What is 'good' digital infrastructure?

Measuring digital infrastructure to maximize development outcomes and mitigate risks

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Summary and approach

Digitization has the *potential* to create new pathways out of poverty and empower people in new ways, but it could just as easily, and perhaps more naturally, exacerbate inequalities, undermine trust in critical institutions, and erode social norms. The difference between a positive future state and a negative one will, in large part, be defined by whether digital public infrastructure is designed, implemented, and governed in service of the public good.

As the digital development community begins to coalesce around new approaches and funding models for supporting digital infrastructure for the public good, it is not only critical that a common vision exists but also that there are tools for understanding how digital technologies are supporting or hindering development goals.

To that end, this paper examines whether current measurement tools suffice in capturing the positive development impact of digital infrastructure *and provide* a lens through which to assess its potential downside risks. The inquiry focused primarily on payments, identity, and data exchange technologies—which together are commonly referred to as the "digital stack" and recognized as foundational components of any national digital transformation

The paper finds that there is no systematic method for evaluating whether a digital stack is designed, implemented, and governed to maximize positive outcomes. More specifically, the paper finds current measurement approaches and tools are:

1. **Highly fragmented and inconsistent**: Numerous indices exist to track the deployment of technologies; yet these indices track different technologies or different elements of the same technologies and apply different approaches to presenting the data, resulting in a patchwork of indicators that is highly limited in its ability assess how these technologies are designed, implemented, and governed to serve the social and economic needs of people and the countries in which they live.

2. **Focused primarily on availability and usage, not on impact:** Given the duality of digital technologies described above, tracking progress towards access to and adoption of technology is important but not sufficient. For instance, with existing data collection tools, it is possible to answer whether a citizen is likely to have access to digital identification, but it is less possible to answer whether that identification helps accelerate access to vaccines, welfare payments, or other social services. It is also not possible to discern whether the same ID solution enables government surveillance or seeds mistrust in other ways.

3. **Constrained by traditional funding and project administration silos as well as the lack of clear standards with which to measure underlying infrastructure:** The challenge in measuring enabling technologies mirrors a challenge in funding and administration: just as the development community tends to allocate resources in functional silos that focus primarily on a specific outcome like financial inclusion or health, it also tends to measure in silos. Furthermore, any efforts to bridge these silos are complicated by the lack of standards around digital infrastructure terminology.

With these findings in mind, the paper also offers an initial framework that would not only monitor the availability of digital services but also the quality and implementation of the infrastructure that enables them in order to better assess impact at a household, market, and societal level.

While the paper does offer findings and a proposed framework, it is ultimately meant to foster discussion about better measurement of digital infrastructure in service of the public good. To start this conversation, the paper considers three questions:

1. What indicators are currently and regularly collected?
2. What should be measured to better assess the quality and performance of digital infrastructure at a national level?
3. What are the important considerations and challenges in trying to create a more holistic measurement framework for digital infrastructure?

This exercise was carried out through a rapid assessment of existing surveys and tools used to assess payments, identification, and data exchange technologies as well as several composite indices. Additionally, consultations were carried out with a targeted group of experts to validate the results of the assessment.

The assessment phase scanned existing tools for measures of safeguards relevant to fostering trust in digital infrastructure as well as indicators of outcomes of digital infrastructure investments for individuals, markets, and public service delivery (competitiveness, financial inclusion/resilience, trust in government, e-government services, surveillance, vaccine delivery, and government-to-person payments). Relevant indicators from the tools we reviewed are detailed in Appendix 1.

In the analysis phase, desk research was complemented by consultations with partners at the World Bank, Freedom House, USAID, Tufts University, Center for Financial Inclusion, Center for Global Development, and Digital Impact Alliance in order to a) test some emerging assumptions about the opportunities for strengthening the causal link between the supply of digital public infrastructure and development outcomes and b) offer a broad outline of a holistic framework for measuring digital infrastructure and its intended outcomes.

Findings

Finding 1: Fragmented universe of digital indicators makes for an uncertain and complex relationship between digital infrastructure and development outcomes

There is no comprehensive source for understanding the state of digital infrastructure in lower-middle-income countries (LMICs). This gap hinders the ability to benchmark progress (in time or against other countries) and the ability to establish a strong causal chain of impact. In other words, with robust indicators of digital infrastructure, it would be more possible to understand how the characteristics of that infrastructure directly impact usage and quality of services and ultimate outcomes.

Broadly, two types of indicators were identified during the rapid assessment: Those capturing the uptake of digital services and those capturing the presence of people's digital rights (over their data, over freedom from surveillance, and so forth).

Within the first category: Indicators of digital infrastructure and services tend to align with the silos of funding institutions, with digital finance and digital health being the most robust. However, as described below, even these fields focus mostly on the availability and usage of services without providing mechanisms for understanding the underlying characteristics of the infrastructure enabling them.

Within the second category: A number of organizations, most notably Freedom House, track digital rights and user experience. For instance, Freedom House's Freedom on the Net survey assesses not only the policy safeguards on the books but the enforcement of those said policies that may hinder surveillance and freedom of expression.

Despite the fragmentation and limitations outlined above, country-level case studies and analyses are often very rich sources of insight. Countries such as Kenya, India, Estonia, and Peru have been studied extensively. These studies, often qualitative, offer important insight into the motivations, implementation practices, and user experiences of digital infrastructure and services.

Finding 2: Overemphasis on the scale of digital services obscures the complexities of the impact on people and markets

Perhaps not surprisingly, there are more robust efforts to track the scale (availability and usage) of services than the characteristics of the infrastructure enabling them. As a result of this over-indexing, current measurement models and tools obscure two critical aspects of development outcomes:

1. **Competitive, healthy markets for long-term development impact**: What can have positive near-term benefits for individuals and households—such as greater usage of digital banking solutions—can be harmful to market competition if those payments solutions are not underpinned by open, interoperable payments infrastructure. Likewise, a robust and competitive digital marketplace can exist in parallel to an authoritarian government that uses digital identity infrastructure to surveil citizens and censor content. A meaningful monitoring framework must attempt to assess impacts at these levels as well. Payments tracking tools are among the more mature indicators which attempt to evaluate the factors that influence long-term health of the marketplace—for instance through tracking the regulatory environment and, to a lesser extent, interoperability of mobile money services. These indicators offer a starting point for how to think more holistically about the ways in which digital services may be contributing to competitive markets or, conversely, toward monopolistic trends.

2. **User experience, trust, and empowerment:** Several current indices effectively capture the existence of data protection laws, policies, and regulations but, in some cases, also attempt to use this as a proxy for upholding individual rights. This is an inadequate approach to understanding the presence and performance of safeguards since these databases do not indicate the extent to which the laws are upheld nor do they effectively track specific clauses that are important to building agency and trust such as data portability, redressal systems, or effectiveness of oversight mechanisms. This is not to suggest that such provisions do or do not exist within the laws and policies but rather an observation of what is and is not systematically tracked and documented. Fortunately, the rapid assessment did identify a few notable exceptions that track perceptions (e.g., Tufts Digital Intelligence Index—Trust Indicators) and behavior (e.g., RDR Corporate Accountability Index), offering a useful point of departure for developing a more integrated approach to assessing the relationship between user experience and the design, implementation, and governance of digital infrastructure.

Finding 3: Structural and intellectual constraints are mutually reinforcing and limit efforts to develop a more holistic measurement model for digital infrastructure

While the consultative process carried out for this paper reinforced the findings of the rapid assessment, it also provided additional insights into "why" measurement tools and approaches are constrained in the ways described above. There is consensus among the community of experts engaged in the development of this paper that a more holistic approach is essential to understanding the socioeconomic impact of digital infrastructure. The question is not if such measurement tools are needed but how to overcome two reinforcing hurdles:

1. Structurally, the cross-cutting nature of digital infrastructure—affecting every sector of society—combined with the rapid introduction of new technologies, new business models, and evolving consumer expectations demand new institutional frameworks and ways of organizing. Those consulted for this paper reinforced the idea that too often measurement of digital investments mirrors traditional development sector-specific practices and are therefore ill-equipped to reflect impact across society.

2. Intellectually, there is a lack of standards for assessing digital infrastructure. Interoperability, for example, is a term with several meanings. Even more basic is the question of "usage" of digital services. Recently the Web Foundation introduced the measure of "meaningful connectivity" to recognize that most indicators of usage of broadband services mask the real extent to which people are connected to the internet. Until there is coherence around definitions it will be difficult to accurately draw the throughline between the characteristics of digital infrastructure and how those impact people and markets.

Proposing a more holistic approach to measuring good digital infrastructure

In light of these findings, there is an opportunity to build out a measurement framework that helps test a causal link between digital infrastructure and ultimate impact on people, societies, and markets.

Establishing and using such a measurement framework creates the basis for data-informed pivots by policymakers and donors focused on digital transformation. A measurement framework may also evolve into a readiness index and can serve to diffuse what may currently be described as biased or political assertions of good practice.
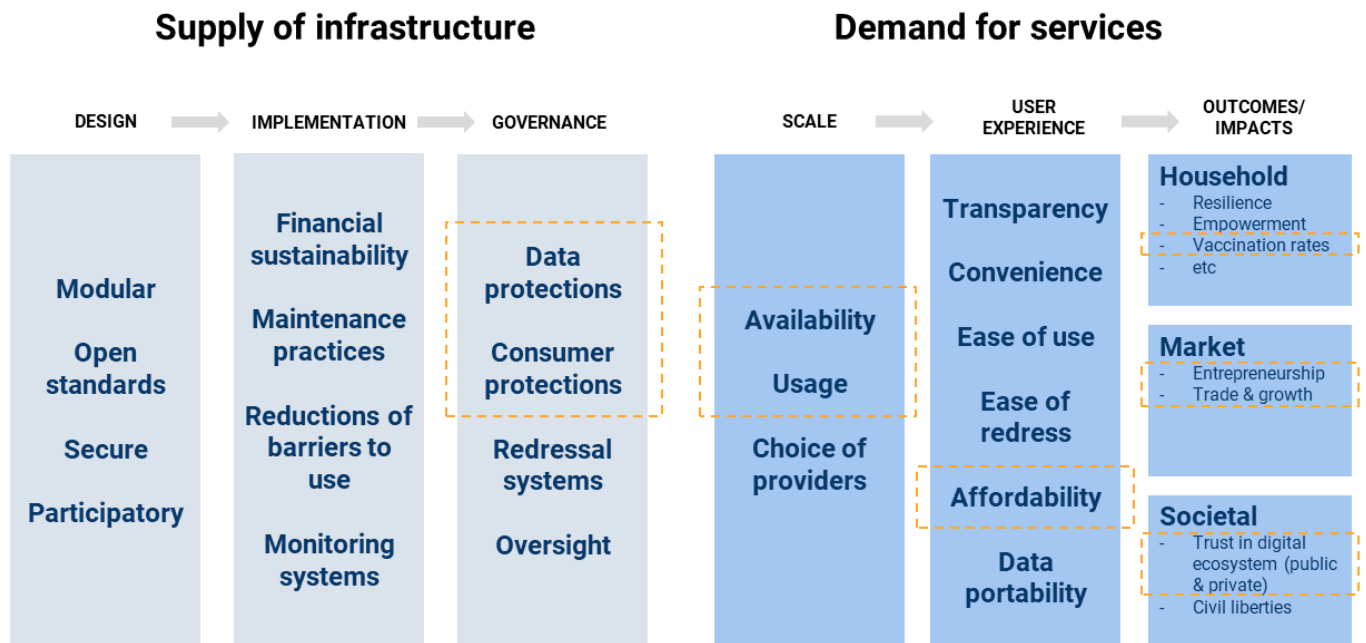
The notional framework presented below reflects the trends of monitoring and evaluation already underway in the identity and payments arenas. This framework, therefore, attempts to bring together those ideas to foster discussion about a holistic approach to understanding how a digital stack can influence people, markets, and societies. Note that much more work must be done to refine a framework and the indicators that can offer a holistic view.

We rely on three concepts to make up the framework:

1. Infrastructure versus services: We distinguish between enabling infrastructure and the services that ride on top. Infrastructure in this exercise refers to the platforms of payments, identity, and data exchange. Services are the applications that are, for the most part, consumer facing such as digital banking (enabled by payments and identity infrastructure), e-government service portals (enabled by identity and data exchange infrastructure), for example.

The left side of the framework focuses on measures of the enabling infrastructure whereas the right side of the framework focuses on measures of consumer-facing services.

Figure 1. Toward a more comprehensive understanding of digital infrastructure's impact on people and markets

INDICATES WHERE GOOD INDICATORS ALREADY EXIST

Source: Authors

2. Defined causal link: The framework suggests a measurement system must track the entire causal chain in order to discern whether the availability of digital infrastructure is leading to the broad set of outcomes at the individual/household, market, and societal levels. As a starting point, the framework hypothesizes that the design, implementation, and governance of infrastructure will affect the adoption and satisfaction in services for households but also the competitive nature of markets and societal level of trust in digital services and information.

3. Lifecycle of supply: The framework recognizes the importance not only *of* enabling digital infrastructure but *how* it conforms to good practices in the different stages of design, implementation, maintenance, and governance. While we do not fully capture the opportunity to examine digital infrastructure choices throughout the lifecycle, we include some aspects including, for example, the need for a multiplicity of online and offline implementation tactics. Any final framework adopted should build upon this attempt to monitor across the lifecycle.

Caveats and considerations

While much more can and should be done to understand the extent to which digital infrastructure is designed, implemented, and governed to maximize impact, there are important considerations to take into account:

1. Understanding the impact of infrastructure is inherently complex and has its limits. Digital services and the infrastructure that enable them must be understood as offering new choices and new capabilities. But their presence, no matter how well designed, does not guarantee positive outcomes. For example, having access to a digital bank account—even one that offers a great user experience—does not guarantee good money management choices. Any monitoring framework must accept this inherent limitation.

2. Methods of understanding the supply and demand sides will require mixed methods. As noted, rich qualitative insights exist at the country level, often focusing on user experience. The need for qualitative approaches will be great given the limitations of quantitative methods to reveal why and how digital tools perform. That said, there is an opportunity to use quantitative, supply-side surveys to reveal issues of user experience. For instance, it would be helpful to capture standard metrics around the number of complaints handled through grievance systems, (further broken down, perhaps, by gender and outcome of the complaint). While such statistics will not give a full picture of the strength of redressal systems, they will help reveal where to further prod.

3. Even the proposed framework above does not speak to the practices of digital transformation which can support learning and improvement. We endorse (a) agile/iterative design and feedback loops that can support data-informed pivots; (b) sustained financing to ensure proper maintenance; (c) technology expertise embedded within government to ensure strategic decisions are serving the public good. These practices, and many others, should be encouraged and, perhaps, monitored.

Despite these challenges, the need for a holistic framework—and an organization with a clear mandate to shepherd such a framework—for understanding digital infrastructure is critically important. Without such measures in place, the opportunity to leverage advancements in technology to support the Sustainable Development Goals may elude us.

Appendix 1. Review of indicators

Digital payments indicators

Indicator	Description	Source	Date	Geographic coverage
Account ownership	Do you, either by yourself or together with someone else, currently have an account at a bank or another type of formal (regulated) financial institution?	Global Findex (World Bank)	2017	Global (140 countries)
Account usage	Have you used a mobile phone to make payments, to buy things, or to send or receive money?	Global Findex (World Bank)	2017	Global (140 countries)
Account usage	Have you used the Internet, whether on a mobile phone, a computer, or some other device, to pay a bill?	Global Findex (World Bank)	2017	Global (140 countries)
Account usage	Have you used the Internet, whether on a mobile phone, a computer, or some other device, to buy something online?	Global Findex (World Bank)	2017	Global (140 countries)
Interoperability	What are the main payment networks (i.e. Visa, Mastercard, Safaricom, Tigo)? Are there major barriers for interoperability among these networks?	Global Microscope (Center for Financial Inclusion)	2020	55 countries (LMICs)
Interoperability	Mobile money service-to-service interoperability	GSMA State of the Industry Report on Mobile Money	2020	
Interoperability	Open APIs that enable third-party integration with mobile money providers	GSMA State of the Industry Report on Mobile Money	2020	
Iterative innovation	Does the government foster financial innovation? (e.g. are there sandboxes and/or other test-and-learn approaches?)	Global Microscope (Center for Financial Inclusion)	2020	55 countries (LMICs)
Consumer protection	Is there a framework and specialised capacity in place for financial consumer?	Global Microscope (Center for Financial Inclusion)	2020	55 countries (LMICs)

				55
Consumer protection	Are funds held in e-money accounts adequately protected through the following mechanisms: (i) prefunding and storage of funds in safe, liquid investments; (ii) isolation of customer funds using a trust or similar fiduciary arrangement; and (iii) application of direct or pass-through deposit insurance to e-money account balances?;	Global Microscope (Center for Financial Inclusion)	2020	countries (LMICs)

Digital identity indicators

Indicator	Description	Source	Date	Geographic coverage
Access	Do you personally have a (local version) of the National Identification Card?	Global Findex (World Bank)	2017	Global (140 countries)
Access	Number of people without ID by country, gender, and age	ID4Development (World Bank)	2018	Global
Access	Measures coverage of registries or a master patient index of uniquely identifiable individuals	Digital Health Index	2017-2020	25 LMICs
Access	Availability of birth registry	Digital Health Index	2017-2020	25 LMICs
Access	Measures coverage of death registry of uniquely identifiable individuals	Digital Health Index	2017-2020	25 LMICs
Access	Asks whether an individual has a government issued birth certificate	Living Standards Measurement Survey (World Bank)	Collected every 5 years	Global
Access	Asks whether an individual has a government identity number	Living Standards Measurement Survey (World Bank)	Collected every 5 years	Global
Quality	Key characteristics of national ID (NID)	ID4Development (World Bank)	2018	Global

Data exchange indicators

Indicator	Description	Source	Date	Geographic coverage
Presence of health data exchange	**Tracks deployment of DHIS2, an open source platform for collecting and analyzing health data**	[DHIS2](#) **University of Oslo**	**Real time tracking**	**70+ countries**
Presence of health data exchange	Tracks the extent to which digital health systems support the monitoring & evaluation of public sector priority areas of health	[Digital Health Index](#)	**2017-2020**	**25 LMICs**
Data standards for sharing	Tracks the existence and maintenance of health information standards for data exchange, transmission	[Digital Health Index](#)	**2017-2020**	**25 LMICs**
Data standards for sharing	Focuses on the first step of data sharing: publicly available datasets. It does not focus on the quality of the data but, rather, availability, ease of finding/understanding, format of sharing data, etc.	[Global Open Data Index (Open Knowledge Foundation)](#)	**2016**	**Global**

Authors also reviewed:

[Web Foundation's Meaningful Connectivity Indicators](#)
[University of New South Wales' Table of Data Privacy Laws and Bills](#)
[UNCTAD's Consumer Protection Legislation](#)
[Freedom House's Freedom on the Net](#)
[New America's Ranking Digital Rights](#)
[World Bank's Civil Society Participation Index](#)
[Tufts University Digital Intelligence Index](#)
[World Bank's Ease of Doing Business](#)
[Carnegie Endowment's Artificial Intelligence Global Surveillance Index](#)
[International Telecommunications Union's Global Cybersecurity Index](#)
[United Nations Department of Economic and Social Affairs' eParticipation Index](#)

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