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Pathways to Prosperity

Public Digital Infrastructure Playbook

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About the authors

Carlos Montes is Visiting Fellow at the Cambridge University Judge Business School.

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1. Introduction

Playbooks are a series of reports to share lessons on how to make societies more open and prosperous. This Playbook focuses on how digital identity and payment tools have the potential to become development 'silver bullets' by removing key obstacles to prosperity in low and middle-income countries.

Not all countries have benefited equally from global economic growth, partly because many people in poorer countries lack secure property rights and access to credit, public services, information, and other critical economic infrastructure. Exclusion from these key parts of the economy has also affected social cohesion in some countries, particularly where political leaders focus on providing economic rents to their narrow groups of supporters.

The digital tools that this Playbook focuses on – that permit universal identification and payment systems – can empower citizens of these poorer countries by lowering the barriers to formal property rights and key modern economic institutions (like finance). The innovations presented in this report are modelled on the Indian experience of a government-backed system of digital ID and payment interfaces (APIs) that should, in principle, be viable in other low and middle-income countries with relatively low state capacity.

Different approaches to development can be grouped as “top-down” or “bottom-up”. Top-down interventions focus on political development (democratisation/political leadership) and improving the quality of macroeconomic policies at the national level, with an emphasis on aggregate measures of success. Bottom-up approaches, on the other hand, focus on improvements at the level of individuals and firms – strengthening and formalising property rights, improving access to finance, increasing participation in the formal economy – with a focus on ease of doing business and improvements in microeconomic outcomes as measures of success.

The level of success of these approaches may differ in different contexts. Conventional top-down policies, however, have often proven insufficient to support development due to their inability to reach the informal sector, which is often very large in the poorest countries and falls outside the scope of those policies. It is this weakness of conventional approaches to development that digital tools seek to remedy by providing basic property rights protection to every citizen. Bottom-up solutions are also potentially more attractive for some states because instruments like digital tools do not challenge their authority directly and, in some cases, can offer other advantages, such as broadening the tax base.

The Indian experience shows a ‘third way’ of developing digital infrastructure, different from the more *laissez-faire* US approach or the more centralised, interventionist Chinese approach. In partnership with the private sector, the Indian government provided critical digital infrastructure to kick-start the digital economy (focused on micro-payments), ensured level competition, and provided tools to the poor and the informal sector to participate in the economy, strengthening property rights and access to markets for people who would otherwise be marginalised and disempowered.

Problems facing low and middle-income economies

- Chronic rent-seeking and economic cartelisation because of the political and economic power wielded by insiders, who can suppress competition and oppose pro-competitive reforms at the expense of outsiders (the rest).¹
- The resulting weak social cohesion and civil instability when “outsiders” recognise their disenfranchisement and exploitation by “insiders”.
- Low productivity in rural areas and the informal sector, and limited access to infrastructure, finance, and knowledge.
- Lack of universally recognised documents for people to prove their identity and the property they hold, preventing capital accumulation and access to credit. Key for Peruvian economist Hernando de Soto.²
- Large informal economies with low productivity and low growth that do not contribute to the tax base, creating a vicious circle of higher taxes on the formal economy, low public investment, low growth, and diminished state legitimacy.³
- Inefficiency and leakages in the delivery of government services and welfare transfers.
- Frictions in markets related to transaction costs, limited information, limited competition, and non-instantaneous market adjustments.⁴

Notes

- 1 Hertog, S. *Locked Out of Development: Insiders and Outsiders in Arab Capitalism*, Published online by Cambridge University Press: December 22, 2022.
- 2 Without this documentation, economic agents find it more difficult to use their property as collateral to obtain loans, participate in investments, and trade in markets. De Soto notes that “the enterprises of the poor are very much like corporations that cannot issue shares or bonds to obtain new investment and finance. Without representations, their assets are dead capital.” De Soto, *Mystery of Capital*. Basic Books, 2010. De Soto finds that the widespread protests of the 2010 Arab Spring were motivated precisely by a lack of documents to allow the poor to buy or sell and raise capital.
- 3 Hertog, S. *Locked Out of Development: Insiders and Outsiders in Arab Capitalism*, Published online by Cambridge University Press: December 22, 2022.
- 4 These frictions limit the positive welfare impact of markets, as per the Arrow-Debreu General Equilibrium Model.



APIs empower individuals by facilitating the establishment and protection of their property rights.
Credit: xavierarnau, iStock.

2. Digital solutions as part of a bottom-up toolkit to support property rights

Peruvian economist Hernando de Soto argues that giving people the ability to trade and own property is key to unleashing the power of markets to raise prosperity, and that many developing countries fail to grow because their citizens lack these basic rights.¹ De Soto argues that many poor people have *de facto* property for which they lack *de jure* ownership, preventing them from accumulating capital and using their existing property to, for example, access capital markets.

Work in this area has historically focused on giving *de jure* property rights to these *de facto* property owners. In this paper, we argue that control over and the ability to do business easily, using one's identity and finances, are similar forms of property rights that, while taken for granted by people in high-income countries, are out of reach for many in low and middle-income countries. We assert that, if people were given the ability to control these property rights, more economic opportunities would be available to them, particularly in the formal economy. Digital tools that allow people to verify their identity and access banking and payments, in order to access more of the formal economy, should be considered as a new part of the development toolkit in building these rights.

This report focuses on two main tools: digital identity services and payments interfaces, both based on standardised application programming interfaces (APIs). It draws primarily on India's success with the Aadhaar identification system and the Unified Payments Interface (UPI) system. These are government-sponsored initiatives that have given Indians a cheap and easy way to verify their identity and initiate payments to, and receive payments from, trusted third parties.

At their core, digital identity and open payment processing interfaces (APIs) empower individuals by facilitating the establishment and protection of their property rights in an increasingly digital world. In contemporary economies, transactions and property titles are predominantly digital, making identity verification crucial for asserting and exercising property rights. For those in high-income countries with passports, pre-existing bank accounts, and extensive prior online activity, verification may be a simple process. However, for some individuals residing in low and middle-income countries, this task can be financially burdensome or altogether unattainable.

By implementing digital identity systems, low and middle-income countries can ensure that their citizens have access to the basic tools necessary to prove their identity and access critical services. This verification enables them not only to participate in the global digital economy, but also to assert their rights to property, government services, and financial resources. Similarly, open payments processing interfaces (APIs) permit seamless transactions between various parties, fostering financial inclusion and promoting economic growth.

These two tools can allow citizens – particularly the poor – to:

- Have universal ID, recording their existence in the country;
- Access banking and finance where Know Your Customer (KYC) checks would previously have been too expensive and unreliable to allow them to do so;
- Access mobile phones where KYC checks would previously have been too expensive;
- Hold money in their own bank account and receive money directly;
- Access public services directly, including cash benefits;
- Make user-friendly, zero-cost micro-payments to other citizens or small businesses;
- Participate actively in markets;

- Join the formal economy, including paying taxes, since the benefits of doing so often outweigh the costs.

As well as these direct benefits, the tools may permit the development of additional products/services/technologies such as:

- Easier creditworthiness checks, facilitating access to credit (e.g., for the creation of a business);
- The ability to demonstrate streams of income, even if small, thereby also facilitating access to credit;
- Strengthening of the digital economy, including the penetration and cost of mobile phones since they also benefit from cheaper e-KYC.

Developing and implementing an effective digital ID and payments solution may have other benefits too. The solution can, for example, be rapidly scaled up internationally: while designing this digital infrastructure from scratch at the population level is technically very complex, it can, once designed and implemented in one country, be rolled out (with country-specific adaptations) to many other countries.

The introduction of digital tools may also face less political resistance than more large-scale, top-down attempts at reform. This is because digital tools may be perceived as linked to efficiency and higher tax revenues, without requiring destabilising political and structural changes that could be blocked by existing 'rentist' political and economic elites and other vested interests. We have seen this in the past in relation to other technological innovations. For example, the Green Revolution of the 1960s and 1970s increased crop yields and appeared benign to the states that adopted these technologies, but ultimately led to structural transformations as food costs and famine rates fell and the middle classes grew and demanded more political and economic rights.

This may be especially true in the case of the tools proposed in this Playbook. They make it easier for states to collect and maintain information about their citizens, while digital payments make it easier to track transactions and financial flows which, in turn, facilitates a broadening of the tax base. Both may be appealing to developing world governments, even if the resulting economic empowerment of citizens subsequently leads to demand for economic reforms.

The bottom-up interventions outlined here can provide citizens with greater control over their political and economic lives, empowering them to exercise their rights and responsibilities and enhancing their ability to participate in the market economy. Broad-based access to digitalisation may lead to greater social cohesion, stability, and economic inclusion by growing the 'outsider' share of the economy and tax base and eroding the positions of insider vested interests and their privileged position in policymaking. As such, these digital tools may support more wide-ranging reforms in countries that suffer from costly rent-seeking.

Notes

- 1 Hernando de Soto found that the 2010 Arab Spring was largely motivated by the frustration of poor people at not being able to trade in the economy. Source "Unlikely Heroes of the Arab Spring", https://www.youtube.com/watch?v=K_CnTANr0YU.



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In India, UPIs are accepted even in food markets.
Credit: Dinesh Hukmani, iStock.

3. India – a trailblazer in digitalisation that creates better markets

In India, the government has successfully implemented two powerful tools – a minimalist and universally accessible identification system (Aadhaar) and a user-friendly payment system (UPI) – that have removed many of the obstacles faced by the informal sector and the economically disadvantaged when participating in trade and business (see Appendix 1 for full details).

In just 15 years, since the introduction of the first of these measures, India has transformed how it identifies its citizens, how peer-to-peer payments are made, and how the government operates in relation to citizens (for example, by making cash transfers directly to citizens' bank accounts). This success has been recognised by international organisations such as the IMF and the Bank for International Settlements (BIS) (see Appendix 7) as well as business leaders, including Jack Ma of Alibaba, Sundar Pichai of Google, and others.¹ In March 2023, Bill Gates praised India for laying strong digital infrastructure that has provided room for innovation and applications, asserting that no country has built a more comprehensive digital infrastructure than India and that it can be an example for other countries.²

A 2019 Bank for International Settlements report on India's digital infrastructure also concluded that its financial ecosystem has the potential to serve as a model for other countries seeking to promote financial inclusion through digital means.³ International organisations have recognised that India's digital infrastructure has allowed it to reshape the geography of finance in a way that few countries have managed before,⁴ making it a global pioneer in technological innovations in finance.⁵

Even developed countries have been urged to emulate India. In December 2019, Google recommended that the US Federal Reserve Board look at India for specific suggestions on how to build the new instant payment system FedNow.⁶

India's digital transformation through the lens of a Tea Maker

We can gain insight into the social impact of the introduction of universal identification and peer-to-peer payments through the experiences of a young *Chaiwala* (tea maker), as told by Saurabh Mukherjea, founder of Marcellus Investment Management.⁷

The *Chaiwala* works outside Saurabh's offices in Mumbai. Some 18 months ago, he started making 500 cups of tea a day to sell to customers. Saurabh would pay him 50 rupees and get 25 rupees back in change. Today, the *Chaiwala* does not accept cash or credit cards, only the new payment system, Unified Payments Interface (UPI), which he uses through his mobile.

Because he no longer has to handle change, the *Chaiwala* has more time to make tea and serve customers. The risk of theft is also much lower because he does not carry cash. Furthermore, there are productivity gains for his milk supplier, who no longer has to spend time collecting payment and can receive it digitally at the end of every day.

In addition to making the *Chaiwala's* life easier, UPI also means that he cannot evade taxes (and since he has chosen to use the system, it is reasonable to assume that its benefits outweigh this additional tax burden). The *Chaiwala* now also has a bank account – a requirement for operating with UPI – and his bank can see his 8,000 credits (for every tea) every day (at 25 rupees), enabling it to offer him working capital.

Countless similar stories have unfolded in India,⁸ to the point where the impact can be seen at the macro level through a large increase in unsecured working capital finance for small businesses. Moreover, UPI has resulted in a significant decline in the cost of capital for the *Chaiwala*, who is now able to borrow via UPI at 11%, rather than 25% on the informal lending market.

India's digital transformation has improved citizens' lives and created better markets

National Identity

- National ID has been distributed to 1.3 billion people in India. Most of the population now has ID and the satisfaction rate reaches 90%. This provides individuals – including those who cannot read or write – with a trustworthy identity, independently of income, location, gender, and ethnicity, allowing them to be acknowledged in the country. In 2008, only 4% of the population had a passport, which was the only unique and multi-purpose form of identification available.⁹ In Bill Gates's words, this ID helps the poorest people to become visible.¹⁰

Payments

- UPI is used by 260 million people, accounting for 64% of all transactions. This radically different way of making payments has become part of the fabric of society and has democratised the payment system. It is an easy, seamless, free, and ubiquitous micro-payment system that can be used for any kind of electronic transaction. By establishing a central system that anyone can join and use, it avoids the creation of payment islands. UPI is offered as one of a variety of payment systems so that citizens have a greater choice.
- The Aadhaar-enabled payment system has helped to take bank services to remote villages and towns. This gives the elderly door-step banking access to their government benefits.
- People benefit from the ability to pay merchants easily through QR codes.
- Aadhaar has reduced the cost of KYC checks by a factor of 200.¹¹ This has directly contributed to making lower-income clients more attractive and to the expansion of cheap mobiles and data and a large increase in bank accounts (as both require KYC).
- Aadhaar has enabled almost 50% of people to open their first bank account and almost 40% to access mobile services.¹²
 - The availability of cheap mobiles has expanded. Connections and data consumption increased to 0.5 GB a day (from 0.15 GB a month) and India now has one of the world's lowest data charges.¹³
 - Access to bank accounts has increased, reaching 80% of the population in six years (which would normally have taken 47 years).¹⁴ This is one of the largest increases in account ownership in the world, according to the Global Findex 2021.¹⁵

Government transactions

- Citizens benefit from improved targeting of government programmes.
- Citizens receive Direct Benefit Transfers in their Aadhaar-linked bank account, not only increasing speed and convenience, but also reducing leakages.¹⁶ Benefits totalling \$310 billion have been transferred so far, reducing the diversion of funds and corruption.
- The system facilitates citizens' monitoring of government expenditures, including the Public Distribution System (flagship food security programme) and the Mahatma Gandhi National Rural Employment Programme (MGNREGA) (the largest in the world).

DigiLocker and e-Sign

- Citizens can access documents issued by the state and central government through a platform (DigiLocker) without having to queue physically. This is especially useful for rural households.
- People obtain access to various digital services: e-Sign (to endorse any document with an e-signature), DigiLocker (secure depository for all digitally signed documents), the digital opening of a bank account, electronic toll collection, and digital tax filing, etc.

Access to loans and the innovation ecosystem

- 4.5 million individuals and companies have benefited from more accessible loans, thanks to the streamlining of procedures and the lower costs of financial services due to the introduction of the "account aggregator" framework for data governance.
- The digital footprint of UPI is beginning to provide informational collateral for expanding credit to some of India's 60 million small enterprises (potential expansion of 2 million jobs).
- People have also benefited from the entrepreneurial and employment opportunities created by the expansion of the digital economy as a result of these digital tools. These tools not only use international technology but also technology based specifically on India's digital infrastructure. There is an ecosystem of products that are built leveraging the digital ID and UPI. The number of start-ups increased from 445 in 2016 to 86,713 in 2022, including 27,000 active tech start-ups.¹⁷
- The innovation ecosystem is reflected in the EY Global Fintech Adoption Index 2019¹⁸ in which India and China led the survey of 27 markets. Similarly, fintech investment doubled to \$35 billion in 2022 and India's share of global fintech funding has doubled since 2016. Fintechs are expected to capture 15% of India's enterprise value by FY 2026 compared to 1.4% in 2021.¹⁹
- Micro-payments have provided the digital economy with the necessary dynamism (which could not be based on advertising).
- Remittances from cities to rural villages are easier.

Informal economy

- Overall, citizens in the informal economy have gained in different ways from these digital tools and, as a result, the benefits of the formal economy have substantially increased. Individuals and micro-enterprises have joined the formal economy because it now offers them benefits, not only hassle. This has contributed to a substantial increase in the formal economy, resulting in a net gain for society, contributing to integration and social cohesion, and supporting the state's revenue-raising capacity. Between July 2017 and March 2022, 8.8 million new taxpayers registered for the digital sales tax.²⁰

Better markets

- Markets are more competitive and transaction costs lower for all citizens. More consumers have access to markets. Small companies have gained easy access to markets.
- By lowering the cost of credit and making it easier for people to set up businesses and transact, particularly in emerging markets where access to capital and resources has been historically restricted, these digital tools may also increase overall economic growth.
- The digital tools available today have the potential to address one of the central grievances of protesters during the 2010 Arab Spring: the inability to conduct business openly and freely, which was the catalyst for the original protests in Tunisia.²¹

These substantial improvements in the life of Indian citizens have been possible thanks to technological solutions, rather than conventional high-level top-down political or economic interventions. Nandan Nilekani, co-founder of Infosys and one of the programme's architects, has argued that, by empowering the poor and the informal sector, the tools are helping to create a more inclusive and democratic society, one that offers greater opportunities and benefits to all its citizens.²²

Notes

- 1 Among key reports on the success of India's digital strategy, see BIS Papers No 106 "The design of digital financial infrastructure: lessons from India" by Derryl D'Silva et al., BIS Monetary and Economic Department, December 2019, and Stacking Up the Benefits. Lessons from India's Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, March 2023.
- 2 CNBC TV18, <https://www.cnbctv18.com/technology/bill-gates-ashwini-vaishnaw-no-country-has-built-a-more-comprehensive-digital-infra-than-india-16070431.htm>.
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- 5 "How India's Central Bank Helped Spur a Digital Payments Boom", Jeff Kearns and Ashlin Mathew, October 27, 2022. IMF Country Focus.
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- 10 "Making the World's Invisible People, Visible", Bill Gates, January 29, 2019. Gates Notes, The Blog of Bill Gates. Video: Nandan Nilekani, Heroes in the Field.
- 11 The use of e-KYC lowered the cost of compliance from \$12 to \$0.06. Also based on Hariharan, V, 2016: "A leapfrog moment for Indian banking", Indian Software Product Industry Roundtable – iSPIRT, December 28, and Stacking Up the Benefits. Lessons from India's Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, March 2023.
- 12 State of Aadhaar Report, 2019, quoted in Stacking Up the Benefits. Lessons from India's Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, March 2023.
- 13 Competition policies in the telecom market have also been key. "The entry of a new network operator in 2016 lowered the cost of mobile data by 90 percent leading to a jump in data usage from 154 MB/month in 2015 to 15.8 GB/month in 2021." A mobile data and voice basket (including 70 min + 20 SMS + 500 MB) costs \$1.8 in India compared to a world median of \$11.5 and \$7.6 among lower middle-income peers. Stacking Up the Benefits. Lessons from India's Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, March 2023.
- 14 BIS Papers No 106 "The design of digital financial infrastructure: lessons from India" by Derryl D'Silva et al., BIS Monetary and Economic Department, December 2019. Also quoted in Stacking Up the Benefits. Lessons from India's Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, March 2023.
- 15 The Jan-Dhan Yojana programme also contributed to this spectacular result. As of August 2022, 462.5 million bank accounts had been opened. Stacking Up the Benefits. Lessons from India's Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, March 2023.
- 16 PM Gandhi had stated in 1985 that beneficiaries only receive 15% of every rupee spent.
- 17 The number of start-ups in India grew to 72,993 in 2022, up from 471 in 2016, Economic Times, Feb 15, 2023. "India now has nearly 27,000 active tech start-ups, added 1,300 last year." <https://economictimes.indiatimes.com/tech/startups/india-now-has-nearly-27000-active-tech-startups-adds-1300-last-year/articleshow/97940297.cms?from=mdr>.
- 18 EY Global FinTech Adoption Index 2019. https://www.ey.com/en_uk/ey-global-fintech-adoption-index.
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- 20 Stacking Up the Benefits. Lessons from India's Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, March 2023.
- 21 Hernando de Soto researched these protests thoroughly and found that the reason street sellers decided to self-immolate in such a dramatic way was simply because the state was denying them the opportunity to trade in markets. "The Economic Roots of the Arab Spring", April 23, 2012, Council on Foreign Relations, <https://www.cfr.org/event/economic-roots-arab-spring>.
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Many Indians possess strong educational skills in mathematics, engineering and IT.
Credit: triloks, iStock

4. Factors that permitted India's digital success

In 2008, political leaders and the private sector in India joined forces and turned their attention to the 'modernisation' of India following decades of state-led development with an emphasis on traditional socialist and pro-poor policies. Nandan Nilekani, one of the programme's architects, called for a "Reimagined India" or what Prime Minister Modi would later call a "New India".

Nilekani and other reformers focused on reducing the gap between India's booming economy and stable democracy and, on the other hand, chaotic conditions in the provision of even the most rudimentary services.¹ They sought to tackle the duality of the economy, with one of the largest informal sectors in the world,² a third of the population in poverty,³ and a population with poor access to banking facilities and state services. Nilekani envisioned that these intractable challenges for the country's social and economic development could be addressed through population-wide digital infrastructure interventions, such as universal identification linked to a digital payment system.

Nilekani's vision was not only revolutionary; it was also breathtaking in scope. Yet, universal identification and a new peer-to-peer payment system were introduced surprisingly rapidly for an economy as large and complex as India's and, as we have shown, soon delivered major results.

The universal identification and digital payment systems implemented in India are more sophisticated than those introduced in most high-income countries.⁴ Uniquely, India's digital ecosystem combines government services (so well developed in Estonia) with digital payments infrastructure for the entire economy, including electronic toll collection on roads (through radio frequency identification technology), data management for the benefit of citizens, and digital tools to be developed in the health and agricultural sectors.⁵

How has a lower middle-income country, with a clientelist political system and a highly bureaucratic and hierarchical civil service, been able to design and implement world-class universal identification and payment systems so quickly?

Firstly, the need for a universal identification system and a versatile, low-cost digital payment system was far greater in India than in high-income countries, most of which already have sophisticated payments and ID infrastructure in place. Due to the general lack of such infrastructure in India, these innovations have faced far less opposition from entrenched legacy technologies and incumbent companies. Moreover, a cheap and fast digital payment system for small transactions was imperative for the development of India's digital economy because other revenue streams for online services, such as digital advertising, are too small.

Second, the digital programme has produced positive results for citizens, and politicians want to be associated with this success. Moreover, there has been a strong commitment from political leaders and private-sector entrepreneurs to the vision of a "Reimagined India" and the "New India". Prime Minister Modi believes that India can reclaim its greatness by advancing economically while drawing on the past Hindu civilisation for inspiration. This nationalism has given special impetus to ambitious government programmes for economic development.

This has also informed the crucial collaboration between a reform-seeking public sector with strong support from Prime Minister Modi, leadership by the Reserve Bank of India (RBI),⁶ and cutting-edge input from the private sector. The close public-private partnership was well coordinated by Nilekani with the leadership of the RBI and the non-profit National Payments Corporation of India (NPCI).

By providing universal ID and digital payments for all Indians, the project has been able to lay claim to genuine universality, making it a true grand national project in line with the vision of a "New India".

The project's success also offered India the potential to reap 'soft power' benefits by standing out as a global leader in digital innovations for development. This is particularly the case because the project took a lead in technology in a way that has been quite distinct from the US and Chinese models of digital infrastructure. This is consistent with India's non-aligned and independent tradition.

Third, the vision, ability to execute, and leadership of Nandan Nilekani have been central to the success of these initiatives. He envisaged the changes needed in his 2008 book, *Imagining India: Ideas for the New Century*. Moreover, setting and surpassing a target of issuing 600 million identification cards in the first five years was something only Nilekani could have done.⁷ He joined the public sector to set up the Unique Identification Authority of India (UIDAI) to implement universal digital identification initially as a small start-up with limited resources and staff. He brought not only his own managerial and technical talent, but also his unique ability to attract the best professionals from the private sector, the Silicon Valley diaspora, and the civil service. Nilekani's reputation meant that very few would refuse an offer to work with him. This unique ability to attract and manage the best talent in the public sector can be compared to that of Lee Kuan Yew in Singapore (see also Appendix 3.)

In addition, Nilekani spent considerable time travelling around the country to socialise the idea with politicians, civil servants, financial and tech sector companies, and civil society and persuade them of the importance of Aadhaar for the vision of a New India. He made the effort to go to their regions and offices because he wanted to show that, "I am coming to you because I want your help in doing something nationally important." Nilekani broke with protocol because he visited not only senior officials, but also junior officials and telecom companies, oil companies, international organisations, and embassies. This approach created a powerful coalition in support of Aadhaar.

Finally, India was able to draw on the skills of many Indians, with a strong education in mathematics, engineering, and IT, including those who had been working in Silicon Valley businesses, both in the US and through work outsourced to India. This clearly illustrates the key role that diasporas can play in national development, far surpassing the contribution of foreign aid and technical assistance. India's high-level IT capabilities also permitted the in-house development of Aadhaar, avoiding vendor lock-in and lack of interoperability, something that will not be as easy to replicate in other countries.

Notes

- 1 Nilekani and Viral, *"Rebooting India, Realising a Billion Aspirations"*, Penguin Books, 2015.
- 2 "India Wage Report: Wage policies for decent work and inclusive growth" published by the International Labour Organization (ILO) in 2018. The report estimated that 80% of the Indian workforce was employed in the informal sector, making it one of the largest informal sectors in the world. In his book, Nilekani estimates that 90% of people are employed in the informal sector (page 50, footnote 4) and that the informal sector accounts for 90% of small businesses, etc.
- 3 Press Information Bureau, Government of India, Planning Commission, Poverty Estimates, March 2012.
- 4 Google recommended that the US Federal Reserve Board look at India for specific suggestions on how to build the new instant payment system FedNow (expected to be deployed in 2023).
- 5 In health, the Ayushman Bharat Digital Mission will connect disparate health systems through a unique health ID and registers of health professionals and health facilities, supporting an electronic medical record. Some 338 million unique IDs have been issued. Stacking Up the Benefits. Lessons from India's Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, March 2023.
- 6 The role of the Reserve Bank of India has been critical to the success of UPI. See Appendices 6 and 7 on the collaboration of the RBI and the private sector and on the regulatory challenges faced by the RBI.
- 7 As he narrates in his book, no adviser with knowledge of the sector thought this was a realistic target. Nilekani himself did not know what strategy to follow to reach the target. In the event, the UIDAI delivered 600 million Aadhaar documents in the first five years, above the initial ambitious target.



India's digital infrastructure has empowered many digital innovations.
Credit: pixelfusion3d, iStock.

5. Design principles that permitted digital success

The universal identification programme was implemented through a public organisation, the Unique Identification Authority of India (UIDAI), that, under Nilekani, followed a start-up model, focusing on being agile, resourceful, and innovative with small teams and resources. It also shared the IT culture of strong openness and collaboration and a commitment to a more open and inclusive society.

The digital infrastructure design teams have a very strong sense of “mission” and an IT culture of collaboration. Many work on a voluntary basis. The digital project is still strongly supported by mission-oriented non-profit organisations such as the Indian Software Product Industry Round Table (ISPIRT).

The digital infrastructure’s public-private nature ensured that all products had a focus on ensuring access for all citizens, including the poor (although, in practice, India’s poorest citizens have still not been able to take advantage of many of these policies – see below). Nilekani also explicitly referred to the need to mirror the competition of free markets and give support to a self-evolving digital ecosystem. The digital architecture mimicked decentralised markets, being minimalistic, interoperable, modular, and based on APIs, and permitting the provision of open-ended solutions by the private sector.

The team faced the challenge of designing digital tools for a population of 1.3 billion, including people with limited education and access to different types of technologies. To overcome this challenge, the design team again embraced market principles and focused on providing digital tools that were easy to use, cheap, and offered people as many benefits as possible. To understand the needs and constraints that people face, Nilekani and the team travelled extensively around the country.

Understanding the needs of ordinary people

One person was waiting patiently to receive his Aadhaar, despite already having three other forms of ID. When Nandan asked him why, he replied, “Idiot, if I have three buffaloes, and the government is giving me a fourth, won’t I stand in line?”

Source: Nilekani and Viral, *Rebooting India, Realising a Billion Aspirations*, Penguin Books, 2015.

The design team has consistently emphasized the programme’s: strong benefits for users, simplicity, cheapness for the user, interoperability, open architecture, a modular approach.

Interoperability has been central to this digital project, both in each digital layer and across layers. Interoperability and the adoption of an open-source approach ensure that this digital infrastructure promotes a competitive environment and provides access to the digital market for all market participants. The modular approach means that different components can easily be swapped in and out without requiring significant changes in the overall architecture and that other solutions (often local solutions with local knowledge) can be built on top of the key digital platforms, mixing and matching tools through open interfaces. This permits flexibility and innovation.

IMF Characterisation of India's Digital Infrastructure

India Stack's development is guided by a foundational building-blocks approach and a focus on supporting innovation across the ecosystem. The building-block approach involves unbundling the solution's components to a set of problems and identifying a minimal common core. This modular approach fosters innovation, allowing solutions to be built for multiple problems based on the common core. For a large and diverse country such as India, a building-block approach provides those closer to the problem with the basic tools to create tailored solutions.

The open-source approach has permitted access to low-cost, off-the-shelf solutions, enabling the country to offer its citizens the identification and payment system at no charge. In other words, when a user makes a UPI payment for 1 US cent, the recipient receives exactly 1 US cent, with zero deductions.

The digital infrastructure is also ubiquitous, universal, and inclusive. It serves not only those with access to a smartphone, but also those with a feature phone or even no phone at all.¹

These digital tools have the effect of enhancing the positive impact of markets by reducing transaction costs and entry barriers, disseminating information, increasing access to both consumers and producers, and supporting competition and innovation. In addition, they make it easier for governments to deliver services in a citizen-centric way and gain greater trust from citizens.

These design principles have created digital infrastructure that follows market principles by being orderly (has structure and operates within certain parameters), open-ended, and with the ability to draw on knowledge and self-organise.^{2,3} As a result, these tools promote competition and innovation but without determining the outcomes.

India's digital infrastructure has, therefore, been able to support many digital innovations, resulting in a large digital ecosystem. For example, authentication APIs are now used by many different apps that provide different customer journeys.

This confirmed Nilekani's belief that, if you build population-scale infrastructure that is cheap and widely available and provide interfaces (APIs) that people can embed in their apps and workflow, you open the way for all kinds of innovation.⁴

Notes

- 1 For example, through the Aadhaar-Enabled Payment System using business correspondents.
- 2 Market participants, through their interactions with one another, generate and utilise information that help to guide the allocation of resources, leading to efficient allocation without the need for centralised planning.
- 3 Nilekani and Viral, *"Rebooting India, Realising a Billion Aspirations"*, Penguin Books, 2015. He refers to this as an hour-glass system, where open and interoperable systems enable great innovation above (APIs) and below (wireless/wired networks). He also believes that this system has political advantages because the minimalist approach avoids stepping on too many departmental 'toes'.
- 4 Nilekani and Viral, *"Rebooting India, Realising a Billion Aspirations"*, Penguin Books, 2015.



Digital Public Infrastructure comes with its risks: the potential of data breaches or hacking by third parties.
Credit: lakshmiprasad S, iStock.

6. Potential challenges and risks

This report presents an overwhelmingly positive view of the achievements of India's universal identification and peer-to-peer payment system and its potential for emulation or direct replication in other developing countries. However, there are a number of factors that can potentially limit the positive impact of these digital tools:

Digital documentation is gaining primacy in India. This increases the risk and potential cost of large-scale data breaches, calling for greater emphasis on safeguards and security. Estonia is a global leader in the use of blockchain technologies to protect the integrity of digital identity, land registry, health-care, and voting systems. It has achieved this despite a well-resourced, hostile neighbour that has attempted to hack its databases. Leveraging blockchain technology in a similar way may have the potential to improve data security.

As well as the risk of hacking by third parties, there is the risk of abuse by governments. Digital infrastructure in India is owned by the government. Data use and privacy need to be monitored by democratic checks and balances. The potential weakening of democracy in India could, in turn, also weaken these protections.

India's Supreme Court has demanded a robust data protection and privacy law to accompany Aadhaar. A recent IMF report concurs: "A robust data protection framework is essential to protect citizens' privacy, prevent companies and governments from indiscriminately collecting data, and holding companies and governments accountable for data breaches to incentivise appropriate data handling and adequate investments in cybersecurity."¹ However, India has not yet approved a Data Protection and Privacy Law.² See also Appendix 4 on data protection and privacy.

As well as these risks, it must be noted that India's digital tools still have a long way to go to reach full coverage of the poorest citizens. Less than 15% of rural households have internet access, compared to 42% of urban households.³ Moreover, in 2019, only 27% of Indian adults had a minimum level of financial literacy as defined by the Reserve Bank of India. Despite 1.3 billion people adopting a digital ID, the IMF review also notes that only 35% of persons aged 15 and over have made or received a digital payment, indicating that the use of UPI is concentrated in select segments of the population.⁴ In Estonia, with a wealthier population, high levels of digital inclusion were achieved through large digital education programmes funded by banks and telecom companies. Ten percent of the adult Estonian population was educated on the use of digital tools by the Look@World project.⁵ In India, investment in financial and digital education is still limited and it is likely that full adoption across India's poorest citizens will take many years and require other advances out of the scope of this report, such as increased electrification in rural areas and greater penetration of smartphones in this segment of the population.

Notes

- 1 Stacking Up the Benefits. Lessons from India's Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, March 2023.
- 2 James Grieco, "The State of Data Privacy in India," April 27, 2023, <https://www.mineos.ai/articles/the-state-of-data-privacy-in-india>.
- 3 Stacking Up the Benefits. Lessons from India's Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, March 2023.
- 4 Stacking Up the Benefits. Lessons from India's Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, March 2023.
- 5 Kristjan Vassil, 'Estonian E-Government Ecosystem: Foundation, Applications, Outcome. Background Paper: Digital Dividends.', World Development Report 2016, Institute of Government and Politics, University of Tartu, June 2015. The "Look@World" Project: An Initiative from Estonia's Private Sector to Boost Internet Use. Alar Ehandi, Baltic IT&T Review Issue 21, 3f.



1.3 billion people in India now have National IDs that allow them to participate in the digital public infrastructure.
Credit: VikramRaghuvanshi, iStock.

7. Can other countries benefit from India's digital toolkit?

India has accomplished a seemingly impossible task, obtaining significant rewards that are likely to grow as more and more people adopt its digital tools. This naturally raises the question of whether other countries can replicate India's success and enjoy similar benefits.

In many respects, India is not unlike other low and middle-income countries. Its political regime – a democracy with several weaknesses and clientelism – is common among similar nations.¹ Additionally, India's civil service is well known for its excessive bureaucracy and hierarchical processes. With capable leadership from an exceptional entrepreneur, Nilekani, the public-private partnership delivered results, quickly garnering political support for this ambitious initiative.

However, India does possess certain advantages that set it apart. One such advantage is the government's strong commitment to modernisation, centred around its vision of a "New India". Furthermore, India boasts a robust technology sector and connections to the Silicon Valley diaspora.

Prime Minister Modi has expressed his willingness to share India's knowledge on building digital infrastructure with other low and middle-income countries. Thanks to the open architecture and minimalist approach of the Indian solution, the technological demands of adapting its universal identification and digital payment systems are not insurmountable. Consequently, entry barriers for countries seeking to emulate India's experience are relatively low. India has also offered all the technology for its digital transformation, the "India Stack" – (1) universal digital identification, (2) digital payments, and (3) data owned by citizens, not IT corporations – for free to other countries. In essence, India has transformed the "India Stack" into a "World Stack" (see <https://indiastack.org/>).

For countries to benefit from India's model of building digital public infrastructure, they will also have to display a strong national commitment to making their project successful and forming robust public-private partnerships. In the absence of these two factors, foreign aid will have not a positive impact in this area.

Notes

- 1 India ranks 103rd out of 167 countries in the Legatum Institute Prosperity Index 2023. It is classified as a "flawed democracy" by the Economist Intelligence Unit 2022, ranking 46th out of 167 countries, and 97th out of 179 countries in V-Dem's Democracy Report 2023 where it is classified as an electoral autocracy with large declines in the last ten years.



Adopting public digital infrastructure may be the most effective way to enhance political, economic, and social development for low and middle-income countries.
Credit: xavierarnau, iStock.

8. Conclusion: Deploying digital infrastructure may be the most effective toolkit for prosperity

India's digital infrastructure for identification and payments, and the effort to make these processes open-access, may become India's greatest contribution to the world in the years ahead.

Digital infrastructure, which amplifies the benefits of joining the formal economy, can bring substantial gains to the informal sector and society, contributing to the formalisation of the economy and societal inclusion. It does so by giving poor people the ability to trade and own property, as the protesters of the Arab Spring had demanded. The integration of people, in turn, supports social cohesion. Digital tools are making markets more competitive, reducing transaction costs, and improving tax efficiency and collection.

The bottom-up digital innovations implemented in India can assist in the move towards a more democratised, open-access society, where participation in markets leads to greater benefits and fewer special privileges. This can help counteract wealth concentration and the exclusion of people from economic opportunities.

This Playbook concludes that, for low and middle-income countries, adopting digital infrastructure like that developed in India may be the most effective way to enhance their political, economic, and social development. This unique opportunity should not be missed.



Customer scanning QR code with smartphone to pay for her goods.
Credit: triloks, iStock.

9. Appendices

1. Deploying universal identification and a user-friendly payment system in India

As described above, the deployment of universal identification and a new digital payment system has been the basis for the improvements detailed in the previous section. In addition, a third piece of India's digital infrastructure, a new model for data governance, is being introduced. In this section, we outline the process by which these solutions have been introduced.

Unique Identification for All (Aadhaar)

The decision to deploy a universal identification system in India was made in 2006 to support welfare payments¹ and satisfy demand for identification for disadvantaged people, who could not otherwise access an official form of ID.²

The Unique Identification Authority of India (UIDAI) was created in 2009 to issue a unique identification number (Aadhaar) to all Indian residents. This digital 12-digit number is issued after verifying their identity and taking a minimum of demographic³ and biometric data (iris, fingerprints, and facial photograph). After a few weeks, residents receive their number, which corresponds to a record in a central database that contains their demographic and biometric information.

Components of digital identity



Source: BIS Papers No 106 "The design of digital financial infrastructure: lessons from India" by Derryl D'Silva et al., BIS Monetary and Economic Department, December 2019.

After five years under Nilekani's leadership, the UIDAI had already issued 900 million Aadhaars.⁴ This was achieved not by creating a large bureaucratic organisation but by working through partners that were already dealing with people, such as state governments, banks, insurance companies, the oil company, etc. The UIDAI embedded enrolment in its partners' workflow and provided the technology. The total cost of the programme was less than \$1 per identification document.⁵

The UIDAI was also key to the introduction in 2016 of e-KYC, with support from the Bank of India, financial companies, and other service providers, including telecom operators. e-KYC enabled individuals to use their Aadhaar number and biometric data to authenticate their identity online for access to a range of services, including banking, telecom, and insurance.

The leverage of Aadhaar and e-KYC was also increased through the 2014 introduction of the Jan-Dhan Yojana programme, which promoted access to a basic savings bank deposit for unbanked individuals, providing remittance, credit, insurance, and pension services in an affordable manner.

The government of India also developed several complementary digital services, including e-Sign and DigiLocker.

User-friendly and free digital payments (UPI)

The Aadhaar system permitted the roll-out of the second pillar of India's digitalisation programme: the Unified Payments Interface (UPI). Promoting digital micro-payments was seen as critical to the digital economy because, in a low-value, high-transaction economy, the digital advertising revenues that often finance digital platforms in developed countries are small. It was key to be able to buy and sell low-value products and services at zero cost, both online and offline.

UPI was launched by the National Payments Corporation of India (NPCI) in 2016⁶ as an instant real-time payment system. It can be used to transfer money between bank accounts instantaneously, without charge, and in one simple step.⁷ In addition, multiple bank accounts can be stored and managed in a single mobile app and payments are made using a simple virtual address for the payee (lastname@bankxyz), instead of requiring bank details. It is interoperable and can, therefore, be used by anyone with a bank account, regardless of their bank or mobile network operator. UPI's simplicity makes it accessible for people with different levels of digital literacy.

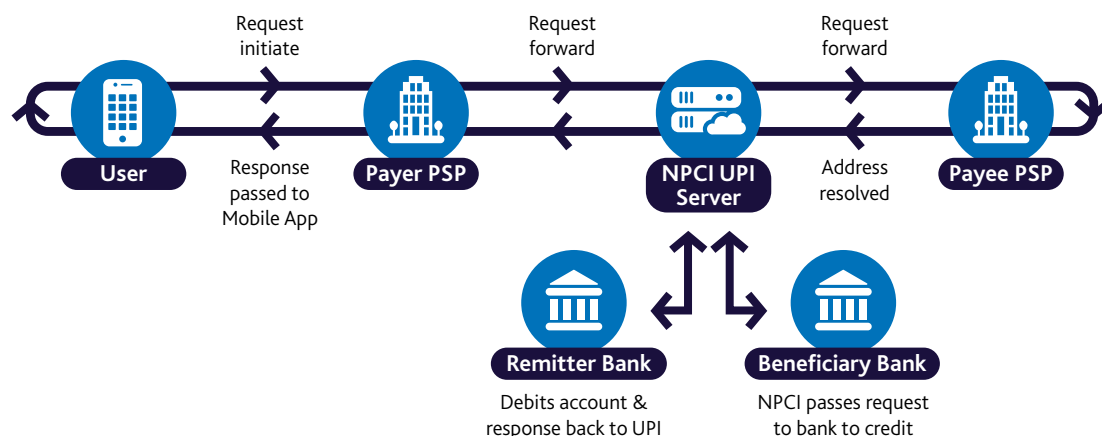
UPI also sought to adapt to the needs of all users. A capability, introduced in March 2022, to allow it to work with feature phones (older devices with buttons instead of touchscreens) means that it can potentially connect 400 million users in remote rural areas.⁸

UPI was designed as a thin solution, a platform that can be layered on top of existing payment systems with minimal effort. It gives consumers the choice of using any bank and enables an ecosystem that provides opportunities for businesses and services to make the digital payments platform reach all villages. The platform itself enables further follow-on innovation built on top of the protocol.

Around the world, one of the most challenging elements of developing open APIs for payments has been the authentication layer: allowing third-party services to confirm to a user's bank that the user is who they say they are and approve the payment. Whereas in, say, the UK's Open Banking programme, each bank was required to develop its own authentication process, which led to a fragmented, complicated, and often off-putting system,⁹ Aadhaar permitted a simple approach, built on a universal standard.

UPI has been incredibly successful because it is primarily a mobile-based service and focused on the innovations it provides to users. It was able to offer top-level customer service because the NPCI provided APIs to front-end consumer platforms (Google Pay, PhonePe, Paytm, Amazon) so they could design an optimal user experience as, for example, through the Bharat Interface for Money (BHIM) platform.¹⁰

The government's demonetisation initiative to invalidate large currency notes has also significantly contributed to the adoption of UPI.



Source: Stacking Up the Benefits. Lessons from India's Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, April 2023.

The NPCI has also worked on the development of a set of APIs and protocols to foster open interchange and connections between shoppers, technology platforms, and retailers. The ONDC company was established as a non-profit in December 2021 to develop an inclusive ecosystem for e-commerce, with the aim of becoming the “world’s first inclusive large-scale e-commerce system”. It seeks to dramatically increase e-commerce penetration, especially in small towns and rural areas, and to provide an alternative to the siloed approach of existing e-commerce platforms.

User data: ownership and control by rightful owners

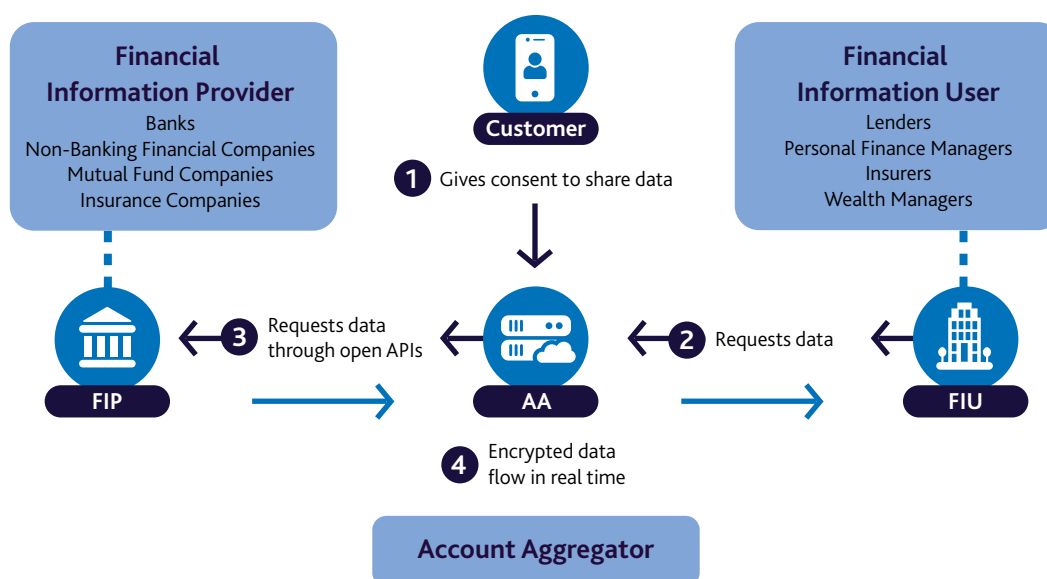
In addition to the unique identification and payment system discussed here, India has introduced a third key component of its digital infrastructure: a model for data governance that aims to “restore ownership and control over user data to its rightful owners”.¹¹ It is India’s response to the challenges of individual privacy and data ownership faced by high-income countries that have resulted in legislation such as the General Data Protection Regulation (GDPR) of the European Union and Open Banking in the UK.

India’s Data Empowerment and Protection Architecture (DEPA) aims to help new bank account holders – possible because of Aadhaar and UPI – to “leverage the data trail they leave behind as they go about transacting and operating in the digital economy”.¹² DEPA’s key components include: (a) the Data Protection Bill; (b) an electronic consent artefact; and (c) “consent managers” or regulated entities that, in financial services, will be known as “account aggregators”.¹³

The Reserve Bank of India (RBI) issued the account aggregator frameworks in September 2016¹⁴ and eight banks went live on the Account Aggregator Network in September 2021. As of August 2022, 22 major banks had joined the framework, covering 1.1 billion accounts.

The Ministry of Finance has described the process as the “first step towards bringing open banking to India and empowering millions of customers to digitally access and share their financial data across institutions in a secure and efficient manner”.¹⁵

The “account aggregators” are regulated intermediaries who will allow citizens to access their digital footprint as informational collateral when applying for financial loans. This means that citizens will control and be able to benefit from their own digital footprint, doing so via a centralised resource required to act in their interests, rather than through decentralised (and often costly and unwieldy) approaches such as those mandated by the GDPR.



Source: Stacking Up the Benefits. Lessons from India’s Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, April 2023.

2. Universal Identification Digital Models: Other countries

Universal Identification Digital Models (UIDMs) are used to provide individuals with unique digital identities that are interoperable and can, in other words, be used across different digital systems and platforms without the need for duplicate identities or authentication.

- National Identity Management Commission, Nigeria, and Unique Identity for Citizens, Brazil. These systems assign a unique National Identification Number to residents based on biometric and demographic data. They are linked to government and private services and are used for identity verification and authentication.
- Digital Identity and Authentication Service, European Union. This system provides a framework for cross-border electronic identification and authentication, enabling citizens to use their national digital identities across different EU countries to access public and private-sector services.

3. Nilekani: How to deliver an ambitious public initiative

The key to success was the recruitment of the co-founder of Infosys (with 100,000 employees at the time) to implement the project. This meant that the UIDAI was not a typical government organisation trying to deliver the 'biggest social project in the planet'. The UIDAI did not have a large budget and initially did not even have its own office. Nilekani's ability to recruit the best talent also explains the UIDAI's capacity to resolve the unique and unprecedented technological challenges linked to Aadhaar.

Setting up teams to fix all the major problems facing India

We propose that a team of 100 carefully selected individuals can fix all the major problems that ail India. How would such a system work? Let's say the prime minister identifies ten grand challenges that India faces. Each idea can be the nucleus of a 'government start-up.' Ten enterprising leaders are given charge of each of these problems. They, in turn, form ten-member teams of the best brain within government and domain specialists from outside government to apply out-of-the-box thinking that can deliver innovative solutions. We give examples of such potential solutions throughout the book.

Any new government project should be treated, in essence, like a start-up that needs to stake a claim for itself. The officials in charge of such a project need to display a considerable amount of entrepreneurial savvy. A true entrepreneur will figure out all the government process and follow them to the letter. He will navigate the byways of the bureaucracy, keep his multiple masters happy, get his project mentioned in every important speech and every government document of relevance, get his bills tabled in Parliament and enacted as law, secure his budgets, cooperate with investigating agencies, respond to court orders, answer Parliament questions, tirelessly provide information sought in RTI requests, build general consensus with multiple interest groups within government as well as citizen groups outside, find allies who will support him when under attack, and do all this while staying focused on hiring the best team and building an organization that is dedicated towards achieving a well-defined goal.

Source: Nilekani and Viral, "Rebooting India, Realising a Billion Aspirations", Penguin Books, 2015.

4. Aadhaar: Data protection and privacy regulation

The Bharatiya Janata Party has faced criticism for linking Aadhaar to various government services. The system has recently become mandatory for the delivery of a number of government services.¹⁶ This has potential implications for citizens' privacy and security. In 2018, the Supreme Court of India upheld the validity of Aadhaar but also imposed restrictions on its use to ensure respect for the right to privacy and individual liberty. It demanded a strong data protection law. The Supreme Court gen-

erally tries to limit the risks of Aadhaar being used as a tool for surveillance and profiling. The Digital Personal Data Protection Bill has still not been approved.

Potential data privacy and security issues:

- **Identity theft:** Aadhaar numbers are linked to personal information that includes biometric data, bank accounts, and mobile phone numbers. Unauthorised access to this information could result in identity theft.
- **Profiling:** Aadhaar data could potentially be used to profile individuals based on their demographic information, such as religion, caste, or ethnicity. This could, in turn, be used to discriminate against certain individuals or communities.
- **Surveillance:** The system could allow the government to track individuals' activities and movements.
- **Data security:** Data could be stolen or misused due to inadequate security measures, leaving individuals' personal information vulnerable to hackers and cybercriminals.
- **Data sharing:** There are concerns about the sharing of Aadhaar data between government agencies and other service providers and a lack of transparency in this process, for example, in relation to health digitalisation.¹⁷ There is a potential risk of misuse of Aadhaar data by third parties. While the government has mandated strict guidelines for the use of Aadhaar data by service providers, there is a risk of its unauthorised use for commercial purposes.

5. UPI, RBI, and private-sector cooperation

In 2009, the RBI quickly realised that Aadhaar would help to scale up digital payment solutions. At a meeting in December 2009, the UIDAI, the RBI, the NPCI, and major banks discussed how the RBI's business correspondents could be integrated into Aadhaar biometrics, creating a blueprint for the interoperable system. Moreover, Aadhaar would provide the financial address for bank payments.

The NPCI was set up as a non-profit company by the RBI and the Indian Banks' Association (IBA) and is owned by a group of public and private banks, of which there are now over 400, up from an initial group of 21. The NPCI was established to provide cost-effective, secure, and efficient payment solutions for banks and other financial institutions. It operates under RBI supervision and supports government initiatives to foster financial inclusion.

One of the NPCI's key successes was to identify the agents committed to the national challenge of making digital payments faster, more ubiquitous, and accessible to everyone. Banks, financial institutions, fintech companies, and the government worked together to make this possible.

The RBI's full commitment, capabilities, and openness to innovation allowed the project to overcome many regulatory challenges. Technical challenges resulted in innovations such as the use of QR codes and the development of a secure authentication system, with the RBI pioneering the use of biometrics and business correspondents. The UIDAI and the NPCI also worked to extend the reach of digital payments by widening regulation on who could work as a business correspondent.

The NPCI ensured that the system was user-friendly and feature-rich (payment by QR, Aadhaar number, mobile number, Virtual Payment Address, and bank account number; functions for paying bills, recharging a mobile phone, and making donations; use of different payment methods). This has permitted its widespread adoption by popular payment apps (Google Pay, PhonePe, Paytm, and Amazon Pay) and banks.

6. UPI and regulatory challenges

- **Interoperability:** The challenge is to ensure seamless integration between different banks. The NPCI played a key role in creating a common platform and setting up guidelines to ensure interoperability.
- **Regulatory framework:** The RBI played a central role in establishing the necessary regulatory framework for this new payment system.
- **Security:** UPI transactions involve the transfer of sensitive information. To address this challenge, the NPCI established strict security protocols and guidelines.
- **Competition:** UPI faced competition from other digital payment systems and it was necessary to ensure a level playing field. This was provided by the regulatory authorities which promoted competition and innovation.
- **Customer grievance redressal for UPI transactions:** The NPCI set up a customer grievance redressal mechanism to ensure that customer complaints were resolved in a timely and efficient manner.

7. 2019 review of UPI by the Bank for International Settlements

The 2019 report of the Bank for International Settlements (BIS) on India's digital infrastructure concluded that its financial ecosystem has the potential to serve as a model for other countries seeking to promote financial inclusion through digital means.¹⁸ It found that "the provision of a national digital biometric identity to all residents has effectively granted them broad access to the banking system." It also noted that, "by providing cheap and instantaneous payment services to ordinary citizens, the design of the Indian payment system challenges the business case for standalone private payment systems."¹⁹ Digital payment interoperability appears to be a useful feature for other countries. The report also concluded that, "the establishment of a legal framework for data fiduciaries promises to ensure that individuals can readily access the data generated by their online activity and dictate the circumstances for sharing those data." (See Appendix 1.)

8. UPI: Competing in the marketplace

UPI has competed against (a) mobile wallets: Paytm, MobiKwik, and PhonePe (already present when UPI was launched); (b) debit and credit cards; (c) the Immediate Payment Service launched by the NPCI in 2010, which provides the underlying infrastructure for UPI, but the UPI is only digital and more user-friendly; and (d) the National Electronic Funds Transfer in which transactions can take up to a few hours to complete.

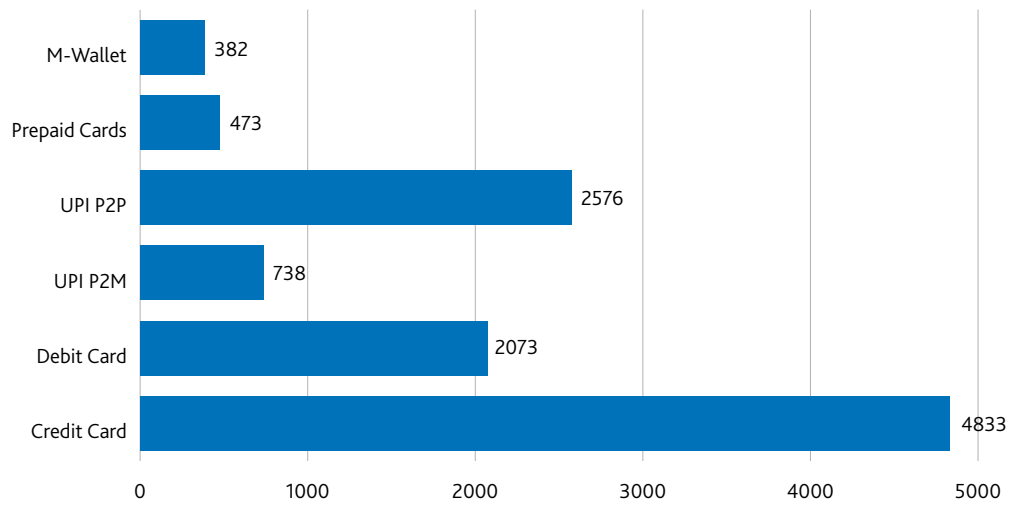
As of 2022, UPI was the most popular digital payment system. In FY 2022, UPI payments (launched only in 2016) accounted for more than half of all digital transactions (52%).²⁰ UPI transactions are equivalent to 55% of GDP.²¹

Table: Market share value/volume of transactions Q1 2022

	Market share value	Volume of transactions
UPI	50%	64%
Credit Cards	26%	7% transactions
Debit Cards	18%	10%

Source: Times of India, July 5, 2022. In charts: UPI emerges as most preferred payment mode with market share.

Average Ticket Size (INR)



Source: Worldline. Worldline India Digital Payments Report, Q3 2022.

Notes

- 1 In a similar way to the deployment of Social Security Numbers in 1936 as part of the Social Security Act.
- 2 See Appendix 2 for references to unique ID systems used in other countries.
- 3 The information requested includes full name, date of birth, gender, address, and mobile/e-mail (optional). There is also a channel available for residents without documents to verify their identity.
- 4 Overshooting Nilekani's ambitious target of issuing 600 million Aadhaars in five years. Nilekani and Viral, *"Rebooting India, Realising a Billion Aspirations"*, Penguin Books, 2015.
- 5 Stacking Up the Benefits. Lessons from India's Digital Journey, Alonso, C, et al., IMF Working Paper/23/78, March 2023.
- 6 The National Payments Corporation of India (NPCI), owned by banks and the RBI and founded as a non-profit organisation, ensured that the new payment system, UPI, was regulated through the RBI and that it would work.
- 7 For more details on how it works, see this simple Forbes guide: <https://www.forbes.com/advisor/in/personal-finance/what-is-upi-and-how-does-it-work/>.
- 8 "How India's Central Bank Helped Spur a Digital Payments Boom", Jeff Kearns and Ashlin Mathew, October 27, 2022. IMF Country Focus.
- 9 "Why data interoperability is harder than it looks: the open banking experience", Sam Bowman, CPI Anti-Trust Chronicle, April 2021. Competition Policy International.
- 10 See Appendix 8 on the competition of UPI in the marketplace.
- 11 See section on Data from the India Stack website: <https://indiastack.org/data.html>.
- 12 See section on Data from the India Stack website: <https://indiastack.org/data.html>.
- 13 On the role of account aggregators, see BIS, October 2022 "API Standards for Data Sharing – account aggregator." Report submitted by Consultative Group on Innovation and the Digital Economy.
- 14 See BIS, Central Bank Hub, Rajeshwar Rao: Regulatory framework for account aggregators. Remarks by Rajeshwar Rao, Deputy Governor of the Reserve Bank of India, during a virtual event organised by iSpirt, September 2, 2021.
- 15 See Ministry of Finance, Know all about Account Aggregator Network – a financial data-sharing system. Press Release, September 10, 2021, PIB Delhi. <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1753713>. This also includes the key points on the Account Aggregator framework.
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- 19 'BIS Papers No 106 "The design of digital financial infrastructure: lessons from India" by Derryl D'Silva et al., BIS Monetary and Economic Department, December 2019.'
- 20 Pre-budget Economic Survey 2023.
- 21 Union Minister Ashwini Vaishnaw recently stated that UPI transactions accounted for the equivalent of 55% of India's gross domestic product (GDP) in a meeting with Google's CEO reported Inc 42. <https://inc42.com/buzz/upi-transactions-worth-55-indias-gdp-ashwini-vaishnaw-google-for-india-2022/>.

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LEGATUM INSTITUTE

11 Charles Street
London W1J 5DW
United Kingdom

t: +44 (0) 20 7148 5400
www.li.com

Twitter: @ProsperityIndex

www.prosperity.com

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