How far have Philippine LGUs come in developing into smart cities?

Tatum P. Ramos, Pauline Joy M. Lorenzo, Jenica A. Ancheta, and Marife M. Ballesteros

Local government units (LGUs) in the Philippines have endeavored to address urbanization challenges with innovative solutions, such as smart city initiatives. However, whether they can fully realize the potential of the smart city concept is unknown. For one thing, the readiness of cities for smart city development has not been established. The idea of a smart city in the Philippine context also remains vague despite the availability of a Philippine National Standards (PNS) defining the term. This *Policy Note* summarizes the findings of a PIDS study that looked into selected cities' prospects, challenges, and pathways for smart city development. Data were obtained through a desk review and interviews with representatives of LGUs, businesses, development organizations, and national government agencies (NGAs).[1]

The smart city concept

Smart city development is already being explored in the Philippines. Some LGUs have employed smart city solutions in addressing urbanization challenges. Furthermore, the Bureau of Philippine Standards, as reflected in PNS ISO 37122:2020, has adopted the International Organization for Standardization (ISO)

Salient Points:

- *Partnerships, smart city champions, information and communications technology personnel, and digitized data are recognized as enablers of smart city development. The presence of these drivers and smart city initiatives in some Philippine cities shows that the country has started to tread the path toward building smart cities.*

- *However, based on interviews with local government units, national government agencies, and private sector entities, challenges related to funding, interoperability of data systems, public uptake, and sustainability exist.*

- *Addressing the challenges requires actions at the local level and support from the national government in developing policies and standards to improve data flow, promoting technology and innovation-powered cities, and ensuring transparency and accountability in the implementation of smart city initiatives.*

definition of a "smart city", which is, a "city that increases the pace at which it provides social, economic, and environmental sustainability outcomes and responds to challenges, such as climate change, rapid population growth, and political and economic instability, by fundamentally improving how it engages society, applies collaborative leadership methods, works across disciplines and city systems, and uses data information and modern technologies to deliver better services and quality of life to those in the city (e.g., residents,

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[1] The LGUs included in the study were the cities of Cauayan, Tuguegarao, San Fernando, Malabon, Mandaue, and Tagum. The NGAs were the Department of the Interior and Local Government (DILG), Department of Information and Communications Technology (DICT), Department of Science and Technology–Philippine Council for Industry, Energy, and Emerging Technology Research and Development (DOST-PCIEERD), Public-Private Partnership (PPP) Center, and National Privacy Commission (NPC).

businesses, visitors), now and for the foreseeable future, without unfair disadvantage of others or degradation of the natural environment"[2] (BPS 2020, p.2).

However, the readiness of Philippine cities for smart city development has not yet been established despite the apparent interest in the smart city concept. To assess the capacity for smart city development, a working definition of smart city was formed by categorizing words that have been associated with the concept based on the PNS and other reviewed references (e.g., Ramaprasad et al. 2017; Ludher et al. 2018; DOST-PCIEERD n.d.-a). To summarize, the formulated working definition provides that a "smart city" is a technology and innovation-powered system that senses, monitors, processes, translates, and communicates industry and innovation, built infrastructure, quality environment, safety and security, health and well-being, and civic and social data, information, and knowledge by,
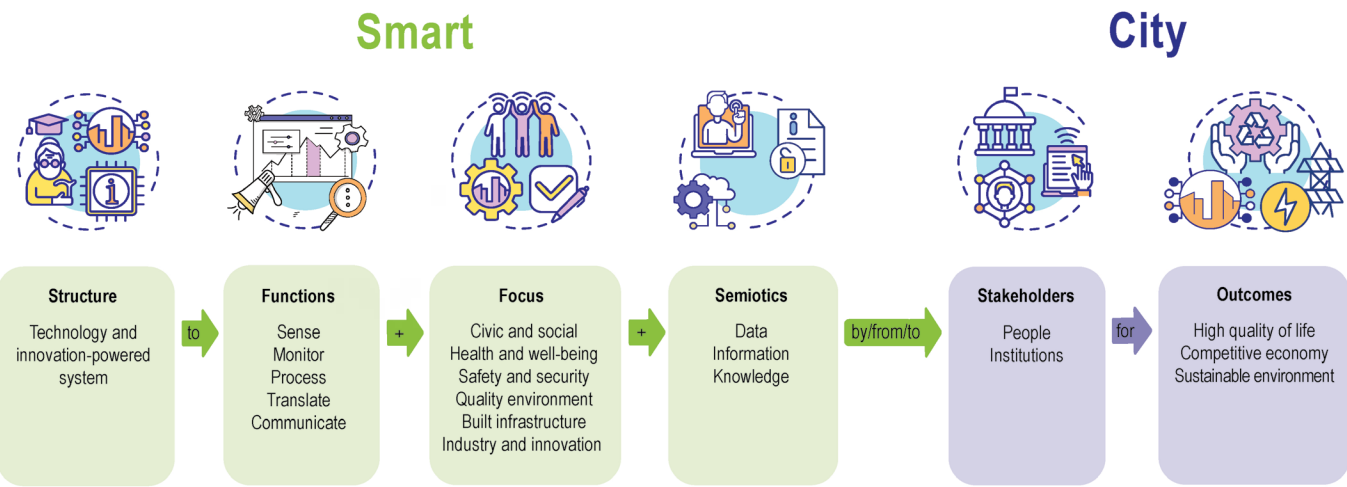
from, or to people and institutions for sustainable environment, competitive economy, and high quality of life (Figure 1).

Interviewees' understanding of smart city
Keywords related to smart city were derived from discussions with LGUs, NGAs, businesses, and development organizations to check their alignment with the formulated working definition. The top descriptive words were pooled in a word map (Figure 2) wherein the following gained the highest frequency: development, digital, sustainable, right, safe, quality, public, efficient, local, and national. Based on the interviews, LGUs perceived a smart city as using technology to improve service delivery and realize sustainable development. Meanwhile, the NGAs' understanding of a smart city is influenced by development frameworks and their respective mandates and their participation in smart city-related projects. Private sector stakeholders understood a smart city as one that takes advantage of technology to ensure economic growth and sustainable environment. The derived keywords and descriptions are generally consistent with the working definition. However, the lack of emphasis on the sharing of data, information, and knowledge with people is notable.

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[2] The smart city indicators per PNS ISO 37122:2020 involve the following: (1) economy, (2) education, (3) energy, (4) environment and climate change, (5) finance, (6) governance, (7) health, (8) housing, (9) population and social conditions, (10) recreation, (11) safety, (12) solid waste, (13) sport and culture, (14) telecommunication, (15) transportation, (16) urban/local agriculture and food security, (17) urban planning, (18) wastewater, and (19) water (BPS 2020).

Figure 1. Working definition of "smart city"

Structure	Functions	Focus	Semiotics	Stakeholders	Outcomes
Technology and innovation-powered system	Sense Monitor Process Translate Communicate	Civic and social Health and well-being Safety and security Quality environment Built infrastructure Industry and innovation	Data Information Knowledge	People Institutions	High quality of life Competitive economy Sustainable environment

Source: Authors' compilation

Figure 2. Smart city-related keywords based on interviews

Source: Authors' compilation

Extent of LGU initiatives in smart city development

Numerous smart city initiatives supported by NGAs have been implemented by Philippine cities across the infrastructure, data, and service phases of smart city development[3] (Table 1). Most of the initiatives, such as installing fiber optics and providing free WiFi, are in the infrastructure phase. NGAs play a key role in this phase by providing support to increase access to necessary infrastructure, including the internet, and implementing relevant programs, such as the National Broadband Program. In the data phase, initiatives include the development of data systems. Expected to support this phase are policies under the Data Privacy Act of 2012 (Republic Act [RA] 10173) and the Freedom of Information Program (Executive Order 2, series of 2016). Initiatives in the service phase include platforms enabling electronic transactions. These are supported by policies such as those under the Ease of Doing Business and Efficient Government Service Delivery Act of 2018 (RA 11032). All these show that the efforts on smart city development at the local level are complemented by policies issued at the national level.

Additional insights were derived using the working definition. Generally, cities focus more on the built infrastructure and civic and social domains. The main target of efforts across LGUs is to provide a high quality of life to their constituents. There are also more initiatives involving institutions and data and information, while people and knowledge fall short in their respective categories of stakeholders and semiotics, respectively. These reflect some similarities in the elements of smart city development adopted by LGUs. They also reveal the elements that can still be explored in the journey to becoming smart cities.

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[3] The breakdown of smart city development to three phases—infrastructure, data, and service—is adopted from World Bank (2021), which describes the infrastructure phase as made up of geospatial information, information and communications technology (ICT), and city infrastructure; the data phase as composed of data sharing and Internet of Things; and the service phase as made up of city innovation, algorithm, and service.

Table 1. Smart city initiatives of some Philippine cities

Initiative	Description
Malabon City (HUC, first income class)	
CCTV cameras	CCTV cameras for emergency monitoring and response
Mobile connectivity	4G
Free WiFi	Fiber infrastructure
Contact tracing app	Application with QR code technology integrated into the city health monitoring system
Computerization of tax collection data and transactions	Computerization in revenue-generating departments; GIS
Online payment services system	Online payment services for government transactions
Mandaue City (HUC, first income class)	
Guardian emergency response system	Mobile application for reporting incidents or requesting assistance; software for dispatch and deployment
Traffic management system	Traffic lights; digital clocks; CCTV and high-definition cameras; LED streetlights
Internet	Fiber broadband connection
Electronic business permit and licensing system	Online processing of business permits with QR code and a security sticker
Purok database system	Database per purok
Low-carbon city	Green building program; solid waste management technologies; Project GUHeat; urban gardening; biodegradable waste shredder; rotary drum composter
San Fernando City, Pampanga (first income class)	
Command and control center	Telemetry for flood monitoring; LED information board; communication tower; 360-degree thermal camera; video analytics; license plate recognition; facial recognition; body cameras; public address system
Free WiFi in city hall and old public market	Fiber-powered WiFi in city hall and old public market
Free WiFi in public schools	WiFi for selected public schools
Smart City Phase II program	Integration of CCTV features; fiber optic cabling
Solar panels	Renewable energy source
Online business transactions	Online platform for business permit transactions and payment of business taxes
Integrated/centralized systems for interoffice transactions	Development of applications and integrated/centralized systems to expand linkage of interoffice transactions
Tagum City (first income class)	
Revenue administration and mobilization program	Automated and integrated management system; GIS
ISDN and PABX for city trunkline services	IP telephones and a centralized trunkline
Use of quad media	Television; radio; print media; social media
LED walls	LED walls for information dissemination
Traffic signalization system and no contact apprehension	Installation of traffic lights in priority junctions; traffic surveillance cameras; monitoring of traffic violations using figures and summaries of traffic violations in various areas
Smart street lighting	Solar-powered streetlights along barangay roads
Internet	P2P internet tower
Euro 4-compliant heavy equipment and vehicles	Equipment and vehicles for reduced greenhouse gas emissions

Table 1 *(continued)*

Initiative	Description
Tagum City Waste-to-Energy Plant Project	Transformation of waste to energy
E-center	Computers; internet service
Cauayan City (third income class)	
E-tricycles and Charging in Minutes station	E-tricycles (some models with solar panel on roof); charging station
Hybrid electric road train	4 air-conditioned interlinked cabins for a maximum of 200 passengers
E-scooter project	E-scooters with app for control and global positioning system for tracking
Platform for Assessment and Tracking of Urbanization-Related Opportunities	Data hub; smart index; sandbox
WiFi routers	WiFi routers for free
Fiber optics	Installation of fiber optics
Cell sites and cellular network system	Installation of cell sites and/or expansion of cellular network system; 4G/LTE
WiFi	Obtainment of WiFi services
Barangay centralized WiFi network	Enables messaging and file sharing via 5GHz radio signal and high sector antenna; extranet; LAN messenger
QR code for barangay constituents	Intended for household profiling
Cauayan City app	Enables electronic transactions
Cauayan City identification card	Version 1 (simple ID); version 2 (ATM-enabled); version 3 (Mastercard-enabled)
Juan Time campaign	Synchronization of time across devices; providing weather updates
Kiosk machines	Payment of bills at kiosk machines
Police drones	To keep constituents safe, capture criminals, and implement lockdown restrictions
Digital twin	From drone photos to 3D map of the landscape; AI for damage estimation
Waste-to-energy plant	Generate energy using waste products from Cagayan Valley
Aquaponics	IoT-based aquaponics with integrated sensors
Investment website	Presents investment opportunities and incentive package
Water quality testing laboratory	Tests the quality of water
No QR code, no entry policy	Requirement to register for unique QR code to facilitate contact tracing
RxBox biomedical devices	Measures heart rate, oxygen saturation, temperature, etc.
Cauayan City Care COVID-19 Consult	Telemedicine
Smarter dengue early warning system	Dengue vector surveillance; smarter dengue early warning system app; disease mapping on 3D model using AI; dengue information mapping
Tuguegarao City (third income class)	
Digital twin	Conversion of drone photos to 3D model
Command center	Real-time monitoring center; CCTV
Free direct internet	Direct internet enabling connection between offices
Free WiFi	Free WiFi in some public areas through fiber-optic wide area network
Tuguegarao government portal	Online government services
MyCure system	Online medical consultations

HUC = highly urbanized city; CCTV = closed-circuit television; 4G = fourth generation; QR = quick response; GIS = geographic information system; LED = light emitting diode; Project GUHeat = Geospatial Assessment and Modelling of Urban Heat Islands in Philippine Cities; ISDN = integrated services digital network; PABX = private automatic branch exchange; IP = Internet protocol; P2P = point-to-point; e-center = electronic center; e-tricycle = electric tricycle; e-scooter = electric scooter; LTE = long-term evolution; 5GHz = 5 gigahertz; LAN = local area network; ID = identification card; ATM = automated teller machine; 3D = three-dimensional; AI = artificial intelligence; IoT = Internet of Things; COVID-19 = coronavirus disease 2019
Source: Authors' summary based on documents from interviewees and/or online resources cited in Ramos et al. (2021)

Enablers of smart city development

The motivations for implementing smart city initiatives are generally consistent with the outcomes in the working definition—high quality of life, competitive economy, and sustainable environment. LGUs' desire to address pressing urban challenges has encouraged them to implement smart city initiatives. Meanwhile, NGAs and development organizations participate in such initiatives because of their respective mandates and objectives, while businesses provide support as part of their corporate social responsibility and to help foster a good economic environment. These findings indicate that aside from LGUs, NGAs and the private sector have been motivated to support smart city development.

Within LGUs, officials or staff serving as smart city champions, ICT personnel, digitized data, and ICT infrastructure facilitate the adoption of smart city initiatives. Government policies also encourage involvement. Furthermore, leaders with vision and willingness to adopt innovative approaches positively influence the sustainability of smart city initiatives.

LGUs aspiring to build smart cities cannot do everything by themselves. Stakeholder engagement is seen as an essential factor for the success of smart city initiatives. Partnerships with stakeholders, including NGAs, businesses, and development organizations, contribute by providing financial support, capacity building, and technology development. These findings highlight that involvement in smart city development is not exclusive to LGUs.

Challenges to smart city development

Challenges to smart city development include the lack of funding and infrastructure. Procurement and installation and maintenance of infrastructures require investments. Some LGUs mentioned that upgrading computers, CCTV (closed-circuit television) cameras, and other high-tech sensors around their cities are expensive. Additionally, it is costly to install faster and more stable internet connection and hire and train ICT staff to support all the technical systems. Financing issues have prevented the implementation of plans. Some LGUs experienced delays in project implementation because of the lack of partners that could share in financing their initiatives.

Moreover, some interviewees think that there are not enough policies and standards to guide the implementation of smart city initiatives. Many interviewees did not mention using PNS ISO 37122:2020 and the Department of Science and Technology's (DOST) Framework for Smart Sustainable Communities and Cities as references. The identified issue can be linked to another identified challenge: the lack of interoperability of data systems. Some LGUs even go through the process of collecting and comparing data from different offices for verification. A lack of policies and standards on data collection and management results in siloed data systems, preventing real-time analysis.

Some private-sector partners and NGAs cited the lack of public trust in data collection, storage, and/or usage as reasons for the slow public uptake of smart city initiatives. Meanwhile, LGUs attributed it to the adjustment period for understanding and learning and regarded it as a manageable issue.

Changes in local leadership were also a concern, especially for the private sector, as these may lead to changes in priorities that can affect existing projects, particularly those that have not been institutionalized by an ordinance. This uncertainty can prevent the private sector from engaging in long-term projects that contribute greatly to smart city initiatives.

Policy recommendations

Addressing challenges to smart city development requires changes at the local level, but it also demands that the national government provides support by creating policies and standards to improve data flow, developing consistent branding, and ensuring transparency and accountability in the implementation of smart city initiatives.

Consistent branding is essential. Aside from "smart city", the government uses other terms such as "digital city" and "intelligent city". Regardless of the term, what is important is that the essence of the selected brand should be clear to both the public and private sectors. If the Philippines decides to package suitable initiatives as smart, DOST-PCIEERD may take the lead, given its

mandate to develop and implement strategies in energy, industry, and emerging technology sectors through science and technology activities (see DOST-PCIEERD n.d.-b). The agency can also leverage its experience in linking smart city stakeholders with LGUs to implement support strategies. Additionally, it can assess the readiness for smart city development of aspiring LGUs. Based on the discussed enablers, the indicators can include the (1) presence of smart city champions; (2) presence of ICT personnel; (3) number of completed projects supported by ordinances, resolutions, and/or memoranda of agreement involving businesses, development organizations, and/or NGAs; (4) number of constituents with internet access; and (5) availability of digitized data. Meanwhile, the Department of the Interior and Local Government (DILG) can promote PNS ISO 37122:2020 and the DOST Framework for Smart Sustainable Communities and Cities as a reference for LGUs to increase smart city adoption. For those eyeing to take on public-private partnership (PPP) projects, the PPP Center can guide in the conduct of feasibility studies. These suggested actions are expected to promote the image of technology-driven and innovation-powered Philippine cities to local and international stakeholders.

Policies and standards should be developed to improve data flow within and across aspiring smart cities. The Department of Information and Communications Technology and the National Privacy Commission can issue policies and standards to guide aspiring LGUs in developing their data repositories and application programming interfaces. Aspiring smart cities are not required to be equipped with only one technology addressing all urbanization challenges to meet their objectives for the sake of ensuring interoperability. However, they need technologies to transfer data into common but secure repositories to enable faster evidence-based decisionmaking. Following the standards will allow LGUs to efficiently use data in policy decisions while assuring their constituents that their data are securely stored and managed.

The development of smart cities requires continuous public and private support, which can only be attained through transparency and accountability in LGUs' implementation of smart city initiatives. Smart city development entails data collection and provision of data. Constituents and the private sector are expected to eventually demand greater participation in monitoring the progress of LGU projects through smart-enabled platforms, given the knowledge that aspiring smart cities should not only collect data but also provide them to stakeholders. NGAs will have to guide LGUs in addressing such demands to ensure continuous support to smart city initiatives. The DOST-PCIEERD can enhance the DOST Framework for Smart Sustainable Communities and Cities by incorporating the accountability principle. Meanwhile, the DILG can monitor the adoption of the framework and gauge smart city development among Philippine cities based on the smart city indicators under PNS ISO 37122:2020. Furthermore, it can implement an accreditation system following the PNS and the framework to incentivize cities to adopt the smart city concept. The DILG can then be equipped with data and evidence when showcasing Philippine cities. Such efforts will encourage stakeholders to continue participating in building smart cities.

Finally, the national government plays a crucial role in realizing the full potential of the smart city concept. The identified challenges can be addressed by (1) issuing policies and standards to improve interoperability among data systems, (2) promoting what technology-driven and innovation-powered cities can offer and ensuring that the message gets captured in the brand associated with those localities, and (3) guaranteeing transparency and accountability in smart city development. These recommendations would be best carried out by the national government to ensure consistency of efforts across aspiring smart cities and eventually enable interoperability between Philippine cities. Coordinated efforts will send stakeholders, including potential investors, a stronger message of the quality of smart city initiatives that can be implemented in the country. These can elicit support in terms of funding and greater public uptake of the smart city concept. While LGUs can implement smart city initiatives on their own, the full potential of those initiatives will not be realized unless the national government provides the necessary support in addressing the identified challenges to smart city development.

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