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Policy frameworks for emerging economies sustainable smart city development: The adoption of artificial intelligence and Internet of Things for the revolutionisation of urban infrastructure

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Background: Innovative urban development techniques are required in emerging economies because of the increased urbanisation, infrastructure deficiencies and environmental difficulties they face. With artificial intelligence (AI) and the Internet of Things (IoT) support, smart cities may improve governance and optimise resource use, all of which contribute to sustainable growth.

Objectives: The purpose of this study is to examine how policy frameworks driven by AI and IoT may facilitate adaptive and sustainable urban infrastructure in developing nations such as South Africa.

Methods: In this study, a range of articles from the Science Direct, Scopus and Sabinet databases were consulted using the systematic literature review approach. Additionally, the inclusion and exclusion criteria are based on the Preferred Reporting Items for Systematic reviews and Meta-Analyses framework.

Results: Findings suggest that developing countries should create integrated frameworks for smart cities that match local implementation capabilities with national vision, to fill financial shortfalls, creative financing methods like technology-specific Public Private Partnership models and municipal funding need to be expanded.

Conclusion: This study demonstrates that successful integration of AI and IoT into urban planning requires a fundamental change requiring strong, flexible policy frameworks rather than just a technology advancement. Such frameworks are crucial for emerging economies to use these technologies for sustainable and equitable infrastructure, guaranteeing that the development of smart cities promotes inclusive growth and long-term resilience.

Contribution: This article adds to the conversation on sustainable urban development by putting out a thorough policy framework that uses both applications to improve adaptable infrastructure in smart cities in emerging economies.

Keywords: artificial intelligence; emerging economies; governance; Internet of Things; smart cities.

Introduction

The concept of 'smart cities' has received significant support, especially in emerging nations where rapid urbanisation, technological breakthroughs and sustainable development objectives are causing change (Fromhold-Eisebith & Eisebith, 2019). The benefits of smart cities are to improve public services, optimise resource management and upgrade urban infrastructure; smart cities must make use of digital technology, data analytics and the Internet of Things (IoT) (Raghuvanshi & Sharma, 2022).

Khan (2022) highlights that by incorporating the innovation into urban design, transportation, energy and governance, smart cities can offer underdeveloped countries a rare chance to overcome conventional development obstacles. It is noted in the study that overcrowding, poor infrastructure, pollution and ineffective public services are some of the urgent problems facing emerging economies. This results in shifting towards smart cities and making it difficult to address issues. In nations such as Nigeria, Brazil, Indonesia and India, public and private sectors are funding smart city projects to promote environmental sustainability, economic expansion and better living

standards as discovered in a study by Browne (2020). In addition, the shortcomings are witnessed leading to resilience, which are based in urban settings; these initiatives frequently concentrate on digital connectivity, e-governance, smart mobility and renewable energy.

This study has noted that several gaps exist for adoption of smart cities in developing nations, such as exorbitant expenses, gaps in technology, infrastructure and legislative restrictions. Furthermore, these gaps most depend on addressing maintenance cost, accessibility and cybersecurity issues, which is leading to smart cities projects failing. Notwithstanding these obstacles, smart cities have enormous potential to improve urban liveability, lower carbon footprints and boost economic competitiveness in emerging nations. A study by Chatterjee and Kar (2018) noted that emerging economies may set the path for a more intelligent and sustainable future by using scalable and flexible solutions that become an advantage.

Kummitha and Crutzen (2019) suggest that there are several difficulties in developing smart cities in emerging countries, such as a lack of capital, poor digital infrastructure, and socioeconomic inequality. Smart cities may be crucial in changing urban living, spurring innovation, and lowering inequality in developing countries as these projects gain traction (Mageto et al., 2024).

According to Camargo et al. (2021), emerging economies are rapidly becoming more urbanised, which brings with it both opportunities and challenges as cities fight to keep up with population growth while maintaining resilience, efficiency and sustainability. Waghmare (2024) suggests that governments must create strong policy frameworks that incorporate the IoT and artificial intelligence (AI) into urban planning to address these problems. To ensure that technological innovations benefit all citizens while addressing digital disparities and environmental issues, effective regulations must strike a balance between innovation and inclusivity (Yadav et al., 2019).

A study by Javed et al. (2022) claims that the development of adaptive urban infrastructure, which can react dynamically to shifting urban demands, is made possible by AI and IoT. Moolngearn and Kraiwanit (2024) further add that to maintain long-term sustainability, emerging economies must also give priority to scalable and affordable solutions. Cities in poor nations may overcome the constraints of old infrastructure and create sustainable, future-ready urban ecosystems by coordinating policy frameworks with technological innovation. Tan and Taeihagh (2020) emphasise that smart cities in developing nations have the potential to set the standard for intelligent and sustainable urban development worldwide with careful planning and inclusive policies.

Policy design and governance

According to Kummitha and Crutzen (2019) and Lim et al. (2019), particularly in emerging nations where rapid urbanisation puts a strain on the infrastructure already in place, the idea of smart cities has emerged as a revolutionary approach to urban development. It is noted that, to improve sustainability, efficiency and resilience, policy frameworks play a crucial role in directing the integration of AI and the IoT, according to a scholarly study. Sergi (2019) asserts that inclusive governance and technological adoption are essential components of smart city plans that guarantee the benefits of digital transformation for all socioeconomic groups. In a similar study, Rana (2019) stresses that data-driven decision-making should be given top priority in smart urban policy, allowing cities to maximise public services, transportation and energy use through analytics driven by AI.

Bibri and Krogstie (2020) discovered that cities can react dynamically to changes in the environment and population because of adaptive infrastructure systems made possible by real-time IoT sensors and machine learning. For example, IoT-based traffic management can ease congestion in rapidly expanding megacities, and smart grids with AI-driven demand forecasting can cut down on energy waste (Alsamhi et al., 2021; Ghasempour, 2019). On the other hand, a study by Yigitcanlar et al. (2020) provided another view that in the absence of robust regulatory frameworks, these technologies run the risk of escalating privacy issues and digital divides, especially in urban regions with limited resources.

Emerging economies face policy issues, such as limited funding, insufficient institutional ability and fragmented governance, as highlighted by recent studies. According to Kummitha and Crutzen (2019), cross-sector cooperation and public–private partnerships (PPPs) are crucial for the expansion of smart city projects.

Allam and Dhunny (2019), who stress the need for specific policy frameworks, a one-size-fits-all approach usually fails in diverse urban situations. To guarantee that AI and IoT developments result in sustainable, inclusive and adaptable urban futures in emerging countries, literature emphasises the necessity of striking a balance between innovation and fairness in smart city regulations. Angelidou (2017) and Kitchin (2021) identified that for AI and IoT to be successfully integrated into the development of smart cities in emerging economies, effective policy design and governance are essential to guarantee the efficient use of these technologies by citizens, companies and local governments. Therefore, implementing comprehensive governance frameworks that link technological innovation with socioeconomic inclusion, environmental sustainability and institutional capacity, scholars stress that urban policies must transcend technology-centric approaches (Angelidou, 2017; Kitchin, 2021). A study by Yigitcanlar et al. (2020) states that making sure that the adoption of AI and IoT does not worsen digital inequalities. However, the major challenge in co-creating policies is ensuring equitable access to smart urban services through AI and IoT. These policies address local urban concerns while utilising global technological breakthroughs, multi-stakeholder interaction is necessary, involving governments, business sector actors, academia and civil society (Kummitha & Crutzen, 2019).

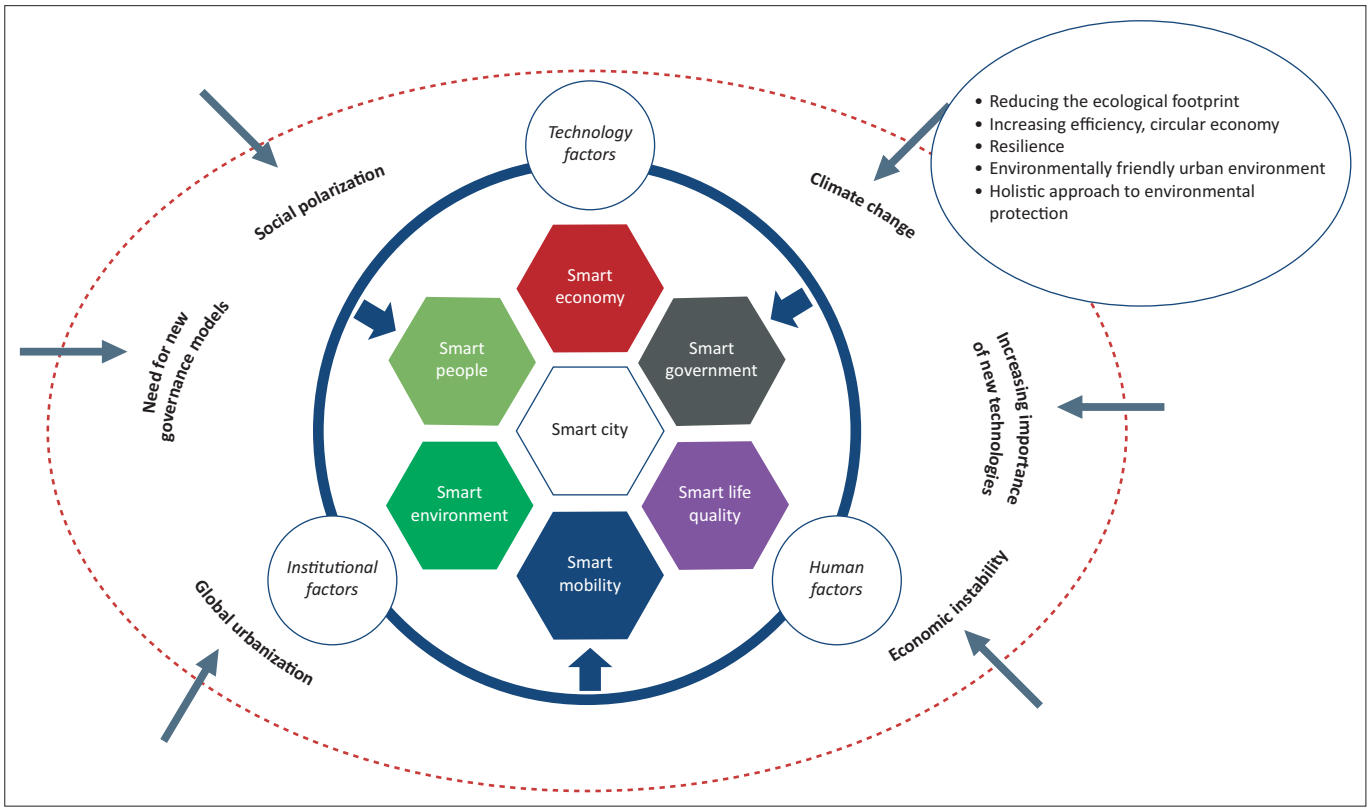
Adaptive regulatory frameworks that can change quickly with technology must also be given top priority in governance models for smart cities in emerging economies. In dynamic urban environments, traditional top-down policy approaches frequently fall short, requiring flexible, iterative policymaking that integrates AI-driven analytics and real-time data feedback from IoT networks (Bibri & Krogstie, 2020). For example, proactive urban planning as opposed to reactive fixes can be made possible by predictive governance, which uses AI to predict infrastructure demands, traffic patterns and energy needs (Allam & Dhunny, 2019). To guarantee cybersecurity, privacy protection and moral AI use; however, this necessitates robust data governance regulations.

Furthermore, innovative governance solutions are needed to overcome institutional and financial constraints in rising economies. Transparent contractual agreements and risk-sharing mechanisms are essential for the success of PPPs, which have become a crucial tool for mobilising investments for smart infrastructure (Sanchez Guzman et al., 2020). Hence, regulations that increase capacity are necessary to give local officials the know-how to oversee AI and IoT systems (Anthopoulos, 2017). Strong political leadership, unambiguous regulatory standards and citizen-centric design are essential for expanding smart city solutions, as evidenced by case studies from places like Singapore (smart country programme) and Barcelona (IoT-enabled urban services). Bibri and Krogstie (2020) assert that a smart city framework addresses sustainability, governance and inclusiveness while providing a thorough roadmap for incorporating cutting-edge technology like AI and the IoT into urban development. As a result, it creates organised standards for implementing data management, digital infrastructure and citizen-focused services, guaranteeing system compatibility and scalability in various urban settings. In Figure 1, the primary trends impacting cities are displayed.

Methods

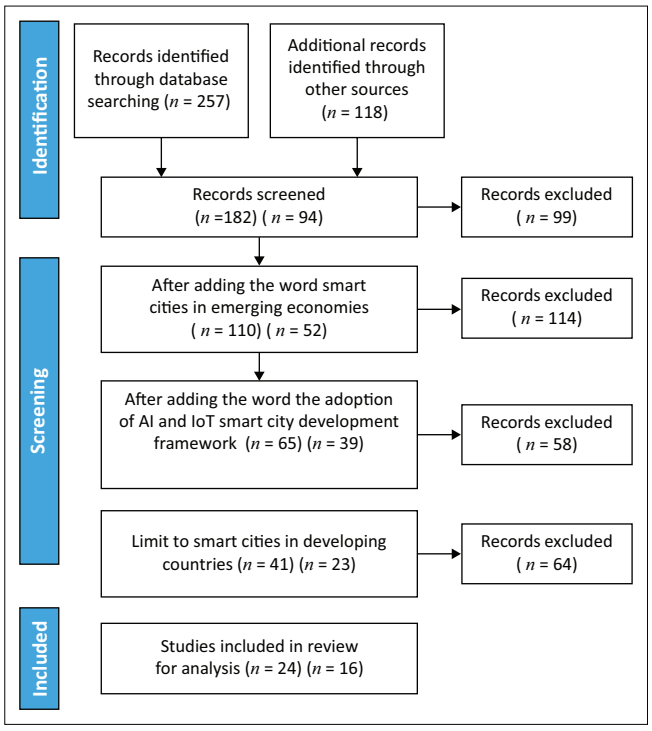
This study used a literature review strategy, referencing a range of articles from the science direct, Scopus and Sabinet databases. By combining a variety of journals that provide insights into digital technology, AI, IoT integration, smart cities in developing economies and their implications. Figure 1 illustrates the importance of a policy framework for smart city development as well as the challenges faced in its implementation. Insights from 40 studies were used in the study to explore how emerging economies need to create efficient policy frameworks for the development of sustainable smart cities using AI and IoT technology.

The variety of academic viewpoints highlights the revolutionary possibilities as well as the intricate difficulties that policymakers in poor nations face when attempting to use AI and IoT to modernise urban infrastructure. By avoiding common traps like technological lock-in or exacerbating already-existing disparities, these many perspectives assist in providing a comprehensive understanding of how smart city technologies may be ethically employed to address urgent urban sustainability concerns.



Source: Szendi, D. (2022). The role of sustainability dimension in the smart city strategies. In *7th International Zeugma Conference on Scientific Research, 21–23 January 2022* (pp. 160-170). European Commission.

FIGURE 1: Smart city framework.



Note: This figure outlines the systematic process in the selection of scholarly literature. Using a predetermined string of keywords pertaining to AI, IoT, smart cities, and policy in emerging economies, three major academic databases (ScienceDirect, Research Gate, and Sabinet).

n, Count of studies included and excluded.

FIGURE 2: Preferred reporting items for systematic reviews and meta-analyses flow diagram.

An analysis of several publications that have been downloaded and reviewed is shown in Table 1. This further shows the following sample of the reviewed articles' findings.

Research settings

Using ScienceDirect, Scopus and Sabinet databases, this study found that the smart cities in emerging economies comprised 162 published research publications from all time periods without any constraints. The following setup was utilised to source pertinent articles from 2017 to 2024 aside from the current year. One particular query is: (Title-key) smart cities, (Title-key) emerging economies and (Title-key) AI and IoT. Other characteristics, like the year of publication (2017–2019), the document type (article 97), conference articles (45) and journals with book series (20), were also employed to increase the efficacy of the research cycle. 40 documents were the focus of this study and were utilised for further analysis after the parameters were put into place. In addition, the government and corporations were included in the various categories. A further stage in completing the characteristics of the selected articles for this study is locating pertinent journals and their individual contributions to Policy Frameworks for Emerging Economies Sustainable Smart City development.

Documents analysis

ScienceDirect, Scopus and Sabinet databases were used in this study to find 162 articles from 2017 to 2024 that included all of the terms, emerging economies, developing countries, governance, AI, IoT and Smart cities. To make the study more realistic and practical, 40 documents were selected based on a single criterion. The document must contribute to the Policy Frameworks for Emerging Economies Sustainable Smart City Development. The adoption of AI and IoT for the revolutionisation of urban infrastructure development. The articles offer a comprehensive grasp and justification of how AI and the integration of IoT and AI technology are transforming the development of urban infrastructure and providing game-changing answers to persistent problems in public services, energy, transportation and governance (see Figure 2).

Ethical considerations

Ethical clearance to conduct this study was obtained from the University of South Africa College of Science, Engineering and Technology School of Computing Ethics Research Committee (No. 6109).

Discussion and results

The study reveals that there are notable differences in the ways that emerging economies are implementing AI and IoT technology for the creation of smart cities. While some nations have advanced quickly because of strong government backing and PPPs, others struggle because of legislative barriers, insufficient financing and poor infrastructure. Smart traffic systems, AI-driven energy management and IoT-based public safety solutions, for example, have been effectively implemented in countries with aggressive policies and investments in digital connections. Cities in less-prepared areas, on the other hand, struggle with disjointed deployments and frequently depend on experimental projects that are not scalable. These differences emphasise the significance of customised approaches that consider regional economic circumstances, technology preparedness and governance structures.

Internet of Things and artificial intelligence applications

In growing economies, the combination of IoT and AI technology is transforming the development of urban infrastructure and providing game-changing answers to persistent problems in public services, energy, transportation and governance (Nieto Bernal & García Espitaleta, 2021). While AI's predictive analytics and machine learning capabilities enable cities to optimise resource allocation, prevent infrastructure failures and improve decision-making processes, the IoT network of interconnected sensors allows for real-time data collection on everything from air quality to traffic flows (Bibri & Krogstie, 2020). In emerging nations, where increased urbanisation puts a strain on current systems and necessitates innovative solutions that circumvent conventional growth pathways, these technologies have a particularly significant impact. But for them to be implemented successfully, policy frameworks that maximise public benefits while addressing

TABLE 1: Review methodology, findings, key contributions and research limitations.

Author	Methodology	Findings	Key contributions	Limitations
Angelidou (2017)	A comparison of 12 smart city projects.	• Mechanisms for involving citizens are absent from 60% of initiatives. • There is a strong link between implementation success and governance maturity.	• The maturity index of smart city policies. • Models of government.	Eurocentric emphasis; scant African data.
Bibri and Krogstie (2020)	150 studies were systematically reviewed between 2010 and 2019.	• The use of AI boosts urban efficiency by 30–45%. • 78% of cases involve data privacy concerns.	• Guidelines for implementation of IoT. • An ethical AI framework for municipalities.	Focus is theoretical; however, it lacks case validation.
Allam and Dhunny (2019)	Mixed methods: 120 stakeholder interviews plus eight city cases.	• Only 35% of cities have policies in place to adapt to climate change. • About 65% of successful ventures are PPPs.	• A framework for climate-resilient smart cities. • PPP assessment matrix.	Limited sample size and short-term information.
Kummitha and Crutzen (2019)	An ethnographic investigation in four smart cities in India.	• Co-designing with the community increases adoption by 40%. • Localisation is necessary for 70% of solutions.	• The model of participatory governance. • Framework for technology adaption.	Focus on a single nation; subjective metrics.
Yigitcanlar et al. (2020)	Analysis of 10,000+ urban variables using big data.	• In 85% of cities, the digital gap still exists. • Emissions are reduced by 22% with smart mobility.	• A platform for urban analytics. • Toolkit for equity assessment.	Problems with data quality; no cost analysis.
Anthopoulos (2017)	An examination of 15 cities in the global south as case studies.	• Funding shortages affect 50% of initiatives. • 65% of deployments are hampered by legacy systems.	• The finance model for smart cities. • A strategy for the infrastructure transformation.	Limited viewpoint of the private sector.
Hu and Zheng (2021)	An examination of 25 municipal rules' policies.	• Only 30% have frameworks for AI governance. • Laws pertaining to data localisation impact 45% of initiatives.	• Model of cross-border data governance. • The regulatory sandbox method.	No results of implementation.
Sadowski and Spachos (2020)	An examination of smart city narratives through critical discourse analysis.	• About 60% of projects are influenced by corporations. • Issues with surveillance in intelligent security systems.	• Evaluation of democratic technology. • Framework for public interest.	Conceptual; devoid of empirical evidence.
Sanchez Guzman et al. (2020)	Comparison of 50 cities in emerging economies.	• The majority of adoption (65%) occurs in middle-income cities. • Forty per cent of projects are limited by basic infrastructural shortages.	• The measure of smart city readiness. • Model of the implementation pathway.	Evaluation that is static and devoid of motion.
Charnock et al. (2021)	Six Latin American situations are analysed using political economy.	• Wealthy districts receive 55% of the advantages. • About 30% of automation scenarios result in labour displacement.	• Framework for inclusive growth. • Only transitional instructions.	Limited generalisability; small research.
Alsamhi et al. (2021)	Technical evaluation of IoT implementations.	• Latency is reduced by 60% with edge computing. • About 70% of applications are impacted by 5G coverage gaps.	• Network architecture that is hybrid. • Economical deployment of sensors.	Limited technical focus.
Anthopoulos (2017)	40 experts participated in a Delphi research.	• 50% of implementations are hampered by workforce shortages. • The hazards associated with cybersecurity are growing.	• The framework for skills in smart cities. • The procedure for risk management.	Expert prejudice; no validation from the ground.
Kitchin (2021)	An approach to critical urban informatics.	• Forty-five per cent of planning systems exhibit algorithmic bias. • Common abuses of data justice.	• Checklist for responsible AI. • The model of urban data governance.	Philosophical; lacks solutions.

Note: Please see the full reference list of the article, Mukhithi, A., Malungana, L., & Phahlane, M. (2026). Policy frameworks for emerging economies sustainable smart city development: The adoption of artificial intelligence and Internet of Things for the revolutionisation of urban infrastructure development. *African Journal of Career Development*, *8*(1), a181. https://doi.org/10.4102/ajcd.v8i1.181, for more information.

AI, artificial intelligence; IoT, Internet of Things; PPP, public–private partnerships.

social, economic and technological hurdles are necessary (Allam & Dhunny, 2019).

This study has noted that through dynamics and modification of signal timings and public transportation routing, IoT-enabled smart traffic systems and AI-driven predictive modelling are easing traffic in places like Jakarta and Bangalore (Alsamhi et al., 2021). Similarly, data-optimised minibus routes enabled by AI-powered demand-responsive transport are enhancing last-mile connectivity in African cities. Another crucial application is energy management, where cities like Santiago and Mumbai can integrate renewable energy sources and minimise distribution losses by using smart grids with IoT sensors and AI-based load predictions (Ghasempour, 2019). These technological applications show how data-driven infrastructure can improve sustainability, but they need rules that guarantee interoperability across systems and standardise IoT deployment standards (Bhattacharya et al., 2020).

Through innovative applications, AI and IoT are revolutionising urban administration and service delivery beyond physical infrastructure. While IoT-based water quality monitoring is averting disease outbreaks in informal settlements, AI-enabled chatbots and voice assistants are improving access to municipal services in multilingual communities (Anthopoulos, 2017). Although these applications create significant ethical policy problems regarding monitoring and bias, predictive policing technologies that use AI pattern recognition are assisting understaffed police forces in efficiently allocating resources (Sadowski & Spachos, 2020). Most notably, cities are now able to test infrastructure scenarios and climate adaptation plans prior to execution because of digital twin technology, which combines IoT sensor networks with AI simulation models (Kitchin, 2021). In order to guarantee that technologies serve the public interest rather than worsen inequality, these applications emphasise the necessity of regulations that strike a balance between innovation and responsibility.

Key policy aspects for the implementation of AI and IoT

The key policy aspects for the implementation of AI and IoT were listed as follows:

- Creating consistent protocols for IoT device compatibility and data sharing is known as infrastructure standardisation.
- Creating structures for algorithmic transparency and bias reduction is known as ethical AI governance.
- Frameworks for cybersecurity: Defending vital urban infrastructure against online attacks.
- Ensuring that solutions benefit all socioeconomic levels through inclusive technology access.
- Building capacity: Educating municipal employees in system administration and data analytics.

Directions for the future

Akande et al. (2020) emphasise that future-focused policy frameworks that fully utilise AI and IoT while tackling systemic issues are necessary for the development of smart cities in emerging countries. Adaptive governance approaches that strike a balance between equitable development and technological innovation must be given top priority in future directions. Aghimien et al. (2022) further highlight that to enable iterative testing of AI and IoT solutions while preserving strong protections for data privacy and algorithmic accountability, policymakers should concentrate on developing dynamic regulatory sandboxes. These frameworks must be both designed to guard against exploitation and guarantee the general welfare while remaining adaptable enough to handle the quick advancements in technology. The creation of mechanisms for cross-border digital cooperation that allow emerging economies to exchange best practices while preserving data sovereignty is a crucial area for development (Jonek-Kowalska & Wolniak, 2022).

Antwi-Afari et al. (2021) adds the creation of sustainable funding structures is yet another important avenue for future policy. For that reason, emerging economies must create novel financial instruments suited to smart city projects to transcend conventional public funding patterns. This entails investigating impact investment funds that concentrate on urban technology solutions, blockchain-enabled municipal bonds and performance-based contracting models that link private sector compensation to quantifiable gains in urban sustainability measures. Alderete (2022) adds that future regulations should also encourage the growth of regional AI and IoT ecosystems by reducing reliance on foreign suppliers through technology transfer initiatives, startup incubators and focused research and development (R&D) investments. These strategies can create high-value jobs in the digital economy and encourage domestic innovation.

A study by Li et al. (2019) emphasise that equal policy emphasis must be given to the human aspect of smart city development. Participatory design techniques that involve individuals in co-creating urban tech solutions, especially for underprivileged communities, must be institutionalised in future frameworks. Thus, to guarantee accessibility for all urban dwellers, irrespective of their degree of digital literacy, policies should require AI interfaces and IoT devices to adhere to universal design standards. Janani et al. (2021) assert that programs for workforce transition must be created concurrently to address automation-related job displacement, with a focus on reskilling employees in industries most at risk from AI disruption. To build genuinely inclusive smart cities that ensure no one is left behind in the digital transformation, these social strategies must be combined with technology roadmaps.

Ashwini and Savithramma (2022) claim that future smart city policies must make climate resilience a top priority. To build climate-adaptive urban infrastructure, emerging economies should design integrated frameworks that merge IoT sensor networks with AI-powered predictive analytics. This includes laws that support smart solutions rooted in nature, such AI-enhanced green areas and IoT-powered urban agricultural systems. Future regulatory frameworks should set requirements for energy-efficient AI computation in urban applications and mandate climatic stress testing for all significant smart city projects. Emerging economies have the chance to advance to sustainable urban development models that concurrently solve technology and environmental concerns as a result of the convergence of the digital and green transitions (Bokhari & Myeong, 2022).

Furthermore, strong mechanisms for ongoing learning and adaptation must be incorporated into future policy frameworks. This entails setting up observatories to track the effects of smart cities, formulating uniform metrics to assess AI and IoT deployments and establishing knowledge-sharing platforms among Global South cities (Ismagilova et al., 2019). Therefore, emerging economies should create policy frameworks that use AI and IoT not only to advance technology but also to make cities more sustainable, habitable and equitable for all citizens by adopting these future orientations (Ahad et al., 2020).

The importance of scalable and reasonably priced solutions in guaranteeing long-term success is another key finding. Cities that put an emphasis on energy-efficient AI models and modular, inexpensive IoT devices have seen faster adoption and higher returns on investment. Before moving on to more sophisticated AI applications, several towns, for instance, employed basic sensor networks for water or trash management. However, the survey points out problems including data silos, a lack of interoperability and local stakeholders' reluctance to change. Strong community involvement, capacity-building initiatives and transparent explanations of the advantages of smart technologies are frequently found in successful examples. These findings imply that, although technology is an essential facilitator, social and

organisational elements are just as significant in the creation of sustainable smart cities.

The study emphasises the necessity of more vigorous regulatory frameworks to handle ethical, security and privacy issues. Public mistrust can impede the deployment of IoT and AI in areas with lax or inconsistent data protection regulations. On the other hand, citizens have been more accepting of cities that have put in place open data governance procedures and cybersecurity safeguards. The study also draws attention to the widening digital divide adoption, which puts metropolitan areas with little resources in danger of deteriorating further in the absence of focused initiatives. The report suggests financial structures, knowledge-sharing platforms and international cooperation to close this gap and promote the development of smart cities in an equitable manner.

Emerging economies challenges

Despite their revolutionary potential, emerging economies have a difficult time implementing AI and IoT technologies for the construction of smart cities. The introduction of IoT systems is hampered by several significant obstacles, including a lack of sensor networks, erratic power supplies and restricted Internet access (Anthopoulos, 2017). Effective machine learning is hampered by fragmented or nonexistent datasets in many cities, which lack the fundamental data ecosystems required to support AI applications (Kitchin, 2021). These problems are made worse by financial limitations, since municipal budgets in underdeveloped countries sometimes cannot support the long-term upkeep of smart technology or pay for their high upfront expenditures (Allam & Dhunny, 2019). The digital divide between smart cities in rich and emerging economies will keep growing in the absence of creative funding solutions such as PPPs or mixed finance mechanisms (Sanchez Guzman et al., 2020).

Good implementation is also severely hampered by institutional and governance issues. Smart city initiatives are hampered by bureaucratic inefficiencies and overlapping authorities in many emerging nations with fragmented municipal administration (Kummitha & Crutzen, 2019). Concerns regarding technology lock-in and loss of sovereignty over urban data are raised by local governments' reliance on foreign vendors because of a lack of technical experience (Sadowski & Spachos, 2020). Conflicting policies are another common consequence of poor policy coordination between national and local authorities, especially when it comes to data privacy, cybersecurity and AI ethics (Ma & Zhu, 2022). For instance, insufficient legal frameworks run the risk of permitting biased policing or mass surveillance, particularly in politically unstable areas, even though IoT surveillance may improve public safety (Yigitcanlar et al., 2020).

Another significant issue is socioeconomic inequality, since smart city technologies frequently favour wealthy metropolitan regions while underserving low-income and informal settlements (Angelidou, 2017). In emerging economies, where a sizable portion of the population lacks access to smartphones or digital literacy, the digital gap is especially severe, preventing people from using AI-driven public services (Bibri & Krogstie, 2020). Additionally, unless inclusive reskilling strategies are put in place, the automation of municipal services through AI may result in the displacement of low-skilled workers, worsening unemployment (March & Ribera-Fumaz, 2021).

Summary of key challenges

The summary of key challenges was as follows:

- Infrastructure gaps include a lack of dependable Internet, electricity and IoT-ready civic systems.
- Financial barriers: Limited funding and high deployment and maintenance costs.
- Lack of technical skills and bureaucratic fragmentation are governance weaknesses.
- Policy and regulatory gaps: No legislation pertaining to cybersecurity, data privacy or AI ethics.
- The exclusion of informal settlements and the possibility of employment displacement are examples of social inequality.
- Climate vulnerability: Resilient smart infrastructure is necessary in regions that are prone to disasters.

Customised policy frameworks that promote inclusive digital transformation, consider local settings and support domestic innovation ecosystems are necessary to address these issues. Therefore, without these steps, the smart city revolution in emerging nations runs the risk of turning into yet another cause of inequality rather than a means of promoting sustainable urban growth (Alsamhi et al., 2021). Overall, the results highlight that comprehensive planning, inclusive policies and adaptable governance are just as important as technology for the effective integration of AI and IoT in emerging economies.

Conclusion

In conclusion, the adoption of AI and IoT in emerging economies to create sustainable smart cities necessitates carefully balancing policy frameworks that consider both the potential of technology and the realities of execution. Even though these cutting-edge technologies have revolutionary possibilities for improving urban infrastructure and services, their effective integration will require resolving important social, economic and governance issues. Beyond technical blueprints, effective frameworks must include equitable access methods, localised adaptation measures and long-term sustainability concerns that consider the circumstances of developing cities.

The data unequivocally demonstrates that the most effective implementations integrate innovative technology with strong institutional capabilities and inclusive planning procedures. When it comes to expanding pilot programs to city-wide solutions, cities that place a high priority on workforce development, participatory governance and

hybrid funding approaches show higher resilience. To ensure that technological improvements enhance rather than replace expenditures in social services, environmental protection and basic infrastructure, it is equally critical to integrate smart city programs with larger urban development goals.

Policymakers need to take a more comprehensive stance going forward, seeing AI and IoT as instruments for sustainable urban change rather than as objectives in and of themselves. This calls for creating regulatory frameworks that are flexible enough to change as technology does while yet protecting the interests of the public. Measurable gains in everyone's quality of life, economic opportunity and environmental sustainability should be the ultimate criterion of success rather than just technological competence. Emerging economies may use smart city technologies to build more liveable, equitable and future-ready urban settings by concentrating on these human-centred outcomes.

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Competing interests

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CRediT authorship contribution

Avrill Mukhithi: Conceptualisation, Writing – original draft. Mampilo Phahlane: Writing – review & editing, supervision. Lario Malungana: Writing – review & editing, supervision. All authors reviewed the article, contributed to the discussion of results, approved the final version for submission and publication, and take responsibility for the integrity of its findings.

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