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Perspective

Responsible Urban Innovation with Local Government Artificial Intelligence (AI): A Conceptual Framework and Research Agenda

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Abstract: The urbanization problems we face may be alleviated using innovative digital technology. However, employing these technologies entails the risk of creating new urban problems and/or intensifying the old ones instead of alleviating them. Hence, in a world with immense technological opportunities and at the same time enormous urbanization challenges, it is critical to adopt the principles of responsible urban innovation. These principles assure the delivery of the desired urban outcomes and futures. We contribute to the existing responsible urban innovation discourse by focusing on local government artificial intelligence (AI) systems, providing a literature and practice overview, and a conceptual framework. In this perspective paper, we advocate for the need for balancing the costs, benefits, risks and impacts of developing, adopting, deploying and managing local government AI systems in order to achieve responsible urban innovation. The statements made in this perspective paper are based on a thorough review of the literature, research, developments, trends and applications carefully selected and analyzed by an expert team of investigators. This study provides new insights, develops a conceptual framework and identifies prospective research questions by placing local government AI systems under the microscope through the lens of responsible urban innovation. The presented overview and framework, along with the identified issues and research agenda, offer scholars prospective lines of research and development; where the outcomes of these future studies will help urban policymakers, managers and planners to better understand the crucial role played by local government AI systems in ensuring the achievement of responsible outcomes.

Keywords: responsible innovation; responsible urban innovation; artificial intelligence (AI); responsible AI; local government AI; AI revolution; urban technology; urban policy; community engagement; smart city

1. Introduction

Over the last 50 years, the pace of technological development has increased significantly. We owe this remarkable progress to the efforts of the stakeholders of the global innovation ecosystem that activated two ground-breaking digital revolutions [1–3]. The First Digital Revolution occurred in the 1980s and 1990s—some scholars even date it back to the 1970s, when the development of the personal computer commenced [4]. These technological developments resulted in mass digitization, an increasing number of products and services being encoded in the cyberspace, and the diffusion of the internet on a pervasive scale [5]. Today, the world is on the verge of the Second Digital Revolution—where an increasing number of computing- and internet-enabled objects and devices allow for ubiquitous computing and open innovation opportunities in our everyday lives [6–8].

Moreover, Makridakis [9] estimates that the next digital revolution will take place within the next couple of decades, and calls it the ‘artificial intelligence (AI) revolution’. He further predicts that it will have a greater impact than both the first and the second digital revolutions combined. However, we are already on track towards the AI revolution. For instance, the Internet-of-Things (IoT) links objects wirelessly to a network that enables data sharing, and within this network AI is simultaneously analyzing IoT data and making decisions autonomously [10–12]. The smart home can be offered as an example of the popular application areas for this technology [13,14]. While highly innovative technologies—e.g., artificially intelligent internet-of-things (AI-IoT) [15]—are disrupting the industrial processes—i.e., Industry 4.0 [16]—, they are disrupting our cities and societies as well—i.e., smart city and smart community [17–19].

Nonetheless, this disruption is not necessarily solely generating positive externalities and delivering the desired outcomes or the desired outcomes for all [20]. For instance, on the one hand, autonomous vehicles—in the form of autonomous shuttle buses—could increase public transport coverage and patronage, and hence decrease the carbon emissions associated with transport [21,22]. On the other hand, autonomous vehicles—in the form of private autonomous cars—could increase mobility and urban sprawl, and thus increase transport carbon emissions [23]. Issues similar to these bring up the need for technological innovation in the context of cities, or in other words urban innovation, to become responsible for maximizing the desired outcomes and positive impacts for all and minimizing the unwanted ones [24–26].

Responsible innovation is vital in order to tackle the challenges our cities face, irrespective of whether they are related to natural resource degradation, climate change, economic progress or social welfare [27]. According to Von Schomberg [28] (p. 51), “responsible innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the ethical acceptability, sustainability and societal desirability of the innovation process and its marketable products in order to allow for the proper embedding of scientific and technological advances in our society”. Responsible urban innovation can be defined as “a collective commitment of care for the urban futures through responsive stewardship of science, technology and innovation in the present” [29] (p. 27). That is to say, responsible urban innovation challenges us not only to generate science, technology and innovation which can have a positive impact on our cities and societies today, but also makes us think about and act upon our responsibility to build the desired urban futures for all [30].

This perspective paper is written with the purpose of contributing to the existing responsible urban innovation discourse—that is an understudied and a relatively under-advocated area. With a specific focus on technology for responsible urban innovation, the paper concentrates on AI and its use as part of local government systems. The rationale behind this selection is as follows: (a) AI, a technology with an increasing number of applications in the urban context, is referred to as one of the most powerful technologies of our time with both positive and negative externalities for cities [31,32]; (b) AI is an integral part of a smart city structure that provides the required efficiencies and automation ability in the delivery of local infrastructures, services and amenities [33,34], and; (c) there is a

trend among local government agencies to adopt AI for managing routine, complex and complicated urban issues, where the knowledge and the experience of the staff in the area of responsible innovation, in general, are fairly limited [35–37].

As for the methodological approach, this perspective paper undertakes a review of the literature, research, developments, trends and applications concerning responsible urban innovation with local government AI systems, and develops a conceptual framework. In the light of the findings, the paper advocates the need for balancing the costs, benefits, risks and impacts of developing, adopting, deploying and managing local government AI systems targeting responsible urban innovation.

Following this introduction, Section 2 provides an overview of the notion of responsible urban innovation. Subsequently, Section 3 focuses on local government AI systems including their common application areas. Next, Section 4 presents the concept of responsible local government AI and its necessity for obtaining the desired urban outcomes as well as for showcasing responsible urban innovation practices. Section 5 introduces a conceptual framework of responsible urban innovation with local government AI. Lastly, Section 6 closes the paper with some concluding remarks and prospective lines of research.

2. Responsible Urban Innovation

Cities continue to experience significant challenges—e.g., resource demands, governance complexity, socioeconomic inequality and environmental threats—where innovation is seen as an important means of addressing these problems [38–40]. In other words, innovation is considered necessary for tackling urbanization problems and ensuring smart, sustainable and inclusive growth [41–43]. While local governments conducting urban experiments to trial combatting urban problems in a novel way with technological innovation [44], this also created a lucrative business opportunity for the high-tech companies—such as Cisco, IBM, Siemens, Huawei and Sidewalk Labs—which merged technology solutions with urban planning and development under the popular ‘smart city’ brand [45,46].

Some initiatives are renowned for their success in the use of advanced technologies, such as AI to guide urban planners in making improvements in the city. The following are just some of the success cases: “(a) Massachusetts Institute of Technology (MIT) Media Lab’s agent-based simulation to explore possible designs for busy public spaces, including a regenerated Champs-Élysées in Paris; (b) the AI application of Topos, a New York based startup, including image recognition and natural language processing, to help understand how the layout of a city affects those living in it, and to identify how different areas of New York were used by the residents; (c) University of Melbourne’s AI utilization for future urban design decisions through the use of generative adversarial networks (GANs) to reproduce Google Street View images in the style of Melbourne’s neighborhoods with public health characteristics” [47] (p. 4); (d) the Array of Things (AoT) project of the University of Chicago that comprise “a network of interactive, modular devices, or nodes, that are installed around Chicago to collect real-time data on the city’s environment, infrastructure, and activity. These measurements are also shared as open data for research and public use” [48] (p. 1)—also see Hawthorne [49] for how citizen devices are being used for tracking Chicago’s pollution hot spots, and; (e) additional examples can be given with the cities’ living lab experiments that utilize quadruple helix as a form of local innovation system [50], deploying innovative technology to encourage citizen participation in urban decisions [51], and social innovation initiatives concerning urban problems, such as sustainable development and climate change [52].

Nonetheless, the short-term profit-at-any-cost mindset of many disruptive technology companies has been generating innovation with more negative externalities—e.g., increased energy demand, pollution, damage to physical and mental health, and waste of taxpayers’ money—than positive externalities [53,54]. This is to say, innovation without responsibility creates more problems than it solves—e.g., technology push, negligence

of fundamental ethical principles, policy pull, and lack of precautionary measures and technology foresight [55,56].

Some of the common examples of the negative consequences of urban innovation involving advanced technologies, such as AI, include, but are not exclusively limited to: (a) the failure of algorithmic decision-making and predictive analytics of Pittsburgh, PA, in solving urban poverty, homelessness and violence problems, particularly by misdiagnosing child maltreatment and prescribing the wrong solutions [57]. This issue of automating inequality is discussed in length in the seminal work of Eubanks [58]. (b) Bias algorithmic decision-making has become one of the major unintended negative externalities, and the examples range from excluding women [59] to excluding people of color [60], and from excluding religious minorities [61] to excluding indigenous people [62]. (c) In most cases the failure and bias of algorithmic decisions led to the abolition of AI adoption endeavors in local governments. A good example is scrapping of the use of algorithms in benefit and welfare decisions in 20 local councils in the UK [63]. Furthermore, as stated by McKnight [64] (p. 1), “as AI has no a moral compass, OpenAI’s managers originally refused to release GPT-3 (Generative Pre-trained Transformer 3)—an autoregressive language model that uses deep learning to produce human-like text—ostensibly because they were concerned about the generator being used to create fake material, such as reviews of products or election-related commentary. Similarly, AI writing bots may need to be eliminated by humans, as in the case of Microsoft’s racist Twitter prototype AI chatbot—i.e., Tay”. (d) The other negative externalities include “creating opaque decision-making processes, challenges in accountability and trust in AI-enabled decisions, and risks to privacy due to sensitive, granular and in-depth data collection practices” [65] (p. 3).

Moreover, even the most celebrated smart city initiatives—that represent urban innovation in management and policy as well as technology—have failed to deliver their promises or have even been abandoned before project initiation—e.g., Songdo, Masdar, PlanIT Valley and Sidewalk Toronto [66,67]. The main reasons behind this failure include technology myopia, a top-down approach, solutionism and the lack of clear objectives and socio-spatial responsibility [68]. Consequently, technology giants—e.g., Google’s Sidewalk Labs and Cisco—have recently pulled back from the smart city push that did not practiced clear responsible urban innovation principles—including accountability, anticipation, reflexivity, transparency, responsiveness, inclusiveness and sustainability [69–71]. As argued by Green [72] (p. 1), we need to “recognize the complexity of urban life rather than merely see the city as something to optimize, truly smart cities are the ones that successfully incorporate technology into a holistic vision of justice and equity”.

Responsible urban innovation is central to addressing the current and emerging challenges of cities characterized by complexity, uncertainty, risk and myopia [73]. It encompasses a public and environmental value-sensitive approach to technology design and adoption, which makes environmental (e.g., eco-responsibility) and societal (e.g., social-responsibility) factors as relevant as the economic (e.g., frugality) ones in the urban innovation and development processes [74–76]. In other words, responsible urban innovation carefully considers the effects of innovation on the environment and society [77]. Responsible urban innovation, thus, is characterized by its sustainability, which is vital for generating long-lasting solutions [78].

Furthermore, as stated by Ziegler [79] (p. 195), there are two roles for responsible urban innovation to play for socio-spatial justice. These are: “(a) to contribute to the long-term stability of the society, and thus to find creative responses to socio-spatial challenges such as climate change, and; (b) to find ideas that specifically improve the benefits for the least advantaged members of the community in the present”.

3. Local Government Artificial Intelligence Systems

As stated by Das and Rad [80] (p. 1), AI-based algorithms “are transforming the way we approach real-world tasks done by humans; where recent years have seen a surge in the use of these algorithms in automating various facets of science, business, and social

workflow". In particular, government agencies are increasingly interested in using AI capabilities to deliver policy and generate efficiencies in high-uncertainty environments [81,82]. A study by De Sousa et al. [83] disclosed a growing trend of interest in AI in the public sector, with the US as the most active country. This is also the case with many local government agencies [84]. According to Wirtz et al. [85], the most common AI applications in government agencies are as follows: (a) AI-based knowledge management software; (b) AI process automation systems; (c) chatbots/virtual agents; (d) predictive analytics and data visualization; (e) identity analytics; (f) cognitive robotics and autonomous systems; (g) recommendation systems; (h) intelligent digital assistants; (i) speech analytics, and; (j) cognitive security analytics and threat intelligence.

AI offers urban innovation opportunities to generate novel solutions to the problems of our cities [86,87]. It has the potential to create a great impact on the way citizens experience and receive services and interact with their government, as recent advances in AI have resulted in an increasing number of decisions being handed over to algorithms [88,89]. This also applies to local government operations and services [90,91]. Today, AI is not only becoming an integral part of local government operations and services, but is also impacting and shaping the future of our cities and societies [92]—e.g., the forthcoming autonomous vehicle disruption [93–95].

In the context of cities, AI systems were first introduced as part of smart city initiatives [96] (Ullah et al., 2020). Nonetheless, today AI is no longer exclusively associated with smart city projects. For instance, there is an increasing number of local governments, with no smart city agenda, which have utilized AI-driven chatbots in their customer and service delivery services [97,98]. This is because local government agencies are becoming more aware of the benefits of AI. According to the International City/County Management Association (ICMA) [99], these benefits include: (a) local governments can run more efficiently; (b) local governments can focus on their residents; (c) local governments can remove a great deal of bias, and; (d) local governments can make data-smart decisions and gain that extra edge for under-resourced departments.

Besides AI-powered chatbots for engaging with the local community, local governments are using AI for automating routine tasks via self-service, and enhancing public services with data and analytics [100,101]. Additionally, hyper-personalized services, predictive maintenance of assets, workforce, schedule and resource optimization, reducing our carbon footprints, optimizing energy usage, and combatting child abuse and financial fraud are among the applications of AI used in local governments [102].

Today, many cities around the world are trying to position themselves as the leaders of urban innovation through the development and utilization of AI [103]. Some of these cities which are experimenting with and adopting AI systems include, but are not exclusively limited to, New York, Washington, Los Angeles, San Antonio, Pittsburgh, Phoenix, London, Singapore, Barcelona, Oslo, Helsinki, Hong Kong, Beijing, Brisbane, Sydney, Melbourne, Bangalore, Dubai and Jeddah [104]. Moreover, the world's first 'AI City'—or artificially intelligent city—is being planned in Chongqing (China) with wired AI-IoT, robotics, networking and big data [105].

While the popularity of AI is skyrocketing in the urban context, Allam [106] (p. 31) warns us that, "whilst AI stands as a potential savior and as its role is being accentuated in urban planning, governance and management, there are increasing concerns that its practical implications and planning principles are disconnected with sensibilities linked to the dimensions of sustainability". This very issue has also been raised by other urban scholars [107].

Importantly, as today AI-based decision-making is in a trend to become commonplace, local government AI systems should be used "responsibly and ethically that extends beyond compliance with the narrow letter of the law. It also requires the system to be aligned with broadly-accepted social norms, and considerate of impact on individuals, communities and the environment" [108] (p. 1).

Despite the use of AI in local governments being relatively new, it is already possible to find promising examples of responsible practices, which include, but are not limited to: (a) AI-driven transportation analytics and decision-making systems to address the urban traffic problems of Austin, TX [109]; (b) autonomous shuttle buses are currently being used as first- and last-mile solutions to increase public transport patronage and/or to provide transport service to disadvantaged populations in cities, including Lyon (France), Geneva (Switzerland), Wien (Austria), Oslo (Norway), Las Vegas (USA), Masdar City (UAE), Thuwal (Saudi Arabia), West Kowloon (Hong Kong) and Renmark (Australia) [110,111], and; (c) computer vision and machine learning for robots to identify material characteristics while sorting waste and increasing the capacity of recycling of the San Francisco Bay Area [112].

Building on the aforementioned practices which are limited but promising practices, Schmelzer [113] (p. 1) raised the following key issues which must be fully tackled so that many more local governments can successfully implement responsible AI practices: “(a) identifying the unique challenges around data at the local government level; (b) determining the areas that AI has the biggest impact at the local level; (c) understanding the challenges local governments face around data privacy, transparency and security; (d) developing an AI-ready local government workforce, including upskilling the current workforce around data and AI skills, and; (e) having a responsive lens when deploying and managing AI technologies.” A study by Chen et al. [114] reveals the success factors for AI adoption as: (a) innovation attributes of AI; (b) organizational capability, and; (c) external environment.

4. Responsible Local Government Artificial Intelligence

Amid the global push for AI use at the local government level [115], there are growing concerns over AI uptake in the absence of an in-depth understanding of the implementation challenges, contextual local differences, and local government readiness [116]—as well as the lack of responsible urban innovation practices [117].

The upcoming digital urban infrastructure that will be supporting future societies will intrinsically be based on AI [118]. This is evident from the work on the sixth-generation (6G) networks with extreme-scale ubiquitous AI services through the next-generation software, platformization, heterogeneity and configurability of networks [119–121]. Such infrastructure will provide unimaginable opportunities for urban innovation. Nevertheless, a responsible approach is critical when it comes to eliminating the negative externalities of innovation which could otherwise have catastrophic consequences—e.g., worsening socioeconomic inequity, widening digital divides, devastating environmental externalities and increased bias.

Some promising developments being made at present. A good outcome of the academic discourse is the ‘Montreal Declaration for Responsible AI’, developed under the auspices of the University of Montreal, following the Forum on the Socially Responsible Development of AI of November 2017 [122]. Another notable example is AI regulation and ethics frameworks being rolled out in various countries. The most celebrated of these is the European Parliament’s initiative on the guidelines for the European Union (EU) on ethics in AI [123]. While thus far, more than 50 countries have developed their national AI strategies—where the intention is mainly economic development and national security [124]—only a few have attempted to form their AI ethics frameworks that advocate responsible AI [125].

Despite the increasing interest in the scholarly debate, responsible urban innovation and responsible local government AI remain highly understudied, and thus far, there is a limited empirical evidence base and few conceptual expansions [126]. Thus, local governments’ adoption and use of AI systems [127], in the context of urban innovation, is an important topic of scholarly research, and key to expanding our understanding of the pathways leading to the achievement of responsible urban innovation through these systems.

Moreover, in the absence of an abundance of responsible urban innovation with local government AI, the generation of new insights and evidence is of utmost importance. Prospective research in this interdisciplinary field will aid in conceptualizing and providing a sound understanding of the most appropriate approaches for local governments engaging with AI to achieve responsible urban innovation. Such conceptualization will also aid in the efforts to develop clear pathways for healthy AI design and deployment. Furthermore, the outcomes of these future studies will help urban policymakers, managers and planners better understand the crucial role played by local government AI systems in ensuring responsible outcomes. This consolidated understanding will guide the efforts in developing new coordination and delivery practices for local government AI systems to achieve the desired responsible urban innovation outcomes in their cities.

5. Conceptual Framework

We have developed a conceptual framework of responsible urban innovation with local government AI. The main rationale behind the development of this high-level information, i.e., the conceptual framework, is to highlight the relationship between the key drivers, components and the fundamental principles of responsible urban innovation in the context of local government AI. We believe this approach will create an interest and curiosity in the academic community to further investigate the topic and subsequently generate new research directions and practical solutions for the government and industry to adopt or benefit from. Hence, the framework, which is illustrated in Figure 1 and elaborated below, shall not be seen as an operational framework to directly guide the AI system development, deployment and management practices of local government agencies.

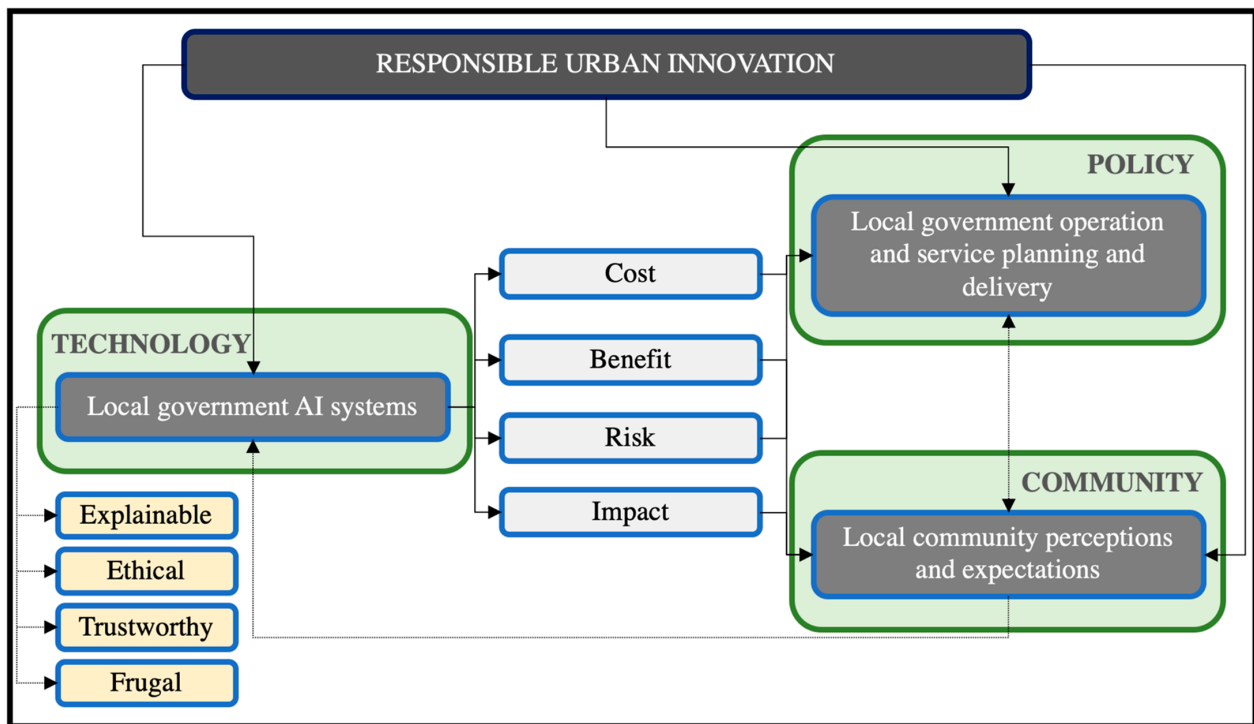


Figure 1. Conceptual framework of responsible urban innovation with local government artificial intelligence (AI).

In this framework, the responsible urban innovation phenomenon is conceptualized through a process that involves technology, policy and community to produce strategies, action plans and initiatives, with balanced costs, benefits, risks and impacts of developing, adopting, deploying and managing local government AI systems.

First, technology, policy and community are envisaged as the key drivers of responsible urban innovation; where local government AI systems represent ‘technology’, local

government operation and service planning and delivery decisions represent ‘policy’, and local community perceptions and expectations represent the ‘community’ views and input. This is attributed to the fact that the trio of ‘technology, policy and community’ are being widely seen as the key drivers of smart cities—urban localities that use digital data and technology to create efficiencies for boosting economic development, enhancing the quality of life, and improving the sustainability of the city [128]—or technology-based urban growth practices [129–131] or technology-based public policy [132].

Second, ‘cost’, ‘benefit’, ‘risk’ and ‘impact’ are identified as the central foci of the framework for realizing responsible outcomes concerning local government AI systems. This is attributed to the need for undertaking a cost-benefit analysis before developing, adopting and deploying AI systems in order to ensure the worthiness of the investment [133]. Likewise, being aware of the potential hazards by undertaking a risk analysis, is critical when it comes to assuring the success of the AI system [134]. Similarly, forecasting the impact of the AI system on the society and the environment is crucial for identifying both positive and negative externalities [135]. Additionally, rather than only looking at costs and benefits overall, responsible use of AI should also consider the distribution of costs and benefits, and whether some groups or places (e.g., disadvantaged neighborhoods) bear more risk. This is an ethical concern—equity as a public value.

Moreover, this conceptualization advocates that local government AI systems should include the following characteristics: to be (a) explicable; (b) ethical; (c) trustworthy, and; (d) frugal.

First, the effectiveness of the AI systems is limited by the machine’s inability to explain its thoughts and actions to human users. Hence, explainable AI (XAI)—which refers to methods and techniques that generate high-quality interpretable, intuitive, human-understandable explanations of AI decisions—is essential for operators and users to understand, trust, and effectively manage local government AI systems [136,137].

Second, the ethical considerations made by the designers and adopters of AI systems, are critical when it comes to avoiding the unethical consequences of AI systems [138,139]. As stated by Floridi et al. [122] (p. 694), “ensuring socially preferable outcomes of AI relies on resolving the tension between incorporating the benefits and mitigating the potential harms of AI, in short, simultaneously avoiding the misuse and underuse of these technologies. In this context, the value of an ethical approach to AI technologies comes into starker relief”.

Third, today, we are seeing an increasing trend of autonomous decision-making, but we are not there yet. This is especially true for most government services [140,141]. In particular, local governments around the world are looking at technological solutions, including decisions being made autonomously by AI systems with limited or null human involvement, to address a range of social and policy challenges. While this handover of decisions to AI provides benefits—e.g., reduction in human error, faster decision-making, 24/7 availability, completion of repetitive tasks—it also creates risks, e.g., algorithmic bias caused by bad/limited data and training, privacy violations, removing human responsibility, and a lack of transparency [142]. The public is already becoming increasingly distrustful of many AI decisions; robodebt and systematic racism traumas caused by AI systems in Australia and the US are among the recent examples [143–146]. In order to prevent these risks from occurring and gaining public confidence, AI must be trustworthy [147–149].

Fourth, at present comprehensive AI systems are significant investments for local governments, with many of these organisations having limited budgets and responsibilities for justifying the investment and management cost to their citizens and taxpayers. For a wide-scale AI adoption in local governments, AI systems should become accessible and affordable, or in other words frugal [150]. In this context, frugality is the minimum use of scarce resources—e.g., capital, time, workforce and energy. Alternatively, the resources can be leveraged in new ways or other solutions can be found that do not jeopardize the delivery of high value outputs [151].

The framework, illustrated in Figure 1 and elaborated above, underlines the key drivers, components and the fundamental principles of responsible urban innovation with local government AI. It sheds light on the overall principles of the development and deployment of AI systems that assure the delivery of not only the desired urban outcomes, but also the desired urban outcomes for all citizens, stakeholders, users and the environment. The approach outlined in this framework is invaluable for local government agencies when it comes to being aware of the issues around responsible innovation; as local governments continue in the phase of experimentation with AI technologies, they need guidance on how best to design, develop, and deploy these solutions in a responsible manner that advances public value. Nevertheless, it should be noted that the framework presented here is a conceptual one developed with the goal of contributing to the academic discourse on the topic and generating directions for future research agendas. Thus, prospective research is needed to develop more operational frameworks involving specific guidelines for local governments so that they can make informed decisions regarding their investments in AI systems.

6. Concluding Remarks and Research Agenda

With the advent of powerful technologies and the strong short-term profit-at-any-cost mindset of many disruptive technology companies, ensuring responsible urban innovation will continue to be a major challenge in the third decade of the 21st century as well [152]. In particular, there are some important issues, in the context of responsible urban innovation with local government AI, that require urgent attention.

With the aforementioned urgency in mind, in this perspective paper, we underlined the importance of local government agencies making informed decisions while developing, adopting, deploying and managing AI systems. This is becoming a highly critical issue, as stated by Arrieta et al. [137] (p. 82), in recent years, the “sophistication of AI systems has increased to such an extent that almost no human intervention is required for their design and deployment. When decisions derived from such systems ultimately affect humans’ lives, there is an emerging need for understanding how such decisions are furnished” and how responsible they are. Moreover, this also increases the danger that unintended consequences can grow and multiply through policy inattention or delayed recognition.

Nevertheless, at present there are no operational frameworks and clear guidelines to assist local governments in achieving responsible innovation through AI practices. In the absence of such guidelines, the conceptual framework illustrated in Figure 1 is a step towards increasing awareness on the matter and triggering potential research agendas for the development of operational frameworks and guidelines. In this instance, we underline some of the fundamental issues, as listed below, where focusing on these could pave the way for a new research agenda concerning responsible urban innovation with local government AI:

- How can local governments utilize AI systems effectively, what are the requirements for making them responsible, and how can local government AI support responsible urban innovation efforts?
- Why do some local governments experiment with and adopt AI systems when the risks are not clearly known, while the others prefer to take a wait and see approach before making this decision?
- How can local governments conduct trade-offs between costs, risks, benefits and impacts, and utilize AI systems in their municipal operations and services, and what externalities do these trade-offs generate?
- How can the AI systems’ costs, risks, benefits and impacts be distributed across the local government service users and communities, and how can the equity concerns be addressed?
- Further dwelling on the above issue, if some groups or geographic areas bear greater risk or costs, should AI be used anyway, should there be a just compensation in some manner, and if yes, how?

- How can local governments align the public perceptions and expectations of AI, and mitigate the impact of consequential negative externalities of AI systems on the environment and society?
- How can local governments support and ensure high levels of trust, transparency, and openness in the local community culture and extend these concepts of digital trust to AI?
- How can local governments successfully adopt, deploy and manage AI systems to generate responsible urban innovation in their cities, and how can the guidelines for successful adoption be developed?
- How will local government AI systems shape the future of our cities and impact the lives of citizens, and how can the negative externalities of the disruption be alleviated?
- How can operational frameworks and guidelines be developed for local governments in regard to adopting, deploying and managing AI systems to achieve responsible urban innovation outcomes?

There is very limited to no coverage on either theoretical or applied aspects concerning the aforementioned questions in the literature and practice—as the responsible local government AI notion is still cutting-edge but incipient in nature. Most studies reported in the literature, thus far, are drawn from the intuitions and predictions of scholars rather than hard evidence obtained through exhaustive empirical research. We strongly believe that investigation of these issues in prospective research projects, by the scholars of this highly interdisciplinary (more correctly transdisciplinary) field, will shed light on the better conceptualization and practice of responsible urban innovation with local government AI.

Thus, the future research agenda should focus on tackling the aforementioned issues via carefully designed empirical studies in international contexts. In this regard, the conceptual framework, presented in Figure 1, is a useful compass to guide in the design of new empirical investigations. For instance, an example of a prospective research agenda, concerning responsible urban innovation with local government AI, could be as follows.

At present, AI is not only becoming an integral part of urban services, but also is impacting and shaping the future of living and cities [153,154]. Nevertheless, the current AI practice has shown that urban innovation without responsibility generates more problems than it solves. In particular, the absence of a deep understanding of the costs, benefits, risks and impacts of deploying local government AI systems creates concerns. Focusing on the local government case studies, prospective projects can generate new knowledge on the local government use of AI systems, and expand our understanding of the pathways for responsible urban innovation. These studies could also produce invaluable outcomes that include the local government AI adoption and implementation of guiding principles for informed decisions.

In conclusion, the AI revolution is already under way and its disruption will likely be comparable to that of the agricultural and industrial revolutions, which changed the course of human civilization radically [155]. Nevertheless, it should not be forgotten that the AI revolution contains an equal measure of opportunities and challenges [156,157]. According to Walsh [158], the ethical challenges posed by AI—e.g., fairness, transparency, trustworthiness, protection of privacy and respect, and many other fundamental rights—are the biggest issues, and they must be addressed with utmost care and urgency. Importantly, the actions to address these challenges should be adopted before the local government AI systems are actually in use [159–161].

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