Determinants of Digital Public Infrastructure Implementation

Ishya Jain | Advisor: Dr. Shareen Joshi

Georgetown University

LAIDLAW SCHOLARS

GEORGETOWN UNIVERSITY Center for Research & Fellowships

Abstract

As digital transformation accelerates globally, Digital Public Infrastructure (DPI) is emerging as a key framework for public service delivery. This study investigates which country-level conditions, specifically population size, enabling infrastructure, and state capacity, are associated with the successful adoption of DPI. To examine this, a dataset of countries was constructed using publicly available global indicators, including both DPI adopters and non-adopters to assess the individual and joint effects of the selected indicators on DPI adoption. Independently, indicators for population size, enabling infrastructure, and state capacity were found to be higher in countries with digital ID systems. However, when analyzed collectively, digital infrastructure was found to have the strongest association with overall DPI implementation, followed by population size. State capacity was not associated with higher rates of overall DPI implementation. By identifying the conditions most strongly associated with DPI adoption, this study provides a framework for governments to assess whether they are well-suited to implement DPI and likely to benefit from such investments.

Background

DPI systems are "society-wide, digital capabilities that are essential to participation in society and markets as a citizen, entrepreneur, and consumer in a digital era" (Eaves and Sandman). It is public in that it is created through a collaborative process involving cross-sectoral stakeholders and is proactively governed by the state to provide for the common good (Mazzucato et al.). As seen in Figure 1, rather than delivering services directly, DPI operates as an enabling layer between physical infrastructure and sector-specific applications including social protection, healthcare, and e-commerce (World Bank, 2024).

The World Bank identifies both technology and non-technology enablers for DPI. Technology enablers include internet connectivity, cloud storage, and access to AI/ML, and non-technology enablers include legal frameworks for data protection, cybersecurity protocols, and widespread digital literacy (Clark et al.). The World Bank also identifies multiple approaches to building DPI, depending on a country's existing infrastructure. Countries with legacy identity systems, such as Indonesia, tend to build on top of existing architectures. Alternatively, countries seeking to overhaul their systems, such as Bangladesh, build from the ground up (Clark et al.).

The OECD offers a similar but distinct list of key enablers for successful DPI. They note that countries with legacy systems may find DPI harder to implement efficiently, since replacing existing infrastructure is often expensive and difficult. Additional enablers identified by the OECD include collaboration with the private sector; a sustainable financing model; and safeguards to mitigate social and technological challenges (OECD).

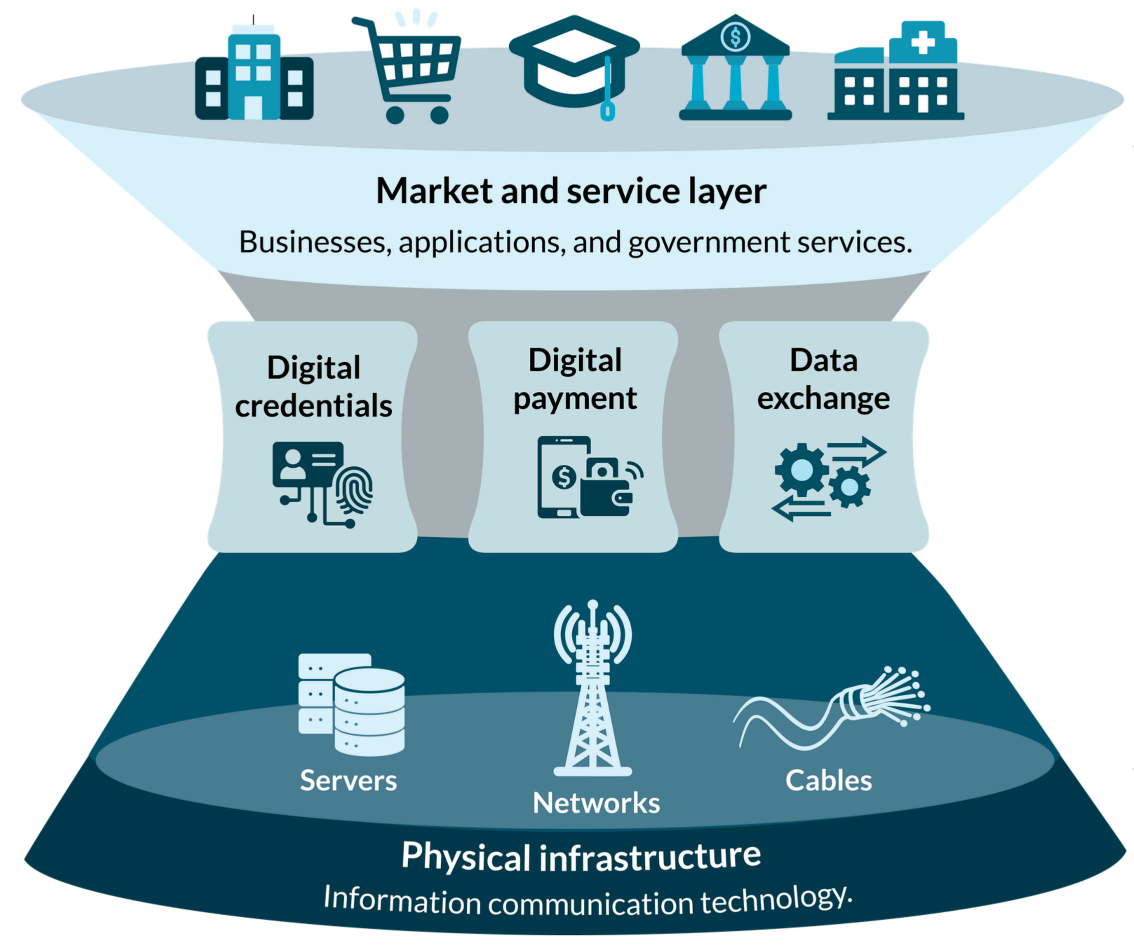

Fig. 1 Digital Infrastructure and Services Layers. Image from Canda School of Public Service

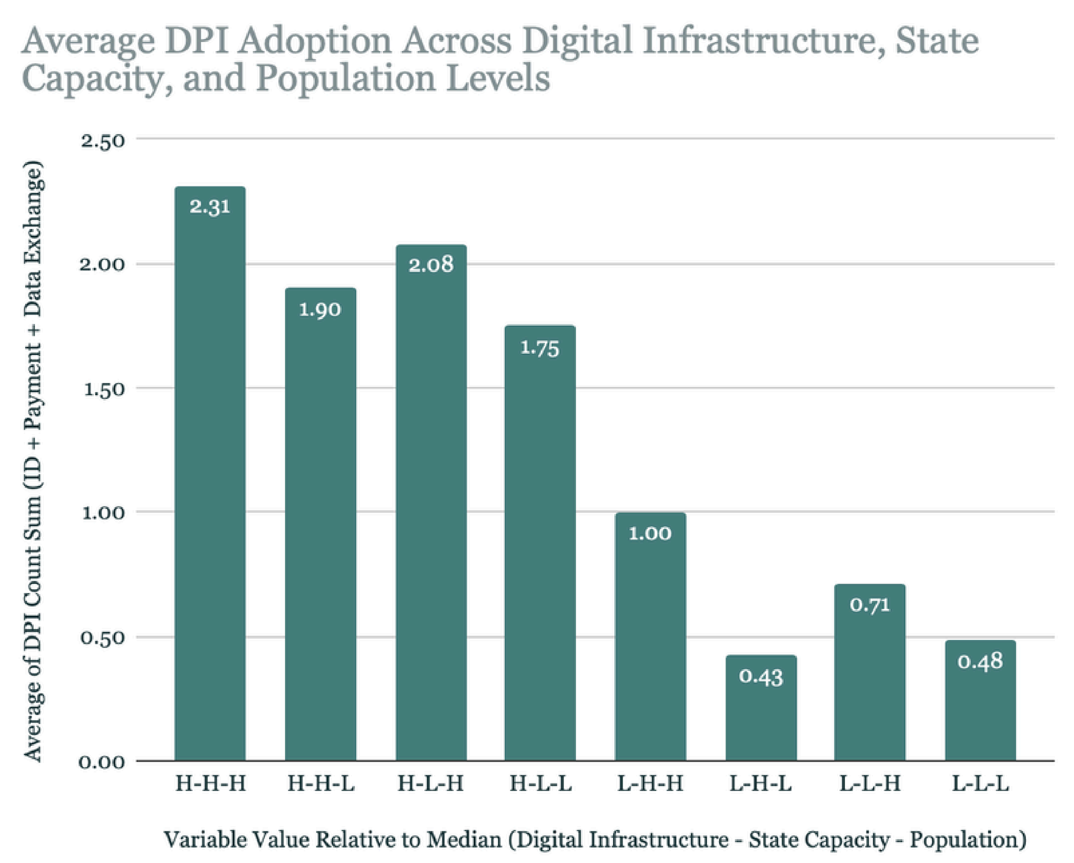

Fig. 2 Average DPI Adoption Across Digital Infrastructure, State Capacity, and Population Levels. Data from World Bank World Development Indicators, UN E-Government Knowledge Base, World Bank World Governance Indicators, and DPI Map.

Objectives

Hypothesis: DPI adoption is driven by the interaction of three factors:

1. **Population size:** DPI systems exhibit strong economies of scale due to high fixed costs and low marginal costs. As a result, DPI becomes economically attractive in larger countries because it improves service delivery and reduces per-user administrative costs.
2. **Enabling infrastructure:** Even if DPI systems are implemented, low connectivity limits uptake and reduces effectiveness. Therefore, stronger existing digital infrastructure is expected to be a necessary precondition for effective DPI adoption.
3. **State capacity:** DPI requires coordination across agencies, reliable governance capacity, and institutional stability. Countries with stronger bureaucratic systems are therefore more likely to move from feasibility to actual implementation.

By identifying the conditions under which DPI adoption is most successful, this study provides a framework for governments to assess whether they are well-suited to implement DPI and likely to benefit from such investments.

Methodology

The foundational dataset for this study is the DPI Map, produced by the University College London (UCL). The DPI Map records, for 211 countries, whether three core DPI systems, digital ID, payment, and data exchange, are present, using a binary indicator. To contextualize DPI adoption, 5 additional indicators were merged onto the DPI Map dataset at the country level, drawn from three publicly available sources, as seen in Figure 4. The methodology used a two-stage analysis:

1. **Univariate Analysis:** Each population, digital infrastructure, and state capacity indicator was compared between countries with and without a digital ID system using descriptive statistics and Mann-Whitney U tests to identify the variables most strongly associated with digital ID adoption.
2. **Multivariate Analysis:** The strongest indicators were then used in a multivariate regression model to determine which variables were most strongly associated with overall DPI adoption, measured by a country's combined adoption of digital ID, payments, and data exchange systems.

Statistical Analysis Results

Variable	Indicator	Univariate Analysis	Multivariate Analysis
Population Size	Total population (in thousands), 2025	p-value: 0.0014 Reject H_0	Reject H_0
Digital Infrastructure	Individuals Using the Internet (% of population), Most Recent Year (2014 - 2024)	p-value: 1.8800 E-08 Reject H_0	Reject H_0
	Mobile Cellular Subscriptions (per 100 people), Most Recent Year (2021 - 2025)	p-value: 0.0028 Reject H_0	
	E-Gov Development Index - Overall Score, 2025	p-value: 1.2751E-10 Reject H_0	
State Capacity	Government Effectiveness Score, 2024	p-value: 4.2335E-08 Reject H_0	Fail to Reject H_0
	Control of Corruption Score, 2024	p-value: 2.7864E-05 Reject H_0	

Discussion

Mann-Whitney U tests reveal statistically significant differences in the distributions of all 6 indicators between countries with and without a digital ID system (all p-values < 0.05). In the second stage, total population, the E-Government Development Index, and Government Effectiveness were selected to represent population size, digital infrastructure, and state capacity, respectively. Figure 4 demonstrates that digital infrastructure has the strongest association with DPI adoption across digital identification, payment, and data exchange systems, while population size shows a moderate but statistically significant association. This suggests that digital infrastructure may serve as a foundational requirement for DPI adoption by facilitating population-wide access to the systems and larger countries may be more likely to develop comprehensive DPI ecosystems because of economies of scale or greater returns on investment. In contrast, state capacity does not have a statistically significant association with overall DPI adoption, suggesting that the relationship observed in the first stage may be driven by the overlap between state capacity and digital infrastructure rather than by an independent effect of state capacity. Alternatively, state capacity may be associated primarily with digital ID adoption rather than with digital payment or data exchange systems.

Conclusions

The purpose of this study was to examine the strength of association between population size, digital infrastructure, and state capacity and DPI implementation, with the goal of understanding which of these factors is most closely associated with the implementation of DPI. The findings should be considered within the limitations of the study. Because the analysis does not establish temporality, it cannot determine causality or conclude that any of these indicators are necessary preconditions for DPI implementation. Further research should therefore examine the causal relationship between these variables and DPI implementation. Individual case studies could provide a stronger understanding of the factors that influence stakeholder decisions to plan, pilot, and ultimately implement DPI systems. Future research should also examine the role of regional partnerships and international investment in creating the conditions for successful DPI implementation and supporting countries that may not yet have the necessary infrastructure.

Although state capacity was not found to be significantly associated with overall DPI implementation in this model, effective governance remains an important component of ensuring the long-term success of DPI (Clark et al.). Countries seeking to implement DPI must therefore look beyond technological and economic readiness. Successful implementation also requires investment in public institutions and governance protocols capable of mitigating potential harms and ensuring that DPI delivers its intended benefits.

Acknowledgements

Thank you to Dr. Shareen Joshi for her generous guidance. I am grateful to the Laidlaw Scholars Foundation and the Georgetown University Laidlaw Scholars Programme for their support.

References

Canada School of Public Service. "Explaining Digital Public Infrastructure (DDN2-A62) - CSPS." Csps-Efpc.Gc.Ca, 2026, https://www.csps-efpc.gc.ca/tools/articles/digital-infrastructure-eng.aspx. Accessed 14 Aug. 2026.

Clark, Julia, et al. "Digital Public Infrastructure and Development: A World Bank Group Approach." Digital Transformation White Paper, vol. 1, World Bank, 2025.

"Data Center." Un.Org, 2018, https://publicadministration.un.org/egovkb/en-us/Data-Center. Accessed 14 Aug. 2026.

DPI Map (2026-03-31). Institute for Innovation and Public Purpose, UCL. https://dpimap.org/data

Eaves, David, and Jordan Sandman. "What Is Digital Public Infrastructure?" UCL Institute for Innovation and Public Purpose, Medium, 22 Aug. 2022, https://medium.com/iipp-blog/what-is-digital-public-infrastructure-6fbfa74f2f8c.

Mazzucato, Mariana, David Eaves, and Beatriz Vasconcellos. 2026. "Digital Public Infrastructure and the Economics of Public Value: What Is 'Public' about DPI?" Journal of Economic Policy Reform 29 (2): 113–41. doi:10.1080/17487870.2026.2662285.

OECD (2024), "Digital public infrastructure for digital governments", OECD Public Governance Policy Papers, No. 68, OECD Publishing, Paris, https://doi.org/10.1787/ff525dc8-en.

United Nations Division for Public Institutions and Digital Government. "E-Government Development Index (EGDI)." EGOVKB | United Nations > About > Overview > E-Government Development Index, https://publicadministration.un.org/egovkb/en-us/About/Overview/-e-Government-Development-Index. Accessed 1 August 2026.

World Bank. "Indicators | Data." Worldbank.Org, 2024, https://data.worldbank.org/indicator. Accessed 1 Aug. 2026.

World Bank. 2024. Digital Progress and Trends Report 2023. Washington, DC: World Bank. doi:10.1596/978-1-4648-2049-6. License: Creative Commons Attribution CC BY 3.0 IGO

World Bank (2025). "The Worldwide Governance Indicators: Revised Methodology for Measuring Governance Using Perception Data." Washington, DC: World Bank Group.

Worldwide Governance Indicators, 2025 Revision, World Bank (www.govindicators.org)