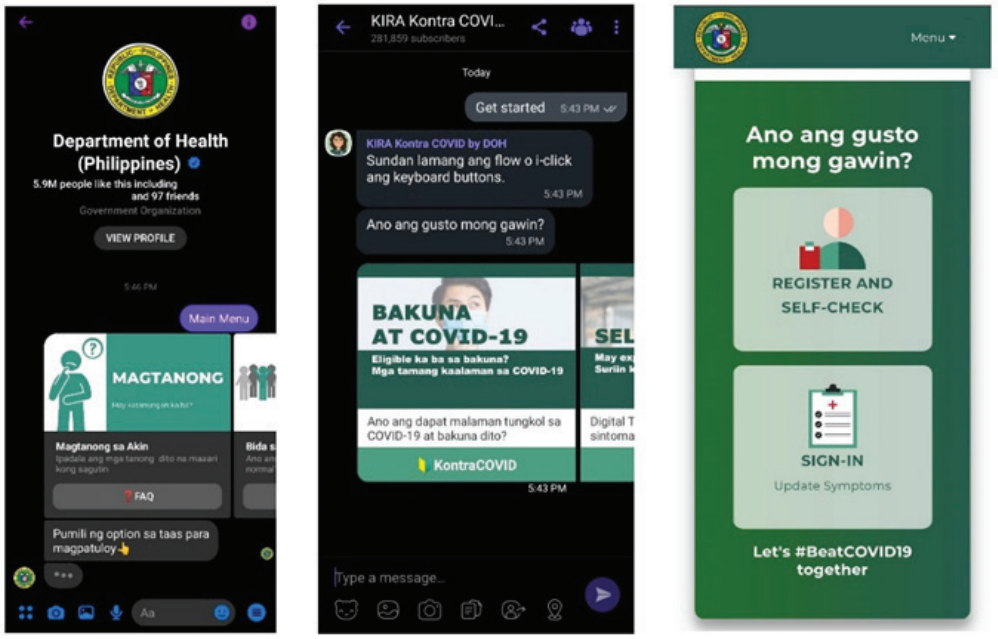

Figure 4: KIRA chatbot on Facebook, Viber, and DOH website (Distor & Moon, 2022)

grappling with the demands of pandemic-related responsibilities.

These challenges underscore the importance of integrating sustainable practices in AI deployment, especially in healthcare. To address the turnover of trained personnel, there is a need for sustainable capacity-building initiatives and measures to ensure knowledge continuity. Implementing practices that alleviate the burden on healthcare workers, such as optimizing the digital triage feature (e.g., the COVID-19 self-assessment and linking with relevant local health units) for efficiency, becomes essential. This aligns with the broader goal of promoting sustainable and responsible AI, ensuring that these technologies enhance, rather than strain, the capabilities of those at the forefront of public health.

There are several takeaways from the implementation of KIRA. While KIRA operates as an AI-powered solution, its effectiveness stems from a collaborative approach that intertwines information and communications technology expertise with insights from the health and medical fields. Moreover, KIRA's implementation underscores the role of partnership in guiding and empowering governmental stakeholders. This proactive engagement helps mitigate potential apprehensions and challenges related to the complexity of AI, fostering a conducive environment for responsible and sustainable AI deployment. Also, KIRA's ongoing nature is a testament to the agility and adaptability inherent in AI technology. The project demonstrates that AI can evolve to meet stakeholders' changing needs, responding dynamically to shifts in citizen usage patterns. This adaptability ensures that AI remains a responsive tool aligned with evolving public health priorities. An essential takeaway from KIRA's implementation is the observed shift in citizens' engagement—from seeking information to actively reporting information. This transformation reflects the platform's responsiveness to the evolving demands of the community, contributing to a more engaged and participatory public health approach.

Finally, the ongoing modelling and replication of KIRA for additional health concerns, such as measles, rubella, and polio, showcase the scalability and versatility of AI in addressing a spectrum of health challenges. This scalability enhances the long-term impact of AI solutions, demonstrating their potential to contribute sustainably to diverse healthcare needs.

In essence, KIRA's implementation underlines the importance of responsible AI practices that address immediate challenges and foster sustainability by adapting to evolving needs, promoting interdisciplinary collaboration, and empowering stakeholders for informed decision-making.

Aligning AI initiatives with the SDGs: key considerations and policies

Implementing AI in the Asia-Pacific region is confronted with multifaceted challenges, which not only impede its efficacy but may also hinder progress toward achieving the SDGs. Foremost among these challenges is the issue of policies and ethical standards for AI deployment. While most Asia-Pacific countries covered in this study have their respective AI policies, plans, or roadmaps at the national level, their localization is still almost non-existent. Only Hong Kong, China was found to have a published local AI guideline among the 30 cases (Office of the Privacy Commissioner for Personal Data Hong Kong, 2021).

Furthermore, poor infrastructure continues to be a significant hurdle to effective AI implementation in the region, which undermines the functionality of

AI systems and impedes their accessibility to the broader population. For instance, the implementation of the AI-enabled sowing advisory app and commodity price forecasting in Andhra Pradesh and Karnataka, India, faced challenges from its target users, who are smallholder farmers as they still have unreliable internet connections and limited smartphone penetration (UNESCAP, 2019). Additionally, challenges related to digital inclusion further exacerbate disparities in AI utilization and access, with marginalized communities facing barriers to accessing AI technologies.

Moreover, challenges related to data management pose substantial barriers to AI deployment. For instance, there is still a need to develop dictionary data in English and local languages and alphabets to improve search accuracy, such as in the case of the family register administration system in Osaka, Japan (Okazaki, 2019). At the same time, the lack of timely verification mechanisms for citizen-contributed information may also pose an issue, especially during disasters such as in chatbots like Indonesia's *PetaBencana* (Diwakar, 2021). Dependence on data availability from third-party sources like Google Maps, such as the case of Kolkata, India's traffic management analytics, may also hinder the sustainability of AI initiatives (Ghosh, 2022).

Similarly, the robotic approach and lack of human contact in AI systems, particularly chatbots, impedes communication and engagement with citizens. This deficiency not only limits the gathering of important user feedback but also detracts from the user experience, which may hinder inclusive citizen participation in governance processes such as in Hamilton, New Zealand's *Frankly* chatbot (Inside Government, 2021). While the intent of having the chatbot to gather citizen feedback for the council's policies is beneficial, it may unintentionally exclude citizens who do not have access to the chatbot. Some governments have also recognized the importance of having humans in the loop in AI initiatives. Still, as evident in the KIRA chatbot case from the Philippines, implementers indicated this added additional administrative and workload burdens to the civil servants.

The importance of skills transfers for utilizing AI in the public sector extends beyond technical proficiency exclusive to tech professionals to also encompass civil servants and citizen users. Equipping civil servants with the necessary skills to leverage AI technologies is paramount for enhancing governance efficiency and service delivery. Moreover, empowering citizen users with AI awareness and literacy fosters broader participation in decision-making processes and facilitates informed engagement with AI-enabled services. At the same time, promoting coordination among various stakeholders, including big tech companies, academe, and civil society, is essential for maximizing the societal benefits of AI.

These challenges underscore the urgent need for comprehensive strategies to address the ethical, infrastructural, and operational complexities inherent in AI deployment, ensuring that AI technologies contribute effectively to sustainable development efforts in the Asia-Pacific region. While the insights garnered from the cases in the Asia-Pacific are vital in scoping the regional context, future research is still necessary to provide evidence that can shape effective policy and programs relevant to AI governance.

Acknowledgment

This paper is based on a study entitled "Global Assessment of Responsible AI in Cities" commissioned by the UN-Habitat with funding from the International Development Research Centre and carried out in cooperation with the United Nations University Operating Unit on Policy-Driven Electronic Governance (UNU-EGOV).

This document is a result of the project "INOV.EGOV-Digital Governance Innovation for Inclusive, Resilient and Sustainable Societies / NORTE-01-0145-FEDER-000087", supported by the Norte Portugal Regional Operational Programme (NORTE 2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund (EFDR).

References

- ✓ Alekseeva, L., Azar, J., Giné, M., Samila, S., & Taska, B. (2021). The demand for AI skills in the labor market. *Labor Economics*, *71*, 102002. Retrieved from https://doi.org/10.1016/j.labeco.2021.102002
- ✓ Alzubi, J., Nayyar, A., & Kumar, A. (2018, November). Machine learning from theory to algorithms: an overview. In *Journal of Physics: conference series* (Vol. 1142, p. 012012). IOP Publishing. https://doi.org/10.1088/1742-6596/1142/1/012012.
- ✓ Aoki, N. (2020). An experimental study of public trust in AI chatbots in the public sector. *Government Information Quarterly*, *37*(4), 101490. https://doi.org/10.1016/j.giq.2020.101490.
- ✓ Baker, R. S., Hawn, M. A., & Lee, S. (2023). 9. Algorithmic bias: the state of the situation and policy recommendations. Retrieved from https://www.oecd-ilibrary.org/sites/09e55ac4-en/index.html?itemId=/content/component/09e55ac4-en#.
- ✓ Bashraheel, A. (2019, December 12). Saudi university launches Kingdom's first self-driving buses. Retrieved from https://www.arabnews.com/node/1597686/saudi-arabia.
- ✓ Birkstedt, T., Minkkinen, M., Tandon, A., & Mäntymäki, M. (2023). AI governance: Themes, knowledge gaps, and future agendas. *Internet Research*, *33*(7), 133–167. Retrieved from https://doi.org/10.1108/INTR-01-2022-0042
- ✓ Chen, T., Ran, L., & Gao, X. (2019, June). AI innovation for advancing public service: The case of China's first Administrative Approval Bureau. In *Proceedings of the 20th Annual International Conference on Digital Government Research* (pp. 100-108). https://doi.org/10.1145/3325112.3325243.
- ✓ Da Nang Department of Tourism. (2018, April 20). Press Release: Launching Chatbot Application In the Tourism Industry. Retrieved from https://danangfantasticity.com/en/news/press-release-launching-chatbot-application-tourism-industry.html.

- ✓ Distor, C. B. & Moon, M. J. (2022). Artificial Intelligence and Big Data in COVID-19 Response: Lessons from the KIRA Chatbot and Data Management Platform of the Department of Health – Philippines. *Great Transformation Research Review, 5*. http://dx.doi.org/10.13140/RG.2.2.36497.51047/1.
- ✓ Diwakar, A. (2021). How an Indonesian chatbot uses social media to manage disasters. Retrieved from https://www.trtworld.com/magazine/how-an-indonesian-chatbot-uses-social-media-to-manage-disasters-48717.
- ✓ Gan, D. Y. (2020, October 12). Smart Energy: Taiwan street lights integrated with AI to promote energy saving and innovative applications. Retrieved from https://www.smartcitiesdive.com/press-release/20201008-smart-energy-taiwan-street-lights-integrated-with-ai-to-promote-energy-sav/.
- ✓ Ghallab, M. (2019). Responsible AI: Requirements and challenges. *AI Perspectives*, *1*(1), 3. Retrieved from https://doi.org/10.1186/s42467-019-0003-z.
- ✓ Ghosh, D. (2022, March 11). Kolkata cops seek AI boost for traffic control, ask IT firms for live demo. Retrieved from https://timesofindia.indiatimes.com/city/kolkata/city-cops-seek-ai-boost-for-traffic-control-ask-it-firms-for-live-demo/articleshow/90137131.cms.
- ✓ Haseeb, M., Sasmoko, Mihardjo, L. W., Gill, A. R., & Jermsittiparsert, K. (2019). Economic impact of artificial intelligence: New look for the macroeconomic assessment in Asia-Pacific region. *International Journal of Computational Intelligence Systems*, *12*(2), 1295-1310. https://doi.org/10.2991/ijcis.d.191025.001.
- ✓ Henman, P. (2020). Improving public services using artificial intelligence: Possibilities, pitfalls, governance. *Asia Pacific Journal of Public Administration*, *42*(4), 209–221. Retrieved from https://doi.org/10.1080/23276665.2020.1816188
- ✓ India AI. (2021, August 10). Improving learning outcomes using low-cost AI technology. Retrieved from https://indiaai.gov.in/case-study/improving-learning-outcomes-using-low-cost-ai-technology.
- ✓ Inside Government. (2021, March 29). AI chatbot to help with Hamilton plan. Retrieved from https://insidegovernment.co.nz/ai-chatbot-helping-hamilton/.
- ✓ Islam, M. R., Ahmed, M. U., Barua, S., & Begum, S. (2022). A Systematic Review of Explainable Artificial Intelligence in Terms of Different Application Domains and Tasks. *Applied Sciences*, *12*(3), Article 3. Retrieved from https://doi.org/10.3390/app12031353.
- ✓ Kyushu University. (2017, September 5). Fujitsu AI Ideally Matches Children to Daycare Centers Matched about 8,000 children in Saitama to daycare centers in just seconds. Retrieved from https://www.kyushu-u.ac.jp/en/researches/view/73/.
- ✓ Marvin, S., While, A., Chen, B., & Kovacic, M. (2022). Urban AI in China: Social Control or hyper-capitalist development in the post-smart city? *Frontiers in Sustainable Cities*, *4*, 1030318. https://doi.org/10.3389/frsc.2022.1030318.
- ✓ Misuraca, G., & Van Noordt, C. (2020). AI Watch-Artificial Intelligence in public services: Overview of the use and impact of AI in public services in the EU. *JRC Research Reports*, (JRC120399). Retrieved from https://ideas.repec.org/p/ipt/iptwpa/jrc120399.html.
- ✓ Morley, J., Kinsey, L., Elhalal, A., Garcia, F., Ziosi, M., & Floridi, L. (2023). Operationalizing AI ethics: Barriers, enablers and next steps. *AI & SOCIETY*, *38*(1), 411–423. Retrieved from https://doi.org/10.1007/s00146-021-01308-8
- ✓ Murphy, D. (2021, August 13). Nokia Scene Analytics AI tech powers Melbourne waste-dumping trial. Retrieved from https://mobilemarketingmagazine.com/nokia-scene-analytics-ai-tech-powers-melbourne-waste-dumping-trial/.
- ✓ New South Wales Government. (2022). LandiQ. Retrieved from https://www.dpie.nsw.gov.au/housing-and-property/our-business/advisory-and-transactions/land-iq.
- ✓ Newsbytes. PH. (2020, February 16). Manila city gov't deploying AI to analyze public complaints. Retrieved from https://newsbytes.ph/2020/02/16/manila-city-govt-deploying-ai-to-analyze-public-complaints/.
- ✓ Office of the Privacy Commissioner for Personal Data Hong Kong. (2021). Guidance on the Ethical Development and Use of Artificial Intelligence. Retrieved from https://www.pcpd.org.hk/english/resources_centre/publications/files/guidance_ethical_e.pdf.
- ✓ Okazaki, H. (2019, March 24). Osaka to introduce AI for a quick, smooth childcare facility selection process. Retrieved from https://mainichi.jp/english/articles/20190324/p2a/00m/0na/002000c.
- ✓ Organization for Economic Cooperation and Development-Observatory of Public Sector Innovation. (2017). Prevention of solitary deaths through smart care ICT (KakaoTalk, mobile phones, and AI). Retrieved from https://oecd-opsi.org/innovations/ict-care/.
- ✓ Organization for Economic Cooperation and Development-Observatory of Public Sector Innovation. (2018). Potential for mapping the world's land resources using satellites and artificial intelligence: an Australian case study in land use. Retrieved from https://oecd-opsi.org/innovations/potential-for-mapping-the-worlds-land-resources-using-satellites-and-artificial-intelligence-an-australian-case-study-in-land-use/.
- ✓ Oxford Insights. (2023). Government AI Readiness Index 2023. Retrieved from https://oxfordinsights.com/wp-content/uploads/2023/12/2023-Government-AI-Readiness-Index-2.pdf.
- ✓ Powell, A. (2021, October 7). AI traffic sensors inform Council transport planning. Retrieved from https://councilmagazine.com.au/ai-traffic-sensors-inform-council-transport-planning/.
- ✓ Rodrigues, R. (2020). Legal and human rights issues of AI: Gaps, challenges and vulnerabilities. *Journal of Responsible Technology*, *4*,

100005. Retrieved from https://doi.org/10.1016/j.jrt.2020.100005

- ✓ Schiff, D., Rakova, B., Ayesh, A., Fanti, A., & Lennon, M. (2020). *Principles to Practices for Responsible AI: Closing the Gap* (arXiv:2006.04707). arXiv. Retrieved from http://arxiv.org/abs/2006.04707.
- ✓ Smart City Korea. (2021, March 10). Seoul, streetlights, traffic lights, WiFi, CCTV all at once... Completed the first construction of 26'smart poles'. Retrieved from https://smartcity.go.kr/en/2021/03/10/%EC%84%9C%EC%9A%B8%EC%8B%9C-%EA%B0%80%EB%A1%9C%EB%93%B1%E2%80%A7%EC%8B%A0%ED%98%B8%EB%93%B1%E2%80%A7%EC%99%80%EC%9D%B4%ED%8C%8C%EC%9D%B4%E2%80%A7cctv-%ED%95%9C-%EB%B2%88%EC%97%90- %EC%8A%A4/
- ✓ Schmitt, L. (2022). Mapping global AI governance: A nascent regime in a fragmented landscape. *AI and Ethics*, *2*(2), 303–314. Retrieved from https://doi.org/10.1007/s43681-021-00083-y
- ✓ United Nations Economic and Social Commission for Asia and the Pacific. (2019). Artificial intelligence in the delivery of public services. Retrieved from https://www.unescap.org/publications/artificial-intelligence-delivery-public-services.
- ✓ United Nations Human Settlements Programme. (2024, Forthcoming). *Global Assessment of Responsible AI in Cities*. Nairobi, Kenya.: UN-Habitat.
- ✓ Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., Felländer, A., Langhans, S. D., Tegmark, M. & Fuso Nerini, F. (2020). The role of artificial intelligence in achieving the Sustainable Development Goals. *Nature Communications, 11*(1), 1-10. https://doi.org/10.1038/s41467-019-14108-y.
- ✓ Yan, Z., Jiang, L., Huang, X., Zhang, L., & Zhou, X. (2023). Intelligent urbanism with artificial intelligence in shaping tomorrow's smart cities: Current developments, trends, and future directions. *Journal of Cloud Computing*, *12*(1), 179. Retrieved from https://doi.org/10.1186/s13677-023-00569-6
- ✓ Yigitcanlar, T., Agdas, D., & Degirmenci, K. (2023). Artificial intelligence in local governments: Perceptions of city managers on prospects, constraints and choices. *AI & SOCIETY*, *38*(3), 1135–1150. Retrieved from https://doi.org/10.1007/s00146-022-01450-x
- ✓ World Bank. (2020). Artificial Intelligence in the Public Sector Maximizing Opportunities, Managing Risks. Retrieved from https://openknowledge.worldbank.org/server/api/core/bitstreams/b04570ef-b033-5b25-ab7d-c18d44b6cd7d/content.