

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY: APPLIED BUSINESS AND EDUCATION RESEARCH

2025, Vol. 6, No. 1, 48 – 58

<http://dx.doi.org/10.11594/ijmaber.06.01.04>

Research Article

An Analysis of the Definition of Smart City and its Critical Role in Future-Proofing Projects and Estate Development for the Philippine Construction Industry

Bennegreg P. Siman*

President, Stern Asia Corporation, The Philippines

Article history:

Submission 24 December 2024

Revised 07 January 2025

Accepted 23 January 2025

*Corresponding author:

E-mail:

Polocamillejade@gmail.com

ABSTRACT

Since the concept of smart city came into existence about a decade ago, it certainly has taken a different meaning from basic infrastructure management to integrating advanced technologies in the form of 5G, IoT, and AI. This paper investigates how the definition of smart cities is evolving, its relevance to the Philippine construction industry, estate development, and how it navigates through the challenges and opportunities of integrating it into the society. The research utilized a meta-analysis research design of peer-reviewed journals, government reports, and other articles published from year 2000 to 2024. The result of the study showed that building or integrating a smart city is beneficial for a country experiencing rapid economic development. Nonetheless, the Philippines, even if it is considered as one of the fastest-urbanizing countries with visionary and competent infrastructure developers among the countries in Southeast Asia, the nation still faces significant challenges such as outdated land planning, government fragmentation, and inefficient resource management. The strategic and sufficient education about what a smart city is would lead to a high probability that concerned industries and institutions will find ways to integrate smart city principles in their school communities, which will help contribute to training and producing citizens who advocate for a country with smart city systems and technologies. This study emphasized the necessity of designing high quality educational initiatives, policy developments, and facilitating public-private collaborations where it would promote sustainable urban development and eventual national growth in the Philippine's construction industry.

Keywords: *Philippine Construction Industry, Smart City, Future-Proofing Projects and Estate Development*

How to cite:

Siman, B. P. (2025). An Analysis of the Definition of Smart City and its Critical Role in Future-Proofing Projects and Estate Development for the Philippine Construction Industry. *International Journal of Multidisciplinary: Applied Business and Education Research*. 6(1), 48 – 58. doi: 10.11594/ijmaber.06.01.04

Introduction

The idea of a smart city was first proposed in the 1990s. Since then, many scholars and industrial forums have attempted to establish the most suitable definition for the smart city (Rana et al., 2018). Smart city is considered a dynamic idea and to this date, there is no universally accepted definition for it even among the members of the smart city community. A smart city, therefore, can loosely be defined as an urban setting in which existing necessarily networked and service-based systems are made more responsive, intelligent and sustainable using information and digital and telecommunications technologies to optimize urban living for its citizens. For some, smart cities are equated to the idea of a community that is greener, safer, faster, and friendlier (Mohanti et al., 2016).

The Origins of Smart City

Smart city is a terminology used to describe a city that can monitor and manage conditions of all of its key infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, and other significant structures that can use its resources more effectively, schedule its preventive maintenance, and take care of its security concerns more effectively while providing the maximum services to the public (Hall et al., 2000).

Furthermore, another research conducted by Giffinger et al. (2007) stated that a smart city consists of six dimensions: smart people, smart living, smart governance, smart mobility, smart environment, and smart economy. In addition, Nam and Pardo (2011) also pointed out that the 'smart city' approach had three known elements that are integrated with one another, namely technology, human and institutions. Moreover, Washburn and Sindhu (2010) has also stated that the application of Smart Computing technologies will enhance the essential subsectors and services of a city — which include city management, education, health, protection, housing, transportation, and utilities. Forrester defines Smart Computing as a new generation of system hardware, software, and networks which develop IT systems that have

real time context of the real world along with strategic analytics to aid people make informed decisions on options and actions that are optimal for business and business balance sheets (Washburn & Sindhu, 2010).

"Smart Cities" today

In today's context, the most recent definition of a smart city is a place having the latest 5G, IoT, and AI technology, networks, and services that are more pliable, efficient and sustainable with the help of information, digital and telecommunication technologies to enhance the working and living standard of the inhabitants (Lee, 2020). Furthermore, the advancement of smart building not only indicates the expansion of smart city themes but also implies a positive influence on the urban development and national economy as well as the creation of high quality of life for the total population as the world responds to the global challenge of sustainability. These challenges can be addressed by employing smart building and smart city technologies since these are now implemented across all the real estate (RE) project development phases (Apanaviciene et al., 2020).

According to the studies that have been examined here, smart cities enhance the availability and quality of public and business services in cities for citizens, traders, and authorities by leveraging digital technologies. Thus, the successful concept of smart city implies development of a complex strategy. However, the concept of smart cities does not have a one size fits all method, and the operational model depends on the existing condition in a certain country and city. Within Asia and the Pacific, the settings are consumption, development, digital development, and government capacity, all of which are different. Thus, it recognizes that smart city programs can range from establishing foundational ICT systems and platforms to developing high level big data and AI-supported applications and platforms. Based on a conducted desk review of 29 smart city models, most of which have been applied in both developed and developing countries across multiple regions, three common features of smart cities were identified by Lee (2020):

- High level objectives, e.g. good quality of life, economic growth, sustainability, resilience and inclusiveness.
- Enabling factors that serve as cross cutting entry points for digital transformation, from technology, skills, policy, business, and planning.
- Smart city solutions that can be applied to action fields.

Additionally, while these broad objectives exist, the Philippines has its own challenges when it comes to adopting smart city principles. Progress is slowed down by urbanization, geographic vulnerabilities and digital divide. Localized approach to disaster resilience, equitable access to technology and sustainable development models compatible with tropical climate conditions are necessary given the unique socio-economic and infrastructural conditions. At present, a smart city can be concretely defined as an urban area (which might comprise specific zones and scales of a city, a street, a square, a neighborhood or even a whole city) which employs electronic data collecting sensors placed in infrastructures, facilities, transport means, institutions and devices IoT (Internet of Things) to provide real-time data on the key operating systems of the major cities. The latter include energy, transportation, water and sewage, waste, policing, and information and communication. The efficiency of data management is observed as AI-censored data is captured into Information and Communications Technology (ICT), where city managers and decision-makers can view and control connected and command various systems to enhance the effectiveness and robustness of city operations and services, as well as for communicating with stakeholders like citizens, the corporate sphere, institutions, and civil society organizations. Overall, the smart cities aim to introduce ICT technologies to enhance transparency, accountability, effectiveness, and efficiency in transactions between citizens and government (Shi & Shi, 2023).

Purpose of the study

The rationale for this study was to provide a comprehensive understanding of the idea of a smart city. The study also aims to look into the

evolution of the meaning of “Smart Cities” over the years and its potential impact to the countries that plan to integrate it in their society. Specifically, the study sought to answer the following questions:

- 1 What is the existing definition of smart cities?
- 2 What is the present condition of the Philippines in relation to its readiness in adapting a smart city design?

Scope of the Study

The study is confined and focused on defining the concept of “Smart City” 10 years ago and determining its relevance in the context of the Philippine construction industry in the present time. Correctly predicting its meaning and, more importantly, evaluating the essential findings about the topic of this study may lead to informed and well-researched decisions which will be beneficial to society. Different sources were retrieved from peer reviewed journals, literature, and government reports. Most of the research journals were published from 2000 to 2024, and the government reports were also collected from the same period. The data that was sourced from the publication journals and websites was utilized to come up with the critical appraisal of the definite meaning of the smart city and then identify its relevance in the Philippine Constructions Industry.

Significance of the Study

Economic Sector

This study may contribute to stimulating economic growth by defining and evaluating the concept of smart cities. To generate operational efficiency and attractiveness of investments, as well as the possibility of innovative business models, are increased in smart cities. With the aid of smart city technologies, the construction industry's growth and advancement may generate jobs and stimulate economic development, thus increasing the GDP of the country.

Government and Policymakers

This study highlights the need for data driven governance and policy making. Adequate readiness and requirements for smart

city integration can be understood by policy-makers, and frameworks and guidelines can be developed to promote sustainable urban development. Philippine Institute for Development Studies (PIDS) has stated that smart city efforts should have national government support (Ramos et al., 2023). It suggests branding cities as 'smart' to attract investment and long-term strategic planning with standardized regulation. The role of public private partnership (PPP) as a key funding source for smart city development that is sustainable has been established. Frameworks for knowledge exchange and capacity building across Southeast Asia are offered by the ASEAN Smart Cities Network (ASCN) and the ASEAN Sustainable Urbanization Strategy (ASUS). Toolkits and action plans (*Smart Cities: Challenges and Opportunities in ASEAN - EE Times Asia*, 2021) support cities to follow smart city strategies appropriate to local needs. The Philippines needs to consider holistic planning and cross sector partnership in accelerating smart city concepts. Also, encouraging interaction between regulatory authorities and private organizations empowers the latter to allocate resources more efficiently and the delivery of public service more effectively.

Technology and Innovation

The potential for integration of emerging technologies such as 5G, IoT, AI, etc. in smart city frameworks are offered. The opportunity for the development of digital infrastructure, ICT capabilities, and research and development for the improvement of urban systems and services is identified in this study. As a tool for development of smart cities, e-governance is particularly useful in enhancing public service delivery, transparency, and citizen participation (Camorongan, 2023). Government to citizen portals allow closure of the gap between the people (general public) and local government by facilitating issue reporting, service access and participatory decision making. Successful implementations of inclusive digital services, particularly to underserved populations, are demonstrated through the value of interagency cooperation, in Philippine local government units.

Environmental Sector

Inherent to smart cities is a sustainability goal. This study helps mitigate environmental impacts through energy efficient buildings, waste management systems as well as renewable energy technologies through addressing urbanization challenges. It also advocates the use of smart technology platforms to cultivate a greener and more resilient urban environment.

Professional Education

One of the main points of this study is the importance of educating professionals involved in the field of infrastructure and development, urban planning, and other related professions about the concept and the benefits of smart cities. It also hopes to help colleges and universities understand what smart city principles can bring into their curriculum, making sure future generations are well aware and prepared to contribute to smart city development.

Social

A smart city can initiate a change in public services, healthcare, transportation, housing systems that will lead to the improvement of the quality of life of citizens. This study advocates for inclusive urban development that is based on the concept and relevance of smart cities by exploring the concept and relevance of smart cities.

Infrastructure Developer

The study may also serve as a benchmark for infrastructure planning that will allow developers to make cities ready for the future: cities that can effectively manage population growth while pursuing the need for urbanization. The infrastructure for the sustainable evolution of smart city technologies is slowly being integrated into global standards.

Overall, this research adds to a more comprehensive grasp of how smart cities can reshape different sectors to create a better, more sustainable and equitable society.

Methodology

The research design employed in this study is meta-analysis. It is known as a way to

synthesize the data collected from several studies and achieve more refined conclusions. O'Rourke (2007) explained that meta-analysis originated in medical and health related disciplines where the research method has been adopted for the purpose of synthesizing findings. Meta-analysis allows researchers and policy makers to understand what is the average effect of all of the studies and its variability about a specific topic, so that they could make more informed decisions on important policy questions (Pigott & Polanin, 2019). Additionally, conducting a meta-analysis entails a number of criteria for the selection and limitation of the study such as defining a research topic, choosing a particular study design, searching for the literature in modern databases, selection of the right studies with sufficient evidence, and finally analysis of the studies (Myung, 2023). To address the research questions in this study, meta-analysis was used to synthesize different sources from peer reviewed journal articles. The researcher has conducted a preliminary screening stage, where relevant and up-to-date articles and journals that contain only relevant studies are skimmed through titles and abstracts. The researcher read through each article and the content associated with the meaning of 'Smart Cities' and its relevance to the Philippine Construction Industry. The literature that was utilized came from the year 2000 to 2024. These was lifted from reputable and credible publication journals and articles to gain a thorough analysis and understanding of the context and definite meaning of Smart Cities, and how such has affected the Philippine construction sector.

Results and Discussion

The role of smart cities in the Philippine construction industry

Cities like Singapore and Jakarta are leading the way in Southeast Asia's trend towards the integration of AI and IoT writings into urban systems (Woetzel et al., 2018). AI driven traffic systems, smart energy grids, and digital healthcare platforms are these technologies

which solve urban problems like congestion and pollution. Similar data driven governance strategies can help enhance urban mobility and sustainability, and resilience for Philippine cities.

Regarding the importance of smart cities in relation to the construction sector, it is stated to be very significant – especially to the construction industry here in the Philippines. Siman (2023) stipulated in his study that the Philippine government has been redirecting priority towards infrastructure development as a form of economic growth stimulation due to the construction industry being one of the primary contributors to Philippines' economic advancement. With the help of the Build Build Build (BBB) program of former President Rodrigo Duterte of the Philippines in 2022, the construction industry has achieved a net growth of 9.2 % per annum evidently in rise.

In addition to this, one of the Philippine government agencies, namely DOST has shown potential in supporting within the infrastructure phase. Some calls for proposals have been issued by DOST-PCIEERD, which has the task to formulate national policies, plans, programs and strategies especially those under the Convergence of Emerging Technologies / Sectors Towards Industry 4.0 and Smarter Cities and Communities in the Philippines (DOST-PCIEERD, 2021). Projects such as sensors and actuators for intelligent factories, development of 5G products and applications, space technology applications in public services and sustainability through innovative cities are covered (DOST-PCIEERD, 2021). An example of which is the CRADLE Program, whereby Philippine businesses work with Research and Development Institutions and/or academe for product and operations development (DOST, 2021). In the program, businesses are obliged to shell out at least 20% counterpart financing and commit to adapting the technology (DOST, 2021). The DOST-PCIEERD initiative is expected to contribute to generating a comprehensive and concrete smart city framework.

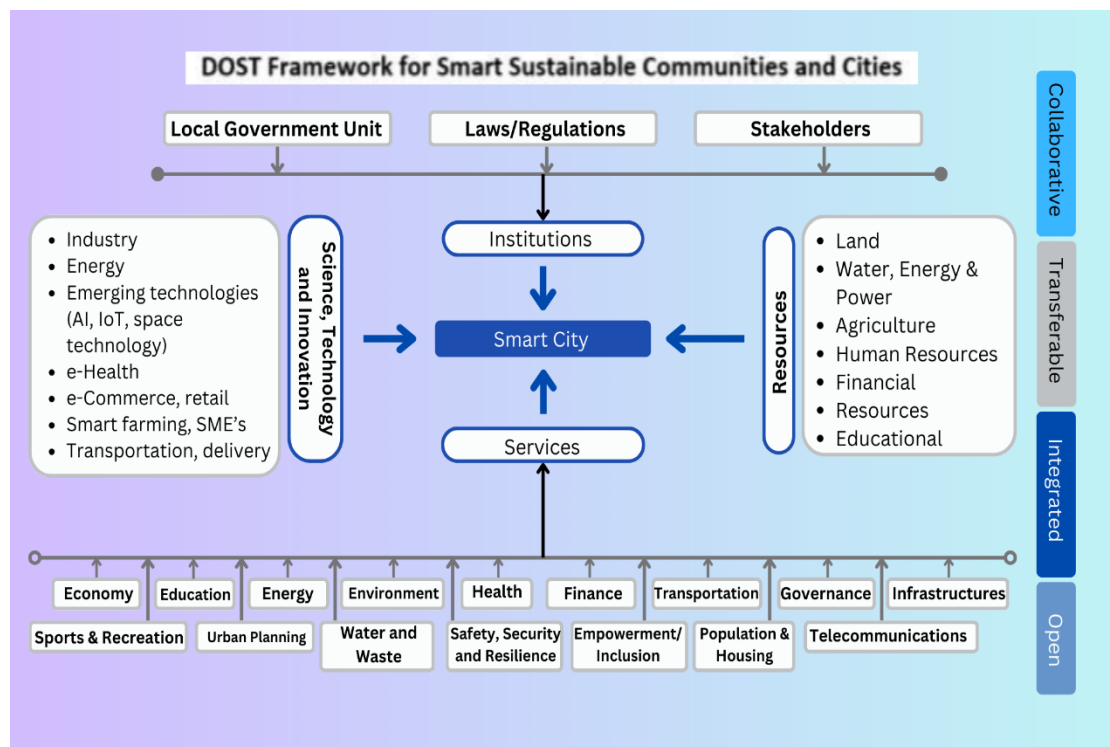


Figure 1. DOST's Framework for Smart Sustainable Communities and Cities
Source: Nazareth-Manzano and Paringit (2021)

This illustration was lifted from the DOST's Framework for Smart Sustainable Communities and Cities aims to depict how the sectors of Science Technology, and Innovation, Institutions, Resources, and Services can address challenges of urban and regional life in cities through the use or improvement of each sector's resources to enhance opportunities and address challenges relating to sustainable urban development and smarter cities as shown in Figure 1.

It is believed that the construction market will be the fastest growing market and is expected to grow 6 percent annually in the next fifteen years. Using a recent study carried out by Fitch Solutions, which took the illustration of 2025 to 2028 as the interval to an annual average 8.2 percent as the average growth rate (Fitch Solutions, 2024), one can analyze recent development trends surrounding the government's focus on infrastructure development. Along with that, the current government also has the vision to build a new and modern national infrastructure system, which will increase construction employment and hopes to bring continuous high growth, more

investments, and the opportunity for growth of each Filipino (Siman, 2023).

For stakeholders in the Philippine construction industry, the integration of smart city principles presents multiple opportunities for them, such as increased project sustainability, improved resource allocation, and more opportunities for collaboration. Through the use of IoT and data analytics, stakeholders can best manage project resources, drive down costs, and improve the overall operation. Sustainable construction methods are emphasized in smart city initiatives that aim at conserving the environment and increasing infrastructure resilience. Also, public-private partnerships, promoted by DOST-PCIEERD, respectively, calls for further research and investment in smart construction technology.

Philippine Department of Budget and Management Secretary Amenah F. Pangandaman even stressed on her report that the administration allocation for development on infrastructure focuses on increasing availability of basic services, improvement in industry linkages, and better connectivity nationwide with the help of programs, activities, and projects in

infrastructure, transportation, and digital sectors (PANGANDAMAN: *INFRASTRUCTURE SPENDING on TRACK to MEET GROWTH TARGETS*, 2024). All the aforementioned are strategic steps in realizing a society's transformation into a smart city. The current administration is keen on launching programs and projects that will ensure the readiness of the Philippines in becoming a digitally competitive country.

Moreover, when specific Local Government Units in the Philippines have adopted the term "smart city," this concept implies a utopia – a local sphere that has numerous positive changes that will enrich the lives of the constituents. However, the absence of research works that present empirical data on the preparedness of Philippine cities to smart city advancement hinders the creation of the cities' experiences in responding to urban issues with their programs (Ramos et al., 2021). More specifically, based on Ramos's study, a desk review of smart city initiatives in the Philippine and international cities was carried out, and interviews were conducted with stakeholders from selected cities in Luzon, Visayas, and Mindanao. According to the results, the Philippines has begun the process of creating smart cities, and several Philippine populations are already showing signs of being ready for this type of development. Although there are currently facilitators for smart cities, their use is not very widespread. There are important issues that must be resolved on both local and national level. Among these are data compatibility, national standards for application programming interfaces and data repositories, risk mitigation techniques, monitoring and assessment, accountability, and more. The Philippines' smart city programs run the risk of not reaching its full potential if these problems are not addressed.

On the same note, leadership and cooperation between the public and private sector as identified from the survey and secondary data collected and analyzed by Mendoza and Betia (2023) were deemed much 'extremely likely' to propel smart city advancement besides governance vision and goals. These factors also have an influence on national and local development and urban policies. The Philippines long term vision of 2040 and the pillars of sustainable

development can be used as a guide. Suggestions for improving leadership capabilities and supporting leaders, while ensuring a particular role for the public, private, and academic sectors, and proper technology for smart cities growth facilitation and maintenance must also be considered. This can also be used by city officials to promote participatory governance, promote collaboration between and among various economists, encourage new business models in both the public and private sectors, and support a more urban sustainable development and a more competitive and attractive business and creative environment (Muora et al., 2019). In general, smart city integration is gradually viewed as a positive change because it has become more popular by time and for reasons stated in recent studies has the potential to solve urbanization issues and boost the country's economic growth if it is integrated correctly and properly.

Nevertheless, smart city framework transition faces governance fragmentation, data management issues and resource inefficiency. Multiple agencies and stakeholders lack efficiency in project coordination that leads to governance fragmentation which means they are operating independently. To address this challenge, a unified governance framework is needed that would help to standardize roles and responsibilities across the sectors. Data management issues, such as data compatibility, lack of standardized APIs, and inadequate data repositories, hinder the effective use of digital technologies. Developing a national data management policy with clear standards is critical to overcoming these barriers. Resource inefficiency, stemming from the inadequate integration of smart technologies, can be addressed by increasing investments in capacity building and technology adoption.

Conclusions and Recommendations

Despite the challenges of smart city development in ASEAN countries, digital divides and governance problems initiatives like the ASCN can help to overcome such barriers (*Smart Cities: Challenges and Opportunities in ASEAN - EE Times Asia*, 2021). Singapore's Smart Nation, and Indonesia's Smart City Program are two programs that demonstrate what AI and IoT

can do to manage cities. While these technologies have been adapted in the technology literature, these technologies must be adapted to local contexts to promote inclusivity especially for underserved communities. With that in mind, even though the Philippines is one of the fastest-urbanizing countries in Southeast Asia, urbanization has been a major driving force of economic growth in this country. Nevertheless, the World Bank Group identified that growth has represented a challenge such as reducing traffic congestion, regulating informal settlements, and the lack of infrastructure responsible for limiting the full realization of the benefits of urbanization (Baker et al., 2017). Adding to the problems are governance fragmentation and outdated land use plans, adding inefficiencies that continue to muddle economic planning and resource management. Their report has demonstrated how adoption of smart city concepts such as the Transit-Oriented Development (TOD) which means inclusive access for all to local and citywide opportunities and resources by the use of the most efficient and healthful combination of mobility modes, at the least financial and environmental expense, but with the highest resilience to disruptive events, and land management systems can help enhance the sustainability and competitiveness of cities. The results are consistent with its larger goal of addressing urbanization challenges and promoting improvement in urban living with the integration of smart city technologies. Because of this, professionals in related fields and researchers alike refer to Smart City as a place that promotes the use of Information and Communications Technology (ICT), including 5G connection, data analytics, large amounts of data, and cloud computing artificial intelligence in managing and improving a city's day to day operations and activities. Most specifically, some examples of smart city technologies can be seen in the integration of IoT devices and AI based traffic management systems that are fed with real time traffic data and coordinated through sensors and such traffic monitoring technologies can reduce congestion as well as optimize transit efficiency as well as reduce greenhouse gas emissions. Additionally, some of the smart city technologies will bring advancements in integration of smart grid

management such as solar panels and wind turbines with advance energy grid management and distributed energy resources, which positively impacts the community in their daily lives, making the usage of clean and efficient energy improve tremendously (Expert Panel, 2023; Khan & Zia, 2021).

Integrating or building a smart city is a good start for a country which economy is rapidly growing. Nonetheless, countries like the Philippines, even if it is considered as one of the fastest-urbanizing and infrastructure developers among the countries in Southeast Asia, the nation still faces significant challenges such as outdated land planning, government fragmentation, and inefficient resources management. With all the factors that affect the integration and building of smart cities in this country, the gradual integration of smart technologies in infrastructure and the improvement in capacity of key government agencies may prepare the Philippines to embrace the idea of a smart city community. Sustainable economic growth and job creation aligned with the booming construction market as a cause of fast urbanization may be realized through risk mitigation by avoiding premature investments in smart city systems that the country may not yet be able to fully support. It is suggested that a targeted educational campaign should be designed to raise awareness of benefits of smart city among policymakers, professionals, and students. Government sponsored hackathons to develop innovative solutions to urban challenges, as well as introduction of smart city modules into STEM curriculum at secondary and tertiary levels should be recommended. Also, universities can be modeled as smart city centers of excellence where research and training can be provided to industry stakeholders and conducted in collaboration with academia respectively. This will surely help or contribute to training and producing citizens who advocate for a country with smart city systems and technologies.

Based on this, recommendations for the Philippines are to adopt Transit Oriented Development (TOD) models in highly urbanized areas such as Metro Manila and Cebu. Inclusive and interconnected transport systems should be set up to cut down traffic congestion and

ease access to economic opportunities. Actions are specific, including expanded light rail networks, public private partnerships for urban mobility projects, and improved urban land use policy to conform with sustainable growth goals. Additionally, by integrating land management systems based on geospatial data and AI analytics, sound zoning, reduced informal settlements and optimized infrastructure development can be achieved.

Lastly, launch of pilot projects in priority sectors like traffic management, renewable energy and e-governance are amongst the strategic steps for implementation. Taking such IoT systems as a test bed for more generic implementation, for instance, deploying in identified critical choke points such as EDSA, is an example. Microgrids based on solar panels and wind turbines in rural areas can be used to support clean energy integration more broadly and can be shown to be scalable. At the same time, digital government platforms rolled out to allow streamlined permit applications and delivery of public services can promote transparency as well as citizen engagement. Policies should provide tax and grant incentives for private sector partners, and encourage the development of resource sharing initiative and innovation.

References

- Apanaviciene, R., Urbonas, R., & Fokaides, P. A. (2020). Smart Building Integration into a Smart City: Comparative Study of Real Estate Development. *Sustainability*, 12(22), 9376. <https://doi.org/10.3390/su12229376>
- ASEAN Smart Cities Network (ASCN) and the ASEAN Sustainable Urbanization Strategy (ASUS). (2018). ASEAN Sustainable Urbanisation Strategy Jakarta: ASEAN Secretariat. <https://connectivity.asean.org/wp-content/uploads/2018/11/ASEAN-Sustainable-Urbanisation-Strategy-ASUS-1.pdf>
- Baker, J. and et al., (2017). PHILIPPINES URBANIZATION REVIEW FOSTERING COMPETITIVE, SUSTAINABLE AND INCLUSIVE CITIES PUBLISHED BY FULL REPORT Public Disclosure Authorized Public Disclosure Authorized Public Disclosure Authorized Public Disclosure Authorized
- Authorized Public Disclosure Authorized. The World Bank Group. <https://documents1.worldbank.org/curated/ar/963061495807736752/pdf/114088-REVISED-PUBLIC-Philippines-Urbanization-Review-Full-Report.pdf>
- Camorongan, J. R. C. (2023). The Pledge of Smart City Development: The E-governance (Under) Development in The Philippines. *International Multidisciplinary Research Journal*, 5(3). <https://doi.org/10.54476/ioer-imrj/042507>
- DOST. (2021). CRADLE: Collaborative R&D to Leverage the Philippine Economy. <https://s4cp.dost.gov.ph/programs/cradle/>
- DOST-PCIEERD. (2021). "2023 Call For Proposals". <https://pcieerd.dost.gov.ph/images/callforproposal/2021/regular-call/priority-areas/2023-Call-for-Proposals-revised.pdf>
- Expert Panel. (2023). Council Post: 18 Smart-City Technologies That Will Genuinely Improve Urban Living. *Forbes*. <https://www.forbes.com/councils/forbestechcouncil/2023/06/05/18-smart-city-technologies-that-will-genuinely-improve-urban-living>
- Fitch Solutions. (2024). *Philippines infrastructure report*. Fitch Solutions. <https://store.fitchsolutions.com/infrastructure/philippines-infrastructure-report>
- Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic, N., & Meijers, Evert J. (2007). Smart cities. Ranking of European medium-sized cities. Final report. *Tuwien.at*. <https://doi.org/10.34726/3565>
- Hall, R. E., Bowerman, B., Braverman, J., Taylor, J., Todosow, H., & Wimmersperg, U. V. (2000). (PDF) *The vision of a smart city*. ResearchGate. https://www.researchgate.net/publication/241977644_The_vision_of_a_smart_city
- Klozwolski, W., & Suwar, K. (2021). *Volume XXIV, Issue 3 - Part 1 - European Research Studies Journal*. Ersj.eu.

- <https://ersj.eu/journal/2442/download/Smart+City+Definitions+Dimensions+and+Initiatives.pdf>
- Khan, U. T., & Zia, M. F. (2021). Smart city technologies, key components, and its aspects. *2021 International Conference on Innovative Computing (ICIC)*. <https://ieeexplore.ieee.org/document/9692989>
- Lee, R. S. T. (2020). Smart City. *Artificial Intelligence in Daily Life*, 321–345. Springer, Singapore. https://doi.org/10.1007/978-981-15-7695-9_12
- Mendoza, C. J. B., & Betia, C. J. R. (2023). Future of Prospective Smart Cities Outside Metro Manila. *Advances in 21st Century Human Settlements*, 473–490. Springer, Singapore. https://doi.org/10.1007/978-981-19-8726-7_28
- Mohanty, S. P., Choppali, U., & Kougianos, E. (2016). Everything you wanted to know about smart cities: The Internet of things is the backbone. *IEEE Consumer Electronics Magazine*, 5(3), 60–70. <https://doi.org/10.1109/mce.2016.2556879>
- Moura, F., & de Abreu e Silva, J. (2019). (PDF) *Smart Cities: Definitions, Evolution of the Concept and Examples of Initiatives*. ResearchGate; Springer, Cham. https://link.springer.com/reference-workentry/10.1007/978-3-319-71059-4_6-1
- Myung, S.-K. (2023). How to review and assess a systematic review and meta-analysis article: a methodological study (secondary publication). *Journal of Educational Evaluation for Health Professions*, 20(1975-5937), 24–24. <https://doi.org/10.3352/jeehp.2023.20.24>
- Nazareth-Manzano, B., and E. Paringit. (2021). *DOST framework for smart sustainable communities and cities*. Taguig, Philippines: Department of Science and Technology – Philippine Council for Industry, Energy and Emerging Technology Research and Development. <https://pcieerd.dost.gov.ph/images/pdf/2021/roadmaps/DOST%20Smarter%20City%20Framework%20Final.pdf>
- Nam, T., & Pardo, T. A. (2011). Conceptualizing smart city with dimensions of technology, people, and institutions. *Proceedings of the 12th Annual International Digital Government Research Conference on Digital Government Innovation in Challenging Times - Dg.o '11*, 282–291. ResearchGate. <https://doi.org/10.1145/2037556.2037602>
- O'Rourke, K. (2007). An historical perspective on meta-analysis: dealing quantitatively with varying study results. <https://pmc.ncbi.nlm.nih.gov/articles/PMC2121629/>
- Pigott, T. D., & Polanin, J. R. (2019). Methodological guidance paper: High-Quality meta-analysis in a systematic review. *Review of Educational Research*, 90(1), 24–46. <https://doi.org/10.3102/0034654319877153>
- PANGANDAMAN: INFRASTRUCTURE SPENDING ON TRACK TO MEET GROWTH TARGETS. (2024). Dbm.gov.ph. <https://www.dbm.gov.ph/index.php/management-2/3029-pangandaman-infrastructure-spending-on-track-to-meet-growth-targets>
- Ramos, T., Joy, P., Lorenzo, M., Ancheta, J., & Ballesteros, M. (2021). *Readiness of Philippine Cities to Smart City Development*. RESEARCH INFORMATION DEPARTMENT Philippine Institute for Development Studies. <https://pidswebs.pids.gov.ph/CDN/PUBLICATIONS/pidsdps2133.pdf>
- Rana, N. P., Luthra, S., Mangla, S. K., Islam, R., Roderick, S., & Dwivedi, Y. K. (2018). Barriers to the Development of Smart Cities in Indian Context. *Information Systems Frontiers*, 21(3), 503–525. <https://doi.org/10.1007/s10796-018-9873-4>
- Ramos, T. P., Lorenzo, P. J., Ancheta, J. A., & Ballesteros, M. M. (2023). *Are Philippine Cities Ready to Become Smart Cities?* ResearchGate; PIDS. <https://doi.org/10.13140/RG.2.2.28265.92002>

- Shi, F., & Shi, W. (2023). A Critical Review of Smart City Frameworks: New Criteria to Consider When Building Smart City Framework. *ISPRS International Journal of Geo-Information*, 12(9), 364. <https://doi.org/10.3390/ijgi12090364>
- Seok, Y., Yoon, H., Lee, T., Zelt, U., Narloch, E., & Aguirre. (2020). ADB SUSTAINABLE DEVELOPMENT WORKING PAPER SERIES SMART CITY PATHWAYS FOR DEVELOPING ASIA An Analytical Framework and Guidance. In *ADB.org*. Asian Development Bank. <https://www.adb.org/sites/default/files/publication/673441/sdwp-071-smart-city-pathways-developing-asia.pdf>
- Siman, B. P. (2023). A Critical Analysis of the Philippine Construction Industry: Current Trends, Forecast, and Business Focus for Engineering Design Firms. *International Journal of Multidisciplinary: Applied Business and Education Research*, 4(8), 2691-2699. <https://doi.org/10.11594/ijma-ber.04.08.01>
- Smart Cities: Challenges and Opportunities in ASEAN - EE Times Asia*. (2021). EE Times Asia. <https://www.eetasia.com/wp-content/uploads/sites/2/2021/05/EE-Times-Recommend-ASEAN-Smart-Cities.pdf>
- Washburn, D., & Sindhu, U. (2009). Helping CIOs Understand “Smart City” Initiatives. *Growth.scholar.google.com/scholar?cluster=5002964174224132359&hl=en&as_sdt=0*.
- Woetzel, L., Lin, D., Sridhar, M., & Yap, S. (2018). Smart cities in Southeast Asia. McKinsey & Company <https://www.mckinsey.com/capabilities/operations/our-insights/smart-cities-in-southeast-asia>