The Philippine Digital Paradox: Challenges, Opportunities, and the Way Forward

Shamir Y. Jakaria[1]

Received 2024-11-27/Revised 2025-04-22/Accepted 2025-05-13

Abstract—The rapid growth of digital technologies is reshaping public governance. This paper examines the challenges and opportunities of digital transformation in Philippine public administration. While digital technologies offer significant benefits, such as streamlined services, enhanced transparency, and improved citizen engagement, the Philippines faces critical barriers, including infrastructure gaps, cybersecurity risks, and a persistent digital divide. Through a systematic review of academic studies, government reports, and policy documents, the study identifies key strategies for advancing e-governance, such as infrastructure development, cybersecurity reforms, and digital literacy programs. The paper highlights successful local and national initiatives, including the Philippine Identification System (PhilSys) and e-government platforms, while addressing implementation challenges like uneven internet access and institutional resistance. The study integrates international models with local context to outline strategies for building inclusive and effective digital governance in the Philippines, targeting service delivery gaps and promoting equal access to digital opportunities.

Keywords: Digital Transformation, Good Governance, Digital Era

1 University Lecturer, College of Politics and Government, Suan Sunandha Rajabhat University, Bangkok City, Thailand.

Introduction

The digital revolution has significantly impacted various aspects of our lives, including work, social interactions, and global connections. The landscape surrounding public governance is changing (Ong 2011; Robinson 2015). This transformation extends to public services, with governments increasingly relying on digital technologies to deliver services and interact with citizens and businesses (Millard 2023). Traditional methods are often seen as inefficient and outdated, highlighting the need for digital transformation in the public sector. By integrating technology into political and administrative systems, governments can achieve e-government, an advanced form of governance that leverages technology for efficient operations. Many developed countries have already embraced this trend, using modern technology to streamline public administration (Liu and Yuan 2015; Thomas 2024). This research builds on existing studies that demonstrate the benefits and challenges of digital transformation for governments. While the potential of digital transformation for the Philippine government is recognized, there is a gap in understanding the specific strategies needed to overcome existing challenges and ensure successful implementation. This study aims to address the gap by identifying and analyzing key strategies for a sustainable digital transformation journey in the Philippines.

This paper will utilize systematic literature review to examine existing literature, government reports, articles and policy documents related to digital transformation in the Philippines. By analyzing these sources, the paper will identify and explore key strategies to successfully implement Digital Transformation. It is expected to contribute valuable insights for policymakers and government agencies working towards digital transformation in the Philippines. The identified strategies can be used to develop a comprehensive roadmap for a successful digital government transformation, leading to improved service delivery, increased citizen engagement, and a more efficient and transparent public sector.

Benefits of Digital Transformation

The simplification of government procedures is among the digital

transformation's most important benefits. Conventional, paper-based procedures can be time-consuming and laborious, which causes delays and irritates citizens. Online apps, data management programs, and e-governance platforms can all greatly enhance service delivery. Imagine a world where digital transformation has made it possible for residents to pay taxes, register businesses, and renew passports online. In addition to saving citizens a great deal of time and work, this also frees up government funds for more important projects.

The government's commitment to digital transformation is evident in initiatives like the Broadband ng Masa program, formerly known as the National Broadband Plan. Launched in 2017, this program aims to expand internet access across the country, bridging the digital divide. The Government Network Project (GovNet) has successfully connected around 1,000 government agencies, streamlining operations and improving service delivery. Additionally, the Free Wi-Fi for All in Public Places project has established 4,563 live sites, providing free internet access to the public in various locations (Department of Information and Communications Technology 2022).

Another essential component of good governance is transparency in government transactions and service delivery, which may be effectively attained through digital transformation (Matheus et al. 2023). This claim, along with other potential benefits of digital transformation in governance, is supported by numerous scholars (ElMassah and Mohieldin 2020; Millard 2023). More public access to government information is made possible by programs like open data portals and online citizen feedback mechanisms (Mountasser and Abdellatif 2023). Budgets are easily accessible to the public, who may also monitor project development and hold public servants responsible. Governance benefits from digital transformation by promoting transparency, evidence-based policy decisions, and institutional accountability (Castillo and Gabriel 2020) Governments can ensure transparent and immutable record-keeping, particularly in critical areas such as identity management, property registries, and procurement, by leveraging blockchain technology. The government's relationship with the people it serves is strengthened and digital platforms foster trust as a result.

Moreover, the digital transition holds promise for empowering

citizens and improving their involvement in the democratic process (Suherlan 2023). Interactive web forums can promote debates on policy matters and public participation in the decision-making process. Platforms for e-government give citizens a way to contribute their opinions, express proposals, and participate in policy discussions. Governments use social media and digital communication channels as platforms to spread information, get public opinion, and encourage communication between residents and public authorities. It can also be used to distribute announcements and public information more effectively and specifically. Governments may enhance democratic processes, foster a feeling of citizen ownership, and foster trust through digital platforms.

In the field of education, digital transformation has accelerated learning innovation. E-learning platforms, digital classrooms, and mobile education technologies enable continuous learning, especially during disruptions. This transition supports flexible learning pathways and lifelong learning opportunities. The Philippines' Department of Education introduced blended and modular learning during the pandemic, catalyzing long-term reforms in digital education delivery (Ignacio 2021). Digital technologies support individualized learning, increase student involvement, and help cultivate essential modern competencies, including analytical thinking, technological fluency, and teamwork (Kalyani 2024).

From a workforce perspective, digital transformation equips citizens with future-ready skills, increasing employability and economic participation. Programs such as JobsNext, launched by the Philippine Business for Education (PBEd), aim to develop in-demand skills among young Filipinos to prepare them for high-value jobs in the digital economy (Philippine Business for Education 2023). Developing digital competencies is key to narrowing the gap between what the education system produces and the requirements of the job market.

Beyond increased effectiveness, openness, and participation from the public, digital transformation opens the door for better government decision-making. Government organizations can use citizen data to their advantage by utilizing data analytics tools to extract insightful information that helps them customize services and programs to the individual requirements of their people (Mountasser and Abdellatif

2023). This data-driven strategy promotes evidence-based policymaking, guaranteeing that funds are distributed wisely and that initiatives have the desired effect.

Importance and Examples of Technology in National and Local Public Administration

Biometric Technology as Attendance for Government Workers

Biometric technology is increasingly used in Local Government Units (LGUs) to monitor employee attendance, aiming to improve accountability, reduce time theft, and enhance service delivery (Villaroman et al. 2018). By replacing manual tracking methods, biometric systems provide verifiable audit trails and real-time updates to records, aligning with democratic values of transparency and accountability (Maggay 2017). Despite these benefits, the technology faces critical challenges. System vulnerabilities, including tampering, fraudulent enrollments, and weak enforcement mechanisms, threaten data integrity and undermine reliability (Abdullahi et al. 2024; Alaswad, Montaser, and Mohamad 2014, 947-958). These issues expose gaps in oversight and emphasize the need for stronger regulations to safeguard biometric data and ensure the technology fulfills its intended role in public administration.

Philippine Government Electronic Procurement System (PhilGEPS)

Republic Act No. 9184, or the "Government Procurement Reform Act," was enacted in 2003 to modernize public procurement in the Philippines, aiming to eliminate collusion, improve transparency, and enhance accountability in government contracts. The law established the Government Procurement Policy Board (GPPB) and introduced the Philippine Government Electronic Procurement System (PhilGEPS) to streamline the process (Bombay 2011). It applies to all government agencies, local government units, and other public entities. Although PhilGEPS aims to improve transparency in public procurement, major challenges remain. Furnas (2013) highlights barriers such as poor compliance, incomplete records, and bureaucratic restrictions that hinder public access to procurement data. Navarro (2023) adds

that delays, flawed bid designs, declining competition, and corruption persist despite digital reforms. These issues point to both technical limitations and institutional weaknesses. While Furnas advocates for stricter compliance, Navarro recommends capacity-building and anti-corruption strategies. Their findings underscore that digital platforms alone are insufficient; effective e-governance requires broader reforms in enforcement, institutional accountability, and bureaucratic behavior to achieve meaningful transparency and efficiency to address issues such as bid rigging and favoritism.

Philippine Identification System Act (PhilSys)

The Philippine Identification System Act (PhilSys) was enacted to create a unified national ID for all citizens and resident aliens, aiming to simplify transactions in both public and private sectors and support digital transformation (Abesamis 2021). The system prioritizes inclusive coverage, particularly for marginalized groups, and integrates advanced technologies to ensure privacy and data security (National Economic and Development Authority 2018). It is designed to improve access to public services and enhance service integrity by reducing fraud and improving identity verification (Nomura et al. 2020; Magcope et al. 2023). However, the system has faced implementation challenges, including delays in ID distribution and limited acceptance of the digital ID by institutions, which undermines its effectiveness (Dhararaj 2024; Respicio 2024). These setbacks have reduced public confidence in PhilSys, highlighting the need for improved operational efficiency and broader institutional adoption for it to achieve its goal of enhancing digital governance.

E-Government: Transformation to Digitalization

The Philippine government, through the Department of Information and Communications Technology (DICT), has launched several e-government projects to improve digital infrastructure and public service delivery. These include platforms such as eLGU, eTravel, eGovPay, eGovCloud, eReport, and the eGovPH app. eLGU centralizes local government services, eTravel streamlines travel declarations, and eGovPay facilitates digital payments for government fees (Caliwan 2023; Department of Information and Communications Technology 2023;

Bangko Sentral ng Pilipinas 2022). The eGovCloud supports cloud computing for efficient data management, while eReport allows citizens to report issues (Montemayor 2024). Additionally, the implementation of eGovPay aims to standardize government payment channels, ensuring seamless transactions with reasonable fees (Philippine Payments Management Inc. 2019). Despite successes, only eTravel and eGovPH have been fully implemented. The eGovPH app integrates services such as PhilSys ID and SIM card registration, improving convenience and reducing the need for in-person visits (Jou et al. 2024). Full integration across platforms to strengthen digital governance, remains ongoing.

Online Services for Government

The Philippines has advanced significantly in e-governance, enabling citizens to access a range of public services online (OpenGov 2019). The Social Security System (SSS) allows online benefit claims and loan applications, while the Philippine Statistics Authority (PSA) provides access to civil documents and PhilSys registration. The Bureau of Internal Revenue (BIR) supports online tax filing and payments. Pag-IBIG Fund enables members to manage contributions and apply for housing loans through its portal. PhilHealth offers digital services for health insurance registration and claims. The National Bureau of Investigation (NBI) has streamlined clearance applications online. The Land Transportation Office (LTO) uses its LTMS platform for license renewals and vehicle registrations. The Department of Foreign Affairs (DFA) allows passport appointments through its website, and the Department of Trade and Industry (DTI) facilitates online business name registration. These digital services save time and reduce bureaucracy, although challenges such as poor internet access and limited digital literacy remain barriers to full inclusion.

At the local level, several cities have implemented innovative digital governance solutions. Quezon City introduced an integrated e-government program featuring digital business permits, tax collection, and disaster response systems, improving service efficiency and increasing revenue (Quezon City Government 2024, 75). Cebu City modernized its traffic system through real-time monitoring and smart technology. This initiative improves public safety, reduces congestion, and supports economic activity by minimizing transportation delays

(Lorenciana 2021).

Cagayan de Oro City enhanced its public health delivery with the Smarter and Integrated Local Health Information System for Cagayan de Oro City (SmILHIS CDOC). The system incorporates electronic medical records (EMRs) through the eHATID platform, improving data accuracy and reporting to the Department of Health. Developed by Ateneo de Manila University and supported by the Department of Science and Technology – Philippine Council for Health Research and Development (DOST-PCHRD), the project strengthens data-driven decision-making and aligns with national healthcare policies (Department of Science and Technology 2021).

Iloilo City promoted financial inclusion through the Paleng-QR Ph Plus program, which enables cashless payments in public markets and transportation. Led by the Bangko Sentral ng Pilipinas (BSP) and Department of the Interior and Local Government (DILG), the initiative facilitates safer, more efficient transactions using QR codes (Land Bank of the Philippines 2023). It supports the National Strategy for Financial Inclusion 2022–2028 and contributes to the city's economic modernization (Bangko Sentral ng Pilipinas 2023).

These examples highlight the critical role of local government units in driving digital transformation. Their success shows the importance of decentralized governance, policy support, technical expertise, and consistent funding. Localized initiatives provide direct, tangible benefits and demonstrate how digital technology can improve public service delivery at the grassroots level.

Challenges of Digital Transformation

The Philippines' archipelagic nature poses a significant challenge in delivering government services to its citizens, especially those residing in rural areas (Esteban and Cruz 2021). One of the primary challenges is the country's inadequate digital infrastructure (World Bank Group 2024). Due to factors such as a lack of digital infrastructure, gaps in access to digital technologies persist (Kanehira, Abdon, and Mirandilla-Santos 2024). According to a discussion paper by Albert et al. (2021), the 2019 NICTHS revealed a significant digital divide between urban

and rural areas in the Philippines. Only 5% of barangays (the smallest administrative division in the Philippines, similar to a village or neighborhood) had full access to broadband infrastructure, with 89% of these located in urban areas. Key services such as fiber optic cables, telecom towers, internet providers, and free Wi-Fi were concentrated in cities. For instance, only 11.9% of rural barangays had fiber optic access, compared to 53.3% of urban barangays. The World Bank report highlights the Philippines' lower internet penetration rate compared to its regional neighbors (Kanehira et al. 2024). Limited access, particularly in rural regions, hinders Filipinos from fully engaging in the digital economy. While urban areas generally have better access to communication infrastructure, rural areas face significant challenges due to the absence or high cost of connectivity (Ramos 2008). Inconsistent and poor internet speeds impede the smooth functioning of online platforms and services (Tinam-isan and Naga 2024; Mioten 2021) and a significant digital divide exists due to socioeconomic disparities (World Bank Group 2020). Low-income households often lack access to digital gadgets and internet connectivity. The Philippine Statistics Authority's (2021) research underscores this disparity between urban and rural areas. This gap prevents many from reaping the benefits of the digital revolution, hindering inclusive progress. According to the report of the World Bank Group (2024), inadequate internet services pose serious obstacles for the nation, despite the report's recognition of digitization as a top goal for increasing production and efficiency across businesses and sectors. Outdated policy frameworks are one of the main reasons for the nation's inadequate broadband infrastructure. The Philippines' broadband market is essentially a duopoly, creating an uneven playing field that discourages new investment and hinders competition. Important regulatory flaws have also been identified, including as the absence of contemporary spectrum regulations and obstacles to market entry. The Philippines is the only country in the world that still requires a legislative franchise to establish and operate networks (International Trade Administration 2024; Kanehira et al. 2024).

Cybersecurity concerns pose a significant challenge. The Philippines ranks fourth globally in cyberattacks, according to Kaspersky Security Network (Philippine News Agency 2022). Despite this, many businesses lack the necessary security infrastructure to protect them-

selves from threats. Malware infections have surged, with a substantial portion targeting businesses and home users. Additionally, high-profile incidents such as the hacking of the Philippine Voter's Database and cyber espionage attempts highlight the severity of the issue (National Privacy Commission 2017). While the government has established the Department of Information and Communications Technology to address cybersecurity, more comprehensive measures are needed to safeguard the country's digital landscape. The Bangko Sentral ng Pilipinas' (2022) report indicates a rise in cybercrime incidents. Data breaches and financial losses threaten individuals, businesses, and government agencies that lack robust digital security infrastructure and cybersecurity awareness. Cyfirma (2023) reports that the Philippines faces escalating ransomware threats, aligning with the National Privacy Commission's (2024) warnings about growing data privacy risks and cyber threats. The Philippine government has been sluggish to put in place the controls and protections that are required in Philippine cyberspace so that the public can conduct business and learn more online without worrying about being compromised. In a 2023 survey, the FBI's Internet Crime Complaint Center (IC3) ranked the Philippines as the thirteenth most attacked country globally (Federal Bureau of Investigation 2023).

Additionally, the workforce's lack of digital skills may impede digital change (Nikou, De Reuver, and Mahboob Kanafi 2022). While the Philippines' existing workforce's abilities are above the regional average, the nation lags behind its neighbors in terms of preparing for the workforce of the future. According to the World Bank Group's (2020) report, the assessment highlights a shortage of skills in areas like cybersecurity, data analysis, and digital literacy. This skills mismatch hampers the effective utilization of digital technologies and hinders the filling of vacancies in the digital industry. The rapidly evolving regulatory environment for digital technologies in the Philippines presents another challenge (Dadios et al. 2018). Businesses struggle to keep pace with the changing legislation, creating uncertainty and discouraging investment in digital solutions. A more efficient and stable regulatory environment is crucial to foster innovation and digital entrepreneurship. Moreover, cultural factors play a significant role in the adoption of digital transformation (Meijer 2015). A substantial portion of the population prefers in-person interactions with government agencies

and financial institutions. Building trust and promoting digital literacy through government programs are essential to encourage wider adoption of internet services (Chetty et al. 2018).

A key aspect often overlooked is the role of education in ensuring long-term digital competency. The Philippines lacks a nationwide curriculum that prioritizes digital literacy, cybersecurity, data science, and emerging technologies such as artificial intelligence and blockchain (Mangarin and Climaco 2024). The Department of Education (DepEd) and the Commission on Higher Education (CHED) must introduce structured programs to equip students with essential digital skills, starting from primary education. Without this foundational shift, the country will continue to face a skills mismatch, limiting its ability to sustain digital transformation efforts.

Strategies to Successfully Implement the Digital Transformation

Digital transformation in public governance has been widely studied, with various nations implementing policies that have successfully bridged the digital divide, strengthened cybersecurity, enhanced digital literacy, and fostered public-private innovation. For instance, broadband expansion initiatives in Indonesia, Malaysia and Thailand have demonstrated significant improvements in digital inclusion through regulatory reforms and infrastructure investments (Wismadi and Iftikhar 2019, 25). The Philippines must adopt a similar approach by revising outdated policies that restrict market competition and implementing shared infrastructure projects to accelerate connectivity in remote areas.

Estonia's comprehensive cybersecurity strategy provides a robust model for the Philippines to strengthen its own approach to deterring cyber threats and enhancing its cybersecurity resilience. The Estonian approach is built on a whole-of-society strategy, which combines both military and non-military elements in cybersecurity. This framework integrates national and allied deterrence actions, emphasizing a cross-domain deterrence model that blends cyber, military, and non-military tools to address cyber threats. By leveraging a coordinated mix of deterrence, prevention, and response mechanisms, Estonia has created a multi-layered defense against cyberattacks, which includes significant involvement from both the government and private sectors (Pernik 2021).

For the Philippines, adopting a similar approach could significantly improve its ability to manage and mitigate cybersecurity risks. Estonia's whole-of-society approach emphasizes that cybersecurity is not solely the responsibility of government agencies or military forces but should involve all sectors, including citizens, businesses, and other stakeholders. This would foster a collaborative environment for addressing cybersecurity issues, ensuring that all sectors are prepared to respond to threats.

The importance of digital skills development is another critical area where policy interventions are needed. Studies indicate that countries that integrate digital literacy into early education experience higher workforce adaptability and innovation levels (Chanda et al. 2024). Estonia and Singapore exemplify distinct yet complementary approaches to embedding digital literacy in education (Thian 2024). Estonia's curriculum prioritizes hands-on technological immersion, mandating robotics instruction from age seven and integrating virtual reality into STEM subjects to cultivate problem-solving and entrepreneurial skills (Liive 2022). In contrast, Singapore's EdTech Masterplan 2030 adopts a structured framework, systematically training students in digital safety, computational thinking, and coding to align with industry demands (Ministry of Education of Singapore 2024). While Estonia emphasizes early exposure to advanced tools, Singapore focuses on scalable skill development tailored to economic needs. This initiative ensures that students are well-equipped to navigate an increasingly technology-driven future. The Philippines must take a similar approach, institutionalizing Information and Communication Technology (ICT) integration in all learning areas, from elementary through senior high school, supported by regular teacher training and curriculum updates.

To adapt Estonia's centralized cybersecurity model and Singapore's EdTech Masterplan 2030 to the Philippines' archipelagic and duopoly-constrained context, localization strategies must prioritize decentralized, hybrid, and community-driven approaches. Estonia's cybersecurity framework, reliant on centralized threat intelligence, could be reconfigured into regional cyber-response units under the Department of Information and Communications Technology (DICT), enabling localized threat monitoring while maintaining national coordination—

critical for an archipelago with fragmented connectivity. Singapore's EdTech integration, which assumes widespread connectivity, must be reimagined through offline-first solutions, such as pre-loaded tablets with localized e-learning modules in regional languages, distributed via mobile libraries or boats to remote islands. To counter the telecom duopoly, the government could mandate "educational bandwidth" discounts for schools under the Universal Access to Quality Tertiary Education Act, while incentivizing tower-sharing agreements and satellite internet partnerships to reduce costs. Culturally, programs should engage indigenous leaders and barangay councils as digital literacy trainers, blending tech adoption with trust-building in communities wary of centralized systems. By decentralizing infrastructure, leveraging hybrid technologies, and embedding reforms within existing policies (e.g., the National Broadband Plan), the Philippines can bridge its unique geographic and market barriers, ensuring global models serve local realities rather than replicating their limitations.

In addition to improving the education system, targeted workforce development programs are essential to help adult workers acquire new skills. Initiatives such as JobsNext have been effective in providing training in high-demand digital fields such as digital marketing, graphic design, and e-commerce (Philippine Business for Education 2023). Expanding these programs to reach a wider audience and aligning training with industry needs will help workers transition into digital roles and enhance their employability. The private sector can play a significant role in this effort. Companies should invest in digital upskilling programs for their employees, particularly in fields such as cybersecurity, data analytics, and cloud computing. Initiatives like Accenture's Skills to Succeed initiative, launched in 2009, has equipped over 1.2 million individuals with essential workplace and entrepreneurial skills, aiming to prepare them for the global economy (Olphert 2016). Similarly, Google's Digital Skills for Africa program, aims to train millions of young Africans in digital competencies to thrive in the evolving job market (Africa News Agency 2024). These industry-led training programs have demonstrated significant positive impacts, and local companies, particularly in the BPO and tech sectors, are encouraged to collaborate with educational institutions to offer digital skills training aligned with market needs.

Lastly, fostering innovation through public-private partnerships has been a cornerstone of successful digital economies, as evidenced by Singapore's Smart Nation initiative, which leveraged collaboration with tech firms to develop digital services (Smart Nation and Digital Government Office 2018). By aligning with global best practices and incorporating these policy insights into strategic recommendations, the study can provide a more robust framework for digital transformation in the Philippines.

Conclusion

The digital revolution has irrevocably transformed the landscape of governance, demanding a paradigm shift in the way public services are delivered. The Philippines, like many nations, stands at a crucial juncture, poised to harness the power of digital transformation to address long-standing challenges and propel itself into the future. Digital transformation has the potential to revolutionize various aspects of society, including how we work, learn, and interact with each other. The Philippines is actively striving to fulfill its commitment to digital transformation.

While the Philippines has embraced technology, significant challenges remain. Many Filipinos, especially those in rural areas, still lack access to reliable internet and affordable devices. This digital divide can hinder economic growth and social progress. Additionally, cybersecurity threats and data privacy concerns are growing, making it crucial to protect sensitive information. The Philippines must overcome obstacles to realize the full potential of digital transformation. By investing in robust digital infrastructure, promoting digital literacy, strengthening cybersecurity, fostering innovation, and streamlining government processes, the Philippines can build a more inclusive, efficient, and prosperous digital society.

References

Abdullahi, Sani, Shuifa Sun, Beng Wang, Ning Wei, and Hongxia Wang. 2024. "Biometric Template Attacks and Recent Protection Mechanisms: A Survey." *Information Fusion 103 (March)*. doi:10.1016/j.inffus.2023.102144.

Abesamis, Pierre Pauline R. 2021. "Multiple-case study on the perceived impacts of Philippine identification system in organizational control: Focusing on e-government services." *Animo Repository*. https://animorepository.dlsu.edu.ph/etdd_infotech/3/.

Albert, Jose Ramon, Francis Mark Quimba, Aubrey Tabuga, Mary Grace Mirandilla-Santos, Maureen Ane Rosellon, Jana Flor Vizmanos, Carlos Cabaero, and Mika Muñoz. 2021. "Expanded Data Analysis and Policy Research for National ICT Household Survey 2019." *Philippine Institute for Development Studies*. https://pidswebs.pids.gov.ph/CDN/PUBLICATIONS/pidsdps2120.pdf.

Africa News Agency. 2024. *Digital Skills for Africa: Google's Initiative for the Digital Future of African Youth.* https://africa-news-agency.com/digital-skills-for-africa-googles-initiative-for-the-digital-future-of-african-youth/#:~:text=The%20%22Digital%20Skills%20for%20Africa,transformation%20of%20businesses%20in%20Africa.&text=Africa%20is%20at%20a%20decisive,in%20an%20increasingly%20digital%20economy.

Alaswad, Abdulmonam Omar, Ahlal H. Montaser, and Fawzia Elhashmi Mohamad. 2014. "Vulnerabilities of Biometric Authentication: Threats and Countermeasures." *International Journal of Information & Computation Technology* 4 (10): 947–58. https://www.ripublication.com/irph/ijict_spl/ijictv4n10spl_01.pdf.

Asian Development Bank. 2021. *ADB Annual Report 2020.* https://www.adb.org/documents/adb-annual-report-2020.

Bangko Sentral ng Pilipinas. 2022. "EGov Pay Transactions Show Remarkable Growth." *Bangko Sentral Ng Pilipinas*. https://www.bsp.gov.

ph/SitePages/MediaAndResearch/MediaDisp.aspx?ItemId=6291.

Bangko Sentral ng Pilipinas. 2023. "Iloilo City Joins Paleng-QR Ph Plus." *Bangko Sentral Ng Pilipinas*. https://www.bsp.gov.ph/SitePages/MediaAndResearch/MediaDisp.aspx?ItemId=6935#:~:text=Iloilo%20City%20Joins%20Paleng%2DQR%20Ph%20Plus&text=%E2%80%8BIloilo%20City%20has%20launched,by%20City%20Mayor%20Jerry%20P.

Bombay, Nide Marie. 2012. "The Philippine Government Electronic Procurement System (PHILGEPS) – Organizational Study." *Asian Development Bank*. https://www.adb.org/sites/default/files/project-documents/42537-012-phi-tacr-02.pdf.

Caliwan, Christopher Lloyd. 2023. "LGUs moving towards automation via eLGU, eReport mobile app." *Philippine News Agency*. https://www.pna.gov.ph/articles/1205835.

Castillo, Laila Castro, and Arneil Garcia Gabriel. 2020. "Transparency and Accountability in the Philippine Local Government." In *Global Encyclopedia of Public Administration, Public Policy, and Governance*, 1–9. https://doi.org/10.1007/978-3-319-31816-5_3895-1.

Chanda, Thelma, Zohaib Sain, Yusuf Shogbesan, Edwin Phiri, and Wisdom Akpan. 2024. "Digital Literacy in Education: Preparing Students for the Future Workforce." *International Journal of Research* 11 : 327–344. https://doi.org/10.5281/ZENODO.13347718.

Chetty, Krish, Liu Qigui, Nozibele Gcora, Jaya Josie, Li Wenwei, and Chen Fang. 2018. "Bridging the digital divide: measuring digital literacy." *Economics* 12(1). https://doi.org/10.5018/economics-ejournal.ja.2018-23.

Cyfirma. 2023. *Philippines Threat Overview - Cyfirma*. https://www.cyfirma.com/research/philippines-threat-overview/.

Dadios, Elmer P., Alvin B. Culaba, Jose Ramon G. Albert, Vicente B. Paqueo, Aniceto C. Orbeta Jr., Ramonette B. Serafica, Argel A.

Bandala, and Jose Carlos Alexis C. Bairan. 2018. "Preparing the Philippines for the Fourth Industrial Revolution: A Scoping Study." *PIDS Discussion Paper Series No. 2018-11*. https://hdl.handle.net/10419/211030.

Department of Science and Technology. 2021. "eHATID LGU's EMR System to Enable Interoperability of Cagayan de Oro City's Health Information Management Systems - Philippine Council for Health Research and Development." *Philippine Council for Health Research and Development*. https://www.pchrd.dost.gov.ph/news_and_updates/ehatid-lgus-emr-system-to-enable-interoperability-of-cagayan-de-oro-citys-health-information-management-systems/.

Department of Information and Communications Technology. 2022. *ITU – Digital Infrastructure*.https://dict.gov.ph/itu2022/itu-digital-infrastructure/.

Department of Information and Communications Technology. 2023a. *Faster, more convenient immigration process now possible through eTravel system*.https://dict.gov.ph/faster-more-convenient-immigration-process-now-possible-through-etravel-system/.

Department of Information and Communications Technology. 2023b. *PBBM cites digitalization gains; DICT vows swift rollout of e-Gov programs*. https://dict.gov.ph/pbbm-cites-digitalization-gains-dict-vows-swift-rollout-of-e-gov-programs/.

Dhararaj, Samaya. 2024. "The Philippines: Enhanced Digital ID Security and Registrations – OpenGov Asia." *OpenGov*. https://opengovasia.com/2024/07/27/the-philippines-enhanced-digital-id-security-and-registrations.

ElMassah, Suzanna, and Mahmoud Mohieldin. 2020. "Digital transformation and localizing the Sustainable Development Goals (SDGs)." *Ecological Economics* 169. https://www.sciencedirect.com/science/article/abs/pii/S0921800919303258.

Esteban, Alfredo, and Mary Joy Cruz. 2021. "Digital Divide in Times

of Pandemic among Teacher Education Students." *Open Access Library Journal* 8(4). https://www.scirp.org/reference/referencespapers?referenceid=2964382.

Estonian State Information Authority. 2024. "Cyber Security in Estonia 2024." *Digital Watch Observatory*. https://dig.watch/resource/cyber-security-in-estonia-2024.

Federal Bureau of Investigation. 2023. "2023 Internet Crime Report." *2023 Internet Crime Report*. https://www.ic3.gov/Media/PDF/AnnualReport/2023_IC3Report.pdf.

Furnas, Alexander. 2013. "Transparency Case Study: Public Procurement in the Philippines: Sunlight Foundation." *Sunlight Foundation*. https://sunlightfoundation.com/2013/10/07/case-study-public-procurement-in-the-philippines/#:~:text=Barriers%20to%20Accessing%20Procurement%20Information,logistical%20barriers%20to%20public%20use.

George, Shaji. 2024. "Bridging the Digital Divide: Understanding the Human Impacts of Digital Transformation." *Partners Universal International Innovation Journal* 2(03). https://doi.org/10.5281/zenodo.11287684.

Hussain, Nazar, and Shumaila Phulpoto. 2024. "Digital Literacy: Empowering Individuals in the Digital Age". *Assyfa Learning Journal* 2(2):70-83. https://doi.org/10.61650/alj.v2i2.231.

Ignacio, Aris. 2021. "Online Classes and Learning in the Philippines during the Covid-19 Pandemic". *International Journal on Integrated Education* 4: 1–6. https://www.researchgate.net/publication/350739843_Online_classes_and_learning_in_the_Philippines_during_the_Covid-19_Pandemic.

International Trade Administration. 2024. "Philippines - Digital Economy." *International Trade Administration*. https://www.trade.gov/country-commercial-guides/philippines-digital-economy.

Jou, Yung-Tsan, Klint Allen Mariñas, Charmine Sheena Saflor, Anelyn

Baleña, Charlie Jade Gutierrez, Ginber Dela Fuente, Hannah Maureen Manzano, et al. 2024. "Investigating Various Factors Influencing the Accessibility of Digital Government with eGov PH Mobile Application." *Sustainability* 16(3): 992. https://doi.org/10.3390/su16030992.

Kalyani, Lohans. 2024. "The Role of Technology in Education: Enhancing Learning Outcomes and 21st Century Skills*"*. *International Journal of Scientific Research in Modern Science and Technology* 3: 5–10. https://doi.org/10.59828/ijsrmst.v3i4.199.

Kanehira, Naoto, Mary Grace Mirandilla-Santos, Mitch Abdon, Jaime Andres Uribe Frias, Luis Andres Razon Abad, and Kimberly May Baltao Chandra. 2024. "Better Internet for All Filipinos: Reforms Promoting Competition and Increasing Investment for Broadband Infrastructure - A Policy Note*"*. *Washington, D.C.: World Bank Group*. http://documents.worldbank.org/curated/en/099011824231036851.

Kanehira, Naoto, Mitch Abdon, and Mary Grace Mirandilla-Santos. 2024. "Updating Policies to Upgrade the Internet for All Filipinos." *World Bank Blogs.* https://blogs.worldbank.org/en/eastasiapacific/updating-policies-upgrade-internet-all-filipinos#:~:text=In%202022%2C%20just%2033%20percent,broadband%20subscription%20(Figure%201).

Khan, Sadia. 2023. "Mapping the Digital Divide: Bridging Inequalities in Access to Information and Technology." *Policy Journal of Social Science Review* 2, no. 2: 48–55. https://doi.org/10.63075/pjssr.v2i02.16.

Land Bank of the Philippines. 2023. "Landbank Accelerates QR Code Payments in Public Markets." *Land Bank of the Philippines*. https://www.landbank.com/news/landbank-accelerates-qr-code-payments-in-public-markets.

Liive, Ronald. 2022. "Raising a Tech-savvy Nation: In Estonia, Even Kindergartens Teach Robotics." *Invest in Estonia*. https://investinestonia.com/raising-a-tech-savvy-nation-in-estonia-even-

kindergartens-teach-robotics/.

Liu, Shuhua Monica, and Qianli Yuan. 2015. "The Evolution of Information and Communication Technology in Public Administration." *Public Administration and Development* 35 (2): 140–51. doi:10.1002/pad.1717.

Lorenciana, Carlo. 2021. "Modern Traffic Light System on in 18 Cebu City Intersections." *Philippine News Agency*. https://www.pna.gov.ph/articles/1135073#:~:text=CEBU%20CITY%20%E2%80%93%20The%20Cebu%20City,an%20underground%20fiber%2Doptic%20network.

Magcope, Algen, Marmelo V. Abante, Randy James Caspe, Florinda Vigonte, and Jona Peñamora. 2023. "Assessing the Utility of Digital Governance for Inter-Generational Public Sector Workers." *SSRN Electronic Journal*.https://doi.org/10.2139/ssrn.4629912.

Maggay, Jake G. 2017. "Biometric Attendance Monitoring System of Cagayan State University – Lasam Campus, Philippines." *Zenodo (CERN European Organization for Nuclear Research)*. https://doi.org/10.5281/zenodo.345444.

Mangarin, Rey Avila, and Jean Lea Climaco. 2024. "Exploring Contributing Factors on Poor Digital Literacy of Students: A Review of Existing Studies - International Journal of Research and Innovation in Applied Science (IJRIAS)." *International Journal of Research and Innovation in Applied Science (IJRIAS)* 9 (9). https://doi.org/10.51584/IJRIAS.2024.909051.

Matheus, Ricardo, Roel Faber, Elvira Ismagilova, and Marijn Janssen. 2023. "Digital transparency and the usefulness for open government." *International Journal of Information Management* 73 (August): 102690. https://doi.org/10.1016/j.ijinfomgt.2023.102690.

Meijer, Albert. 2015. "E-Governance Innovation: Barriers and Strategies." *Government Information Quarterly* 32, no. 2 (2015): 198-206. https://doi.org/10.1016/j.giq.2015.01.001.

Millard, Jeremy. 2023. "Impact of Digital Transformation on Public Governance." Edited by Manzoni, M. and Schade, S. *Publications Office of the European Union*. https://doi.org/10.2760/204686.

Ministry of Education of Singapore. 2024. *Transforming Education through Technology Masterplan 2030*. http://www.moe.gov.sg/education-in-sg/educational-technology-journey/edtech-masterplan.

Mioten, Erika. 2021. "Bridging the digital divide in the Philippines." *BusinessWorld Online*. https://www.bworldonline.com/bweconomicforum/2021/06/07/374124/bridging-the-digital-divide-in-the-philippines/.

Montemayor, Ma. Teresa. 2024. "DTI launches eReport System for online consumer complaints." *Philippine News Agency*. https://www.pna.gov.ph/articles/1237165.

Mountasser, Tiach, and Marghich Abdellatif. 2023. "Digital Transformation in Public Administration: A Systematic Literature Review." *International Journal of Professional Business Review*. https://doi.org/10.26668/businessreview/2023.v8i10.2372.

National Institute of Standards and Technology. 2024. "The NIST Cybersecurity Framework (CSF) 2.0." *NIST CSWP 29*. https://doi.org/10.6028/NIST.

National Economic and Development Authority. 2018. "Philippine Identification System Act (PhilSys)." National Economic and Development Authority. 2018. https://neda.gov.ph/philsys/.

National Privacy Commission. 2017. "Privacy Commission Finds Bautista Criminally Liable for 'Comeleak' Data Breach." *National Privacy Commission*. https://privacy.gov.ph/privacy-commission-finds-bautista-criminally-liable-for-comeleak-data-breach/.

National Privacy Commission. 2024. "NPC Launches Compliance and Security Monitoring Command Center." *National Privacy Commission.* https://privacy.gov.ph/npc-launches-compliance-and-security-monitoring-com-

mand-center/#:~:text=%E2%80%9CThrough%20the%20CSMCC%2C%20the%20NPC,Alzona.

Navarro, Adoracion. 2024. "The Evolution of Reforms and the State of Competition in Public Procurement in the Philippines". *Discussion Paper Series No. 2023-48*. Quezon City: Philippine Institute for Development Studies. https://doi.org/10.62986/dp2023.48.

Nikou, Shahrokh, Mark De Reuver, and Matin Mahboob Kanafi. 2022. "Workplace Literacy Skills—How Information and Digital Literacy Affect Adoption of Digital Technology." *Journal of Documentation* 78(7): 371–91. doi:10.1108/JD-12-2021-0241.

Nomura, Shuhei, Vera Siesjö, Göran Tomson, Wiebke Mohr, Eriko Fukuchi, Kenji Shibuya, Viroj Tangcharoensathien, and Hiroaki Miyata. 2020. "Contributions of information and communications technology to future health systems and Universal Health Coverage: application of Japan's experiences." *Health Research Policy and Systems* 18(1). https://doi.org/10.1186/s12961-020-00585-x.

Olphert, Colleen. 2016. "Accenture Offers Skills to Succeed." Boston College Center for Corporate Citizenship. https://ccc.bc.edu/content/ccc/blog-home/2016/10/accenture-offers-skills-to-succeed.html.

Ong, Peter. 2011. "Public Governance: Challenges in a Changing Landscape." https://knowledge.csc.gov.sg/ethos-issue-10/public-governance-challenges-in-a-changing-landscape/.

OpenGov. 2019. "E-governance systems to improve local government services in the Philippines." *OpenGovAsia.* https://opengovasia.com/2019/06/12/e-governance-systems-to-improve-local-government-services-in-the-philippines/.

Pernik, Piret. 2021. "Cyber Deterrence: A Case Study on Estonia's Policies and Practice." *Hybrid CoE Paper 8*. https://www.hybridcoe.fi/wp-content/uploads/2021/10/20211012_Hybrid_CoE_Paper_8_Cyber_deterrence_WEB.pdf.

Philippine Business for Education. 2023. *PBEd: Integration of Civic*

Education in All Subjects Vital for Nation-building. https://www.pbed.ph/news/130/PBEd/PBEd:%20Integration%20of%20civic%20education%20in%20all%20subjects%20vital%20for%20nation-building.

Philippine News Agency. 2022. "Philippines 4th among Countries Most Targeted by Web Threats." *Philippine News Agency*. https://www.pna.gov.ph/articles/1168257.

Philippine Payments Management Inc. 2019. "Bangko Sentral and the Industry Launches EGOV Pay and QR PH." *PPMI*. https://www.philpayments.org.ph/post/bangko-sentral-and-the-industry-launches-egov-pay-and-qr-ph.

Philippine Statistics Authority. 2021. *2019 Functional Literacy, Educational and Mass Media Survey: Mode of Travel & ICT*.https://rssocar.psa.gov.ph/education/node/55623.

Quezon City Government. 2024. *Quezon City Local Government Annual Report 2022-2023.* Quezon City:Philippines. https://quezoncity.gov.ph/wp-content/uploads/2024/01/Quezon-City-Local-Government-Annual-Report-2022-2023.pdf.

Ramos, Manuel C. 2008. *Addressing the Digital Divide in Philippine Education.* https://www.diva-portal.org/smash/get/diva2:208974/FULLTEXT01.pdf.

Respicio, Harold. 2024. *Concerns Regarding the Verification of a Digital National Identification Under Philippine Law*. https://www.respicio.ph/dear-attorney/concerns-regarding-the-verification-of-a-digital-national-identification-under-philippine-law.

Robinson, Mark. 2015. "From Old Public Administration to the New Public Service: Implications for Public Sector Reform in Developing Countries." *UNDP Global Centre for Public Service Excellence.* https://www.undp.org/sites/g/files/zskgke326/files/publications/PS-Reform_Paper.pdf.

Smart Nation and Digital Government Office. 2018. *Smart Nation: The*

Way Forward. https://www.smartnation.gov.sg/files/publications/smart-nation-strategy-nov2018.pdf.

Suherlan, Suherlan. 2023. "Digital Technology Transformation in Enhancing Public Participation in Democratic Processes." *Technology and Society Perspectives (TACIT)* 1(1): 10–17. https://doi.org/10.61100/tacit.v1i1.34.

Thian, Si Ying. 2024. "Singapore and Estonia's Education Ministries to Partner on Curriculum Enhancements, AI Use in Classrooms." *GovInsider*. https://govinsider.asia/intl-en/article/singapore-and-estonias-education-ministries-to-partner-on-curriculum-enhancements-ai-use-in-classrooms.

Tinam-isan, Mia Amor, and January Naga. 2024. "Exploring the Landscape of Health Information Systems in the Philippines: A Methodical Analysis of Features and Challenges." *International Journal of Computing and Digital Systems* 15(1): 225–37. https://www.researchgate.net/publication/381867003_Exploring_the_Landscape_of_Health_Information_Systems_in_the_Philippines_A_Methodical_Analysis_of_Features_and_Challenges.

Thomas, John. 2024. "Digital Transformation in Public Administration: Embracing the Future." *Journal of Research in International Business and Management* 11: 002.

Villaroman, Gladys Anne C., Anthony B. San Pedro, Khristopher M. Bacani, Erlinda R. Clerigo, and Aron T. Hipos. 2018. "The Use of Biometric Attendance Recording System (BARS) and Its Impact on the Work Performance of Cabanatuan City Government Employees." *OALib* 5(1): 1–10. https://doi.org/10.4236/oalib.1104273.

Vora, Priya, and Jonathan Dolan. 2022. "What is 'Good' Digital Infrastructure? Measuring Digital Infrastructure to Maximize Development Outcomes and Mitigate Risks." 167. *Brookings Global Working Paper*. Brookings Institution. https://www.brookings.edu/wp-content/uploads/2022/02/Good-Digital-Infrastructure.pdf.

Wismadi, Arif, and Parvez Iftikhar. 2019. *The ASEAN Framework for Next Generation Universal Service Obligation (USO2.0).* https://asean.org/wp-content/uploads/2021/08/ASEAN-Framework-for-Next-Generation-Universal-Service-Obligation.pdf.

World Bank Group. 2020. "Harnessing Digital Technologies Can Help Philippines Overcome Impact of Pandemic, Hasten Recovery." *Washington, DC: World Bank*. https://www.worldbank.org/en/news/press-release/2020/10/05/harnessing-digital-technologies-can-help-philippines-overcome-impact-of-pandemic-hasten-recovery.

World Bank Group. 2024. "Better Internet for All Filipinos: Reforms Promoting Competition and Increasing Investment for Broadband Infrastructure - A Policy Note." *Washington, DC: World Bank*. https://openknowledge.worldbank.org/entities/publication/81fa48e6-866b-49bc-8f0d-27c86dee5f68/full.