

Smart City Transformation in Yogyakarta: Governance Barriers Beyond the Smart City Transformation Framework

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ABSTRACT

Yogyakarta City has adopted various smart city programs in an effort to improve public service delivery and municipal government. This study evaluates the smart city transformation in Yogyakarta utilising the Smart City Transformation Framework (SCTF) that includes smart planning, physical and ICT infrastructure, and smart solutions through collaborative governance. Data were acquired through interviews with five key informants from four municipal departments, policy document analysis and field observations. The findings show that Yogyakarta has made efforts on all four SCTF areas. Especially through Jogja Smart Service (JSS) that offers access to more than 250 public services, free public Wi-Fi, and IoT-based traffic control through the Area Traffic Control System (ATCS). Some of the assertions about the extent of services and results, however, are mostly based on informant stories that could not be independently corroborated. Two governance concerns were also identified: First, there were national smart city policies, but local governments lacked comprehensive advice for execution because sanctioned national structures did not exist. Secondly, the advent of legal disputes when the central government mandates overrode local protocols. The results indicate that the smart city transformation in a medium-sized city in Indonesia needs not only technology progress but also more specific guidance from national policy and flexible legal cooperation between the national and local authorities. However, the report represents just the views of the government and does not reflect the experiences of non-government organisations, enterprises or community groups. The results therefore mostly reflect formal government ideas of collaborative governance.

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INTRODUCTION

Cities around the world are growing faster than ever before. Right now, about 55% of people live in cities, and it's expected that number will go up to 68% in the next few decades ([United Nations, 2018](#)). Fast-growing cities are putting more pressure on local governments to handle public services, infrastructure, and the way they run things better ([Bibri & Krogstie, 2017](#); [Neirotti et al., 2014](#)). To address these challenges, the idea of a smart city has come up as a way to make urban areas better managed. This approach uses

information and communication technology (ICT) across different sectors to help with governance, make things more transparent, and support sustainable development ([Lim et al., 2019](#); [Noori et al., 2020](#)).

In Indonesia, the national government has promoted smart city development since 2017 through the "100 Smart Cities Program," which aims to accelerate digital transformation in urban governance through a collaborative initiative involving the Ministry of Communication and Information Technology, the Ministry of Home Affairs, Bappenas, and the Presidential Staff Office ([Kementerian Komunikasi dan Informatika, 2022](#)). Among Indonesian cities, Yogyakarta presents a particularly compelling case. As a medium-sized city with a total area of only 32.8 km², it has developed one of Indonesia's most integrated digital public service platforms, the Jogja Smart Service (JSS) super-application integrating over 250 public services into a single sign-on system ([Gumilar, 2020](#)), alongside IoT-based traffic management through the Area Traffic Control System (ATCS) and full fiber optic coverage across its administrative area. Yet despite this national program, no authoritative benchmark or exemplar city has been designated to guide local governments on what a "successful" smart city should look like — a gap that becomes especially salient at the implementation level, as this study will show. Most existing studies on Indonesian smart cities also rely predominantly on secondary data and policy document analysis, without capturing the lived institutional experiences of officials responsible for implementation.

Kumar et al. ([Kumar et al., 2020a](#)) proposed the Smart City Transformation Framework (SCTF) as a systematic analytical framework for smart city transformation with four main components. The first dimension is strategic planning, which is the foundation of smart city development. Smart city services should be developed based on requirements and demands of residents ([Lee et al., 2013](#)). At this point, governments need to prepare for collaboration among multiple levels of government, provide financial resources, create public infrastructure, and implement regulations that support smart city efforts ([Kumar et al., 2020a](#)). Smart city planning should not only focus on technological innovation but also on institutional improvements, governance reform, and collaboration in order for stakeholders to achieve the targeted goals ([Meijer & Bolívar, 2016](#)). Thus, smart city development should be comprehensive in nature, combining technology with existing social structures and governance processes.

The second factor is the development of the physical infrastructure for urban services and the promotion of smart city initiatives. The basic infrastructure includes proper housing, water supply, sanitation, transport, health care, and environmental management systems ([Kumar et al., 2020a](#)). Singapore's complicated public transport system, which includes the Mass Rapid Transit (MRT) and Light Rail Transit (LRT) ([Diao, 2019](#)), can serve as an example of how physical infrastructure can help develop more efficient and sustainable urban systems. Third, the expansion of ICT infrastructure is a major driver for a smart city transformation. Better network infrastructure, such as

fibre optic networks, wireless systems and sensor networks ([Lee et al., 2014](#); [Novotný et al., 2014](#)) can contribute to an increased quality and availability of digital public services. The application of IoT in urban management has brought greater governance, efficient use of resources, and better decision-making through IoT technology, leading to the well-being of the people ([Engin et al., 2020](#); [Kumar et al., 2020a](#)).

The fourth feature of SCTF is the deployment of smart solutions. The digital technologies and data infrastructure enable cities to give real time urban management services. Sensors and data systems enable the collection, storage, manipulation and visualisation of data with the potential to provide new digital services for municipalities ([Kumar et al., 2020a](#)). A positive example is Chicago's Array of Things (AoT) project, which installs a network of sensors on street infrastructure to collect environmental and urban data, such as air quality, noise levels, traffic flow, and temperature, allowing governments to boost service efficiency and respond faster to urban challenges ([Li et al., 2018](#); [Zubizarreta et al., 2015](#)). Likewise, Barcelona has created innovation districts, 325 km of fibre optic infrastructure, and sensor-based urban management systems that connect physical infrastructure directly to an innovation ecosystem ([Bakıcı et al., 2013](#)). These international examples demonstrate how the four SCTF dimensions act as an integrated transformation pathway rather than as separate treatments.

While the four SCTF dimensions describe what a smart city transformation should technically encompass, they do not fully specify how such transformation is governed in practice — particularly how multiple actors coordinate, share resources, and reach decisions across levels of government. This study therefore incorporates a collaborative governance perspective as a complementary analytical lens: SCTF identifies the substantive components being transformed, while collaborative governance explains the process through which that transformation is negotiated and sustained among stakeholders. Smart governance itself is a type of ICT-based urban government that seeks to make decision making more collaborative, transparent, and accountable, and is generally considered an integral part of smart city transformation ([Meijer & Thaens, 2022](#)). Ansell & Gash ([Ansell & Gash, 2008](#)) define collaborative governance from the standpoint of collaborative governance as a formal process of consensus-oriented decision-making and engagement of non-state stakeholders in collective decision-making by public institutions. Emerson & Nabatchi ([Emerson & Nabatchi, 2015](#)) take this a step further by looking at collaborative governance regimes that consist of three main components; principled engagement, shared motivation, and capacity for joint action. Together, these two frameworks enable this study to explore not only the components of SCTF that have been employed in Yogyakarta. They also assist us in understanding how collaboration, or the absence of it, influences the speed and completeness of the implementation of those components.

Yet even with a clear analytical framework and governance lens in place, cities pursuing smart city transformation usually face considerable obstacles in practice. One

of the most important barriers is financial limitations; it takes substantial investment to establish smart cities in terms of digital services and technological infrastructure ([Jonek-Kowalska & Wolniak, 2021](#)). Traditional funding approaches with an annual budget cycle limit long-term investment, especially in developing countries where local governments face stricter fiscal constraints ([Ferraris et al., 2020](#)). The second main impediment is the lack of human resources; impactful smart city initiatives are often beyond the expertise, experience and institutional capacity of local governments and public officials may not have technical expertise to operate and maintain new digital systems ([Borghys et al., 2020](#); [José & Rodrigues, 2024](#)). A third barrier is the need for public-private partnerships, as local governments often lack technological expertise and financial resources for large-scale projects; collaboration with the private sector can therefore provide important support ([Coletta et al., 2019](#); [Ramaswami et al., 2016](#)). These three barriers are well-documented in the existing literature. However, this study identifies two additional governance-level barriers that are underexplored, particularly in developing country contexts: the absence of a national smart city role model, which creates policy ambiguity at the local government level, and regulatory conflicts between central government application mandates and local innovation needs.

This study therefore aims to analyze the smart city transformation of Yogyakarta City using the Smart City Transformation Framework (SCTF) proposed by Kumar et al., ([Kumar et al., 2020b](#)), integrated with a collaborative governance perspective, through primary data collected from five key government stakeholders across four municipal agencies between September and October 2024. Specifically, this study addresses the following research questions: (1) How is smart city transformation implemented in Yogyakarta across the four SCTF dimensions? and (2) What governance-level barriers shape the pace and depth of this implementation? The collaborative governance approach is, in fact, illustrative of how many organisations cooperate in building a smart city, whilst the SCTF dimensions show what is studied in each step of the process; this seeming difference is also discussed in the Method section. This study provides concrete instances of the transformation of a mid-sized Indonesian city into a smart city, which is not well covered in current studies predominantly focused on large cities.

METHOD

This study adopts a qualitative case study method to analyse the development of the city of Yogyakarta into a smart city. Yogyakarta was chosen as an exemplary case for this study because it is one of the few medium-sized cities in Indonesia that has established a full digital service platform called JSS and has a Smart City strategy that has been running for several years. The first strategy was developed for 2018-2022 and then amended for 2021-2026. The government organization of the city has been chronicled for over eight years, giving contextual information for the current research.

The research examined the strategy used by the Yogyakarta municipal government in transitioning to a smart city, particularly in the Master Plan for 2021-2026.

Qualitative technique is appropriate for the examination of complex social problems in their real contexts, yielding substantial insights into events, pertinent policies, and institutional performance (Creswell & Creswell, 2018). The data collecting is related to an interval of time (September to October 2024), whereas the research uses policy papers from the Master Plan timeframe from 2018 to 2026. This places the contemporary institutional structure in the historical setting of earlier policies, rather than looking at current occurrences in isolation from previous initiatives. This study discusses the general development of Yogyakarta's smart city programs during eight years, but not the details of the developments that took place during that time.

To understand the policy progress and present implementation, researchers collected primary data through in-depth talks with key government officials participating in the smart city endeavour in Yogyakarta. Informants were picked by purposive and snowball sampling, beginning with the Regional Development Planning Agency as the main coordinator of the smart city project in Yogyakarta. They were then transferred to several departments including the Department of Communication and Information Technology, Department of Public Works and Department of Transportation. Snowball sampling ended after five people interviewed since the referral network no longer offered more names. The last interviewee also named the same persons and organisations as mentioned before, which meant that all those who had been involved in the formulation and implementation of the program had been covered. Table 1 provides a complete list of the informants.

Table 1. List of Key Informants

Name	Institution	Role	Interview Date
Informant 1	Regional Development Planning Agency	Smart City Planning Coordinator	25 Sep 2024
Informant 2	Department of Communication and Information Technology	Head of ICT Planning & Implementation	30 Sep 2024
Informant 3	Department of Public Works	Computer Analyst/Infrastructure	17 Oct 2024
Informant 4	Department of Transportation	Traffic Policy Manager A	24 Oct 2024
Informant 5	Department of Transportation	Traffic Policy Manager B	24 Oct 2024

Source: Author's Work

This selection approach centred on government employees that are necessary to understand the planning, organization, and limits of smart city transitions from a bureaucratic perspective. This scope implies that the remarks on collaborative governance in this study are based on the declarations of government officials about their involvement

with interested parties such as scholars, enterprises and community members in the planning process. These claims are not grounded in the non-governmental organisations endorsing or validating those allegations.

Interviews used a semi-structured approach, with a set of questions that were created and then changed as needed during the research based on what the people being interviewed said. Each interview took about 30 to 60 minutes and was done in Indonesian, which is the language the informants used for work. All interviews were recorded using audio and with the permission of the people being interviewed, and then written down by hand by the person doing the interviews. Access to informants was officially organized via a research permit letter provided by Universitas Gadjah Mada. To keep the informant's identity private, which is a usual ethical rule in qualitative research, the people in this study are only identified by their job title at the institution (see Table 1), and their real names are not used anywhere. The English interview quotes in this article were translated from Indonesian by the researcher.

Field observations took place at all four government offices that were part of this study — the Regional Development Planning Agency, the Department of Communication and Information Technology, the Department of Public Works, and the Department of Transportation — throughout the interview period. Please replace this sentence with the following revised version: The Department of Transportation informant did not provide direct access to the ATCS control room; the researcher was informed that ATCS-related CCTV monitoring is accessible as a feature within the JSS application. The JSS application was accessed directly by the researcher via mobile phone, following informants' instructions, rather than through an in-person demonstration. Instead of going to a live presentation, the investigator was able to use their mobile device to immediately access the JSS application and follow informants' directions.

Secondary data were obtained from the official policy documents of the Regional Development Planning Agency. The Yogyakarta Smart City Master Plan was initially created for the period 2018-2022, then updated to be 2021-2026 along with the Regional Long-Term Development Plan for 2025-2045. As mentioned by the informant previously about the self-directed review process, the 2021-2026 Master Plan is a revision of the 2018-2022 plan, not a totally new effort. These records were used to triangulate and elaborate the information acquired from the interviews, especially about the initiation of services, the number of people they included, and any policies mentioned by the respondents.

The data were analysed using a five-step qualitative procedure based on Bingham ([Bingham, 2023](#)) method: organising, sorting, understanding, interpreting, and explaining the data. During the organizing and sorting stages, the interview transcripts were coded in a deductive way based on the four SCTF components—Planning, Physical Infrastructure, ICT Infrastructure, and Smart Solutions—using the same structure as the interview guide. The two main governance issues addressed in this study – the lack of a

national model for smart city and disagreements between central and local authorities on laws – were not included in the original interview questions. But in the understanding part of the inquiry interviewees brought up these issues spontaneously while explaining how their separate organisations performed their tasks. As these patterns had emerged, the researcher then asked others if they had experienced similar challenges. This gave us the opportunity to make sure these difficulties were occurring in other circumstances, not just based on one person's experience. The coding was manual. The transcripts were examined and classified based on the four deductive SCTF classifications and the two barrier classifications created using inductive methodologies. In the phase of elucidation, once consistency of a pattern across all participants was established, instances from the transcripts were selected to substantiate each pattern.

The credibility of the data was increased by cross-checking information from three different sources- interviews, official papers, and direct verifications. This is a strategy that is often used to enhance the reliability and validity of qualitative findings (Mekarisce, 2020). Claims by informants were checked against available evidence wherever possible. Physically inspecting the application, it was confirmed that the JSS super-application has more than 250 public services. This statistic was not cited in the Master Plan or RPJPD papers, which only give a brief overview of the programs and activities that are contained under JSS. Informal member verification was conducted by re-contacting relevant informants for clarification after reviewing the interview recordings, where points required further detail or confirmation. Throughout this process, no contradictions were detected among the assertions of the informants, the papers and the direct observations.

This triangulation is important to provide consistency of findings across different types of evidence, but does not mean that the information is corroborated by non-government sources. All interviews, official records and observation used for this research were sourced from inside the Yogyakarta city government. The material could represent a story common within the administration, rather than confirmed facts from outside sources. This is in line with the wider focus of the study, already described, on analysing smart city developments from the perspective of municipal employees.

RESULTS AND DISCUSSION

This section contains findings from interviews with five important government officials in four different city agencies in Yogyakarta. The data is organised according to the four components of the Smart City Transformation Framework (SCTF) and the related issues.

Planning Phase

The planning phase of Yogyakarta's smart city project follows the Smart City Master Plan, which runs from 2018 to 2022 and was updated for 2021 to 2026. This plan

is based on the goal of creating city growth through services that are effective, efficient, transparent, accountable, and involve the community. A major part of this planning stage is UGM's role in checking the Master Plan using their own system, according to an informant from the Regional Development Planning Agency:

"Before the Master Plan ended, we conducted a review ourselves. We used a self-managed scheme involving UGM to help us review the Master Plan. That was in 2021, valid until 2026" (Interview, Regional Development Planning Agency, 25 September 2024).

Multi-stakeholder collaboration is made stronger through the Gandeng Gendong program, which is a plan to empower villages and communities. This program brings together different groups like the government, academic institutions, local communities, and businesses — especially Bank BPD DIY — instead of depending only on private funding, as explained by an informant from the Regional Development Planning Agency.

According to the source of the Department of Public Works, community opinion is incorporated into the annual Development Planning Deliberation (Musrenbang) forum:

"Before the budget is compiled, we gather the community at the kelurahan level through Musrenbang. We listen to community aspirations first, as well as input from the local legislature" (Interview, Department of Public Works, 17 October 2024).

The data from this research, sourced only from the government, shows that these frameworks exist, whereas Musrenbang and Gandeng Gendong provide official spaces for different groups to give comments. This does not mirror the experiences of normal people, or partner organisations. Like other research on smart cities, this form of engagement typically remains within the consultative phase, where the community is consulted and its ideas are incorporated into the planning process, and does not advance to the co-creative phase, where citizens have equal power in the decision-making process (Mora et al., 2019). Getting closer to communities, rather than just asking for their opinion, may improve the acceptance and relevance of Yogyakarta's smart city efforts to local needs in the future.

Physical Infrastructure Development

Yogyakarta's physical infrastructure is focused on the M3K (Munggak, Mundur, Manggep Kali) program, which aims to improve the slum regions by reorganising the populations living along the riverbanks. This program is working with the Department of Communication and Information Technology to set up public Wi-Fi hotspots. A Department of Public Works source outlined the details of the plan:

" We are committed to upgrading poor communities, especially those next to waterways, to make them more orderly and safe. We also construct pathways for the passage of fire engines and ambulances. The intelligent urban initiative will work with Kominfo to provide free Wi-Fi hotspots in communal places." (Interview, Department of Public Works, 17 October 2024).

It is a combination of better physical infrastructure and digital connectivity. The source did not mention the urban coverage of the effort in relation to all the riverbank settlements. The statistics collected do not clarify the extent to which this combination addresses a city-wide need..

The physical infrastructure is connected to ICT through the JSS complaint-reporting mechanism. As part of their infrastructure build-out, fiber optic cables are being installed beneath city roads, while street lighting poles (PJU) are leased to telecommunications operators as tower infrastructure. The Department of Public Works received 1,397 public reports through this route in 2023, mostly about street lighting and road conditions. This data suggests that people are actively using the reporting system, however this survey does not provide the number of reports actioned or the speed of the responses. We cannot tell how much the maintenance service has improved because of the rise in report volume. In addition, the Department of Transportation has employed the ATCS. The ability to regulate traffic in real time from a centralised hub means that it is no longer necessary to have people on the ground to monitor the state of the roads.

These findings suggest that the development of physical infrastructure in Yogyakarta is not perceived in isolation from digital systems: improvements to infrastructure, connectivity services and complaint handling appear to be integrated rather than delivered as separate projects. This implies that the evaluation of physical infrastructure in smart cities should consider both its accessibility and its integration with digital reporting and service delivery systems; however, to determine whether this combination significantly improves governmental responsiveness, more data is needed than was collected in this study.

ICT Infrastructure Development

The advancement of ICT in Yogyakarta centers on the Jogja Smart Service (JSS) super-application. This application consolidates over 250 public services into a singular platform and employs a unified sign-on mechanism, as reported by a source from the Department of Communication and Information Technology:

"Before 2017, we had developed numerous applications. As their population increased, it became increasingly challenging for the public to comprehend. We devised the concept of implementing a unified interface and single sign-on utilising JSS. Users require only one JSS account to access any service. " (Interview, Department of Communication and Information Technology, 30 September 2024).

The consolidation seems to be more than a technical upgrade, but a change in the way the city government is organised, moving away from different agencies managing separate digital services to a more unified and organised way of running city operations.

Kominfo has also expanded the fibre optic network throughout the city in addition to installing public Wi-Fi and CCTV cameras as part of the JSS system. They also said they have collaborated with the National Cyber and Encryption Agency (BSSN) to protect

data for domestic-made apps. The whole administrative region of the city is covered by these initiatives, according to the source. But the actual sites of fibre deployment and the whole technical narrative of the BSSN partnership are better understood as the informant's description of work in progress, rather than as independently corroborated information.

While there has been expansion in the infrastructure, the use of digital services is not the same for everyone: older persons and others who are less comfortable with technology have more problems accessing JSS-based services. In response, the Technology Information Dissemination Team (TDI) plays a non-technical support role similar to the digital skills training programs of other smart cities Mora et al., ([Mora et al., 2019](#)). This shows that simply investing in ICT infrastructure is not sufficient to ensure that everyone has an equal opportunity to access digital public services; ongoing efforts on technological literacy – such as education, training and community programs – are still required to ensure that the benefits of the improved infrastructure are shared by all, and not just those who are already well-versed in technology.

Implementation of Smart Solutions

Smart solutions in Yogyakarta are using both technology and non-technology techniques to solve problems. From a technology point of view, the Area Traffic Control System (ATCS) makes it possible for traffic signals to coordinate in real time without personnel having to be at the junctions. It employs a similar premise as the Chicago Array of Things project, which combines sensors and the internet of things. But the two projects have quite different functions. "ATCS is mostly about managing traffic, but the Chicago project is looking at a whole range of things like air quality, noise levels and temperature. Interviews with interested parties indicate that coordination between different agencies is not yet fully realised: a person from the Regional Development Planning Agency mentioned that the Department of Public Works often faces delays because of insufficient coordination of underground utility work by PDAM and telecom companies, highlighting the need for better shared urban data systems across agencies..

The Technology Information Dissemination Team (TDI) goes directly into communities to help locals use digital resources without using technology, an informant from the Department of Communication and Information Technology said:

" We have a TDI team that we bring in from outside the federal workforce and they go right into the neighbourhoods. When there is an RT meeting they are invited to get together and practise right then. The young ones can look after themselves but the older generation needs more help" (Interview, Department of Communication and Information Technology, 30 September 2024).

These findings point to the fact that the success of Yogyakarta's smart solutions depends not only on the technology used but also on the ability of government agencies to cooperate and adapt their services to the different levels of technology readiness of the

people — a trend that is aligned with the larger notion that smart city technology has to be aligned with societal and organisational changes.

Challenges and Barriers

People who contributed information also pointed to a number of practical problems in the implementation of smart city ideas, together with the two greater questions of management and decision-making. First, budget constraints were mentioned. said the informant from the Regional Development Planning Agency:

"Jogja is not a rich city in terms of money, but it has a yearly budget of more than 5 trillion rupiah. We depend on a variety of local income sources, such as tourism, and our budget is not as vast as communities that have greater total local income. Big funding needed for smart city. Surabaya has more local income and can develop a smart city more readily than we can" (Interview, Regional Development Planning Agency, 25 September 2024).

Another comparable but distinct issue is the ability of individuals to use digital resources, not the government's own competence to manage digital activities. The informant from the Regional Development Planning Agency said:

"The problem is more the readiness of the community to use digital services. Elderly RT and RW heads struggle to use mobile-based services" (Interview, Regional Development Planning Agency, 25 September 2024).

This means that the TDI team, as stated before, is part of the non-technological effort to address this online literacy gap, but considering that the TDI team is not that huge relative to the size of the city, it cannot bridge the gap rapidly enough across all locations. These practical problems are made considerably worse by problems with cooperation between different agencies, including the delays between Public Works and utility firms noted previously.

The Role Model Vacuum

Informants said there is no common standard for smart cities and this leads to ambiguous policies. As per one informant from the Department of Communication and Information Technology:

"The Kominfo ministry has no perfect model and definition of what the ideal smart city should be like. Depends on each region. There is no one to look up to for guidance. "We are still looking for what the ideal smart city is. If we take Surabaya as the model, we may follow that path, but we don't have that model yet" (Interview, Department of Communication and Information Technology, 30 September 2024).

This explanation assumes that the main issue is not the absence of a national smart city program – since the “100 Smart Cities Program” shows that the country is indeed paying attention to the topic – but the lack of a working example or standard that can help local governments take concrete steps based on that attention.

Regulatory Conflict Between Central and Local Government

Informants also mentioned the lack of suitable role models, as well as the tension between commands from the central government and the actual functioning of local systems. This is what a Department of Public Works informant said directly:

"we want to develop a number of applications, but the rules don't let us do that if the central government has a similar one. Our building permit application was proceeding successfully on our own. Then the SIMBG came from the Ministry of Public Works and we had to use it. There were a lot of hurdles when it was initially introduced and there are still a lot of difficulties today" (Interview, Department of Public Works, 17 October 2024).

This account shows one particular change in regulations — the required move to the SIMBG building-permit system — instead of a trend that has been checked in several other areas of regulation in this study. It still shows an example where a central rule that required standardization actually made it harder, instead of easier, for local areas to be flexible in a region where the local system was said to be working well already.

When we look at all the findings together, it shows that Yogyakarta's smart city changes cover all four dimensions of the SCTF, though not equally. It also shows two problems related to how the city is managed, which go beyond the technical and physical parts of the SCTF itself. [Table 2](#) shows the results for each of the four SCTF parts and the governance issues found in this study.

Table 2. Smart City Transformation in Yogyakarta Based on the SCTF

SCTF Component	Implementation in Yogyakarta	Key Findings	Challenges
Smart City Planning	Musrenbang, UGM master plan review, gandeng gendong pentahelix program	Formal multi-stakeholder planning mechanisms in place	Participation remains consultative rather than co-creative
Physical Infrastructure Dev.	M3K slum upgrading program, fiber optic installation, JSS complaint reporting	Physical upgrades paired with digital connectivity and reporting channels	Coverage and resolution outcomes not independently verified
ICT Infrastructure Dev	JSS super-app (250+ services), public Wi-Fi, CCTV, BSSN data security coordination	Consolidated single sign-on service delivery	Digital literacy gap; fiber and security coverage based on informant accounts
Smart Solutions Implementation	ATCS traffic control, TDI digital literacy	Real-time data traffic management; non-technical outreach for digital adoption	Limited cross-agency system integration
Governance-Level Barriers	Absence of national role model, regulatory conflict (SIMBG case)	Barriers emerged inductively during fieldwork, distinct from	Requires further verification across

	the four SCTF dimensions	additional regulatory domains
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Source: Author's Work

To put these findings into a wider context, [Table 3](#) compares Yogyakarta's smart city efforts with three cities often mentioned in smart city discussions in this study — Barcelona, Jakarta, and Chicago — because each shows a different aspect of smart city development that relates to Yogyakarta's situation: Barcelona for how it connects infrastructure with an innovation environment, Jakarta as the biggest and most well-funded smart city project in Indonesia, and Chicago for its use of sensors to manage the city. This comparison is meant to show an example rather than to compare cities using the same numbers or measurements.

Table 3. Comparison of Smart City Initiatives in Selected Cities

City	Key Smart City Initiatives	Relevance for Yogyakarta
Barcelona	Innovation districts, 325 km fiber optic, sensor-based infrastructure	Integration of infrastructure with innovation ecosystem
Jakarta	JAKI app, smart street lighting, air quality sensors, CCTV expansion	IoT-based urban management in large Indonesian city
Chicago	Array of Things (AoT) — sensors for traffic, air, noise, temperature	Data-driven decision making through sensor networks

Source: (Bakıcı et al., 2013; Syalianda & Kusumastuti, 2021; Zubizarreta et al., 2015)

The ATCS of Yogyakarta is a system comparable to the Array of Things of Chicago which is based on IoT technology. Both systems rely on sensors to gather data in real-time to assist run the city. However, the Yogyakarta system is mostly about traffic control, whereas Chicago's includes a broader variety of environmental monitoring. Yogyakarta has adopted a similar strategy to integrating services, compared to Jakarta, Indonesia's largest and most well-equipped smart city. Yogyakarta is trying to combine its services with a significantly smaller crew and less money. This demonstrates that service integration is not about having more money, although this comparison is not made to the same standards or results. Compared with Barcelona where the infrastructure is closely linked to an innovation system, Yogyakarta's physical and ICT infrastructure development is less focused on stimulating economic growth through innovation and more focused on service delivery; and this provides a pathway for future progress.

CONCLUSION

This research was conducted to explore the transformation of Yogyakarta City into a smart city utilising the Smart City Transformation Framework (SCTF) with the focus on collaborative governance. The study analysed data from five leading public officials in four distinct local agencies. The results of the first study question reveal that Yogyakarta has initiated various projects that cover all four domains of the SCTF

framework. They engage various groups in planning via Musrenbang and the Gandeng Gendong program, enhance physical facilities and digital connectivity, integrate diverse ICT services into a single app named JSS, and employ smart tools such as ATCS and the TDI online literacy team. But the linkage between these activities varies and in some regions there is insufficient clear evidence on how widespread or effective these programs are.

This study identifies two primary governance-level impediments that influence the speed and thoroughness of smart city projects to address the second research question. First, there is no nationally agreed upon standard or guide for smart cities, despite the existence of a national initiative, leaving local governments without clear direction. Second, there is a conflict when rules from the central government override and disturb how local systems work, as in the SIMBG situation. These hurdles arose naturally from the interviews rather than being based on a predetermined set of questions, and they were cited by many different persons.

This study presents real-world examples of a mid-sized city in Indonesia that is being transformed into a smart city. This is a topic that is not well covered in the existing research which generally focuses on big cities. It emphasises a crucial distinction in the management of smart city activities – between having a national program and monitoring performance, which has not been explored in depth in previous research on smart city administration. Other secondary Indonesian cities may do well to allow more flexibility in the interplay between central and local rules and to develop clear national norms to meet comparable concerns. But this is based on the Yogyakarta example and needs more testing in other regions to be truly effective.

There are some drawbacks to this study. First, all the people who provided information were government employees; thus, claims that they worked together with different groups in this study are derived from what the officials said about bringing in multiple stakeholders, not from independent viewpoints of academics, business people, non-profit organisations, or average citizens. Future studies that include these non-governmental voices – community members, private sector partners like those engaged with the Gandeng Gendong initiative, and civil society organisations – could help verify whether the type of dialogue shown here also works from their own standpoints. Second, the data were collected at a single time period, from September to October 2024; policy documents from 2018 to 2026 were used to provide background information, but this research analyzed the current state of Yogyakarta's smart city transformation and does not focus its evolution over time in detail. Third, some of the numbers and facts cited by informants such as the number of individuals the services serve and infrastructure related data were not verified with other government documents. These claims should therefore be read with caution. By investigating similar cases in other secondary cities in Indonesia, it might be determined whether the governance challenges discovered here are specific to

Yogyakarta or whether they are a more general problem in the operation of smart city governance within the framework of Indonesia's decentralised system.

CONFLICT OF INTEREST

The author declares no conflict of interest.

AUTHOR CONTRIBUTION

RIM: conceptualization, methodology, investigation, data curation, formal analysis, writing original draft, writing review & editing.

ETHICAL STATEMENT

Data collection was conducted with a formal research permit letter issued by Universitas Gadjah Mada. Informants participated voluntarily, interviews were audio-recorded with their consent, and informants are identified only by institutional role, with names withheld to protect confidentiality.

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DECLARATION OF GENERATIVE AI

During the preparation of this work, the author used Claude (Anthropic) and QuillBot solely as supporting tools for language-related tasks, including language editing, translation, and limited paraphrasing. These tools were used to assist in improving the clarity and readability of text developed by the author. The research design, data collection, coding, analysis, interpretation of findings, and development of the substantive content were conducted entirely by the author based on the research data and analytical process. All AI-assisted text was reviewed and revised by the author, who takes full responsibility for the accuracy, integrity, and content of the publication.

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