IIAR JOURNALS

Innovating Knowledge. Advancing Research.

IIAR Journal of Urban Development, Infrastructure, and Smart Cities

Vol 1, No 1, 2026

Smart Cities for Informal Cities: A Theoretical Framework of Data, Legibility and Inclusion in the Digital Governance of Rapidly Urbanising African Settlements

NWOGBOJI Emmanuel Usulor[1], Atolagbe Umar Kawu[2], Paul Idowu Bamigbola[3]

[1,2,3] Veristzon Global Research Lab

ABSTRACT

The smart-city model was designed for cities that are already mapped, metered, addressed and formally governed. Most urban growth in Africa is occurring in settlements that are none of these. This theoretical paper asks what a smart city can mean when the city is informal. Drawing on the critical smart-city literature, on urban theory and the scholarship on informality, and on recent research on digital technologies, remote sensing and community data practices in African cities, it distinguishes three functions that digital urban systems perform: rendering the city legible to the state, optimising the flows the state already manages, and extending services to residents. It argues that in informal cities the first function is contested because legibility has historically preceded eviction, the second is largely beside the point because the flows that matter are not state-managed, and the third is where the value lies but where investment is thinnest. The paper develops a framework in which digital urban governance is evaluated by its effects on the security, services and voice of informal residents rather than by sensors deployed or dashboards built, derives seven propositions about the conditions under which smart-city initiatives include rather than displace the urban poor, and examines community-generated data, participatory mapping and incremental formalisation as alternative models. Lagos anchors the analysis. The paper closes with implications for state governments, technology vendors, development partners and the research agenda of African urban studies. It concludes that a smart city built for the informal city would be one in which the residents who built the city are the first to benefit from knowing it better, which is a political choice before it is a technical one.

Keywords: smart cities; informal settlements; urban informality; urban governance; data

Smart Cities for Informal Cities: A Theoretical Framework of Data, Legibility and Inclusion in the Digital Governance of Rapidly Urbanising African Settlements

1. INTRODUCTION

Africa is urbanising faster than any other region and most of that growth is taking place outside the formal city: in settlements built without planning permission, on land held under customary, contested or no recognised tenure, served by water vendors, generator owners and informal transport rather than by utilities, and governed day to day by a mixture of community associations, traditional authorities, landlords and the occasional presence of the state. At the same time, African governments and their partners have embraced the vocabulary of the smart city. National strategies promise sensor networks, command centres, digital identity, e-government portals and data-driven planning, and flagship projects, Eko Atlantic in Lagos, Konza in Kenya, the Abuja Centenary City, are marketed as the urban future. The literature that has grown around these projects is largely critical. It finds that African smart-city initiatives are frequently imported templates, that they privilege greenfield enclaves and the middle class, and that they rarely engage the informal settlements where most urban Africans live (Bandauko & Nutifafa Arku, 2023; Maatallah et al., 2026).

This paper takes that critique as its starting point but asks a more constructive question. If the smart city as conventionally understood does not fit the informal city, what would a digital urban governance that did fit it look like, and by what standard should we judge whether a given initiative is moving toward or away from it? The question is theoretical in the sense that it concerns the concepts by which smart-city initiatives are understood and evaluated, not the empirical performance of any particular system. It is also practical, because the concepts in use shape what gets funded, built and measured.

The argument develops in stages. It first examines the assumptions built into the smart-city model and the critical literature that has exposed them, and then sets out what the scholarship on urban informality reveals about the condition of African urbanisation, arguing that this condition is not a deficit to be corrected before smartness can begin. From there it advances its central analytical move, distinguishing three functions that digital urban systems perform, legibility, optimisation and service, and showing that these functions carry very different meanings in an informal city. That distinction grounds a framework for evaluating digital urban governance by its effects on the security, services and voice of informal residents, from which a series of propositions follows. The analysis then turns to alternative models already visible in practice, including community-generated data, participatory mapping and enumeration, and incremental formalisation, before applying the framework to Lagos and drawing out its wider implications.

The paper's contribution is threefold. It offers a conceptual decomposition of what smart-city systems do that explains why they so often fail or harm informal residents, not as an accident of implementation but as a consequence of which function is being served. It offers an evaluation framework that shifts the metric from technology deployed to outcomes for the people the technology is supposed to serve. And it situates existing alternative practices, often treated in the literature as grassroots exceptions, as the elements of a different model of smart urbanism appropriate to the cities Africa is actually building.

2. LITERATURE REVIEW

2.1 The Smart-City Model and Its Assumptions

The smart city, in its dominant form, is a city that collects data about itself through sensors, cameras, transactions and administrative records, integrates that data through platforms, and uses it to manage services, allocate resources and plan. Reviews of smart governance identify its recurring components: digital infrastructure, data integration, analytics, citizen interfaces and institutional arrangements that allow data to inform decisions (Almulhim & Yigitcanlar, 2025). Artificial intelligence has recently become the model's leading edge, promising predictive analytics, real-time monitoring and automated optimisation across transport, energy, waste and public safety, and this promise is now being made explicitly for African cities (Mhlanga, 2026; Egba et al., 2026). The newest framings go further still, describing platform-mediated and increasingly autonomous urban governance in which algorithmic systems do not merely inform decisions but take them (Shariatpour & Behzadfar, 2026).

Four embedded assumptions

© IIARJournal. All rights reserved.

The model embeds four assumptions that are rarely stated because in the cities where it was developed they are true. The first is that the city is already legible: that its streets have names, its buildings have addresses, its parcels have registered owners and its residents have identities the state recognises. Sensors and platforms add a real-time layer to this base; they do not create it. The second is that the flows to be optimised are managed by the state or its concessionaires: traffic on public roads, water through a utility network, waste through a municipal collection system, electricity through a grid. Optimisation presupposes a system to optimise. The third is that residents interact with the state as customers and citizens through channels, accounts, bills, applications, complaints, that can be digitised. The fourth is that the data the system generates can be trusted to serve the public purpose for which it is collected, because institutions of accountability constrain its use.

The critical turn

A substantial critical literature has shown that these assumptions fail in the Global South and that the failure is not incidental. Datta (2023) describes a digitalising state that governs through the transition from paper to digital data and through the management of informational peripheries, producing what she calls digitalisation-as-urbanisation: a politics in which digitalisation is both the product and the producer of urban transformation, and in which exclusion from the digital record is a form of exclusion from the city. Alizadeh and Prasad (2024) propose a research agenda on the right to the smart city in the Global South, built on three moves, expose, propose and politicise, that treat the smart city's shortcomings as a matter of justice rather than implementation and that explicitly identify the failure to recognise informal urbanism as one of those shortcomings. Prasad et al. (2024), drawing on Indian cases, show that smart-city planning systematically overlooks informality and that city officials show little enthusiasm for including informal populations in smart-city programmes. Sen et al. (2026) push the argument further: informal settlements do not merely sit outside the smart city, they subsidise it, supplying the labour, the services and the land that the formal smart enclave depends on while being excluded from its benefits.

For Africa specifically, Bandauko and Nutifafa Arku (2023) offer a critical analysis of smart cities as a development strategy, finding that interventions are often imported, enclave-based and exclusionary, with the urban poor displaced or marginalised, they cite the displacement of residents around Lagos's waterfront developments, and they ask whether smart cities enhance social inclusion or deepen existing divides. Maatallah et al. (2026), in a systematic review of smart cities in Africa, identify infrastructure deficits, finance, policy frameworks and expertise as recurring challenges but also emphasise the importance of addressing urban informality, which most strategies do not. Das et al. (2026) reach similar conclusions through a systematic review and case analyses, finding socio-economic inequality and informality among the key barriers and noting that strategic pathways are rarely designed with informal settlements in view. Peter and Meyer (2023) respond by proposing urban commoning, organising processes that establish institutions for shared urban resources, as a framework for a smart African city that mitigates rather than reproduces the formal–informal divide.

The critical literature has thus established that the smart-city model does not fit the informal city and that forcing the fit produces exclusion. What it has not yet done is to specify precisely which parts of the model fail, why, and what a model built for the informal city would require. That is the task of the following sections.

2.2 Informality as the Condition of African Urbanisation

Informality is not a marginal feature of African cities but their predominant condition. Estimates of the global extent of informal settlements remain uncertain because national data rely on inconsistent definitions and estimates rather than enumeration, but the best available syntheses place a large share of the urban population of sub-Saharan Africa in settlements that lack secure tenure, adequate services or compliance with planning norms (Boanada-Fuchs et al., 2024). Remote-sensing work has begun to fill the data gap: Büttner et al. (2025) applied deep learning to open-access satellite imagery across 529 major cities in sub-Saharan Africa and found strong slum growth concentrated in the urban periphery between 2016 and 2022, while Li et al. (2026) produced gridded slum-population estimates for 129 Global South countries that show notably high local shares in sub-Saharan Africa. The direction of change matters as much as the level: informality is growing at the edge of African cities faster than the formal city is expanding to meet it.

© IIARJournal. All rights reserved.

Informality as practice, not absence

The urban-studies literature has long insisted that informality is not simply the absence of formality. It is a mode of urbanisation with its own institutions, rules and infrastructures. Fransen et al. (2026) define informality as a dynamic set of interactions that arise when formal regulations fail to meet people's needs, and show through the case of Mathare in Nairobi that households already practise what they call informal smart urbanism: they use digital tools to receive support, to coordinate, to manage shocks and to build what the authors term digital resilience, generating extra-legal rules through repeated digital practice. Kabendela et al. (2026a, 2026b) document, in Dar es Salaam, how residents of informal settlements appropriate everyday digital tools, messaging groups, mobile money, shared phones, to fill institutional gaps, to coordinate land-use disputes and to build what they call community transformative agency, and argue that these communities should be understood not as targets for top-down smart-city solutions but as co-producers of digital urban institutions. Bobbins et al. (2024), examining a solar mini-grid in an informal settlement in Cape Town, show that smart infrastructures disrupt the very categories of formal and informal, revealing that infrastructure in the informal city is hybrid, negotiated and co-produced.

What the informal city already has and lacks

If informality is a mode of urbanisation rather than a void, the question for digital governance is what the informal city already has and what it lacks. It has dense social networks, functioning if unrecognised markets in land, housing and services, local governance arrangements, and increasingly intensive use of mobile technology. It lacks tenure security, recognised addresses, connection to utility networks, effective public-service delivery and a voice in the formal decisions that affect it. Crucially, the things it lacks are not primarily technological. Borofsky et al. (2025), setting out an agenda for data-rich, action-oriented and ethical research on infrastructure in informal settlements, stress that the data gap is real but that filling it is of value only when the data is connected to action and governed in the interest of residents, and they note that informal settlements are often absent from smart-city programmes altogether.

This sets up the central problem. The smart-city model supplies a technological layer to a city whose deficits are institutional, tenure, recognition, service entitlement, voice. Whether the technological layer helps or harms depends on which of those institutional deficits it addresses and which it bypasses or worsens. To see this clearly requires distinguishing what digital urban systems actually do.

3. CONCEPTUAL FRAMEWORK

3.1 Three Functions of Digital Urban Systems

Digital urban systems perform three analytically distinct functions, which the smart-city model bundles together and which the informal city pulls apart. The first is legibility: making the city visible, countable and addressable to the state. The second is optimisation: improving the performance of flows and systems that the state or its agents already manage. The third is service: delivering something to residents, information, access, protection, a channel to be heard, that they did not have before. In a formal city these three reinforce one another: legibility enables optimisation, optimisation improves service, service generates data that improves legibility. In an informal city they come apart, and each must be examined on its own.

Legibility: a contested function

Legibility is the first thing smart-city systems offer an informal city and the thing informal residents have most reason to fear. The reason is historical. Across African cities, the state's acquisition of knowledge about an informal settlement, its mapping, its enumeration, its registration, has repeatedly been the prelude to its clearance. Olajide and Lawanson (2025) document the forced evictions at Maroko and Otodo Gbame in Lagos and the coalitions that formed to contest them, and Shadare (2026), reviewing displacement and resilience governance in Lagos, finds that governance constraints have amplified rather than mitigated the risk that waterfront communities such as Makoko face. The literature on participatory mapping records the same fear from the residents' side: Chumo et al. (2025) report that uncertainty of tenure and fear of eviction loom over social-mapping work in Nairobi's informal settlements, and Muhoja (2026) describes early mistrust in Tanzanian regularisation projects caused by fears of eviction or hidden motives behind the mapping.

Remote sensing and artificial intelligence have transformed the economics of legibility. Reviews by Mudau and Mhangara (2023) and Fan et al. (2026) show that very-high-resolution imagery and machine learning can now delineate informal settlements at scale, and Büttner et al. (2025) have

© IIARJournal. All rights reserved.

done so for hundreds of cities at ten-metre resolution. Breuer and Friesen (2023) review methods for tracking the spatio-temporal change of slum populations, and Mhlanga (2026) notes AI-driven mapping of informal settlements from satellite imagery as one of the principal applications of AI in African urban governance. The informal city can now be made legible from orbit, without the knowledge or consent of its residents. This is a genuine advance for research and humanitarian planning, and the remote-sensing literature is generally careful to frame it so; Fan et al. (2026) in particular stress that detection is a step toward understanding the complexity of informal settlements rather than a tool for their management. But the same maps that support upgrading support clearance, and which use prevails depends entirely on the institutions that receive them. Datta's (2023) analysis of the digitalising state is apt: the transition from paper to digital data is itself a technique of governance, and the governance of informational peripheries is a matter of power before it is a matter of technology.

Digital addressing illustrates the ambivalence. Thiel (2023) analyses Ghana's nationwide GPS-based digital addressing system as a project in the construction of nation-space, a means by which the state extends its reach into territories and populations it previously could not locate. An address is a precondition of service delivery, of emergency response, of credit and of participation in e-commerce; it is also a precondition of taxation, enforcement and, where tenure is insecure, of targeted removal. Legibility, in short, is not a neutral good. It is a function whose value to residents is conditional on what it enables and who controls it.

Optimisation: a largely irrelevant function

The second function is the one the smart-city industry sells hardest and the one that matters least in the informal city. Optimisation presupposes a managed system: a traffic network with signals to retime, a water utility with pressure zones to balance, a waste service with routes to plan, a grid with loads to shift. In the informal city most of these systems are not state-managed. Water comes from vendors, boreholes and tanker trucks; electricity from generators, informal connections or, increasingly, off-grid solar; waste disposal from informal collectors or none; transport from minibuses and motorcycle taxis operating outside formal regulation. The flows are real and often efficient in their own terms, but they are not the state's to optimise.

This does not mean optimisation is impossible, only that it must take a different form. Siwawa (2026) shows, in Cape Town and Johannesburg, that digital innovation in waste management can integrate informal reclaimers into smart-city frameworks through mobile platforms and traceability tools, but only where the frameworks are designed to recognise the informal sector as a partner rather than a problem. Bobbins et al. (2024) show that a solar mini-grid in an informal settlement works by repositioning the categories of formal and informal infrastructure rather than by imposing a utility model. Azeez et al. (2025), in a conceptual model of Afrocentric urban mobility, argue that informal transport must be the starting point of any smart mobility strategy for African cities rather than the thing it replaces. The lesson is general: in an informal city optimisation is meaningful only as the improvement of hybrid, co-produced systems, and the smart-city model's instinct to formalise first and optimise second gets the sequence wrong.

Service: the valuable but under-invested function

The third function is the one that matters most to residents and attracts the least investment. Service here means something delivered to residents that they value: reliable information about flood risk, a functioning complaint channel, access to a subsidy, protection against eviction, a recognised claim to the land they occupy. Fransen et al. (2026) and Kabendela et al. (2026a, 2026b) show that informal residents are already using digital tools to deliver such things to themselves, resilience, coordination, agency, without the state. Maninggar et al. (2026), examining barriers to including marginalised urban communities in digital inclusion planning in Chennai, Nairobi and Malang, find that the barriers are institutional and collaborative rather than technical: the communities are not hard to reach, the planning processes are not designed to reach them. Egba et al. (2026), surveying Nigerian public institutions on the integration of AI and digitalisation into public service, find enthusiasm for efficiency and transparency gains while acknowledging that the findings do not generalise to informal governance contexts, a candid recognition that the service function has not yet been designed for the people who most need it.

The three-function decomposition yields a diagnosis. Smart-city initiatives in African cities lead with legibility, which residents have reason to

© IIARJournal. All rights reserved.

resist; invest in optimisation, which addresses systems the informal city does not have; and neglect service, which is where the value lies. The pattern is not a failure of implementation. It follows from applying a model built for formal cities to cities that are not. The remedy is not better implementation of the same model but a different standard of evaluation, to which the next section turns.

3.2 A Framework: Evaluating Digital Urban Governance by Its Effects on Informal Residents

If the smart-city model is judged by inputs, sensors deployed, cameras installed, platforms launched, data integrated, it will always appear to succeed in African cities, because inputs can be procured. If it is judged by its effects on the people who live in the informal city, it will often appear to fail, and the failures will be informative. This section proposes the second standard and specifies it.

Three outcome dimensions

The framework evaluates any digital urban governance initiative along three dimensions of outcome for informal residents. The first is security: does the initiative increase or decrease the probability that residents can remain where they are, or be resettled on terms they accept? This dimension captures the legibility problem directly. An initiative that maps a settlement without any accompanying commitment to tenure or to upgrading increases the risk of clearance; one that maps it as part of a regularisation process with resident participation may reduce it. The second is services: does the initiative deliver something residents value, in a form they can use, at a cost they can bear? This captures the service function and distinguishes it from optimisation of systems residents do not use. The third is voice: does the initiative increase residents' capacity to influence the decisions that affect them, including decisions about the data collected on them? This captures the governance of data and the right to the city that Alizadeh and Prasad (2024) place at the centre of a Southern smart-city agenda.

The three dimensions are related but distinct. An initiative may deliver services while reducing security, as when a digital property register brings a settlement into the tax base without recognising its tenure. It may increase security without voice, as when a court-ordered mapping protects residents from one eviction without giving them any role in future decisions. The framework requires that an initiative be assessed on all three and that trade-offs be made explicit rather than hidden behind input metrics.

Propositions

The framework generates propositions that can be tested empirically and that guide design. They are stated as conditions under which digital urban governance initiatives include rather than displace informal residents.

Proposition 1. The effect of legibility on informal residents' security depends on the tenure commitment that accompanies it. Where mapping, enumeration or addressing is undertaken without an explicit and enforceable commitment to recognise or regularise tenure, it will on average reduce security; where it is undertaken within such a commitment, it will on average increase it. The historical record reviewed by Olajide and Lawanson (2025) and the resident fears recorded by Chumo et al. (2025) and Muhoja (2026) support the first half; the regularisation and participatory-mapping cases reviewed below support the second.

Proposition 2. Legibility produced by residents themselves is more likely to increase security and voice than legibility produced about them by others. Community-generated data, because it is held and interpreted by the community, can be used to negotiate rather than merely to be governed; satellite-derived data, however accurate, is held by whoever commissioned it. Masimba (2025) shows that technology-aided slum enumerations by Slum Dwellers International groups constitute a political process that alters power dynamics and reshapes narratives about the urban poor, while cautioning that tech-aided data can also be captured. The proposition is about the default tendency, not an iron law.

Proposition 3. Optimisation initiatives improve outcomes for informal residents only where they take the informal system as the system to be improved rather than replaced. Siwawa (2026), Bobbins et al. (2024) and Azeez et al. (2025) each show this in a different sector. The corollary is that optimisation initiatives that formalise first, replacing informal transport with a bus rapid transit system, informal water vending with a utility network, will produce service gains for those who can access the formal system and losses for those who cannot, and the losers will be concentrated among the poorest.

Proposition 4. The service value of a digital initiative to informal residents is proportional to the

© IIARJournal. All rights reserved.

degree to which it was designed with them. Maninggar et al. (2026) show that the barriers to inclusion are in the planning process; Kabendela et al. (2026a) show that communities already configure digital tools to their own needs when given room to do so. Initiatives designed for a generic citizen with a bank account, a formal address and a smartphone will underserve residents who lack one or more of these.

Proposition 5. The voice effect of digital governance depends on whether residents control the data collected about them. Where data is collected by the state or vendors and residents have no access to it, no say in its use and no means to contest it, digital governance will reduce voice relative to the status quo even if it improves services, because decisions will be made on the basis of information residents cannot see. Where residents hold or co-hold the data, voice increases. This follows from Datta's (2023) account of the digitalising state and from Borofsky et al.'s (2025) insistence that data in informal settlements be governed ethically and in the interest of residents.

Proposition 6. Smart-city initiatives concentrated in greenfield enclaves will worsen outcomes for informal residents on all three dimensions, because they absorb public investment, raise land values at the enclave's edge and create a visible contrast that legitimises clearance of the informal settlements adjacent to them. Bandauko and Nutifafa Arku (2023) and Sen et al. (2026) support this directly; the Lagos case illustrates it.

Proposition 7. The institutional capacity to act on digital information, not the information itself, determines whether digital urban governance improves outcomes. Where agencies lack the capacity, independence or will to deliver services, enforce tenure protections or respond to complaints, additional information will be used for the functions that require least capacity, surveillance and enforcement, and not for those that require most, upgrading and service delivery. This is the digital-governance analogue of a finding that recurs across the public-administration literature on African cities, and it explains why the same technology produces inclusion in one city and clearance in another.

Using the framework

The framework is intended for three audiences. For state and municipal governments, it offers a set of questions to ask before procuring a smart-city system: what does this do to residents' security, what does it deliver to them, and what control over the resulting data do they have? For development partners and vendors, it offers a standard against which proposals can be evaluated that is more demanding than technological readiness. For researchers, it offers a set of propositions to test and a language in which to compare cases. It does not require that every initiative score well on every dimension; it requires that the scores be visible.

4. ANALYSIS AND DISCUSSION

4.1 Alternative Models Already in Practice

The framework is not utopian. Each of its components is visible in existing practice, mostly outside the smart-city label. This section examines three such practices as elements of a different model.

Community-generated data and enumeration

The oldest and most developed alternative is community-led data collection, associated above all with the federations affiliated to Slum Dwellers International and their Know Your City programme. Residents enumerate their own settlements, households, structures, services, tenure claims, and use the resulting data to negotiate with the state for recognition and upgrading. Masimba (2025) documents how technology-aided enumerations in Harare have created a new kind of political agency for young people, who bring digital skills to a process that remains politically owned by the community, and how the data has reshaped narratives about the urban poor. Boanada-Fuchs et al. (2024) note that settlement profiles carried out at broad scale through Know Your City are among the few sources of actual enumeration rather than estimate, and Li et al. (2026) use such community data to validate machine-learning estimates. Chumo et al. (2025) extend the approach to social mapping of marginalised and vulnerable groups within settlements, identifying who is most at risk and why through participatory methods.

Community-generated data satisfies the framework's requirements in a way satellite data cannot. It produces legibility, but legibility residents control; it is designed by the people it describes; it generates voice because it gives residents something to bring to the negotiating table. Its weaknesses are also clear: it is slow, it depends on organised communities, and, as Masimba (2025) cautions, it can be captured by external agendas. The right relationship between community data and remote

© IIARJournal. All rights reserved.

sensing is complementary: remote sensing provides scale and change detection, community data provides depth, legitimacy and ownership.

Participatory mapping and regularisation

Participatory mapping has been used across African cities to secure tenure and to plan upgrading. Muhoja (2026) describes how community engagement, participatory mapping and technical support in peri-urban Tanzania moved residents from recipients to co-planners of regularisation, overcoming early mistrust rooted in fears of eviction. Kabendela et al. (2026a, 2026b) show how community digital practices in Dar es Salaam can be the basis of participatory planning rather than an obstacle to it. Bhanye (2026), comparing flood adaptation in thirteen informal settlements across Africa, Asia and Latin America, identifies recurring infrastructures of exclusion, planning by omission and partial participation, and proposes a justice-oriented framework in which citizen science and participatory mapping embed local knowledge in adaptation decisions. Castro (2026) documents the adaptation infrastructures that informal waterfront communities in Lagos build for themselves and the way state demolition destroys them.

These cases show that legibility can be made safe for residents when it is embedded in a process whose end is recognition. They also show the institutional conditions: a state willing to regularise, a community organised enough to participate, and intermediaries, NGOs, universities, professional associations, able to translate between them. Where any of these is missing, the mapping is at best inert and at worst dangerous.

Incremental formalisation and the economics of recognition

The third alternative concerns tenure. Byamugisha and Dubosse (2023), in a cost–benefit analysis of land tenure security in sub-Saharan Africa, find strong returns on investments in tenure security, including land-use certificates for informal settlements and the creation of institutional legibility for customary tenure, and note that the cost of formal property registration in the region remains high. The implication for digital governance is that the digital infrastructure of land, registries, cadastres, addressing systems, can be designed for incremental recognition, recording and protecting the claims that exist rather than only the titles that have been issued. Thiel's (2023) account of Ghana's digital addressing system shows that the state can extend its reach rapidly through such infrastructure; whether that reach protects or exposes informal residents depends on whether the system records their presence as a claim or merely as a location.

Taken together, these practices describe a model of smart urbanism for informal cities in which data is generated with and held by residents, legibility is embedded in recognition, optimisation works on hybrid systems, and the measure of success is what residents gain in security, services and voice. It is not a model without technology; it uses mobile phones, GPS, satellite imagery and databases intensively. It is a model in which technology serves a different purpose.

4.2 Lagos as an Anchoring Case

Lagos illustrates both the problem and the possibility. It is among the largest cities in Africa, with a population variously estimated at between eighteen and twenty-five million, and a very large share of its residents live in informal settlements, many of them on the waterfront and exposed to flooding (Shadare, 2026). It is also the Nigerian city most committed to the smart-city vocabulary. The Lagos State Government has invested in CCTV and traffic-management systems, in digital residents' registration, in e-government portals and in the branding of Lagos as a smart city, and the Eko Atlantic development on reclaimed land off Victoria Island is Africa's most prominent greenfield smart enclave (Bandauko & Nutifafa Arku, 2023).

Legibility and clearance

The history of legibility in Lagos is the history that makes informal residents fear it. Olajide and Lawanson (2025) trace the forced evictions at Maroko in 1990 and at Otodo Gbame in 2016 and 2017, and the coalitions of community federations, legal advocates and researchers that mobilised a right-to-the-city discourse against them. Shadare (2026) finds that resilience and displacement governance in Lagos has been shaped by state-led waterfront projects, including Eko Atlantic, and that the governance response to climate hazard has amplified displacement risk for communities such as Makoko. Castro (2026) shows how the demolition of Otodo Gbame destroyed adaptation infrastructures residents had built. Against this background, any smart-city initiative that begins by mapping the waterfront settlements will be read by residents as a prelude to removal, and on the evidence they would be right to read it so.

© IIARJournal. All rights reserved.

Proposition 1 applies: without a tenure commitment, legibility reduces security.

Enclave and periphery

Eko Atlantic exemplifies Proposition 6. It concentrates investment in a privately developed, digitally managed enclave adjacent to some of the city's poorest waterfront communities, raises land values along the coast and establishes a visible standard of urban order against which Makoko and its neighbours appear as anomalies to be cleared. Sen et al.'s (2026) argument that informal settlements subsidise the smart city is literally true here: the labour that builds and services the enclave lives in the settlements the enclave's logic condemns. Bandauko and Nutifafa Arku (2023) identify Eko Atlantic among the African smart cities criticised for exactly this pattern.

The possibility

Lagos also contains the elements of the alternative model. The Nigerian Slum/Informal Settlement Federation, a member of Slum Dwellers International, has conducted enumerations and participatory mapping in Lagos settlements and used them to contest evictions and negotiate with the state (Olajide & Lawanson, 2025). Residents of waterfront communities have built their own adaptation infrastructures (Castro, 2026). The state has institutional vehicles, the Lagos State Urban Renewal Agency, the resident registration system, the digital addressing capacity that exists in principle, that could be turned toward incremental recognition rather than clearance. The framework specifies what that turn would require: a tenure commitment attached to mapping, resident control of settlement data, optimisation that takes informal transport and water vending as systems to improve, services designed with residents, and a measure of success stated in their security, services and voice. Whether Lagos makes that turn is a political question. The framework makes clear what is at stake in it.

4.3 Implications

For state and municipal governments

The first implication is that smart-city investment in African cities should be evaluated before procurement against its expected effects on informal residents' security, services and voice, and that initiatives which cannot show a plausible positive effect on at least two of the three should not proceed on the strength of input metrics. The second is that legibility initiatives, mapping, addressing, registration, should be sequenced after or alongside tenure commitments, not before them, and that the commitment should be enforceable. The third is that the informal systems through which most residents receive water, energy, transport and waste services should be treated as the systems to be improved, and that optimisation strategies which presuppose their replacement should be recognised as redistributive in favour of the better off.

For vendors and development partners

The smart-city industry sells optimisation to cities that need service, and sells legibility as a neutral foundation when it is a contested political act. Vendors and the development partners who finance them bear responsibility for the mismatch. The framework offers a standard they can be held to: proposals should specify who will hold the data generated, what residents will receive, and what protections against adverse use of legibility are built in. Development partners in particular should recognise that financing satellite mapping of informal settlements without financing the institutional capacity to use it for upgrading risks producing the clearance it was not intended to enable (Proposition 7).

For urban research

Several research directions follow. The propositions can be tested comparatively across African cities with different tenure regimes, state capacities and histories of eviction. The complementarity between remote-sensing and community-generated data, which the literature treats as separate traditions, deserves direct methodological attention: how can satellite-derived change detection be combined with community enumeration so that scale and legitimacy are both achieved? The informal smart urbanism documented by Fransen et al. (2026) and Kabendela et al. (2026a, 2026b) in Nairobi and Dar es Salaam should be studied in Nigerian cities, where the digital practices of informal residents are intensive but under-researched. And the governance of data about informal settlements, who collects, who holds, who may use, who may contest, needs a normative and legal literature that Nigeria's Data Protection Act 2023 and the African data-protection regimes have not yet generated for the urban context.

Limits of the argument

The framework is a conceptual contribution and has the limits of one. It does not measure the effects it describes; it specifies what should be measured. It

© IIARJournal. All rights reserved.

treats informal residents as a category whose interests in security, services and voice are broadly shared, when in practice settlements are internally differentiated by tenure status, gender, age, disability and length of residence, as Chumo et al. (2025) show. It takes the state as the principal actor when in many settlements landlords, traditional authorities and community associations matter more. And it is built from a literature that is concentrated in a few well-studied cities, Nairobi, Cape Town, Dar es Salaam, Lagos, whose experience may not generalise. These limits are reasons to test the framework, not to dismiss it.

5. CONCLUSION AND RECOMMENDATION

The smart city was designed for cities that are legible, formally serviced and institutionally governed. African cities are being built, for the most part, by people the state cannot see, through systems the state does not run, under arrangements the state has not recognised. Applying the smart-city model to this reality produces a predictable pattern: legibility that residents have reason to fear, optimisation of systems residents do not use, and neglect of the services residents need. The critical literature has documented this pattern thoroughly. This paper has tried to explain it by decomposing what digital urban systems do into three functions whose meanings diverge in the informal city, and to move beyond critique by proposing a standard of evaluation, security, services and voice for informal residents, and a set of propositions about when that standard will be met.

The alternative model the paper describes is not speculative. Its elements exist in the enumerations of urban poor federations, in participatory mapping and regularisation, in the digital resilience practices of informal residents and in the hybrid infrastructures that already serve them. What they lack is recognition as a model, investment proportionate to their value, and a state willing to let legibility serve recognition rather than removal. A smart city for the informal city would be one in which the people who built the city are the first to benefit from knowing it better. That is a political choice before it is a technical one, and the framework offered here is intended to make the choice visible.

6. CONTRIBUTION TO EXISTING KNOWLEDGE

The paper contributes a decomposition of what digital urban systems do, rendering the city legible to the state, optimising the flows the state already manages, and extending services to residents, and uses it to explain why the smart-city model so often fails or harms the residents of informal settlements: it leads with legibility, which they have reason to fear, invests in optimisation of systems they do not use, and neglects the services they need.

It further contributes an evaluation framework that judges digital urban governance by its effects on the security, services and voice of informal residents rather than by the technology deployed, giving governments, vendors and researchers a standard that makes the distributional consequences of smart-city initiatives visible rather than hidden behind input metrics.

7. REFERENCES

Alizadeh, T., & Prasad, D. (2024). The right to the smart city in the Global South: A research agenda. Urban Studies, 61(3), 426–444. https://doi.org/10.1177/00420980231183167

Almulhim, A. I., & Yigitcanlar, T. (2025). Understanding smart governance of sustainable cities: A review and multidimensional framework. Smart Cities, 8(4), 113. https://doi.org/10.3390/smartcities8040113

Azeez, R. O., Bhatt, S., Farinloye, T., Mogaji, E., & Orole, F. (2025). Afrocentric urban mobility model for smart inclusive African cities. Discover Cities, 2(1), 124. https://doi.org/10.1007/s44327-025-00165-0

Bandauko, E., & Nutifafa Arku, R. (2023). A critical analysis of 'smart cities' as an urban development strategy in Africa. International Planning Studies, 28(1), 69–86. https://doi.org/10.1080/13563475.2022.2137112

Bhanye, J. (2026). Contested waters, contested spaces: Rethinking justice-driven flood adaptation in informal settlements in the global South. Environment & Urbanization, 38(1), 66–89. https://doi.org/10.1177/09562478261423458

Boanada-Fuchs, A., Kuffer, M., & Samper, J. (2024). A global estimate of the size and location of informal settlements. Urban Science, 8(1), 18. https://doi.org/10.3390/urbansci8010018

Bobbins, K., Caprotti, F., de Groot, J., Pailman, W., Moorlach, M., Schloemann, H., Densmore, A., Finlay, K., Fischat, E., Siwali, S., & Links, J. (2024). Smart and disruptive infrastructures: Re-building knowledge on the informal city. Urban Studies, 61(1), 165–179. https://doi.org/10.1177/00420980231172582

Borofsky, Y., Kersey, J., Caprotti, F., Günther, I., Harttgen, K., Kagho, G., Kammen, D. M.,

© IIARJournal. All rights reserved.

Kostenwein, D., Asiimwe, P. K., Lobo, T., Lukuyu, J., Maha, X., Mayapi, T., Mwesiga, P. M., Nagenborg, M., Rongwana, Y., Sabry, S., Tshabalala, T., Varesio, A., & Walczak, M. (2025). An agenda for data-rich, action-oriented, ethical research on infrastructure in informal settlements. Nature Cities, 2(11), 1026–1036. https://doi.org/10.1038/s44284-025-00340-9

Breuer, J. H. P., & Friesen, J. (2023). Methods to assess spatio-temporal changes of slum populations. Cities, 143, 104582. https://doi.org/10.1016/j.cities.2023.104582

Büttner, N., Stalder, S., Volpi, M., Suel, E., & Harttgen, K. (2025). Large-scale slum mapping in sub-Saharan Africa's major cities: Remote sensing and deep learning reveal strong slum growth in the urban periphery between 2016 and 2022. Habitat International, 161, 103403. https://doi.org/10.1016/j.habitatint.2025.103403

Byamugisha, F. F. K., & Dubosse, N. (2023). The investment case for land tenure security in Sub-Saharan Africa: A cost–benefit analysis. Journal of Benefit-Cost Analysis, 14(S1), 272–300. https://doi.org/10.1017/bca.2023.14

Castro, B. (2026). Climate change at the margins of the megacity: Informal settlements' adaptation infrastructures. Climate and Development. Advance online publication. https://doi.org/10.1080/17565529.2026.2679005

Chumo, I., Kabaria, C., & Mberu, B. (2025). Social mapping of marginalized and vulnerable groups in urban informal settlements: A participatory action research approach. Frontiers in Sustainable Cities, 7, 1693073. https://doi.org/10.3389/frsc.2025.1693073

Das, D. K., Aiyetan, A. O., & Mostafa, M. M. H. (2026). Advancing smart cities in Africa: Barriers, potentials, and strategic pathways for sustainable urban transformation. Smart Cities, 9(2), 38. https://doi.org/10.3390/smartcities9020038

Datta, A. (2023). The digitalising state: Governing digitalisation-as-urbanisation in the global south. Progress in Human Geography, 47(1), 141–159. https://doi.org/10.1177/03091325221141798

Egba, V. N., Ukeje, I. O., Ayanwale, M. A., Robinson, D. F., Ojogbane, R. S., & Akonye, J. E. (2026). Smart urban governance for sustainable cities: Integrating artificial intelligence, digitalization, and renewable energy technologies in Nigeria's public service transformation. Frontiers in Sustainable Cities, 8, 1739482. https://doi.org/10.3389/frsc.2026.1739482

Fan, J., Heiskanen, J., Vuolteenaho, J., & Sa, H. (2026). Game-changers in global slum detection? A review of remote sensing for assessing complexity of informal settlements. International Journal of Remote Sensing, 47(13), 5688–5710. https://doi.org/10.1080/01431161.2026.2673192

Fransen, J., van Tuijl, E., Simon, H. K., Nyagaya, S. O., & Kiriro, S. (2026). Informal smart urbanism: A case study of digital resilience in Mathare informal settlement. Urban Studies. Advance online publication. https://doi.org/10.1177/00420980261450022

Kabendela, G., Huybrechts, L., & Magina, F. B. (2026a). Digitally mediated institutioning in informal settlements: Community transformative agency through socio-technical configuring in Dar es Salaam. Computer Supported Cooperative Work (CSCW), 35(4), 17. https://doi.org/10.1007/s10606-026-09552-6

Kabendela, G., Huybrechts, L., & Magina, F. B. (2026b). Rethinking participatory planning through community digital practices: Evidence from informal settlements in Dar es Salaam. Planning Practice & Research. Advance online publication. https://doi.org/10.1080/02697459.2026.2731065

Li, D., Sun, L., Yu, Y., & Tian, P. (2026). Geospatial micro-estimates of slum populations in 129 Global South countries using machine learning and public data. Earth System Science Data, 18(8), 5969–5993. https://doi.org/10.5194/essd-18-5969-2026

Maatallah, R., Abdessamad, A., & Khatori, Y. (2026). Smart cities in Africa: A systematic literature review of challenges and development strategies. City and Environment Interactions, 30, 100365. https://doi.org/10.1016/j.cacint.2026.100365

Maninggar, N., Fransen, J., Safronova, V., van Eerd, M., Otieno Ogonji, D., & Don Bosco, S. (2026). Planning digital inclusion together, barriers to include marginalised urban communities in the Global South: Lessons from Chennai, Nairobi and Malang. Planning Practice & Research. Advance online publication. https://doi.org/10.1080/02697459.2026.2621415

Masimba, G. (2025). Technology-aided slum enumerations: Examining a new kind of political agency for young people. Environment & Urbanization, 37(2), 513–531. https://doi.org/10.1177/09562478251360158

Mhlanga, D. (2026). Artificial intelligence in smart cities: Implications for urban governance in Africa. Frontiers in Sustainable Cities, 8, 1835768. https://doi.org/10.3389/frsc.2026.1835768

Mudau, N., & Mhangara, P. (2023). Mapping and assessment of housing informality using object-based image analysis: A review. Urban Science, 7(3), 98. https://doi.org/10.3390/urbansci7030098

Muhoja, M. S. (2026). From recipients to co-planners: Community empowerment in informal settlement regularization in peri-urban areas of Tanzania.

© IIARJournal. All rights reserved.

Human Ecology, 54(2), 31. https://doi.org/10.1007/s10745-026-00690-5

Olajide, O. A., & Lawanson, T. (2025). Claiming the right to the city: The politics of urban reform coalitions in Lagos. Environment & Urbanization, 37(1), 57–75. https://doi.org/10.1177/09562478251318231

Peter, C., & Meyer, C. (2023). Organizing for the smart African city: Leveraging the urban commons for exerting the right to the city. Organization Studies, 44(10), 1725–1746. https://doi.org/10.1177/01708406221089609

Prasad, D., Alizadeh, T., & Dowling, R. (2024). Smart city planning and the challenges of informality in India. Dialogues in Human Geography, 14(3), 385–402. https://doi.org/10.1177/20438206231156655

Sen, S., Rasmussen, J., & Kimari, W. (2026). Dialectics of informality in the smart city: Between antagonism and interdependence. Urban Studies, 63(14), 3278–3290. https://doi.org/10.1177/00420980261435846

Shadare, G. A. (2026). Post-disaster planning, compound climate–displacement vulnerability, and urban resilience governance in Lagos, Nigeria: A systematic review. Land, 15(8), 1458. https://doi.org/10.3390/land15081458

Shariatpour, F., & Behzadfar, M. (2026). Governing agentic cities: Platform cognition, power, and post-smart urbanism. Telematics and Informatics, 107, 102399. https://doi.org/10.1016/j.tele.2026.102399

Siwawa, V. (2026). Transforming waste management: The impact of digital innovation on integrating informal sectors in Cape Town and Johannesburg smart cities. Environment & Urbanization, 38(1), 203–255. https://doi.org/10.1177/09562478261422568

Thiel, A. (2023). Digital addressing and the construction of the Ghanaian nation-space. Digital Geography and Society, 4, 100054. https://doi.org/10.1016/j.diggeo.2023.100054

© IIARJournal. All rights reserved.