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A Review on Responsible AI in Smart City

Zahidah Zulkifli[1*]
Kulliyyah of Information and Communication Technology
International Islamic University
Gombak, Malaysia
Email: zahidahz@iium.edu.my

Fakhrul Hazman Yusoff[2]
School of Information Technology
UNITAR International University
Selangor, Malaysia
Email: man.ysf@gmail.com

Shafaf Ibrahim[3]
College of Computing, Informatics and Mathematics
Universiti Teknologi MARA
Shah Alam, Malaysia
Email: shafaf2429@uitm.edu.my

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***Abstract*—As smart cities become a global agenda among governments and municipalities, the integration of Artificial Intelligence (AI) has accelerated due to its potential to enhance urban efficiency, sustainability, and governance. However, this rapid adoption raises ethical and societal challenges that demand the implementation of Responsible AI principles. This paper adopts surveyed literature approach, surveying academic works, industry frameworks, and government policies related to Responsible AI in the smart city context. The review synthesizes key dimensions of Responsible AI including ethics and governance, bias and fairness, privacy and security, sustainability, and human AI collaboration while comparing strategic approaches adopted by major technology companies and national AI policies. Findings indicate that most current efforts remain conceptual, focusing on principles and governance rather than technical deployment. The study highlights the need for practical implementations such as algorithmic transparency, bias mitigation mechanisms, and clear policy technology alignment. Recommendations are proposed to guide future integration of Responsible AI in smart city initiatives to ensure ethical, transparent, and human-cantered outcomes.**

***Keywords*—Smart City, Artificial Intelligence, Responsible Artificial Intelligence Ethics, Moral**

I. INTRODUCTION

As smart cities have become the agenda of various municipalities, local governments as well as national governments, the trend of Artificial Intelligence (AI) integration inside smart cities has become the latest wave, considering AI's benefits to implementers. While previously the focus was on flow optimization, communication, power distribution, efficiency, monitoring, and surveillance, now the trend is to incorporate AI into these initiatives. As a result, we now have AI-based monitoring, AI-based communication, and AI-based optimization, to name a few. As the adoption of AI in smart cities increases, there are concerns about its impact on society itself. Already, we are seeing reports and research initiatives that look into ethics and moral infusion in AI for smart city implementation. Governing the impact of AI on smart cities can be done via Responsible AI. Responsible AI means the development of AI systems in a way that guarantees ethical, transparent, accountable, and equitable outcomes. Responsible AI involves integrating principles such as fairness, inclusivity, privacy, safety, and environmental sustainability into AI processes (Floridi *et al*., 2018; European Commission, 2019).

Despite increasing attention to ethical AI practices, there remains a significant research gap in understanding how Responsible AI principles are operationalized within smart city ecosystems. Most existing studies discuss Responsible AI conceptually or through general ethical frameworks, with limited analysis of its implementation in real-world urban systems. This lack of consolidated understanding makes it difficult for policymakers and technology providers to align governance mechanisms with technical practices. Hence, this review addresses the problem by examining how Responsible AI has been interpreted, structured, and implemented across research, industry, and policy landscapes within the smart city domain.

This paper is divided into seven sections with this section act as introduction and the following section explains the methodology. Section three looks at literature on AI and Smart City in general. This is followed by Section four that looks at literatures on the concept of Responsible AI. A comparison between big tech companies and the definition of Responsible AI is offered. Section five continues on Responsible AI by conducting literature reviews on work in Smart City that touches on Responsible AI. In the end Section six offers some highlights and discussion and finally section seven concludes the paper.

II. METHODOLOGY

This paper adopts a systematic descriptive literature review approach to examine the state of Responsible AI (RAI) in smart city environments. The study focuses on the areas of Responsible AI implementations, its benefits and challenges as well as its implications. Literature was identified through keyword searches such as "Responsible AI," "Smart City," "AI ethics," and "AI governance" in major academic databases and official institutional reports. Rather than engaging in empirical analysis, the purpose is to synthesize and compare definitions, principles, and focus areas of RAI initiatives across different stakeholders, including governments and technology providers. The review also categorizes themes across five RAI dimensions ethics and governance, bias and fairness, privacy and security, sustainability, and human AI collaboration. The analytical focus is qualitative in nature, aiming to identify implementation trends, thematic overlaps, and existing gaps in Responsible AI adoption for smart cities.

The scope of this review is limited to conceptual and policy-based discussions of Responsible AI as applied in smart city contexts. The paper focuses on published academic research, government frameworks, and industry initiatives that define principles, governance mechanisms, and ethical considerations. It does not include empirical case studies, quantitative evaluations, or technical performance analyses of AI systems. Similarly, topics such as AI hardware optimization, deep technical algorithm design, and purely commercial AI applications outside urban governance are excluded from this review. This boundary ensures the paper remains focused on the conceptual and governance dimensions of Responsible AI implementation within smart cities.

III. ARTIFICIAL INTELLIGENCE IN SMART CITY

There are various AI initiatives for smart cities (Rahman & Alam, 2019). AI-driven urban planning, as reported by Batty *et al*. (2012), was one such research effort. Beyond the usual digital transformation, this work showed how urban planning can be assisted by AI. Another project on smart cities was the smart transport system (Gao *et al*., 2021). In this project, the focus was on using AI to fine-tune the traffic light system. This was an enhancement of simple sensors, introducing a dynamic situation with the help of AI.

Sustainable resource management is another key area that researchers have paid attention to. In research by Zhou *et al*. (2020), energy demand prediction, wastage reduction, and renewable energy integration were all assessed with the assistance of AI.

Public security and safety are also very important in smart cities. Attention has been given to this area by various researchers, such as Rahman and Alam (2019), who explored the use of AI in CCTV systems to detect potentially criminal activity. Meanwhile, in the sector of citizen engagement and governance, Nam and Pardo (2011) claimed that AI-driven e-governance platforms and chatbots help citizens reach out to city services. Their research included the use of natural language processing to facilitate multilingual communication between users and city services. Angelidou (2017), on the other hand, surveyed urban system optimization and concluded that AI can reduce manual intervention while simultaneously increasing performance.

The above examples focus on AI implementation in smart cities. Unfortunately, without elements of morality and ethics, such implementations may breach human freedom and rights. Therefore, Responsible AI has been introduced.

IV. RESPONSIBLE ARTIFICIAL INTELLIGENCE

According to Floridi *et al*. (2018), Responsible AI means the development of AI systems in a way that guarantees ethical, transparent, accountable, and equitable outcomes. Responsible AI involves integrating principles such as fairness, inclusivity, privacy, safety, and environmental sustainability into AI processes (European Commission, 2019). There are at least five key areas of Responsible AI, namely ethics and governance, bias and fairness, privacy and security, sustainability, and human AI collaboration. The National Institute of Standards and Technology (n.d.) pointed out that Responsible AI must cover validity and reliability; safety, security, and resiliency; accountability and transparency; explainability and interpretability; privacy; and fairness with mitigation of harmful bias.

Realizing its importance, various IT players have established missions toward fulfilling Responsible AI goals. Among the companies with Responsible AI agendas are Microsoft, Google, and Meta. According to Microsoft, Responsible AI must fulfill the principles of fairness, reliability and safety, privacy and security, inclusiveness, transparency, and accountability (Microsoft, 2024). Google (2024) outlined four dimensions: fairness, accountability, safety, and privacy. Meta (2024) focused on privacy and security, fairness and inclusion, robustness and safety, and transparency and control. IBM emphasized explainability, fairness, robustness, transparency, and privacy (Stryker, 2024).

Atlassian considers fairness, privacy, security, transparency, and accountability as key factors for Responsible AI (Atlassian, n.d.). AWS emphasizes fairness, safety, privacy, security, transparency, robustness, explainability, and governance (Amazon Web Services, n.d.). Nvidia highlights privacy, safety and security, transparency, and fairness as its Responsible AI areas (NVIDIA, n.d.).

Other big tech companies such as Apple did not discuss Responsible AI in detail but made commitments on empowering users, careful design, and privacy (Apple, n.d.; Politico, 2024). Accenture highlights four interrelated pillars organizational, technical, and operational that must work together toward Responsible AI (Accenture, 2021), while

Experian discusses reducing bias and increasing fairness (Experian, 2024).

Various governments have incorporated Responsible AI into their AI agendas, including the United States (The White House, 2023), the United Kingdom (Time, 2025; Department for Science, Innovation and Technology, 2023), the European Union (European Commission, 2019), Canada (Legal Nodes, 2024), Australia (Australian Government, 2019), Japan, Germany, and France (OECD, 2021), South Korea (AI Seoul Summit, 2024), Singapore (Singapore Government, 2020), India (NITI Aayog, 2018), Italy (Italian Government, 2021), the Netherlands (Government of the Netherlands, 2019), Denmark (Danish Government, 2019), Finland (Ministry of Economic Affairs and Employment of Finland, 2017), Norway (Norwegian Ministry of Local Government and Modernisation, 2020), Spain (Government of Spain, 2019), Brazil (OECD, 2021), and the UAE (UAE Government, 2017). Overall, the key aspect of Responsible AI can be succinctly shown in the following Table I.

TABLE I. BIG TECH COMPANIES AND THEIR KEY ASPECT AREA OF RESPONSIBLE AI

	Ms*	Google	Meta	IBM	Atls#	AWS	Nvidia
Fair	√	√	√	√	√	√	√
Reliability	√						
Safety	√	√	√			√	√
Privacy	√	√	√	√	√	√	√
Security	√		√		√	√	√
Inclusive	√		√				
Transparent	√		√	√	√	√	√
Accountable	√	√					
Robust			√	√		√	
Explainable				√		√	
Control			√				
Governance						√	

*Microsoft
#Atlassian

Other major technology companies, such as Apple, do not explicitly discuss the detailed aspects of Responsible AI. However, they have published statements emphasizing their commitment to user empowerment, privacy protection, and responsible design practices (Apple, n.d.; Politico, 2024). Similarly, Accenture highlights four interrelated pillars organizational, technical, and operational that must align to achieve Responsible AI implementation (Accenture, 2021). Experian also supports Responsible AI adoption through its focus on reducing bias and promoting fairness in AI models (Experian, 2024).

The UK Government, for example, recommends Responsible AI through various frameworks and policies and has published a Responsible AI Toolkit to guide organizations (Department for Science, Innovation and Technology, 2023). In the United States, Responsible AI has been defined through multiple executive orders and frameworks, notably the Executive Order on Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence (The White House, 2023). In the European Union, a human-centric approach to AI has taken center stage (European Commission, 2019). The OECD has also catalogued countries that embrace Responsible AI, including Japan, Germany, and France (OECD, 2021). In addition, several other countries have issued national frameworks or strategies India (NITI Aayog, 2018), Singapore (Singapore Government, 2020), the Netherlands (Government of the Netherlands, 2019), Spain (Government of Spain, 2019), Brazil (OECD, 2021), and the United Arab Emirates (UAE Government, 2017).

V. RESPONSIBLE AI RELATED WORK

Research on Responsible AI, ethics, and morality has become prominent. Phillips and Jiao (2023) reviewed 34 papers published between 2014 and 2022 on smart cities and ethics. They found that research mainly focused on three areas: privacy, safety and fairness; IoT and big data; and frameworks and case studies. Their conclusion that privacy, safety, and fairness are priorities aligns with findings by Kairouz *et al*. (2021) and Mehrabi *et al*. (2021), who pointed out that the key to Responsible AI is ensuring privacy and security while addressing bias and fairness.

Several researchers have focused on ethics and governance. Goodman (2020) examined ethics and smart cities conceptually. Zwitter and Helbing (2024) discussed how digital representations of human beings raise ethical issues. Xu (2022) identified aspects of constructing moral systems for smart city governance, including education, social core values, and moral quality of managers. Islam *et al*. (2023) explored reinforcement learning for human–AI collaboration, showing that human intervention improved AI system performance.

Responsible AI key aspects include ethics and governance, bias and fairness, privacy and security, and human AI interaction. For instance, Zheng *et al*. (2020) argued that urban planning frameworks need accountability and trustworthiness to ensure legitimacy when AI is incorporated. Mehrabi *et al*. (2021) emphasized enhancing decision-making algorithms to avoid biases and ensure fairness. Abadi *et al*. (2016) and Kairouz *et al*. (2021) stressed the importance of robust privacy and security, especially in multi-party urban contexts. Rolnick *et al*. (2019) discussed sustainability and urged that AI in smart cities should enhance, not disrupt, sustainable goals. Finally, Rahwan *et al*. (2019) emphasized human–machine collaboration to ensure better decision-making for smart cities.

TABLE II. BIG TECH COMPANIES AND THEIR KEY ASPECT AREA OF RESPONSIBLE AI

Author(s), Year	**Focus / Study Area**	**Methodology / Approach**	**Key Findings**	**Responsible AI Dimension**
Phillips & Jiao (2023)	Review of ethics in smart cities (34 papers, 2014–2022)	Systematic literature review	Identified privacy, safety, and fairness as dominan	Ethics, Fairness, Privacy

Author(s), Year	Focus / Study Area	Methodology / Approach	Key Findings	Responsible AI Dimension
			t concerns	
Goodman (2020)	Conceptual ethics and governance in smart cities	Theoretical analysis	Highlighted democratic accountability and transparency challenges	Governance, Ethics
Xu (2022)	Moral systems for smart city governance	Conceptual model	Stressed moral education and values for decision-makers	Governance, Ethics
Islam *et al*. (2023)	Human–AI collaboration in urban systems	Reinforcement learning	Showed that human intervention improves AI performance	Human–AI Collaboration
Zheng *et al*. (2020)	Urban planning with AI accountability	Framework proposal	Argued for trustworthiness and legitimacy in AI-assisted planning	Accountability, Transparency
Mehrabi *et al*. (2021)	Algorithmic bias and fairness	Systematic survey	Identified fairness and bias mitigation as key Responsible AI gaps	Fairness, Bias
Abadi *et al*. (2016)	Differential privacy in AI	Experimental	Proposed privacy-preserving deep learning methods	Privacy, Security
Kairouz *et al*. (2021)	Federated learning for privacy	Review	Highlighted advances and open problems in federated learning	Privacy, Security
Rolnick *et al*. (2019)	AI and sustainability	Research synthesis	Discussed using AI to tackle climate change and sustainable goals	Sustainability
Rahwan *et al*. (2019)	Human–machine collaboration in AI	Theoretical study	Emphasized shared decision-making in AI governance	Human–AI Collaboration

The summarized studies as shown in the Table II, demonstrate a strong conceptual foundation but limited empirical validation of Responsible AI within smart city contexts. Most prior work concentrates on defining ethical principles, governance mechanisms, and fairness algorithms, while technical deployment and city-level implementations remain scarce. The review reveals five recurring dimensions ethics and governance, fairness and bias, privacy and security, sustainability, and human AI collaboration that collectively form the foundation for Responsible AI integration. However, the lack of standardized frameworks connecting these dimensions to municipal policy or operational design indicates a gap for future empirical exploration.

VI. Discussion

Most of the works presented above focus on conceptual rather than technical deployment. Many explore frameworks for how Responsible AI should be implemented by identifying interconnected components. Others elaborate on specific key areas, such as assessing surveillance systems in smart cities to ensure public privacy.

There are also works, such as Islam *et al*. (2023), that attempt technical implementations. More such efforts are needed to complement conceptual research. One approach is at the parametric level, where bias-related needs (e.g., gender, race, nationality) are integrated as compulsory input parameters during training. If inputs are uncontrolled, rethinking bias infusion is necessary. Neural network weights and activation functions may need redesign to prevent biased outcomes.

The findings from this review reveal several recurring patterns that can be categorized across five main dimensions of Responsible AI within smart city contexts:

1. Ethics and Governance:

Many studies and policy documents emphasize the need for governance mechanisms to ensure ethical AI adoption. However, most frameworks remain at the principle level, with limited translation into enforceable city-level regulations. The comparison of major technology companies (e.g., Microsoft, Google, IBM) indicates alignment on fairness and accountability but variation in governance enforcement models.

2. Bias and Fairness:

Research identifies bias mitigation as a central challenge in AI-based urban systems. Studies such as Mehrabi *et al*. (2021) and Kairouz *et al*. (2021) highlight algorithmic bias and demographic inequities, yet practical mitigation methods remain scarce. Conceptual discussions outnumber empirical implementations.

3. Privacy and Security:

Privacy protection is the most consistently emphasized element across academic, industrial, and policy domains. The majority of initiatives (e.g., EU's Ethics Guidelines for Trustworthy AI, the U.S. Executive Order on AI) embed privacy-by-design principles, though operationalization in large-scale smart city deployments remains underdeveloped.

4. Sustainability:

Responsible AI frameworks frequently reference environmental and social sustainability, yet very few directly measure sustainability outcomes. AI applications in energy optimization and waste reduction show potential, but accountability for environmental impact is seldom addressed.

5. Human–AI Collaboration:

Literature underscores the role of human oversight and participatory governance in Responsible AI for smart cities. Studies such as Islam *et al*. (2023) show that human intervention can improve AI performance, suggesting future models should prioritize hybrid collaboration structures.

Overall, these categories demonstrate that Responsible AI in smart cities has matured conceptually but lacks integrated operational frameworks linking ethics, policy, and technical execution. The synthesis highlights the need for a multi-dimensional approach combining governance enforcement, bias control, privacy assurance, sustainability accountability, and human-centric design to transition from principles to practice.

In summary, the paper contributes by mapping and interpreting the conceptual landscape of Responsible AI in smart cities, identifying key policy and governance patterns that future empirical or analytical research can build upon. The discussion thus serves as a bridge between current descriptive frameworks and prospective analytical investigations into Responsible AI integration within urban ecosystems.

The findings from this review indicate that existing Responsible AI efforts in smart cities are predominantly conceptual and descriptive, emphasizing governance frameworks, ethical principles, and policy directions. Most studies and organizational initiatives concentrate on outlining high-level frameworks rather than conducting technical or quantitative validation. This aligns with the intent of this paper to provide a foundational synthesis of current Responsible AI practices and to bridge theoretical principles with potential implementation pathways.

Several trends emerged from the reviewed literature. First, there is broad consensus among researchers and industry leaders on the need for transparency, fairness, and accountability in AI-driven urban systems. Second, the comparative analysis of global technology firms reveals overlapping but distinct Responsible AI priorities. Third, national policies demonstrate increasing alignment toward ethical AI governance but lack detailed technical deployment strategies. These insights suggest that while the conceptual base of Responsible AI is well established, practical implementation remains limited, and technical guidelines are still evolving.

In summary, the paper contributes by mapping and interpreting the conceptual landscape of Responsible AI in smart cities, identifying key policy and governance patterns that future empirical or analytical research can build upon. The discussion thus serves as a bridge between current descriptive frameworks and prospective analytical investigations into Responsible AI integration within urban ecosystems.

VII. Conclusion

This paper reviewed works on Responsible AI in the smart city context. While ethical issues in AI implementation for smart cities have been in focus for some time, the movement toward Responsible AI has gained momentum as technology providers and governments implement initiatives.

While Responsible AI has become a buzzword, different technology companies have different priorities and agendas some overlapping, others unique. In smart city contexts, implementing Responsible AI requires a combination of policies, regulations, and technical approaches such as algorithmic adjustments. To succeed, policies and regulations must be clear in defining goals and needs.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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